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Childhood Maltreatment and Impulsivity: A Meta-Analysis and Recommendations for Future Study

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Abstract
Both childhood maltreatment and impulsivity have been implicated in a broad array of negative public health outcomes and have been much studied in relation to each other. Characterizing this relationship, and the processes underlying it, are important for informing intervention efforts targeting this association and its psychopathological sequelae. The current review presented a systematic meta-analysis of the empirical literature on childhood maltreatment and impulsivity. In all, 55 eligible studies were identified and included in this review. General support was found for a positive association between childhood maltreatment, including its specific subtypes, and general trait impulsivity, with pooled effect sizes ranging from small in the case of childhood sexual abuse (OR = 1.59 [95% CI = 1.38–1.84]) to medium-to-large in the case of childhood emotional abuse (OR = 3.10 [95% CI = 2.27–4.23]). Support for a relationship between childhood maltreatment and laboratory-based measures of impulsive behavior was generally lacking. The current findings must be interpreted with a degree of caution, given several methodological limitations characterizing much of the empirical literature. Recommendations for addressing these limitations and directions for future research are provided.

Keywords Child abuse · Child maltreatment · Impulsivity · Meta-analysis · Neglect

Introduction

Childhood maltreatment, a common form of adverse childhood experiences, consists of several types of abuse and neglect: physical abuse, sexual abuse, emotional abuse, and neglect (Cicchetti and Toth 2005). This public health concern is quite prevalent. This is particularly true in the United States, where the elevated rate of violent deaths resulting from child abuse stands out as an outlier relative to the rates of this outcome in other high-income countries (Rao and Lux 2012). Based on self-reported and parent-reported childhood maltreatment, lifetime prevalence rates for physical abuse have been estimated at 22.6% in a recent series of meta-analytical reviews (Stoltenborgh et al. 2015). With sexual abuse, a marked sex difference is evident, with a lifetime prevalence rate of 7.6% among boys and 18.0% among girls. Although much less work has been conducted on childhood emotional abuse, available estimates place the lifetime prevalence rate for this form of abuse at 36.3%. Similarly the subject of comparative neglect in the empirical literature, childhood neglect is also notably prevalent, with lifetime prevalence rates of 16.3% for physical neglect and 18.4% for emotional neglect.

In addition to its high prevalence rate, childhood maltreatment has been associated with a host of negative public health outcomes, including subsequent engagement in violent behaviors (e.g., bullying, delinquency, intimate partner violence, and weapon-carrying; Duke et al. 2010), mood disorders (Etain et al. 2008; Infurna et al. 2016), non-suicidal and suicidal self-injury (Dube et al. 2001; Liu et al. 2018; Maniglio 2011), as well as substance use disorders (Gilbert et al. 2009; Teicher and Samson 2013). Moreover, childhood maltreatment experiences appear to be related to an earlier age of onset of several of these clinical phenomena, a more severe course, and worse treatment response (Green et al. 2010; Hill et al. 2004; Nanni et al. 2011; Teicher and Samson 2013; Williams et al. 2014). These deleterious effects of early maltreatment persist well into adulthood (Cicchetti and Toth 2005; Gilbert et al. 2009). In addition to the toll of childhood maltreatment on social functioning and mental health, its economic burden is substantial, with early maltreatment experiences being associated with unemployment,

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poverty, and Medicaid usage, as well as lower educational attainment and earnings (Currie and Widom 2010; Zielinski 2009). Reflecting the long-term cost to productivity associated with childhood maltreatment, there is a 14% gap by middle age between maltreated individuals and non-maltreated counterparts in probability of employment (Currie and Widom 2010). Moreover, the estimated lifetime cost is $210,012 per victim of non-fatal maltreatment, and the estimated total lifetime economic cost is $124 billion for all new cases of child maltreatment in a given year (Fang et al. 2012).

Given the magnitude of childhood maltreatment as a public health problem, there is a particular need for a greater understanding of the mediating pathways through which risk is conferred for these negative outcomes. More specifically, although the negative sequelae of childhood maltreatment are well established, the underlying processes of risk remain comparably unclear (Liu 2017; McLaughlin 2016). Elucidating these risk processes is of particular importance for their potential to advance our ability to intervene with victims of childhood maltreatment, and thereby to reduce the risk in these individuals for subsequent psychopathology and its attendant societal and economic costs.

One potential mechanism underlying the relation between childhood maltreatment and several mental health outcomes (e.g., suicidal behavior; Braquehais et al. 2010) is impulsivity. Although the research literature on childhood maltreatment and impulsivity, respectively, in relation to mental well-being has been previously subject to review, this has not been the case for the association between early maltreatment experiences and impulsivity. A critical analysis of the empirical literature characterizing this latter relationship is a necessary first step in determining the potential viability of impulsivity as a candidate mechanism through which childhood maltreatment experiences may confer risk for detrimental mental health and socioeconomic outcomes later in life. Thus, the principal objective of the current meta-analytic review is to quantify the strength of the association between overall childhood maltreatment, as well as its specific subtypes, and impulsivity in the empirical literature, with separate analyses conducted for distinct facets of this latter construct. Following this systematic review, a discussion will be provided of methodological considerations, conceptual gaps in the existing literature, along with specific recommendations for clarifying the precise nature of the relationship between maltreatment in childhood and impulsivity, the intention being to inform future study in this area.

Developmental Perspectives on Childhood Maltreatment and Impulsivity

Regarding how childhood maltreatment may lead to the development of impulsivity, several possibilities exist. Although it is not within the scope of this paper comprehensively to review all these possibilities, several mutually compatible accounts that merit particular mention include Gershoff's (2002) process-context model and Vasta's (1982) dual-component analysis of childhood physical abuse, life history theory, and neurobiological models.

First, an intriguing possibility is that a transactional relationship may exist, with maltreatment leading to increased risk for impulsivity, and impulsive dispositions and associated behavioral difficulties, in turn, taxing parental resources to manage these difficulties, resulting in an elevated likelihood of subsequent emotional and physical maltreatment, particularly when the parents themselves are prone to impulsivity. Furthermore, this likelihood is strengthened by the heritability of impulsivity, with impulsive parents being more likely to engage in undue parenting practices, including abusive behavior, when stressed by child misbehavior, and similarly impulsive offspring themselves being more likely to engage in this misbehavior. Indeed, this possibility is very much congruent with Gershoff's (2002) process-context model and Vasta's (1982) dual-component analysis of childhood physical abuse, according to which impulsivity in parental figures who engage in corporal punishment may lead to an escalation of this parenting practice toward abuse, and this may be particularly true when the parents are emotionally activated and confronted with negative internal (e.g., feelings of anger or stress) and external stimulation (e.g., child misbehavior). This possibility may also, in part, account for the often cyclical nature of child maltreatment, with parents who experienced maltreatment during their childhood at greater risk for perpetrating maltreatment with their own offspring (Egeland et al. 1988).

Second, if childhood maltreatment does indeed confer risk for the development of impulsivity, a question that naturally follows is what accounts for this relationship. An intriguing potential account of this association between early maltreatment experiences and impulsivity may be found in life history theory (Belsky et al. 2012; Belsky et al. 1991; Del Giudice et al. 2011; Ellis et al. 2009). Couched within an evolutionary framework, this theory holds that organisms strategically allocate resources (i.e., time and energy) to different activities across their life cycle. As these resources are finite by nature, it is not possible maximally to devote them to all major life functions (i.e., somatic effort and reproductive effort), and some trade-off between these competing interests is therefore required. Life history strategies fall broadly within a spectrum from "slow" to "fast." The former is characterized by a stable family environment in early childhood, later reproductive maturity and a preference for more long-term investments and goals, whereas the latter is a more high-risk approach, involving a more difficult rearing environment, earlier age of reproductive maturity and a prioritization of short-term goals in the face of long-term uncertainties.

Importantly, there is no single optimal life history strategy. Rather, it is dependent on the environmental context.

Furthermore, phenotypic expression of these life history strategies seems to be both genetically and environmentally determined (Del Giudice et al. 2011). More specifically, and of particular relevance to the current review, extrinsic morbidity-mortality (i.e., external threats to the organism's well-being) has been identified as a key factor calibrating the development of life history strategies towards the fast end of the spectrum. Indicators of high extrinsic morbidity-mortality include exposure to violence and harsh family environments among others. Harsh environmental contexts during early development have been found to predict an accelerated life history strategy (Belsky et al. 2012). Childhood maltreatment is certainly reflective of a harsh family environment, and thus may contribute toward a preference for a fast life history strategy. Notably consistent with this possibility, among the behavioral traits associated with a life history strategy on the fast end of the continuum are impulsivity and a preference for immediate over delayed rewards (i.e., impulsive choice; Del Giudice et al. 2011; Ellis and Del Giudice 2014).

Third, adverse early life experiences have been suggested to disrupt normative neural development, particularly in prefrontal cortical regions governing response inhibition (Blair and Raver 2016; Hart and Rubia 2012; Pechtel and Pizzagalli 2011). That is, early maltreatment experiences may lead to abnormal neural development, which in turn, may account for greater impulsive tendencies later in life. Aberrations in the anterior cingulate cortex (ACC), in particular, have been implicated in the neuropathology of childhood maltreatment (Teicher and Samson 2016). Indeed, reduced myelination in the ACC appears to occur in individuals with a childhood abuse history (Lutz et al. 2017). This finding is of particular relevance here because the ACC is involved in regulating cognitive and motor responses during situations with conflict (Haber and Knutson 2010), and the deleterious effects of childhood maltreatment on the ACC may be a neurobiological pathway through which early maltreatment experiences may be linked with impulsivity later in life (Lutz et al. 2017; Turecki 2005). Reduced interior frontal gyrus volumes have also recently identified as another potential neurodevelopmental sequela of early adversities (Luby et al. 2017). This is important to note, as the right inferior frontal gyrus has been engaged in performance on certain behavioral measures of impulsivity (i.e., impulsive choice; (Aron et al. 2003; Bari and Robbins 2013). The importance of these findings lies, in part, in the possibility that these aberrations in neural development may function as a mediational pathway underlying the link between early adversities and negative health outcomes later in life (Luby et al. 2017).

If aberrant neural development is indeed a consequence of childhood maltreatment and leads to the development of impulsive tendencies, the timing of exposure to maltreatment experiences becomes particularly important and informative. That is, the brain regions most vulnerable to the deleterious effect of maltreatment are the ones undergoing rapid growth at the time of exposure (Pechtel and Pizzagalli 2011; Teicher et al. 2003). In general, this would involve the hippocampus between birth and age two, the amygdala during early childhood, and the frontal cortex during adolescence (Lupien et al. 2009). It therefore stands to reason that aberrant frontal cortical development during adolescence, relative to other periods of development, would be most strongly implicated in the association between contemporaneously experienced maltreatment and impulsivity. As the current studies relating childhood maltreatment to impulsivity did not evaluate the timing of maltreatment exposure, it was not possible to evaluate this hypothesis. Therefore, including assessments of maltreatment experiences more sensitive to the age of occurrence is necessary for future research to provide a more nuanced understanding of this relation.

Methodological Considerations

In addition to understanding the developmental context in which childhood maltreatment may relate to impulsivity, several important methodological considerations relating to the latter construct should be noted. Impulsivity has been increasingly recognized as a multidimensional construct, with important distinctions existing between different facets of this construct (Cyders and Coskunpinar 2011; Hamilton et al. 2015a, b; Whiteside and Lynam 2001; Winstanley et al. 2006). It has commonly been assessed using self-report trait measures and state-sensitive laboratory-based indices.[1] In line with this conceptual distinction, trait and state-sensitive measures of impulsivity have been consistently observed to be only modestly correlated with each other (Cyders and Coskunpinar 2011, 2012; Peters and Büchel 2011; Reynolds et al. 2008).

