Untangling intelligence, psychopathy, personality disorders, & conduct problems: A meta-analytic review

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Abstract

Across the last several decades, a growing body of research has accumulated concerning the relationship between indicators of general intelligence and the personality construct known as psychopathy. Both traits represent key correlates of life outcomes, predicting everything from occupational and economic success, to various indicators of prosocial and antisocial behaviour. The findings to date regarding the association of the two traits, however, have been somewhat inconsistent. Moreover, there has been a tendency to confuse psychopathy with other clinically significant disorders, which also predict antisocial behaviour. Thus, there remains a need for a more systematic investigation of the extant empirical literature. The current study represents a meta-analysis conducted to evaluate the direction and overall effect size between these traits: intelligence, psychopathy, and antisocial or conduct-related disorders. In a pooled sample of 27,094 participants from 105 correlations, our analyses revealed a small, statistically significant, relationship between intelligence and psychopathy (r = -.07, p = .001). Furthermore, we analysed the relationship between intelligence and antisocial disorders, finding a modest, inverse relationship for Antisocial Personality Disorder (r = -.13, p = .001; n = 2,151; k = 14) and Conduct Disorder (r = -.11; n = 23,171; k = 23), but a small, positive association for Oppositional Defiant Disorder (r = .06, p = .001; n = 10,362; k = 3).

Keywords: psychopathy; general intelligence; cognitive ability

Psychopathy and intelligence represent two psychological constructs that have been studied extensively over the last several decades. Large bodies of psychometric work have consistently supported the reliability and validity of both concepts (Carroll, 1993; Hare et al., 1990; Kranzler & Jensen, 1991; Salekin, Rogers, & Sewell, 1996). General intelligence is one of the most studied traits in all of psychology and has nearly a century of research related to its measurement, development, and etiological underpinnings (Gottfredson, 2002; Ritchie, 2015). Psychopathy, while representing a more recently defined psychological construct (Cleckley, 1941), is nonetheless psychometrically robust, and research continues to shed light on its aetiology and development across the life course.

Of particular interest to the current study, however, is a more recent line of research examining the association between indicators of intelligence and indicators of psychopathy. The last decade, in fact, has seen a sharp increase in studies examining the association between general intelligence and psychopathy, with some evidence suggesting that lower intelligence scores are correlated with increased psychopathic tendencies (DeLisi, Vaughn, Beaver, & Wright, 2010; Vitacco, Neumann, & Wodeshuk, 2008). To date, however, the results gleaned from this growing body of research have been somewhat mixed, with some studies finding evidence of an inverse relationship between the two variables, and other studies failing to find such an effect. The goal of the current study is to systematically review the literature in order to better understand the pattern of findings emerging to date. To the extent that psychopathy covaries with intelligence (regardless of the direction of the association), it may provide insight into the development of both outcomes. Prior to progressing further, we discuss both constructs in more detail.

Psychopathy

Unlike most clinical disorders, which are characterized by a set of symptoms, psychopathy is commonly described as a cluster of relatively stable personality traits

(Cleckley, 1941; Hare, 1991). As others have previously described, the traits most often linked with psychopathy are callousness, remorselessness, and a lack of empathy, as well as grandiosity, impulsivity, deceitfulness, and a tendency toward manipulativeness (Blair, 2007; Cleckley, 1941; Hare, 1991). Additionally, the Psychopathy Checklist-Revised Edition (PCL-R; Hare, 1991), generally viewed as a highly robust diagnostic tool for measuring psychopathy, includes the previously mentioned traits, yet adds traits such as superficial charm, pathological lying, failure to accept responsibility, need for stimulation, parasitic lifestyle, early behaviour problems, lack of long term planning or goals, and promiscuous sexual behaviour (Hare, 1991; Cooke & Michie, 2001). While some debate remains around certain aspects, the general consensus among scholars seems to be that psychopathy represents a confluence of traits that predict a host of antisocial outcomes (Cooke & Michie, 2001; Hare, 1996; Patrick et al., 2006).