The multidimensional nature of impulsivity is evident among self-report trait measures of this construct, the two most widely used being the Barratt Impulsiveness Scale (BIS; Patton et al. 1995) and the UPPS Impulsive Behavior Scale (as well as its subsequent elaboration, the UPPS-P; Cyders et al. 2007; Whiteside and Lynam 2001). That is, in addition to a general index of impulsivity, the BIS was designed to assess three dimensions of this construct: (i) motor impulsivity, (ii) nonplanning impulsivity, and (iii) attentional impulsivity. Similarly adopting a multidimensional conceptualization of impulsivity, the UPPS-P was developed to reflect five distinct facets of this construct: (i) negative urgency, or a tendency to act impulsively when experiencing negative affect, (ii) lack of premeditation, (iii) lack of perseverance, (iv) sensation-seeking,

[1] The reference here is to the influence of one's current affective state on performance on a specific measure of impulsivity, rather than one's self-reported general disposition toward impulsiveness when experiencing positive or negative affect (e.g., negative urgency). Also note that it is not implied here that these measures are solely state-based. Rather, they are sensitive to both state and trait effects (Peters and Büchel 2011).

and (v) positive urgency, or a propensity to act impulsively under conditions of positive affect.

Even among task-based measures, important conceptual distinctions exist (Peters and Büchel 2011; Robbins et al. 2012; Winstanley et al. 2010). Specifically, in addition to being viewed as state-dependent indices (Cyders and Coskunpinar 2011; Dougherty et al. 2004; Moeller et al. 2001), laboratory-based measures of impulsivity have been conceptualized as reflecting either (i) impulsive action (i.e., behavioral or motor impulsivity) or (ii) impulsive choice (i.e., cognitive impulsivity). Impulsive action is characterized by difficulty in preventing the initiation of a behavior or stopping an already-initiated behavior. Contrastingly, impulsive choice involves the tendency to prefer small immediate rewards over larger delayed ones (for a more thorough discussion of these laboratory-based approaches to measuring impulsivity, see Hamilton et al. 2015a, b). Consistent with the view that behavior and cognitive impulsivity are distinct facets of impulsivity, measures of these constructs are modestly correlated with each other (Hamilton et al. 2015a; Lane et al. 2003; Reynolds et al. 2006), and have been found across multiple studies to possess distinctly different underlying neural correlates (Hamilton et al. 2015a; van Gaalen et al. 2006a; van Gaalen et al. 2006b; Whelan et al. 2012; Winstanley et al. 2006).

Given these conceptual distinctions between different facets of impulsivity along with the measures used to index them, several researchers have cautioned against generalizing findings regarding one facet of impulsivity to another, for failure to observe the distinction between them risks obscuring meaningful differences in their relationship with the construct of interest (Cyders and Coskunpinar 2011; Hamza et al. 2015; Liu et al. 2017). Furthermore, it has been generally recommended that care be taken in the field to specify precisely the aspect of impulsivity assessed in relation to the construct under study (Cyders and Coskunpinar 2011; Hamza et al. 2015). These distinctions between different facets of impulsivity were therefore observed in the present meta-analysis.

Method

Search Strategy and Eligibility Criteria

A systematic search of the literature was conducted in PsycINFO and MEDLINE to identify studies of potential relevance to the current review. The following search string was applied: ("physical abuse" OR "sex abuse" OR "sexual abuse" OR "emotional abuse" OR "verbal abuse" OR "physical

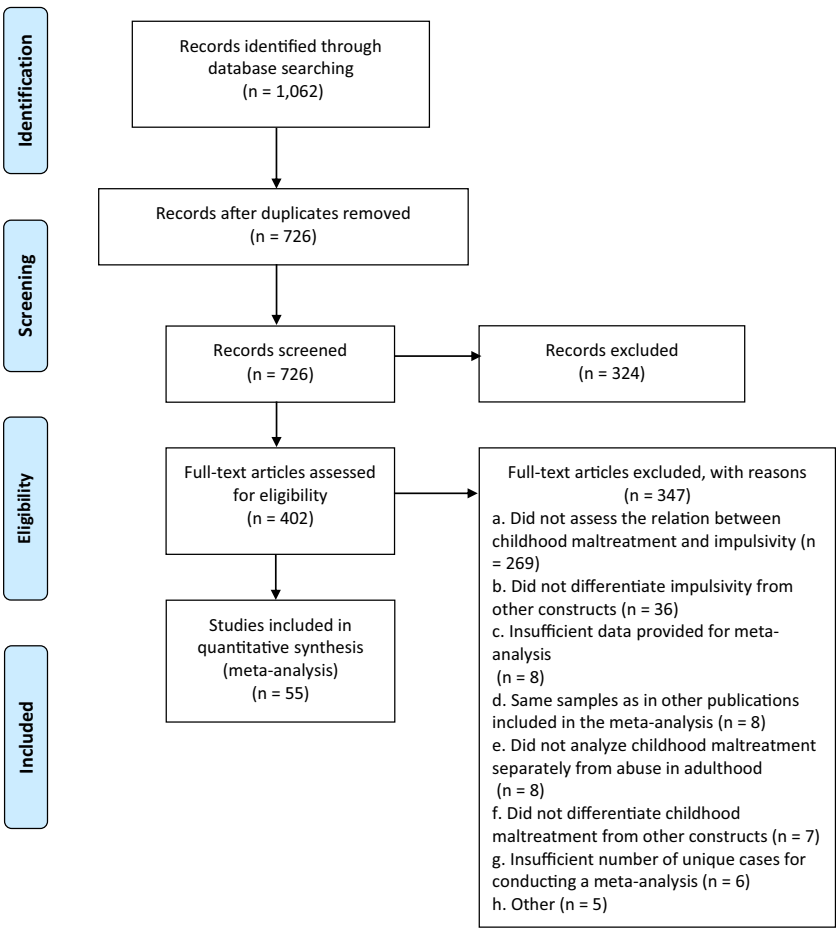


Fig. 1 PRISMA flow chart of literature search

maltreatment" OR "sexual maltreatment" OR "emotional maltreatment" OR "verbal maltreatment" OR "psychological maltreatment" OR "psychological abuse" OR "child abuse" OR "childhood abuse" OR "child maltreatment" OR "childhood maltreatment") AND (impulsiv* OR "response inhibition" OR "delay discounting" OR "delayed reward" OR "stop signal" OR "continuous performance" OR "attentional control" OR "behavioral control" OR "behavioural control" OR "go/no" OR "go no"). The search results were limited to: (i) English-language publications and (ii) peer-reviewed journal publications since inception to June 15, 2017. The search terms used in the current meta-analysis are based on a review of the search terms used in several prior systematic reviews of childhood maltreatment, which when combined yielded a more extensive set of search terms than in any single prior review, thereby ensuring a more thorough screening of potentially eligible studies. This same approach was adopted to arrive at a final and exhaustive set of search terms for impulsivity. This search strategy yielded a total of 1062 articles, of which 726 were unique reports. In cases where the eligibility of an article could not be ruled out based on the title and abstract, the full text was also examined.

The study inclusion criteria were: (i) any form of childhood maltreatment was assessed, distinct from other constructs (e.g., adverse childhood experiences, childhood trauma); (ii) childhood maltreatment was analyzed separately from abuse experienced in adulthood; (iii) impulsivity was assessed separately from related constructs (e.g., risk-taking behaviors); and (iv) quantitative data were presented on the association between any form of childhood maltreatment and any aspect of impulsivity.

Based on these inclusion criteria, 324 reports were excluded based on their titles and abstracts. Following this initial screen, an additional 341 articles were excluded based on a detailed full-text review, leaving a set of 61 publications satisfying the eligibility criteria. Of these 61 publications, however, it was not possible to include six in the current review, with there being an insufficient number of relevant cases (i.e., fewer than four) for meta-analysis (e.g., cognitive impulsivity in the case of Rohrbeck and Twentyman 1986), leaving a final set of 55 studies (see Fig. 1 for PRISMA flow chart). Studies were excluded based on full-text review because they: (i) did not assess the relationship between childhood maltreatment and impulsivity ($n = 269$); (ii) did not differentiate impulsivity from other constructs ($n = 36$); (iii) provided insufficient data for meta-analysis ($n = 8$)[2]; (iv) featured a sample that overlapped with that of a study already selected for inclusion and examined the same form of impulsivity in relation to the same outcome of interest (n = 8)[3]; (v) did not analyze childhood maltreatment separately from abuse in adulthood (n = 8); (vi) did not differentiate childhood maltreatment from other constructs ($n = 7$); (vii) insufficient number of cases in the literature (i.e., < 3) of the analyses reported in the study for conducting a meta-analysis ($n = 6$); and (viii) were not quantitative studies ($n = 5$). Additionally, the titles of the references of all 55 eligible publications included in this meta-analysis were thoroughly reviewed for potential eligibility, with full-text review conducted where warranted. This search yielded no additional eligible studies.

Data Extraction

To assess potential moderators, data on seven study characteristics were extracted. These included four sample characteristics: (i) sample age group (i.e., child, adolescent, or adult); (ii) mean age of sample; (iii) sample clinical status (i.e., community versus clinical, at-risk, or mixed); and (iv) percentage of female participants in the study sample. Data for three study design characteristics were also extracted, including: (i) form(s) of childhood maltreatment assessed; (ii) form(s) of impulsivity assessed; and (iii) cross-sectional versus longitudinal analysis. For a subset of 25 of the 55 eligible studies, a second rater independently extracted data on the seven study characteristics. There was at most two discrepancies for any given variable (κs ranged from .65 to 1.). In the one instance where κ = .65 (i.e., age group of the sample), two studies were coded as having adolescent samples by one rater and one by the other. The low κ in this case was a function of the low number of adolescent samples included in this subset, rather than a high discrepancy between coders.

Data Analysis

The odds ratio (OR) was used as the primary index of effect size. In cases where ORs were not reported, they were derived whenever possible from available data reported in the study (e.g., means and standard deviations, correlation). All ORs were calculated such that values greater than 1.0 are indicative

[2] These eight studies were excluded after attempts to contact the study authors did not produce sufficient data for inclusion in the meta-analysis. An additional six studies (Amr et al. 2016; Conley and Garza 2011; Harden et al. 2015; Narvaez et al. 2012; Rylands et al. 2012; Stoltenberg et al. 2012) similarly did not report data required for meta-analysis, but were retained after the necessary data were obtained from the study authors.

[3] Twenty studies featured overlapping samples. Whenever it remained unclear after inspection of the full text whether two studies reported on overlapping samples, the study authors were contacted to seek clarity on this issue. In cases where two or more studies used the same or overlapping samples but reported on different forms of childhood maltreatment and/or impulsivity, both studies were retained for relevant analyses. In cases where two or more studies used overlapping samples to examine the same forms of childhood maltreatment and impulsivity, the results of analyses based on the largest sample were retained. In the case where two studies assessed the association between childhood maltreatment and impulsivity in different subgroups of the same sample (Becker and Grilo 2006, 2007), the study that provided analyses of this association in the most number of non-overlapping subgroups was included in the main analysis (Becker and Grilo 2007), and the other study, which provided analyses of this association in males and females separately, was included in analyses involving sex as a moderator of effect size (Becker and Grilo 2006).

of a positive association between childhood maltreatment and impulsivity (i.e., childhood maltreatment is associated with greater odds of impulsivity). Conversion of data into ORs and all analyses were conducted with Comprehensive Meta-Analysis Version 3.3.070 (Biostat 2014). The overall weighted effect size was calculated by pooling ORs across all relevant studies. For all analyses, random-effects models were generated in preference to fixed-effects models, thereby accounting for the high expected heterogeneity across studies resulting from differences in samples, measures, and design. Heterogeneity across the studies was evaluated using the I^2 statistic. I^2 indicates the percentage of the variance in an effect estimate that is a product of heterogeneity across studies rather than sampling error (i.e., chance). Low heterogeneity is indicated by I^2 values of around 25%, and moderate heterogeneity by I^2 values of 50%. Substantial heterogeneity that is due to real differences in study samples and methodology is indicated by an I^2 value of 75%, suggesting that the observed heterogeneity is more than would be expected with random error (Higgins et al. 2003). In cases where high heterogeneity is observed, random-effects models are more appropriate than fixed-effects models, as the former accounts for this heterogeneity by incorporating both sampling and study-level errors, with the pooled effect size representing the mean of a distribution of true effect sizes instead of a single true effect size. In contrast, fixed-effects models assume that a single true effect size exists across all studies and any variance detected is due strictly to sampling error. It thus estimates only within-study variance.