Untangling Psychopathy from Other Relevant Traits

Given the range of socially adverse outcomes often associated with psychopathy—including crime—it is possible to conflate the construct with other well-established behavioural and personality disorders, antisocial personality disorder (ASPD) being chief among them, which also raise the risk for various antisocial outcomes. To be sure, there is a resemblance between these phenotypes. Yet, despite significant overlap, and despite the fact that they predict similar outcomes, psychopathy and ASPD, for example, (as well as Conduct Disorder & Oppositional Defiant Disorder) are clinically distinct constructs. As others have noted, in fact, when ASPD was added to the *Diagnostic and Statistical Manual for Mental Disorders – III* in 1980, the intent was that it would also capture variation in psychopathy (see Hare, Hart, & Harpur, 1991).

The result was a behaviourally based construct that poorly captured the nuances of psychopathy (Cooke & Logan, 2015; Hare, Hart, & Harpur, 1991). For example, although

scores on a measure of psychopathy have been found to correlate with symptoms of ASPD in prisoners (Hare, 2003), those labelled as psychopathic based off of diagnostic cut-offs on a psychopathy measure make up only a small subset of those who meet the diagnostic criteria for ASPD (Widiger, 2006). Nevertheless, these two constructs are related, as both psychopathy (e.g., Dolan & Anderson, 2002; Kavish, Bailey, Sharp, & Venta, 2017) and ASPD (e.g., Stevens, Kaplan, & Hesselbrock, 2003) have been associated with intelligence, as well as with overt behavioural problems including criminogenic outcomes.[1] Because of this close connection, and because both constructs are so clinically tethered to one another, the current study includes both psychopathy and ASPD in our analyses (along with related antisocial diagnoses: Conduct Disorder (CD), Oppositional Defiant Disorder (ODD); we will use the description "antisocial disorders" when referring to ASPD, CD, and ODD collectively), but examines them separately so as to better gauge the connection between each trait/condition and indicators of intelligence.

Intelligence

General intelligence, commonly referred to as *g* or the positive manifold, is arguably the best measured trait in all of psychology and research from a variety of disciplines has repeatedly found that it is immensely important in most areas of life (Gottfredson, 2002; Ritchie, 2015). Researchers have been studying and refining the concept of *g* since Spearman (1904) first proposed it in the beginning of the 20th century as a way to conceptualize overall mental ability rather than variation across a specific ability (e.g. verbal ability) (Gottfredson, 1997; 2002). Similar to psychopathy, intelligence has consistently been linked to important life outcomes. IQ predicts socioeconomic status (Kanazawa, 2006; Strenze, 2007), educational achievement (Deary, Strand, Smith, & Fernandes, 2007; Gottfredson, 1997; Lynn & Mikk, 2009; Strenze, 2007), occupational status and job success (Gottfredson, 2002;

[1] We appreciate an anonymous reviewer on a prior version of this paper reminding us of this key point, and encouraging an expansion of the focus of the current study.

Strenze, 2007), mating success (Greengross & Miller, 2011), physical and mental health (Batty, Der, Macintyre, & Deary, 2006; Deary, Weiss, & Batty, 2010; Der, Batty, & Deary, 2009; Gottfredson & Deary, 2004) and longevity (Beaver et al., 2016; Deary, Weiss, & Batty, 2010; Gottfredson & Deary, 2004). Having a higher intelligence has been found to be a correlate of completing more years of education (Deary, Strand, Smith, & Fernandes, 2007; Gottfredson, 1997; Lynn & Mikk, 2009; Strenze, 2007), gaining a higher status career (Gottfredson, 2002; Strenze, 2007) and living longer (Deary, Weiss, & Batty, 2010; Gottfredson & Deary, 2004). At the macro level, estimates of the mean IQs of a state (Kanazawa, 2006) or country (Lynn & Vanhanen, 2002) also predict differences in per capita Gross State Product (GSP) and Gross Domestic Product (GDP), respectively.

Intelligence, Psychopathy, Disorders of Antisocial Behaviour

In his landmark text, Cleckley (1941) gave one of the first authoritative and detailed descriptions of psychopathy. One of the key attributes included in this description was that psychopaths possess "good intelligence" (Cleckley, 1941). Since that early description, the conceptualization of psychopathy, especially in the public eye, has often depicted the psychopath as an evil genius or criminal mastermind (think Hannibal Lector from *The Silence of the Lambs*; as described by DeLisi, Vaughn, Beaver, & Wright, 2010; Kavish, Bailey, Sharp, & Venta, 2017).

When considering the phenotypic outcomes of intelligence and psychopathy, however, it seems reasonable to suggest that there might actually be an inverse relationship between the two. For example, one of the largest behavioural overlaps between psychopathy and *low* intelligence is the increased propensity toward violent and criminal involvement. Numerous studies and reviews have found a robust inverse relationship between intelligence and delinquency in adolescents and juveniles (Hernstein & C. Murray, 1994; Hirschi & Hindelang, 1977; Wilson & Hernstein, 1985). This relationship between intelligence and

antisocial behaviour continues into adulthood with lower intelligence scores being a significant risk factor for criminal behavior (Hernstein & C. Murray, 1994; J. Murray & Farrington, 2010). Lower levels of intelligence have also been found to predict longer criminal careers (Piquero & White, 2003) and higher rates of violence among incarcerated individuals (Diamond, Morris, & Barnes, 2012). And on the opposite end of the spectrum, a meta-analysis of intelligence and crime found that higher intelligence was a protective factor against offending (Ttofi, Farrington, Piquero, & DeLisi, 2016; Ttofi et al., 2016).

Similarly, psychopathy has been repeatedly associated with antisocial behaviour and criminal activity (Hemphill, Hare, & Wong, 1998; Porter, Brinke, & Wilson, 2009; Salekin, Rogers, & Sewell, 1996). A meta-analysis of 53 studies totalling over 10,000 participants determined that psychopathy was a significant predictor of juvenile delinquency and assessment of psychopathy as a predictor of violence was found to be valid as early as middle childhood (Asscher et al., 2011). Additionally, psychopaths tend to commit more violent crime (Porter, Brinke, & Wilson, 2009), more violence in prison (Hare, 1999), and recidivate at much higher rates (Hemphill, Hare, & Wong, 1998; Langevin & Curnoe, 2011).

Given the overlap in outcomes that correlate with both lower intelligence and psychopathy, researchers have recently become interested in directly testing the link between the two phenotypes. The findings of this line of research have been relatively equivocal with some research suggesting a positive relationship between intelligence and psychopathy (Beggs & Grace, 2008), while others found no relationship (Dolan & Park, 2002), as well as significant, negative relationships (Dolan & Anderson, 2002). The ambiguity of these results, and the common limitation of very small samples, necessitates review and meta-analysis to further elucidate the possible link between intelligence and psychopathy at the construct level.

One meta-analysis has already examined the possibility of a relationship between psychopathy and intelligence and found no association (O'Boyle, Forsyth, Banks, & Story, 2013). However, the researchers were specifically interested in a Dark Triad (DT; Paulhaus & Williams, 2002) perspective, and consequently made inclusion/exclusion criteria decisions that left important gaps. Because the DT, the idea that so-called "dark traits" (psychopathy, narcissism, and Machiavellianism) are overlapping, yet distinct traits that frequently co-occur, was conceptualized specifically for non-clinical populations, O'Boyle and colleagues (2013) excluded psychiatric, child, and incarcerated samples. Psychopathy is a personality construct with operationalizations (e.g., Cleckley, 1941) predating the DT, and it has been conceptualized and assessed in all of these populations (e.g., Barry et al., 2000; Hare, 1991; 2003; Skeem & Mulvey, 2001). Indeed, one of the most popular measures of psychopathy, the Hare Psychopathy Checklist (Hare, 1991), was designed for use with prisoners. Thus, the decision to exclude these samples may have resulted in a biasing of the results in O'Boyle et al. (2013).

A second limitation of the previous meta-analysis was the exclusion of a large number of studies made examination of facet and factor level relationships impossible. Researchers have recently begun to attempt to further untangle the relationship between intelligence and psychopathy by evaluating how they are associated at the facet and trait level (e.g. DeLisi et al, 2010; Salekin, Neumann, Leistico, & Zalot, 2004). Preliminary results from this budding area of research suggest that particular facets of intelligence and factors of psychopathy could be driving the relationship that has been found in some of the construct level research. For example, verbal intelligence has been particularly implicated as being positively related to the interpersonal factor of psychopathy (Salekin et al, 2004) and negatively related to the affective (Salekin et al, 2004, Vitacco, Neumann, & Jackson, 2004) and behavioural/lifestyle components (Vitacco, Neumann, & Jackson, 2004). Moreover, there are numerous other

variables that may moderate the relationship between facet and full-scale IQ and the factors and overall psychopathy (e.g., age, race, sex). Previous work (O'Boyle et al., 2013), examined only four potential moderators (age, sex, sample type, and measure of intelligence), leaving other potential moderators (e.g., measure of psychopathy, published vs unpublished data) untested. Finally, no means of testing for publication bias or evidentiary quality was included. Thus, there remain several gaps in the literature on the relationship between psychopathy and intelligence (as well as between intelligence and antisocial disorders) that we seek to fill.