High heterogeneity indicates the need for conducting moderator analyses to account for potential sources of this heterogeneity. Each potential moderator was first assessed separately, with an estimate of the effect size at each level of the moderator calculated.

A frequent concern in meta-analyses is the possibility of publication bias. Specifically, studies with small effect sizes or non-significant findings are less likely to be published, and consequently may be more likely to be excluded from meta-analyses, resulting in potential inflation of estimates of the overall effect size. To evaluate for potential publication bias, the following publication bias indices were calculated: Orwin's fail-safe *N* (Orwin 1983), Duval and Tweedie's trim-and-fill analysis (Duval and Tweedie 2000), and Egger's regression intercept (Egger et al. 1997). Orwin's fail-safe *N* is an index of the robustness of an overall effect size, calculating the number of studies with an effect size of 0 that would be required to reduce the overall effect size in a meta-analysis to non-significance. Duval and Tweedie's trim-and-fill analysis yields an estimate of the number of missing studies based on asymmetry in a funnel plot of the standard error of each study in a meta-analysis (based on the study's sample size) against the study's effect size. This analysis also produces an effect size estimate and confidence interval, adjusting for these missing studies. It should be noted that this procedure assumes homogeneity of effect sizes, and consequently, its results need to be interpreted with caution in cases where significant heterogeneity is present. Finally, Egger's regression intercept estimates potential publication bias using a linear regression approach assessing study effect sizes relative to their standard error.

Results

Included in the present meta-analysis were 55 publications based on 51 unique samples and assessing the relation between at least one form of childhood maltreatment and at least one aspect of impulsivity. A summary of study details is provided in Table 1. As only one study included an assessment of cognitive impulsivity in relation to childhood maltreatment, it was not possible to include this form of impulsivity in the current meta-analysis. There was similarly an inadequate number of studies of positive urgency for meta-analysis. Finally, although several studies employed a longitudinal design, all analyses of childhood maltreatment in relation to impulsivity were cross-sectional. Therefore, this study design feature was not included in any moderator analyses.

Trait Impulsivity

General Impulsivity

Across 21 studies with 24 unique effects,[4] overall childhood maltreatment was positively associated with general trait impulsivity (see Table 2 and Fig. 2a). Heterogeneity was moderately high, indicating the appropriateness of moderator analyses. Age was not a significant moderator of the strength of the association between overall maltreatment and trait impulsivity, regardless of whether age was treated categorically with comparisons made between children, adolescents, and adults ($p = .37$) or with children and adolescents combined in these comparisons ($p = .26$). Consistent with these results, age remained a non-significant moderator when analyzed as a continuous variable ($b = -.01$, $p = .41$). Similarly, the percentage of female participants in each study was not a significant moderator ($b < .01$. $p = .76$). Although only two studies were conducted with community samples, and this low number of effects may yield unstable estimates of effect sizes, exploratory analyses revealed a trend ($p = .06$) toward larger effects in clinical samples (OR = 2.93 [95% CI = 2.20–3.90], $p < .001$) than in ones drawn from the community (OR = 1.47 [95% CI = 0.76–2.86], $p = .26$). At-risk samples did not differ from community ones in terms of the strength of association

[4] One study yielded separate effects for males and females (Becker-Blease and Freyd 2008), and another for three racial groups (Becker and Grilo 2007).

Table 1 Study characteristics

Study Author(s) (year)	N[a]	% Female[a]	Mean Age[a]	Sample	Maltreatment measure(s)	Form(s) of maltreatment[b]	Impulsivity measure(s)	Form(s) of impulsivity[b]
Amr et al. (2016)	58	27.0	30.3	Clinical	TAA	CPA, CSA	BIS	Overall, Attention, Motor, NP
Arens et al. (2012)[1]	407	65.0	20.3	Community	CATS	Overall	UPPS	NU, Persev, Premed, SS
Arens et al. (2014)	600	73.0	19.6	Community	CATS	Overall, CPA, CPN, CSA	UPPS	NU
Auerbach et al. (2014)	194	74.2	15.5	Clinical	CTQ	Overall	CPT	Behavioral Impulsivity
Augsburger et al. (2016)	94	15.0	30.1	At-risk	KERF	Overall	UPPS	NU, Persev, Premed, SS
Baltieri (2014)	315	100	31.6	At-risk	SSM	CSA	BIS	Overall
Barahmand et al. (2016)	74	0.0	17.4	Clinical	CTQ	Overall, CEA, CEN, CPA, CPN, CSA	BIS	Overall
Becker and Grilo (2006)[2, c]	458	58.0	15.8	Clinical	MACI	Overall	ICS	Overall
Becker and Grilo (2007) [2, d]	462	42.0	15.8	Clinical	MACI	Overall	ICS	Overall
Becker-Blease and Freyd (2008)[c]	29	48.3	9.27	At-risk	BBTS	Overall	SNAP-IV	Overall
Berman & Knight (2015)	175	0.0	16.0	At-risk	MASA	CSA	SSM	Overall
Bornovalova et al. (2006)	93	44.0	41.5	Clinical	CTQ	CEA, CEN, CPA, CPN, CSA	MPQ-BF	Overall
Bornovalova et al. (2008)	96	48.0	14.9	Community	CTQ	Overall	EIS	Overall
Brodsky et al. (2008)	236	85.0	45.0	Clinical	CARE, CDTHI, CEQ	CPA, CSA	BIS	Overall
Brown et al. (2017)	500	50.4	18.9	Community	CTQ	CEA, CEN, CPA, CPN, CSA	BIS	Overall
Bücker et al. (2012)	60	45.0	8.67	Mixed	SSM, SSR	Overall	CPT	Behavioral Impulsivity
Carli et al. (2014)	1315	0.0	39.6	At-risk	CTQ	Overall, CEA, CEN, CPA, CPN, CSA	BIS	Overall
Conley and Garza (2011)	147	80.2	26.3	At-risk	SAEQ	CSA	BIS	Overall
Daray et al. (2016)	177	100	37.6	Clinical	SSM	CSA	BIS	Overall, Attention, Motor, NP
Day et al. (2013)[3]	112	39.2	16.8	At-risk	CTQ	CEA, CPA	BIS	Overall
De Bellis et al. (2013)	202	56.9	12.1	Mixed	SSM, SSR	Overall	CPT	Behavioral Impulsivity
Dworkin et al. (2014)	649	66.6	NR	Community	SSM	CSA	BIS	Overall
Evren et al. (2013)	200	0.0	35.3	Clinical	CTQ	Overall	BIS	Overall
Fanning et al. (2014)	648	42.4	34.0	Community	CTQ	CEA, CEN, CPA, CPN, CSA	BIS	Overall
Gagnon et al. (2013)	122	65.5	23.0	Community	CTQ	Overall	UPPS	NU, Persev, Premed, SS
Gaher et al. (2015)[1]	407	65.0	20.3	Community	CATS	CPA, CPN, CSA	UPPS	NU
Gowin et al. (2013)	67	NR	31.5	At-risk	CTQ	Overall	BIS	Overall
Gratz et al. (2011)	225	45.0	12.1	Community	CTQ	CEA	EIS	Overall
Hahn et al. (2016)	425	71.0	19.2	Community	CATS	Overall	UPPS	NU
Hjorth & Ostrov (1982)	49	50.0	13.7	Mixed	SSM, SSR	CPA	OSIQ	Overall
Jakubczyk et al. (2013)[4]	304	26.0	43.5	Clinical	SSM	CPA, CSA	BIS	Attention, Motor, NP
Jakubczyk et al. (2016)[4]	358	26.5	43.7	Clinical	SSM	CPA, CSA	BIS[g]	Overall
Lee & Park (2016)	35	85.7	37.5	Clinical	CTQ	Overall, CEA, CEN	BIS	Overall
Li et al. (2012)	450	55.1	33.9	Clinical	ETISR-SF	Overall	BIS	Overall
Lim et al. (2015)	66	33.0	17.2	Mixed	CECA, CTQ, SSR	Overall	SST	Behavioral Impulsivity
Liu et al. (2012)	206	0.0	NR	At-risk	CTQ	Overall	BIS	Overall
Lopez-Castroman et al. (2014)	696	71.7	39.4	Clinical	CTQ	Overall, CEA, CEN, CPA, CPN, CSA	BIS	Overall
Martins et al. (2014)[e]	81	72.8	37.6	Clinical	CTQ	Overall, CEA, CEN, CPN	BIS	Overall
Minzenberg et al. (2006)	40	88.4	35.1	Clinical	CTQ	CEA, CEN, CPA, CPN, CSA	BIS	Attention, Motor, NP
Mirhashem et al. (2017)	84	46.4	35.2	Clinical	CTQ	CPA, CPN, CSA	UPPS-P	NU
Narvaez et al. (2012)	56	8.0	29.3	Clinical	CTQ	Overall, CEA, CEN, CPA, CPN, CSA	BIS	Overall
Roy (2005)	268	2.2	41.3	Clinical	CTQ	Overall, CEA, CPA, CPN	BIS	Overall
Rylands et al. (2012)	27	0.0	34.0	Community	CTQ	Overall	BIS	Overall
Schafer et al. (2004)[d, f]	1427	50.0	43.5	Community	SSM	CPA	SSM	Overall

Table 1 (continued)

Study Author(s) (year)	N[a]	% Female[a]	Mean Age[a]	Sample	Maltreatment measure(s)	Form(s) of maltreatment[b]	Impulsivity measure(s)	Form(s) of impulsivity[b]
Sergentanis et al. (2014)	154	0.0	41.9	At-risk	SSM	Overall	BIS	Overall
Shin et al. (2016)	333	52.5	21.7	Community	CTQ	CPA, CSA	UPPS	NU
Somer et al. (2012)	96	41.0	34.1	Clinical	CTQ	Overall, CEA, CEN, CPA, CPN, CSA	BIS	Overall
Stetler et al. (2014)	89	0.0	31.8	At.risk	CTQ	Overall, CEA, CEN, CPA, CPN, CSA	BIS	Overall, Attention, Motor, NP
Stoltenberg et al. (2012)[c]	439	64.7	22.4	Community	TAQ	CPA, CSA	BIS	Overall, Attention, Motor, NP
Thibodeau et al. (2015)	1012	49.4	10.0	At-risk	SSM, SSR	Overall	CCQ	Overall
Thompson & Morrison (2013)	571	0.0	18.5	Community	SSM	CSA	IQ	Overall
Veith et al. (2017)	517	67.1	NR	Community	LONGSCAN sexual abuse/assault measure, VEQ-R	Overall, CPA, CSA	BIS	Attention, Motor, NP
Wanklyn et al. (2012)[3]	110	39.0	16.7	At-risk	CTQ	Overall, CEN, CPA, CSA	BIS	Overall
Wardell et al. (2016)	232	52.5	19.7	Community	CTQ	Overall	UPPS-P	NU, Persev, Premed, SS
Wota et al. (2014)	186	48.5	45.0	Clinical	CTQ	Overall, CEA, CEN, CPA, CPN, CSA	BIS	Overall, Attention, Motor, NP

BBFS Brief Betrayal Trauma Scale, *BIS* Barratt Impulsiveness Scale, *CARE* Childhood and Adolescence Review of Experiences, *CATS* Child Abuse and Trauma Scale, *CCQ* California Child Q-Set, *CDTHI* Columbia Demographic and Treatment History Interview, *CECA* Childhood Experience of Care and Abuse, *CEQ* Childhood Experiences Questionnaire, *CPT* Continuous Performance Task, *CTQ* Childhood Trauma Questionnaire, *EIS* Eysenck Impulsivity Scale, *ETISR-SF* Early Trauma Inventory Self Report-Short Form, *ICS* Impulsivity Control Scale, *IQ* Impulsivity Questionnaire, *KERF* Maltreatment and Abuse Chronology of Exposure Scale (German version), *LONGSCAN* Longitudinal Studies on Child Abuse and Neglect, *MACI* Millon Adolescent Clinical Inventory, *MASA* Multidimensional Assessment of Sex and Aggression, *MPQ-BF* Multidimensional Personality Questionnaire – Brief Form, *NR* not reported, *OSIQ* Offer Self-Image Questionnaire, *SAEQ* Sexual Abuse Exposure Questionnaire, *SNAP-IV* Swanson, Nolan, and Pelham Rating Scale, *SSM* study-specific measure, *SSR* social service records, *SST* Stop-Signal Task, *TAA* Trauma Assessment for Adults—Brief Revised Version, *TAQ* Traumatic Antecedent Questionnaire, *UPPS/UPPS-P* UPPS/UPPS-P Impulsive Behavior Scale, *VEQ-R* Violent Experiences Questionnaire Revised, *CEA* childhood emotional abuse, *CEN* childhood emotional neglect, *CPA* childhood physical abuse, *CPN* childhood physical neglect, *CSA* childhood sexual abuse, *NP* non-planning, *NU* negative urgency, *Persev* Perseverance, *Premed* premeditation, *SS* sensation-seeking

[1, 2, 3, 4] Studies with identical superscripts were drawn from same or overlapping samples

[a] The sample size, mean age, and percentage female for participants included in relevant analyses, rather than of the entire study sample, are presented and were incorporated in moderator analyses whenever available. For ease of presentation, whenever the sample size varied across multiple relevant analyses within a study, the largest sample size across these analyses is presented here, and the sample size used in each analysis was retained in the relevant meta-analysis for purposes of obtaining weighted effect sizes

[b] Several studies included analyses of multiple maltreatment and impulsivity subtypes, for some of which there was an insufficient number of cases in the literature for meta-analysis. For ease of presentation, only the maltreatment and impulsivity subtypes submitted to meta-analysis are presented here

[c] Separate effects were reported by sex. In cases where the proportion female and/or mean age are not available for relevant analyses, the corresponding values for the overall sample are presented here. Similarly, in cases where separate analyses were conducted by sex, the proportion of the overall sample that was female is presented here

[d] Three separate effects were reported by race/ethnicity

[e] Separate analyses were conducted with overall childhood maltreatment as continuous and categorical variables. The effect for maltreatment as a continuous variable was included in the meta-analysis

[f] Although this study conducted separate analyses by sex, due to non-independence, it was not possible to observe this distinction in the meta-analysis

[g] This study also assessed childhood sexual abuse in relation to performance on the stop-signal task. As there were not enough studies evaluating this association to conduct a meta-analysis, it was not included in the current review

Table 2 Meta-analytic results for childhood maltreatment in relation to general trait impulsivity

		Effect size analyses			Heterogeneity analyses		Publication bias analyses			
	k	OR	95% CI	*p*	I^2	*p*	Orwin's fail-safe N	Egger's regression test *p*	Trim-and-fill	
									OR	95% CI
Overall maltreatment	24	2.54	2.07–3.13	<.001	65.54%	<.001	212	<.001	2.16	1.76–2.64
Sexual abuse	21	1.59	1.38–1.84	<.001	49.00%	<.01	82	.57	1.54	1.33–1.78
Physical abuse	21	2.05	1.72–2.44	<.001	65.43%	<.001	138	<.01	1.79	1.50–2.13
Physical neglect	13	2.08	1.71–2.54	<.001	53.04%	.01	88	.09	1.66	1.34–2.07
Emotional abuse	15	3.10	2.27–4.23	<.001	82.63%	<.001	163	<.01	2.59	1.95–3.43
Emotional neglect	13	2.17	1.58–2.99	<.001	81.05%	<.001	93	.04	1.98	1.46–2.69

k number of unique effects, *OR* pooled odds ratio, *CI* confidence interval

between overall childhood maltreatment and general trait impulsivity ($p = .30$).

In terms of potential publication bias, Orwin's fail-safe-N indicated that 212 unpublished studies with an OR of 1.0 would be required to reduce the pooled effect size for the relation between overall maltreatment and general trait impulsivity to 1.1 (an a priori trivial effect size), suggesting that the observed weighted effect size is robust. Egger's regression test, however, indicated that significant publication bias was present (intercept = 1.97, [95% CI = .99–2.95], $t(22) = 4.17$, $p < .001$). Additionally, the funnel plot of effect sizes was notably asymmetrical (see Fig. 3a). When the trim-and-fill method was used to correct parameter estimates for potential publication bias, the adjusted weighted OR was reduced to 2.16 (95% CI = 1.76–2.64).

When general trait impulsivity was examined in relation to specific forms of childhood maltreatment, significant associations were found for all maltreatment subtypes, with pooled OR's ranging from 1.59 (95% CI = 1.38–1.84) for childhood sexual abuse to 3.10 (95% CI = 2.27–4.23) for childhood emotional abuse (see Fig. 2b–f). Heterogeneity was significant and ranged from 49.00% (moderate) to 82.63% (high) across these analyses. A summary of these results is presented in Table 2. In moderator analyses, age treated as a categorical variable moderated the association between childhood sexual abuse and general trait impulsivity ($p = .03$),[5] with a larger pooled effect observed for adolescent samples (OR = 2.47, [95% CI = 1.65–3.69], $p < .001$) than in adults (OR = 1.52, [95% CI = 1.32–1.76], $p < .001$). When treated as a continuous variable, however, age no longer moderated the strength of the relationship between childhood sexual abuse and general trait impulsivity ($b < .01$, $p = .52$). For the remaining maltreatment subtypes, age did not function as a significant moderator when considered as a categorical or continuous variable (childhood physical abuse: $p_{Categorical} = .30$, $b_{Continuous} < .01$, $p = .76$; childhood physical neglect: $b_{Continuous} < .01$, $p = .99$; childhood emotional abuse: $p_{Categorical} = .28$, $b_{Continuous} < .01$, $p = .69$; childhood emotional neglect: $b_{Continuous} < .01$, $p = .99$).[6] Sex also was not found to moderate the association between maltreatment subtypes and general trait impulsivity (childhood sexual abuse: $b < .01$, $p = .84$; childhood physical abuse: $b < .01$, $p = .64$; childhood physical neglect: $b < .01$, $p = .99$; childhood emotional abuse: $b < .01$, $p = .67$; childhood emotional neglect: $b < .01$, $p = .34$). Sample type moderated the strength of association with general trait impulsivity in the case of childhood physical abuse ($p = .04$), for which a larger effect size was observed for clinical samples (OR = 2.56 [95% CI = 1.98–3.29], $p < .001$) than for community ones (OR = 1.78 [95% CI = 1.41–2.24], $p < .001$). Sample type did not moderate the observed associations for any of the remaining maltreatment subtypes (childhood sexual abuse $p = .09$; childhood emotional abuse $p = .60$).[7]

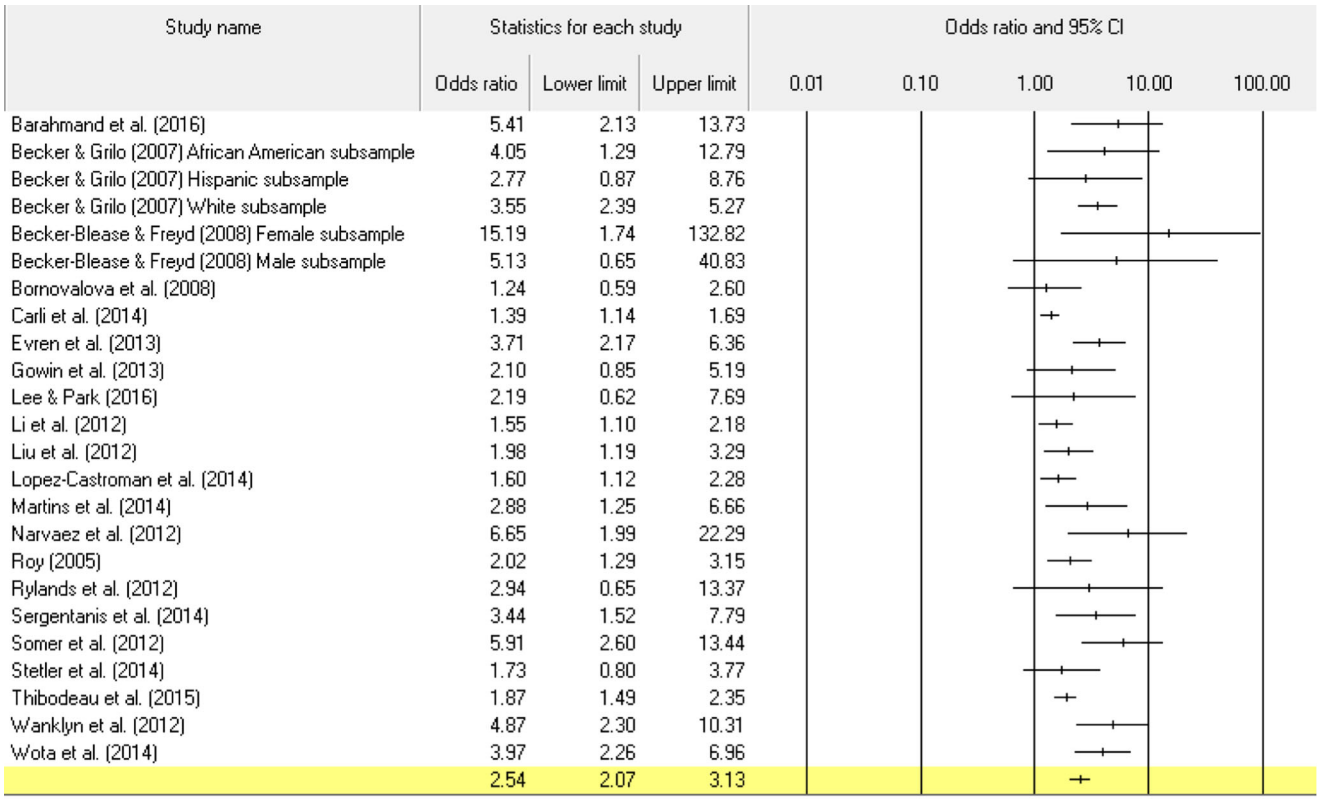
Regarding potential publication bias for studies of maltreatment subtypes, fail-safe *n's* ranged from 82 to 212. Egger's regression test indicated significant publication bias in the case of childhood physical abuse, childhood emotional abuse, and childhood emotional neglect. In general, funnel plots of the effect sizes for maltreatment subtypes were fairly asymmetrical, suggesting the presence of publication bias (see Fig. 3b-f). Although the trim-and-fill method produced a reduction in estimated effect sizes, significant effects remained for all maltreatment subtypes,

[5] As none of the analyses for maltreatment subtypes included child samples, the relevant moderator analyses for age were restricted to comparisons between adolescent and adult samples.

[6] Age treated as a categorical variable was not assessed as a moderator for childhood emotional and physical neglect, respectively, as there were only two relevant studies of each neglect subtype featuring adolescent samples.