Study Aims

The present study is a meta-analytical review on the relationship of intelligence (as measured by IQ tests) with antisocial and psychopathic groups, and to assess whether this association is moderated by specific methodological characteristics such as sample type and geographic location; age group; sex composition; instruments used to assess antisocial disorders, psychopathy, and IQ; use of covariates; type of publication; and publication year. More specifically, this study evaluates the effect sizes of Full-scale (FSIQ), Verbal (VIQ) and Performance IQ (PIQ) and different dimensions of psychopathy (Factor 1, Factor 2).

Method

Inclusion criteria

Studies to be included in the meta-analysis had to meet the following inclusion criteria:

1. The study measured the association between intelligence and a measure of psychopathy and/or antisocial personality traits.
2. The study examines at least one component of psychopathy (i.e. Factor 1, Factor 2, and/or one of its facets). For studies reporting the Dark Triad, only the psychopathy scale was included (for other dimensions see O´Boyle, Forsyth, Banks & Story, 2013). With regard to the antisocial personality criteria, the goal was to base

the analysis on personality traits. Thus, the study had to define antisocial behaviour in terms of psychiatric diagnoses based on psychiatric manual such as *Diagnostic and Statistical Manual of Mental Disorders (any version)* (DSM, The American Psychiatric Association) or *International Statistical Classification of Diseases 10th Revision* (ICD-10, WHO, 1992) [i.e., oppositional defiant disorder (ODD), conduct disorder (CD), disruptive behaviour disorder (DBD), antisocial personality disorder (ASPD)]. If the antisocial behaviour was exclusively based on legal operationalization (i.e. reported delinquency, number of convictions and/or criminality, or aggression/violence) the study was excluded. Studies that used antisocial behaviour questionnaires associated with the DSM (i.e., CBCL, Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) or psychopathy measures (e.g., Antisocial Behaviour Questionnaire (ABQ); Loeber, Stouthamer-Loeber, Van Kammen, & Farrington, 1989) were included (see Fontaine, Barker, Salekin & Viding, 2008; Rispens et al. 1997; Wall, Sellbom & Goodwin, 2013). Other questionnaires must be supplemented with psychiatric diagnostic criteria. Four studies (Ford, Farah, Shera, & Hurt, 2007; Hofvander et al. 2011; Masten et al. 1999; and Nomura, Rajendran, Brooks-Gunn & Newcorn, 2008) used questionnaires without psychiatric diagnosis (e.g., the Life History of Aggression scale; Cocarro et al., 1997). They were included because the items were similar to those studies with psychiatric diagnostic criteria (see sensitivity analysis). Samples with ADHD were excluded given the existence of different background factors and correlates (Lynam, 1996). Finally, studies using the five-factor model (FFM) to measure antisocial personality traits were excluded (for review, see Decuyper, de Pauw, de Fruyt, de Bolle & de Clercq, 2009).

3. The study had to include a standard intelligence test. The Wechsler tests remain one of the most widely used, but any other standard test of IQ was included.

We included any version, abbreviated versions, and any subscale of the WAIS (i.e. Vocabulary, Digit Symbol). Verbal IQ (VIQ; broadly the ability to analyse information and solve problems using language and language-based reasoning skills) and Performance IQ (PIQ; a term we use to reflect non-verbal, visuo-spatial abilities) were recorded when available. We excluded the PIQ–VIQ discrepancy (for review, see Isen, 2010). Although, measures of working memory do correlate with intelligence these cognitive tests were excluded. Additionally, we excluded measures of so-called emotional intelligence.

4. The study had to report the zero-order correlation or the necessary data to calculate the zero-order correlation between IQ and psychopathic or antisocial personality traits. When effect sizes were reported that controlled for covariates (i.e. studies that reported effect sizes as coefficients in a regression with multiple variables entered simultaneously in the model, partial correlations, or structural equation models), the authors were contacted to request the data for zero-order correlations, which were then analyzed in the current study. The studies with covariates were coded to so that they could be examined in the portion of the analyses testing for moderating effects.

5. No restrictions were applied on the following categories: type of population (clinical, institutional and general population), age (adults, adolescents and children) and gender (males, females and mixed). If studies reported different samples, they were considered independent samples.

Literature search strategies

To identify studies for inclusion in the meta-analysis, we conducted searches in the following bibliographic databases: MEDLINE, Web of Knowledge, SCOPUS and Google Scholar. We limited the search to peer-reviewed studies published in English between 1940

and the most recent search date (May 2017) because the first major operationalization of psychopathy appeared in 1941 (Cleckley, 1941). The search for candidate studies to be included in the meta-analysis was conducted using keywords relevant to ("*antisocial personality disorder*" OR "*psychopathy*" OR "*conduct disorder"* OR *"oppositional defiant disorder (ODD)"* OR *"disruptive behavior disorder (DBD)")* AND ("*IQ*" OR "*intelligence"* OR "*general cognitive abilities")* AND *("community"* OR *"students"* OR *"offenders"* OR "*adolescents*"). The search terms were used separately and in different combinations for the database searches. In total 17 personality terms were included regarding antisocial traits (e.g., psychopath*, psychopathic traits, callous-unemotional trait, antisocial personality) and measures (e.g., PCL, LSRP, PPI, DSM). Sixteen general cognitive abilities terms were used (e.g., intellectual functioning, intellectual abilities, general cognitive functioning) and their measures (e.g., WAIS; NART; SILS, Raven´s Progressive Matrices) and 12 population type terms (e.g., youth, juvenile, criminal, offender, viol*, student, general population, community, students, children). Additional articles were obtained through inspection of the reference lists of articles and reviews obtained in the above search. Finally, we contacted authors for unpublished data on the topic under investigation.

INSERT FIGURE 1

Coding moderators

Study characteristics were coded using a coding form. The following moderators were coded for each correlation, with the coding rules based on previous meta-analyses (see Decuyper et al. 2009; Isen, 2010).

Age group of participants. Age groups were coded as follows: child (1–11 years old), adolescent (12–17 years old), or adult (18 years old or older) (Lorber, 2004). If studies considered age ranges, the mean age of the sample was included. Furthermore, age was not reported in some studies of incarcerated individuals or college undergraduates'. In these

cases, a code of "adult" was assigned (college students tend to be within 18–22 years of age) (Isen, 2010).

Gender. A sample was coded as "males", "females" or "mixed". In mixed samples, the percentage of males in the sample was calculated.

Outcome type. Antisocial behaviour type was coded as one of three categories based on a clear definition given by the DSM or specific questionnaire or interview based on the diagnostic manual (the children and adolescent disorders (CD, ODD) and the adult disorder, ASPD). Psychopathy was coded as derived from Hare's/Cleckley's psychopathy description or other validated models (i.e. triarchic (Tri) construct and Dark Triad). In studies in which ASPD and psychopathy were reported, we classify them as ASPD or psychopathy based on the measure reported in the meta-analysis because there were not enough studies to create a ASPD+P group. If a study reported ASPD-P, we coded it as ASPD.

Psychopathy/Antisocial measures. For psychopathy, all versions of Hare´s Checklist for psychopathy were considered as the category "PCL". Other inventories or questionnaires of psychopathic traits were coded as "Other". For the antisocial disorders, all inventories assessing symptoms of ASPD, CD, or ODD were coded as "Antisocial Inventory", and the category "Interview" was used for diagnoses of ASPD, CD, or ODD based off of clinical interviews used to measure antisocial personality traits.

IQ measure. All versions of the WAIS and WISC were collapsed into a single category "Wechsler" (i.e., WISC, WAIS, WASI, WIP, etc). The rest of the tests were coded as "Other" (Isen, 2010).

Recruitment source. Recruitment was coded as "Clinical" (i.e., university evaluation units; referral clinics and courts; social services agencies; psychiatric hospitals and assessment units), "Institutional" (i.e., prisons, youth detention centers, security hospitals and

probationary supervision) or "Community" (i.e. schools, university, general population, Navy Center, prenatal clinics and birth cohort).

Covariates. As pointed out above, some studies reported regression models or adjusted correlations. This was coded as "Yes/No".