[7] Sample type was not assessed as a moderator for childhood physical and emotional neglect, as there were insufficient numbers of studies featuring community samples in both cases.

(a) Overall childhood maltreatment and general trait impulsivity



(b) Childhood sexual abuse and general trait impulsivity

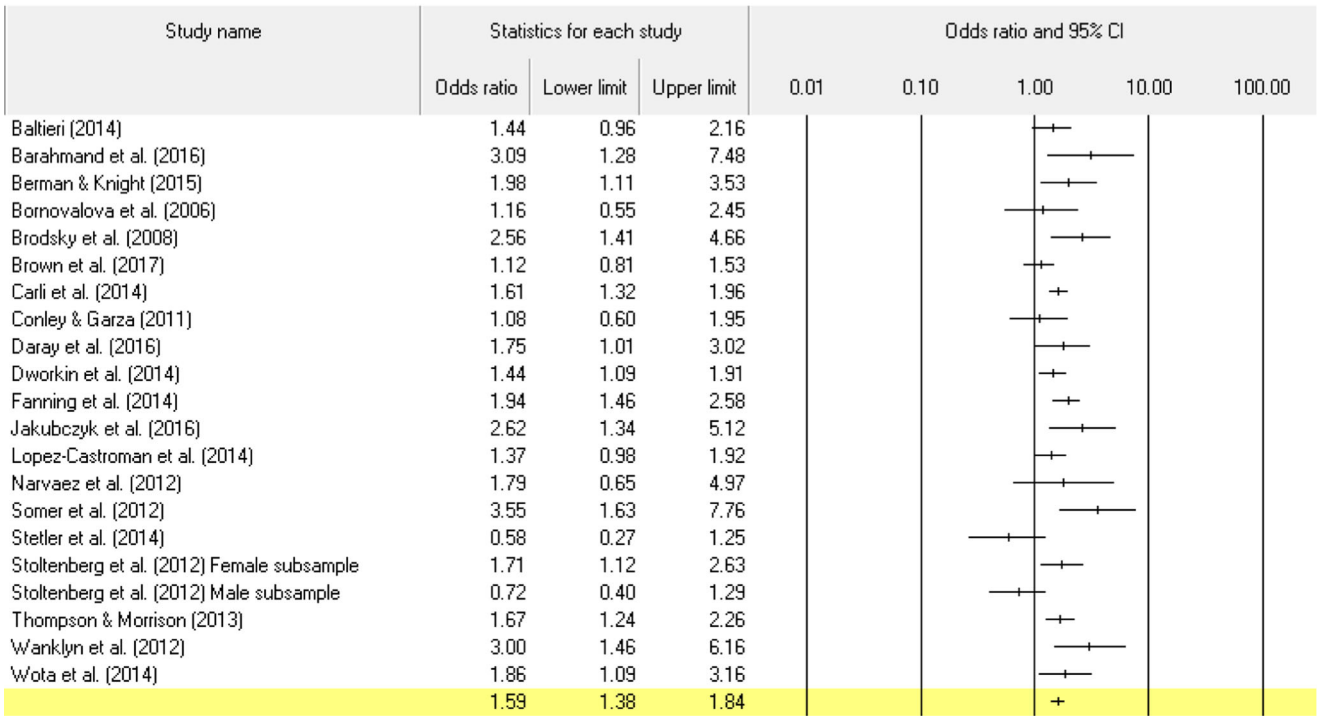
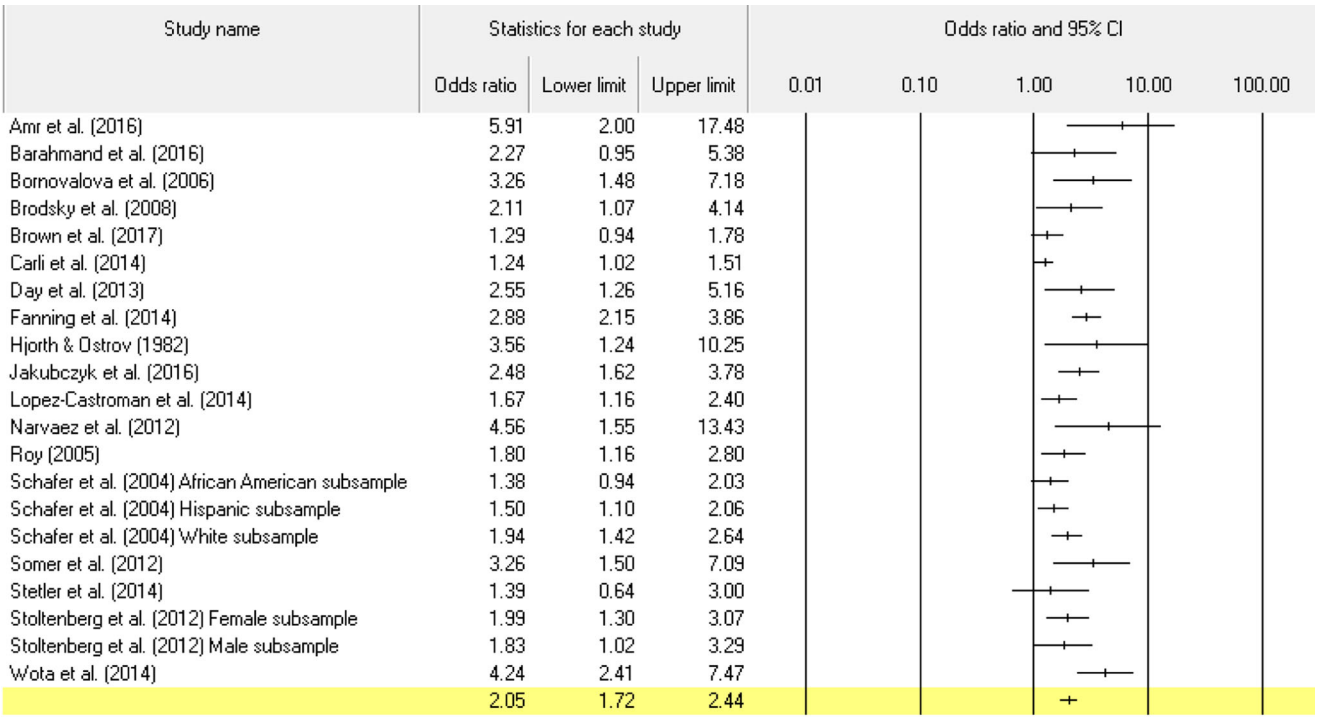


Fig. 2 Forest plots for childhood maltreatment in relation to general trait impulsivity

with OR's ranging from 1.54 (95% CI = 1.33–1.78) in the case of childhood sexual abuse to 2.59 (95% CI = 1.95–3.43) in the case of childhood emotional abuse. These results are summarized in Table 2.

(c) Childhood physical abuse and general trait impulsivity



(d) Childhood physical neglect and general trait impulsivity

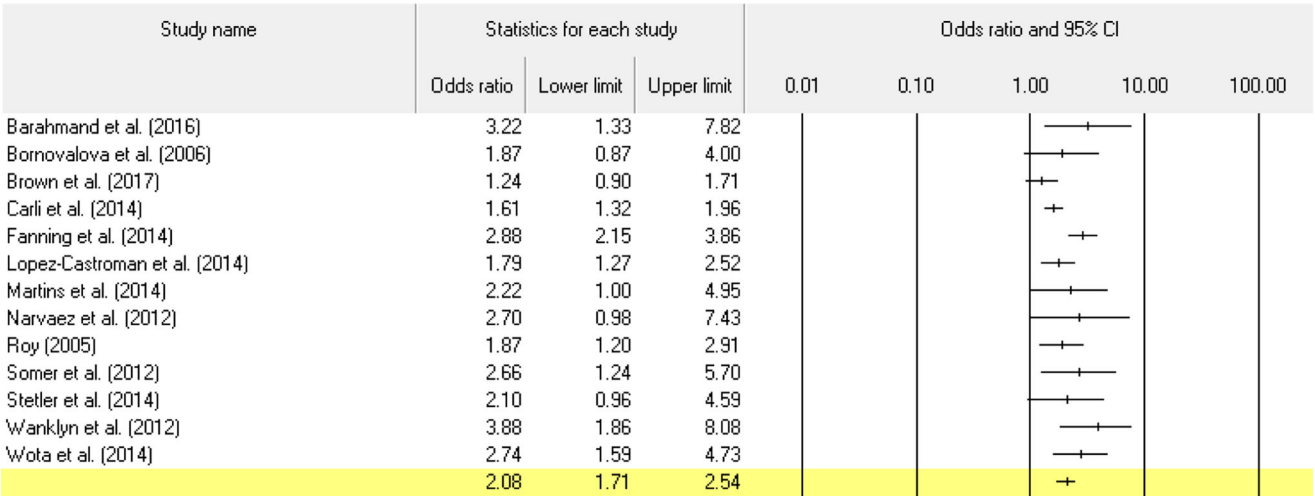


Fig. 2 (continued)

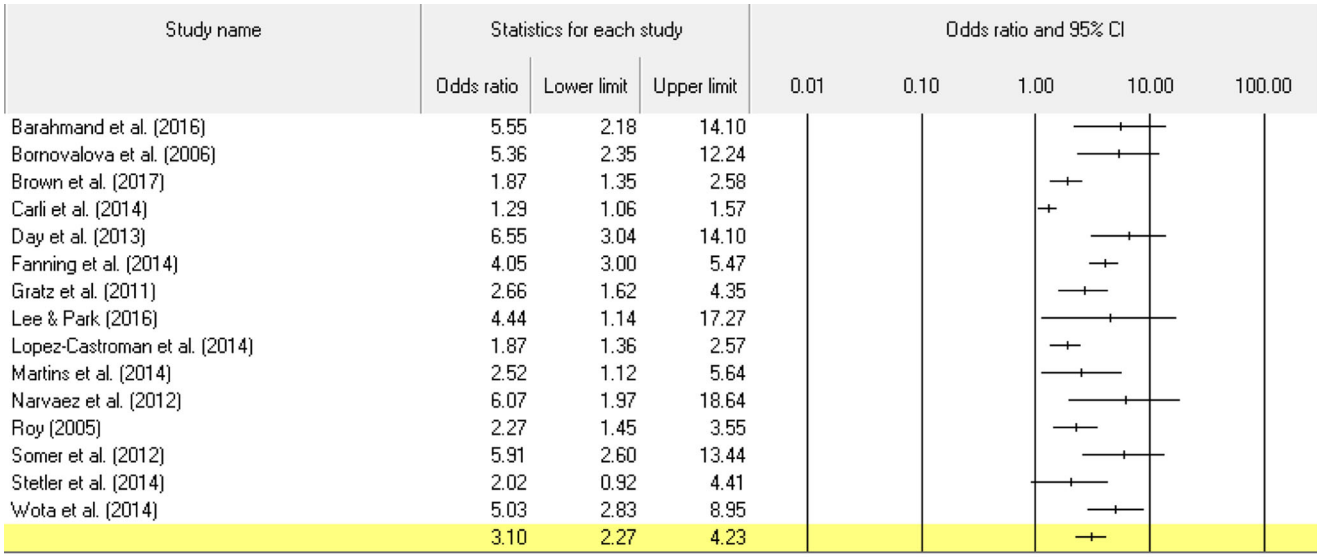
BIS Subscales

Comparably fewer studies examined childhood maltreatment in relation to specific subtypes of impulsivity as reflected by the BIS subscales. Apart from childhood physical and emotional neglect, all forms of childhood maltreatment were found to be positively associated with all three BIS subscales, with pooled OR's ranging from 1.46 (95% CI = 1.03–2.07) in the case of childhood sexual abuse and motor impulsivity to 2.72 (85% CI = 1.55–4.76) in the case of childhood emotional abuse and motor impulsivity. The one other exception that should be noted is the marginal effect observed between childhood emotional abuse and non-planning impulsivity (OR = 1.90 [95% CI = .99–3.63], $p = .05$). These findings are presented in Table 3.

UPPS Subscales

Even fewer studies were available for childhood maltreatment in relation to impulsivity as assessed with the UPPS. As shown in Table 4, overall childhood maltreatment was associated with perseverance and negative urgency, but not

(e) Childhood emotional abuse and general trait impulsivity



(f) Childhood emotional neglect and general trait impulsivity

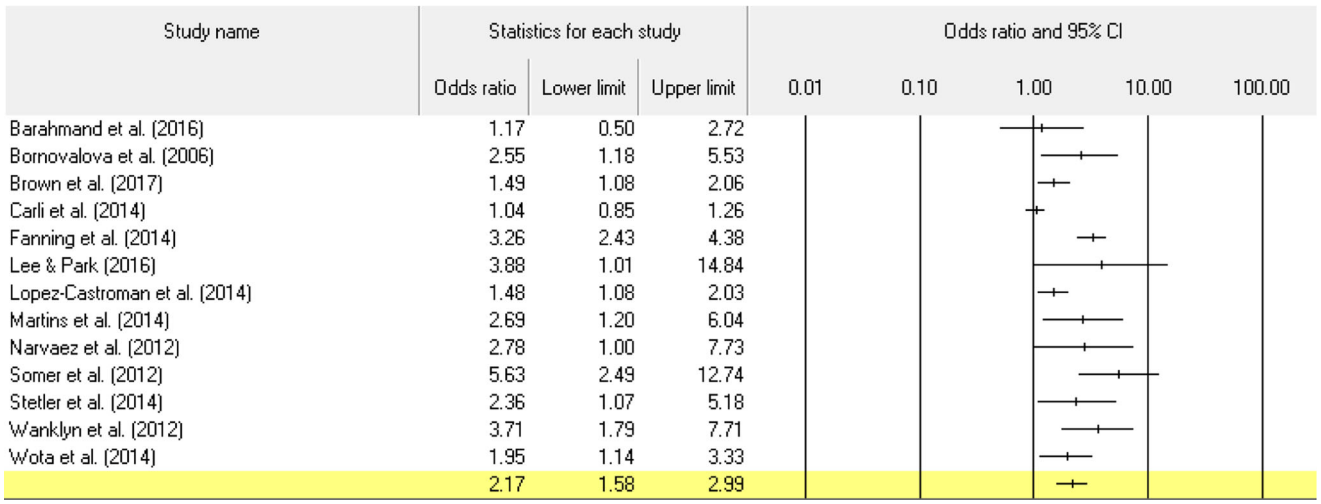


Fig. 2 (continued)

premeditation or sensation-seeking. Furthermore, the strength of association appeared to be strongest for negative urgency. With only three exceptions, there were too few unique effects for meta-analysis of the association between maltreatment subtypes and the UPPS subscales. In these three cases, negative urgency was positively associated with childhood sexual abuse (OR = 1.60 [95% CI = 1.20–2.14], $p < .01$), childhood physical abuse (OR = 1.98 [95% CI = 1.63–2.40], $p < .001$), and childhood physical neglect (OR = 2.44 [95% CI = 1.39–4.30], $p < .01$).

State-Sensitive Indices of Impulsivity: Behavioral Impulsivity

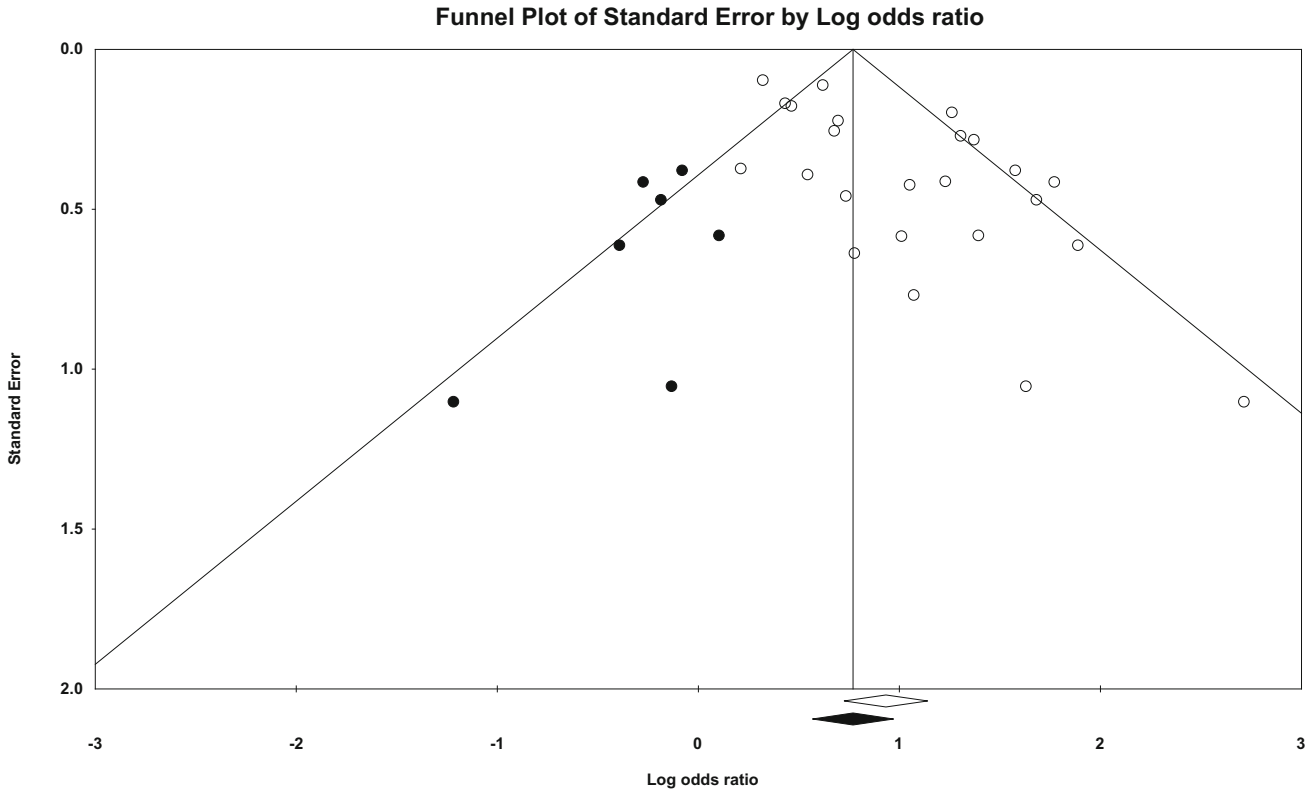
Relatively few studies have examined task-based measures of impulsivity in relation to childhood maltreatment. Indeed, a sufficient number of unique effects was available only for overall childhood maltreatment in association with behavioral impulsivity ($k = 4$). The pooled effect was not significant (OR = 1.07 [95% CI = .52–2.18], $p = .86$).

Discussion

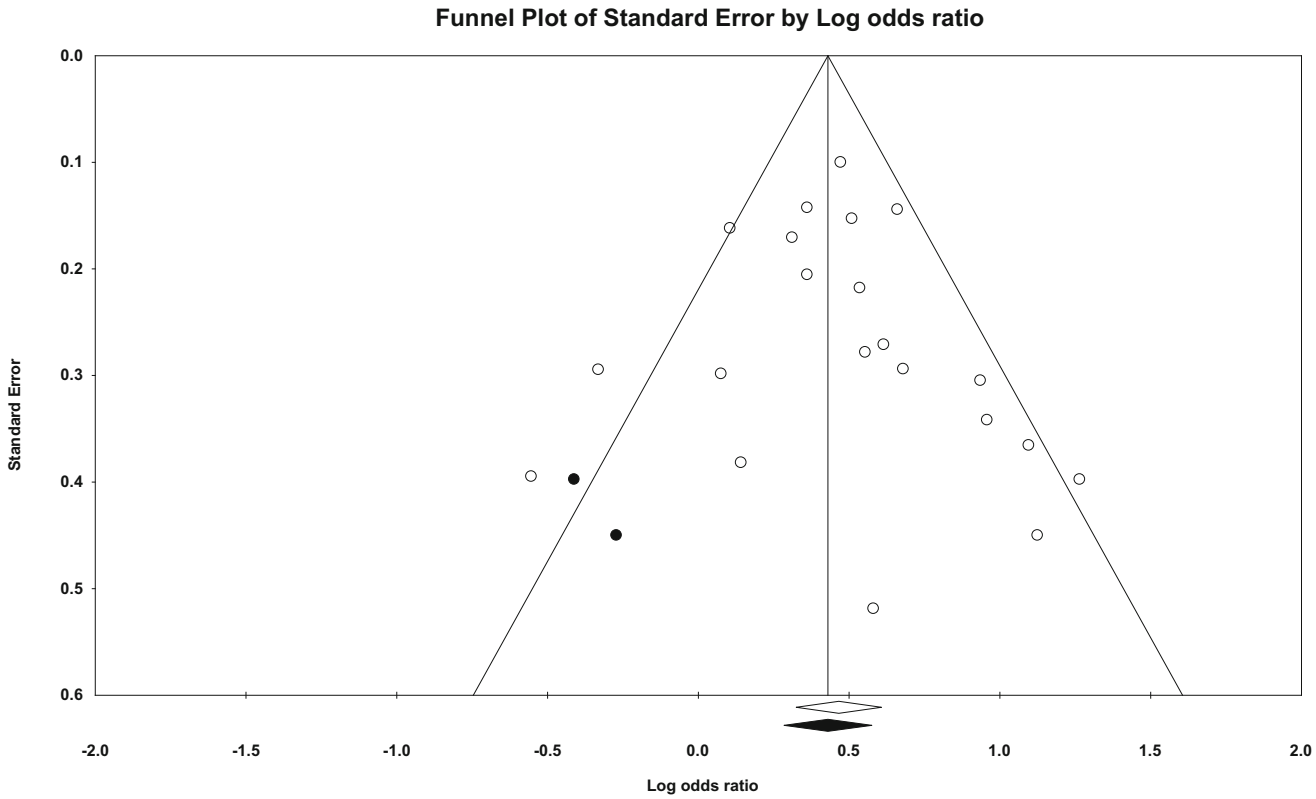
The objective of the current review was to quantify the magnitude of the association between childhood maltreatment and

Fig. 3 Funnel plot for effect sizes in the meta-analyses. The vertical line ▶ indicates the weighted mean effect. Open circles indicate observed effects for actual studies, and closed circles indicate imputed effects for studies believed to be missing due to publication bias. The clear diamond reflects the unadjusted weighted mean effect size, whereas the black diamond reflects the weighted mean effect size after adjusting for publication bias