Region. Region of each sample was coded as "North American", "European" and "Australia/New Zealand" (Decuyper et al. 2009).

Publication type. This was coded as "published data" and "unpublished data". The latter was grey literature, that is, PhD Dissertations and data reported by authors via email, not reported on the published article.

Selection and calculation of effect sizes

The collected data (mainly Pearson correlations) were analyzed using Fisher's Z-transformed correlation coefficients weighted by the inverse of the Variance (see Lipsey & Wilson, 2001) using Comprehensive Meta-Analysis (CMA) statistical software (Borenstein, Hedges, Higgins, & Rothstein, 2009). A random effects model was applied to examine the overall IQ association with psychopathy, as well as the antisocial outcomes (see Lipsey & Wilson, 2001) because we assumed that effect sizes would vary across studies. Cohen (1988) suggested that the effect size (*r*s) of .10, .30 and .50 be considered small, medium and large, respectively. Yet it is worth noting that for psychological research, others have recommended interpreting the effect sizes of .10, .20 and .30 as small, moderate and large effects, respectively (Hemphill, 2003).

Homogeneity (Q and I^2) tests were performed to determine whether the studies can reasonably be described as sharing a common effect size. Put differently, this test examines whether the variation between study outcomes was due to random chance (Q *t*est) and also what percentage of variation across the studies is due to significant heterogeneity (I^2 test) (Hedges & Olkin, 1985, Higgins, Thompson, Deeks & Altman, 2003). Generally, I^2 values

of 25%, 50%, 75% represent low, moderate and high between-study heterogeneity (see Higgins et al., 2003), with higher levels of heterogeneity indicating greater proportions of between-study variation in effect size that are due to differences between the studies. These differences can often reflect the presence of moderating variables (e.g., using different measures of intelligence). A low I^2 value on the other hand, would indicate that between-study variation might be mostly the result of chance.

Thus, we can use these analyses to examine the role of potential moderator variables and determine if we need to conduct additional analyses. For all categorical variables, moderator analyses were conducted using the analog to ANOVA (with random effects), whereas fixed effect meta-regression analyses were conducted for the continuous moderator variable (publication year). Finally, we estimated the robustness of the meta-analytical estimates by performing sensitivity analyses. These adjust for the impact of publication bias as well as the impact of outliers and influential studies. We applied the trim-and-fill method (Duval & Tweedie, 2000) to identify and adjust for publication bias and the Egger's linear regression procedure (Sterne & Egger, 2001). When the relationship between IQ and an outcome variable was reported for multiple measures of the outcome variable, we selected the more commonly utilized instrument for the outcome in question. When different IQ measures were reported for an outcome, we applied the same criteria.

When a study reported only Factors 1 and 2 or facet correlates, we averaged them to create a mean effect size. Composite scores were only created when all dimensions of the measure were available (O´Boyle et al., 2013), that is, if only two facets were reported, we did not create a total psychopathy score. However, in follow up moderator analyses, we also calculated effect sizes for Factors 1 (interpersonal/affective or callous-unemotional in youth) and 2 (lifestyle/antisocial) of psychopathy when available in order to determine whether IQ was more strongly associated with either factor. In addition, when VIQ and PIQ were

reported, we averaged them, but also recorded them for moderator analyses. If the study reported the Vocabulary and/or Similarities subscales, it was included in the VIQ moderator analysis; and if the Block Design and/or Matrix Reasoning subscales were reported, they were included in the PIQ.

The PCL was the most commonly used psychopathy measure across the studies, so we collapsed the different components of other measures (i.e., subscales of MPQ-Tri, PPI, PAI-ANT, IM-P) into PCL-Factor 1 (Interpersonal and Affective) and 2 (Antisocial Behavior and Impulsivity). Our criteria were based on previous correlational studies (see Benning, Patrick, Blonigen, Hicks, & Iacono, 2005; Brislin, Drislane, Smith, Edens & Patrick, 2015, Copestake, Gray & Snowden, 2011; Venables, Hall & Patrick, 2014; Vitacco & Kosson, 2010). In particular, Factor 1 of the PCL-R consisted of the concept of meanness and boldness on the TriPM, Fearless Dominance and Coldheartedness on the PPI-R, and Dominance, Grandiosity and Boundary Violence of the IM-P, whilst Factor 2 was represented by Disinhibition on the TriPM and Impulsive-Antisociality on the PPI-R. Some studies reported overall correlations, as well as separate correlations for males and females; or children, adolescents and adults. When this occurred, independent effect sizes for each one were included in order to use these effect sizes for the gender and age moderator analyses. In total, we assessed 94 studies consisting of 105 effect sizes for IQ and psychopathy (n = 27,094), 14 effect sizes for IQ and ASPD (n = 2,151), 23 effect sizes for CD (n = 23,171), and 3 for ODD (n = 10,362). Some studies reported an effect size for more than one relationship (e.g., intelligence with psychopathy and with ASPD) in the same sample.