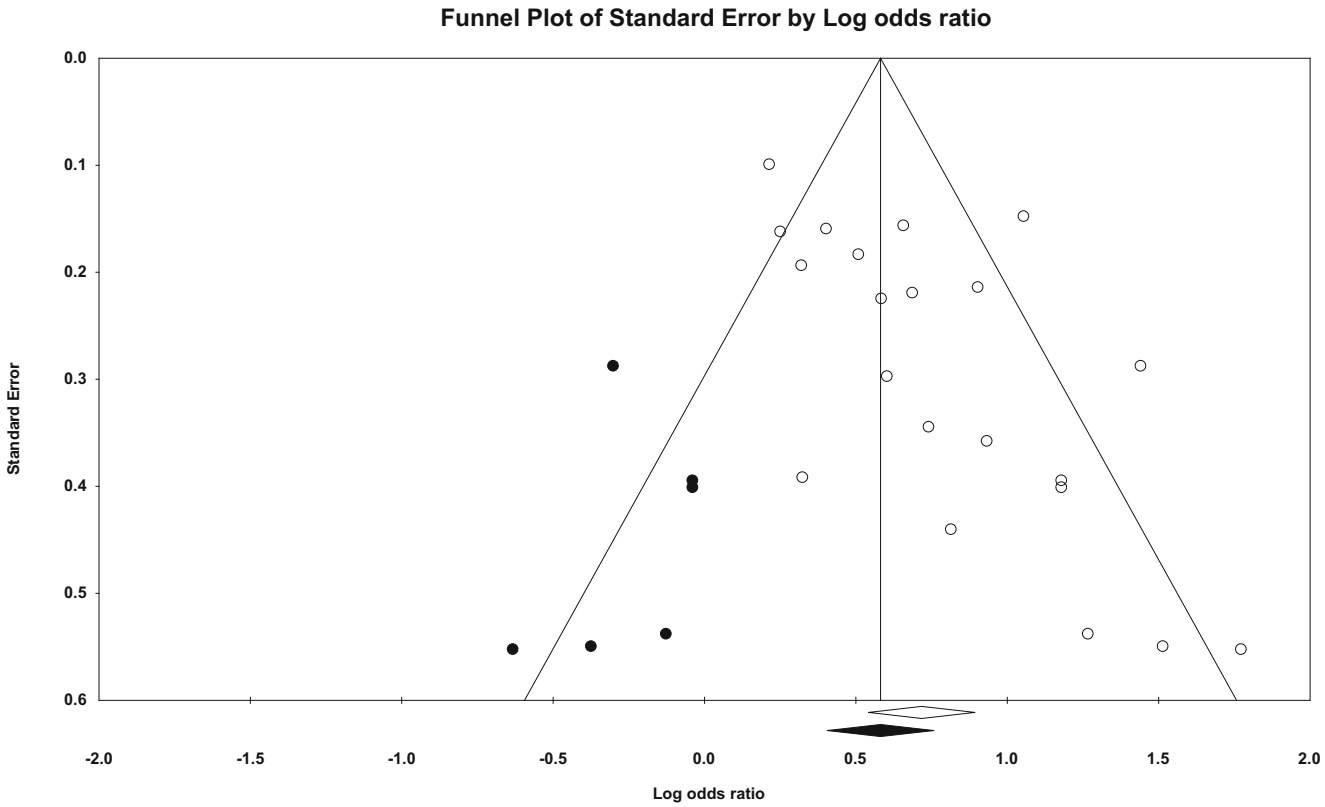
(a) Overall childhood maltreatment and general trait impulsivity



(b) Childhood sexual abuse and general trait impulsivity



(c) Childhood physical abuse and general trait impulsivity



(d) Childhood physical neglect and general trait impulsivity

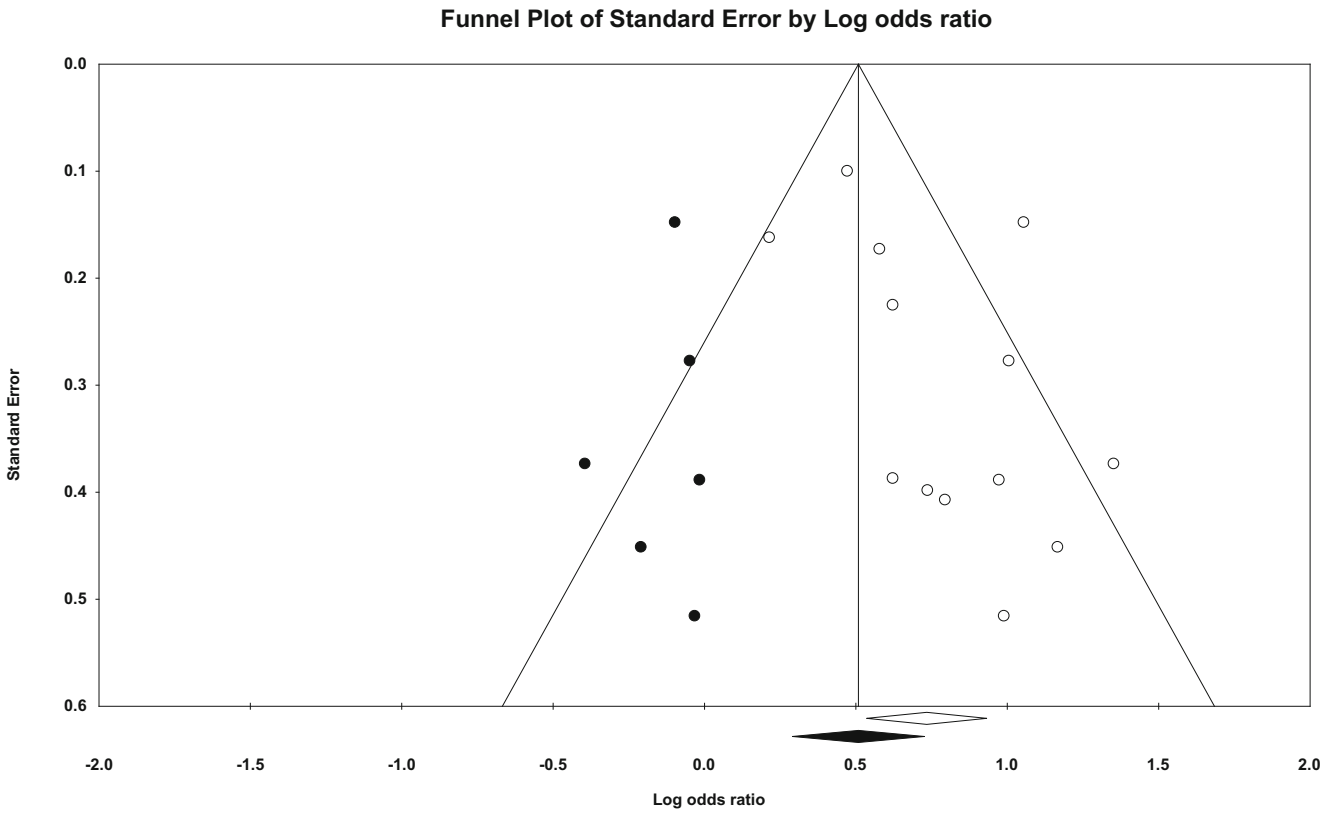
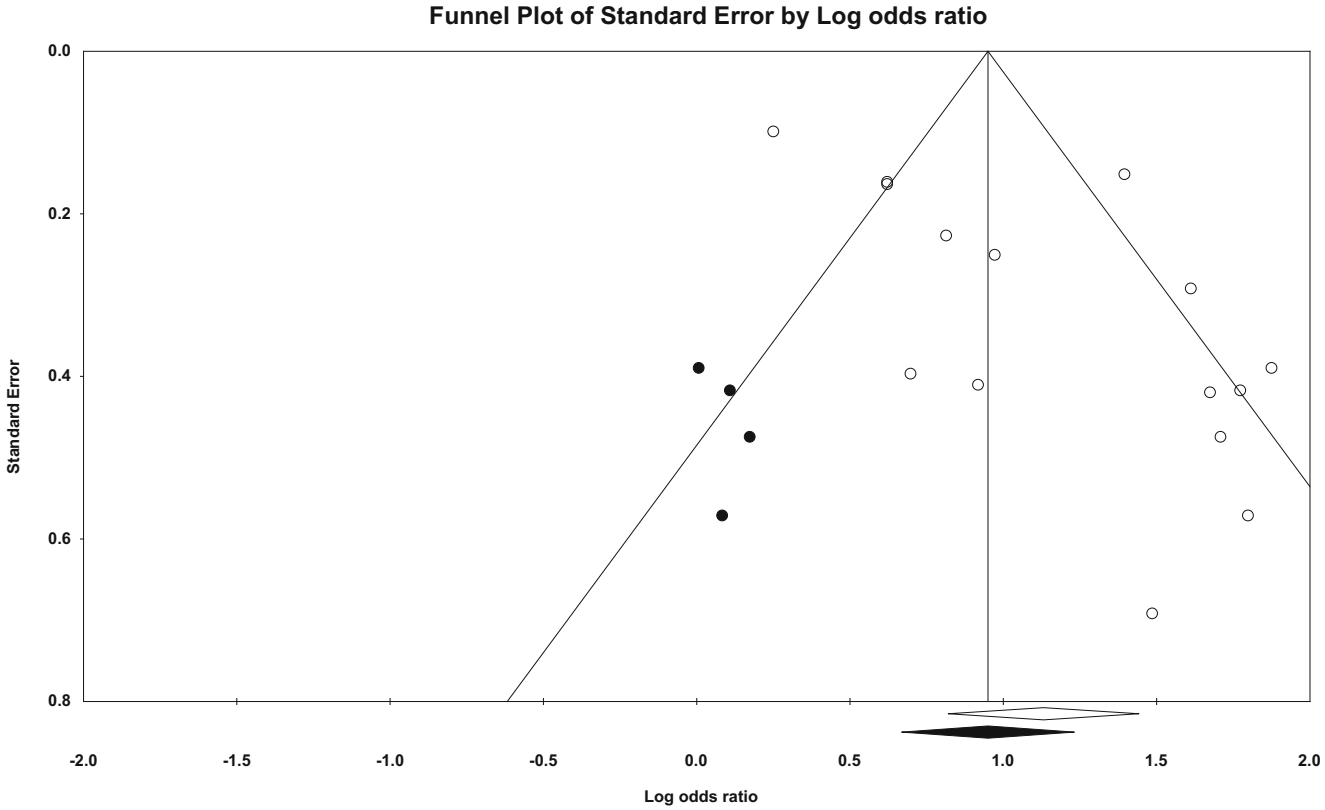


Fig. 3 (continued)

(e) Childhood emotional abuse and general trait impulsivity



(f) Childhood emotional neglect and general trait impulsivity

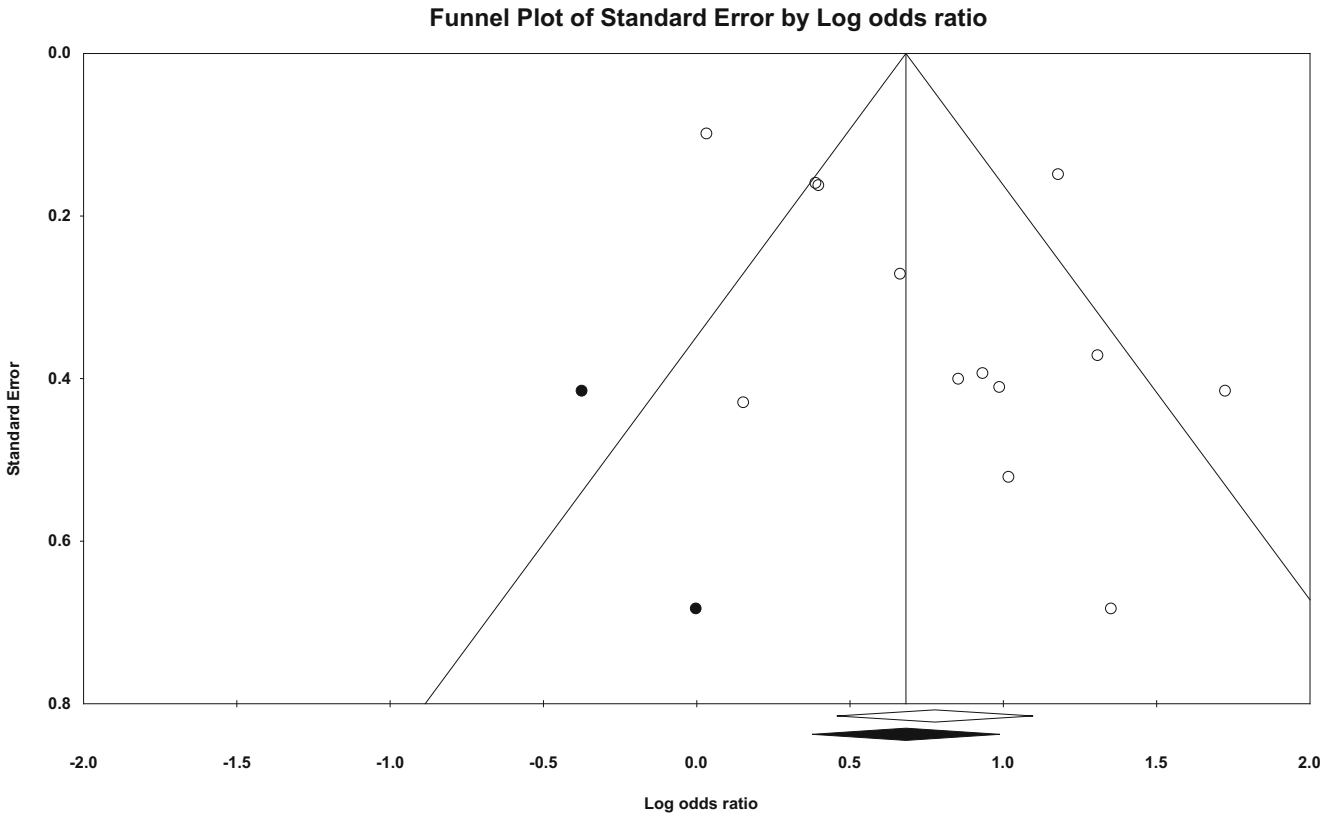


Fig. 3 (continued)

Table 3 Meta-analytic results for childhood maltreatment in relation to the Barratt Impulsiveness Scale subscales

		Attentional impulsivity			Motor impulsivity			Non-planning impulsivity		
	k	OR	95% CI	*p*	OR	95% CI	*p*	OR	95% CI	*p*
Overall maltreatment	3	2.42	1.85–3.17	<.001	2.16	1.42–3.28	<.001	1.82	1.40–2.37	<.001
Sexual abuse	8	1.50	1.07–2.10	.02	1.46	1.03–2.07	.03	1.46	1.11–1.92	<.01
Physical abuse	8	1.99	1.41–2.83	<.001	2.09	1.64–2.68	<.001	1.72	1.39–2.12	<.001
Physical neglect	3	1.57	.80–3.06	.19	1.65	.88–3.09	.12	1.50	.59–3.83	.40
Emotional abuse	3	2.30	1.52–3.50	<.001	2.72	1.55–4.76	<.001	1.90	.99–3.64	.05
Emotional neglect	3	1.87	.93–3.77	.08	1.43	.95–2.15	.09	1.43	.90–2.25	.13

k number of unique effects, *OR* pooled odds ratio, *CI* confidence interval

impulsivity in the empirical literature. In the case of general trait impulsivity, there was consistent support for this association, with weighted effect sizes ranging from small to medium-to-large across all forms of maltreatment. Regarding specific facets of impulsivity, a consistent pattern was observed among BIS subscales, with all three facets of impulsivity being specifically associated with childhood abuse (small to medium pooled effects) but not with childhood neglect. The association with impulsivity generally appeared strongest for childhood emotional abuse and weakest for childhood sexual abuse. Indeed, this difference in effect size was significant for general trait impulsivity, with the 95% confidence intervals for childhood emotional and sexual abuse not overlapping. As for the UPPS, the empirical literature is considerably more limited, and consequently there was an insufficient number of studies for meta-analysis with certain maltreatment subtypes (i.e., $k \leq 3$). Here, greatest empirical interest has been devoted to negative urgency. Paralleling this trend, the association between overall childhood maltreatment and this facet of impulsivity was significantly stronger than in the case of all other UPPS subscales. Even rarer still are investigations of state-sensitive laboratory-based measure of impulsivity, with meta-analysis currently only possible for behavioral impulsivity. Across the four studies in this area, overall childhood maltreatment was not significantly associated with this form of impulsivity.

Of these findings, that childhood emotional abuse appeared most strongly associated with impulsivity, especially relative to childhood sexual abuse, was perhaps among the most interesting. Why impulsivity appears to have a preferential association with childhood emotional abuse is unclear and a subject for future investigation. One possible explanation may lie in the fact that childhood emotional abuse is the most prevalent form of abuse (Stoltenborgh et al. 2015). It stands to reason that this higher prevalence may in part be a reflection of it also being the most chronic abuse subtype (Glaser 2002; Stoltenborgh et al. 2015). That is, although both childhood physical and sexual abuse can occur as either isolated incidents or recurrent events, childhood emotional abuse is an inherently chronic phenomenon (Stoltenborgh et al. 2012), and perhaps its greater association with impulsivity is in part a reflection of the impact of this greater chronicity.

Table 4 Meta-analytic results for overall childhood maltreatment in relation to the UPPS subscales

	k	OR	95% CI	*p*
Lack of premeditation	4	1.40	0.90–2.18	0.14
Lack of perseverance	4	2.08	1.62–2.68	<0.001
Sensation-seeking	4	1.06	0.83–1.35	0.65
Negative urgency	6	3.20	2.69–3.80	<0.001

k number of unique effects, *OR* pooled odds ratio, *CI* confidence interval

The connection in the current review between childhood maltreatment and impulsivity may inform theoretical formulations of the etiology of various forms of psychopathology that have either been theoretically or empirically associated with childhood maltreatment and impulsivity, respectively, including attention deficit/hyperactivity disorder, bipolar disorder, bulimia, substance use disorders, and suicide (Alloy and Abramson 2010; Bickel et al. 2014; Costello et al. 2002; Fischer et al. 2008; Mann et al. 2005; Post and Leverich 2006; Van Orden et al. 2010; Wenzel and Beck 2008; Winstanley et al. 2006; Wright et al. 2014). As just one example, within the interpersonal theory of suicide (Van Orden et al. 2010), both childhood maltreatment and impulsivity are implicated in the etiology of suicidal behavior, but as distinct mechanisms of risk. Specifically, childhood maltreatment and impulsivity are individually associated with risk for this outcome through heightened acquired capability for suicide. Based on the current findings, it may be possible that rather than being separate risk processes, these childhood maltreatment and impulsivity may interrelate in accounting for suicide risk, with the latter mediating the effects of early maltreatment on acquired capability for suicide, and thereby, indirectly, elevated risk for suicidal behavior.

It should also be noted, however, that interpretation of the findings of the current review is constrained by several

important methodological limitations prevalent across the existing literature. First, only zero-order effects (i.e., bivariate associations) were included in this meta-analysis, for only four studies, based on three samples, also featured multivariate analyses of childhood maltreatment relative to impulsivity (Jakubczyk et al. 2013, 2016; Lopez-Castroman et al. 2014; Sergentanis et al. 2014). Across these four studies, there was considerable heterogeneity in other variables included in the analyses. Nonetheless, reductions in effect size for overall childhood maltreatment (Sergentanis et al. 2014) and toward non-significance for specific maltreatment subtypes (Jakubczyk et al. 2013; Lopez-Castroman et al. 2014) were observed. Given the paucity of studies in this area and the inconsistency across studies in maltreatment subtypes reduced to non-significant associations with impulsivity, these findings must be regarded as tentative and require replication in future research.

More importantly, just two of the studies included in this review (Jakubczyk et al. 2013, 2016) covaried different forms of childhood maltreatment in evaluating individual maltreatment subtypes in relation to impulsivity. Even in these two cases, only two forms of maltreatment (i.e., physical and sexual abuse) were considered, with the form of childhood abuse most strongly associated with impulsivity in this review (i.e., emotional abuse) absent from consideration. The importance of these observations lies in the fact that maltreatment subtypes have been found frequently to co-occur (Finkelhor et al. 2007; Higgins and McCabe 2000; Teicher et al. 2006), with co-occurrence of subtypes ranging from 35% in large community samples (Edwards et al. 2003) to 90% or higher in more severe samples (Ney et al. 1994). Thus, it is uncertain to what degree the estimated effect sizes for maltreatment subtypes in the current meta-analysis reflect *unique* effects rather than, in part, a function of this high co-occurrence between different forms of maltreatment. Furthermore, although emotional abuse frequently co-occurs with physical and/or sexual abuse, it also often occurs by itself. In contrast, physical and sexual abuse are less likely to occur alone. Therefore, the observed effects for physical and sexual abuse in the current meta-analysis are likely larger than would be the case if the unique effects of each abuse subtype were observed, whereas a smaller reduction in effect size would likely be observed in the case of emotional abuse were its unique effect to be ascertained. Additional studies addressing this issue are therefore required to clarify the strength of the association between individual maltreatment subtypes and impulsivity.

Perhaps the most substantial limitation of the empirical literature to date is that although several of the studies included in this review employed a prospective design, none featured longitudinal analyses of childhood maltreatment in relation to impulsivity. That is, all evaluations of this association have involved retrospective assessments of maltreatment experiences in relation to current measures of impulsivity. From a purely methodological standpoint, this heavy reliance on retrospective recall of maltreatment experiences is a concern insofar as it may lead to systematic under-reporting due to imperfect recall. Indeed, although evidence exists that adults tend to be reasonably reliable in recalling experiences of childhood maltreatment (Bifulco et al. 1997), recent work has found a significant level of incongruence between prospectively and retrospectively ascertained data on adverse childhood experiences (Colman et al. 2016), and such discrepancy may potentially affect estimates of the strength of the association between childhood maltreatment and outcomes of interest (Liu 2017).

Implicit in these cross-sectional assessments of impulsivity with retrospectively recalled childhood maltreatment is the assumption that this relationship is unidirectional in nature, that maltreatment experiences lead to greater impulsivity. This assumption is potentially problematic for several reasons. First, it may be that children with impulsive tendencies are more likely to experience maltreatment. Parents may find these children more challenging to manage, and in some cases, the resulting parental stress (Mash and Johnston 1990) may lead to an escalation in disciplinary strategies, which could eventually include physical and emotional maltreatment. Such a possibility is not inconsistent with the finding in the present review that childhood sexual abuse, particularly when compared to childhood emotional abuse, was most weakly associated with general trait impulsivity.

A second possibility is that parents' own impulsive tendencies may be a common factor underlying both risk for offspring impulsivity and child maltreatment. Consistent with this possibility, there is accumulating evidence for moderate genetic influences on impulsivity (Bezdjian et al. 2011; Niv et al. 2012) and several studies have found parental impulsivity to be associated with physical abuse (Fréchette et al. 2015; Freisthler and Gruenewald 2013; Price-Wolf 2015) and neglect of offspring (Schumacher et al. 2001).

In summary, support was found in the current meta-analysis for an association between childhood maltreatment and impulsivity, with this relation generally observed to be stronger for emotional abuse, especially relative to sexual abuse. Nonetheless, these findings are qualified by several limitations prevalent throughout the empirical literature. Most notably, there is a need for research concurrently evaluating multiple forms of maltreatment in relation to impulsivity, thereby accounting for the significant level of co-occurrence between maltreatment subtypes and yielding a clearer picture of the unique effect of each form of maltreatment. Research is also particularly needed to extend beyond the current cross-sectional findings by employing longitudinal analyses to lend greater certainty in the temporal relationship between early maltreatment and impulsivity. Additionally, to ensure that this association is not simply a function of a common underlying relationship with parental impulsivity, future studies including an assessment of this construct are required. Finally, in

addition to establishing the association between childhood maltreatment experiences and impulsivity, it would be important for future research in this area to elucidate the processes mediating and moderating this relationship for their potential to inform early intervention efforts. Such work is particularly crucial, given the considerable public health burden that has been associated with both early maltreatment experiences and impulsive behaviors.

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