** INSERT TABLE 1**

Results

A detailed list of the studies included in the meta-analysis is provided in Table 1 (see Figure 1 for excluded studies). The final sample consisted of 94 studies, reporting 145 total

correlations, published during the period of 1965 to 2017. Data were obtained from a total of 47,154 subjects (again it is noted that numerous samples reported effect sizes for more than one relationship within one sample, thus adding up the pooled samples for each relationship will add up to more than the actual number of participants), comprising independent samples. Nearly all studies were conducted in the United States, but other nationalities were represented such as England, Germany, Canada, New Zealand, Australia, Netherlands, Finland, Sweden, France, Romania, Italy, Malaysia, Bulgaria, Switzerland, and Spain. Presented below are separate meta-analyses, one for the relationship between intelligence and antisocial personality traits (i.e., ASPD, CD, ODD) and one for the association between intelligence and psychopathy. Finally, we carried out a meta-analysis for the relationship between the two dimensions of psychopathy (Factor 1 and Factor 2) and different broad indicators of intelligence (Full-scale, verbal and performance).

Intelligence and antisocial personality disorders (ASPD, CD and ODD)

Thirteen correlations between intelligence and ASPD were analyzed; yielding a statistically significant, yet substantively small, negative effect (r= -.13, p= .001). The correlation for CD (r= -.11, p= .001) was comparable to ASPD, indicating that lower intelligence was associated with both ASPD and CD (see Table 2). With regards to ODD (r= .06, p= .001)[2], a very weak, positive association was uncovered. Calculations for the relationship between intelligence and ODD, however, should be interpreted with caution because they were based on only three correlations.

Further analyses revealed that the effect sizes were highly heterogeneous for ASPD (Q=50.04, p= .001; I^2 = 76%) and CD (Q=458.00, p=.001; I^2 = 95%). Heterogeneous effect sizes can emerge for a couple of reasons. First, they might simply occur by chance. However, differences in effect sizes might also represent the presence of moderating

[2] P-values for all summary effect sizes were calculated the same way. While seemingly low due to the low number of studies (k = 3), the significant results and large sample size of one of the studies (n > 10,000) likely drove the p-value further downward.

variables, or the fact that studies are not, in reality, measuring the same outcomes. Our analyses seemed to suggest that chance variation was unlikely to explain all of the heterogeneity observed for these outcomes. Conversely, ODD did not demonstrate evidence of heterogeneity (Q= 0.131, p= 0.94, I^2 = 0%), suggesting that variation between studies is likely the result of chance variation. Therefore, moderator analyses were run for the studies examining ASPD and CD.

Prior to presenting our findings regarding moderation, however, we further examined potential relationships between aspects of intelligence (VIQ and PIQ) and antisocial disorders. For this portion of the analysis, there was no association between ASPD and verbal intelligence (VIQ) (r= -.01, *ns*) or PIQ (r= -.007, *ns*), whereas CD showed a negative association with both VIQ (r= -.17, p= .001) and (PIQ) (r= -.16, p= .05). With regards to ODD, only one study examined an association with VIQ, and no study examined associations between ODD and PIQ. Thus, we were unable to directly test relationships between ODD and facets of IQ. Heterogeneity analyses were not significant for ASPD and VIQ (I^2 = 0%) or PIQ (I^2 = 13%), but effect sizes were significantly heterogeneous for CD and VIQ (I^2 = 86%) and PIQ (I^2 = 94%). These analyses suggest that most of the differences in findings between studies examining CD's relationship with VIQ and PIQ is the product of moderating variables.

INSERT TABLE 2 & 3

Moderator analyses

As mentioned above, we next conducted moderator analyses in order to further evaluate which aspects of the studies included in our review (e.g., variation in measures used) might be contributing to the variation we observed across studies. Results from categorical moderator analyses are presented above in Table 3 for ASPD and CD. In total, we examined eight potential categorical moderators (i.e. gender, age group, antisocial personality measure,

IQ measure, recruitment site, covariates, region, and publication type) and one continuous variable (year of publication). None of the categorical variables we tested significantly moderated the relationship between intelligence and ASPD. However, the intelligence measure used was a significant moderator for CD. Finally, meta-regression analysis revealed that year of publication was not associated with between-studies variation in effect sizes for either ASPD (*B*= 0.02, SE= 0.02, *p*=.23) or CD (*B*= 0.007, SE= 0.004, *p*=.09).

Intelligence and psychopathy

Next, we examined the associations between various indicators of intelligence (FSIQ, VIQ, and PIQ) with psychopathy to evaluate how intelligence might be related to psychopathic traits. Across 105 correlations, a weak but statistically significant negative association emerged between FSIQ and psychopathy (r= -.07, p =.001). Because there was a large amount of variability in the effect sizes reported across the 105 correlations, we followed our analysis with heterogeneity analyses to evaluate the likely source of the differing effect sizes. Heterogeneity analyses revealed a high degree of between-studies variation that seem unlikely to be the result of chance (I^2 = 83%) among studies examining FSIQ and psychopathy.

Before testing potential moderators, we sought to further elucidate the relationship between intelligence and psychopathy by examining associations at the domain level of intelligence. VIQ was more strongly associated (*r*= -.11, p= .001) with psychopathy than was PIQ (r= -.05, p= .01), but both relationships were inverse and statistically significant (see Table 2). Effect sizes were strongly heterogeneous for VIQ (I^2 = 85%), but moderate for PIQ (I^2 = 65%) (see Table 2). Thus, heterogeneity analyses indicated that moderating variables might explain the differences in effect size among these samples.

INSERT TABLE 3

Moderator analyses

Two out of eight categorical moderator variables were significant in our analysis of the relationship between psychopathy and FSIQ (see Table 3). First, gender was found to significantly moderate the association (Q_B=13.12, p = .001). Perhaps somewhat contrary to expectations, female psychopaths reported the strongest effect size (r= -.19), whereas no significant association was reported for male psychopaths. Mixed samples yielded a significant small effect size (r= -.07). Second, the degree of heterogeneity between studies when categorized into child, adolescent, and adult samples was statistically significant (Q_B=6.03, p=.05). Psychopathic adults yielded a significant, but weak, negative correlation (r= -.08), whereas children and adolescents yielded non-significant correlations. Finally, meta-regression analysis suggested that the effect size was not significantly associated with the publication year (*B*= 0.001, SE= 0.001, p=.40). Unfortunately, there were not enough studies examining the association between psychopathy and VIQ or PIQ to allow for assessing moderators of those relationships.

INSERT TABLE 4

Total, Verbal and Performance Intelligence and Factors 1 and 2 of psychopathy

Finally, we sought to extend our levels of analysis to examine how intelligence and its domains might differentially relate to aspects of psychopathy (i.e., Factors 1 and 2). The meta-analysis for FSIQ and Factors 1 and 2 of psychopathy revealed a non-significant relationship (r= .005, *ns*) and a significant, inverse relationship (r= -.09, p= .001), respectively. Thus, there appears to be no association between FSIQ and Factor 1, which encompasses the interpersonal and affective component of psychopathy. There does, however, appear to be a significant, albeit small, negative association between FSIQ and Factor 2 psychopathy, suggesting that those who score higher on the impulsive and antisocial

behavior component of psychopathy tend to score lower on intelligence tests, a result that aligns with prior work on the association between indicators of intelligence and overt forms of aggression (e.g., Duran-Bonavila et al., 2017; Kennedy et al., 2011).

When examining facets of intelligence, Factor 1 demonstrated a non-significant relationship for VIQ (r= -.04, *ns*) and PIQ (r= -.04, *ns*). With regard to Factor 2 psychopathy, analyses yielded a small negative relationship with VIQ (r= -.16, p= .001), and a weaker negative relationship with PIQ (r= -.08, p= .01) (see Table 4). In other words, no association was found between Factor 1 psychopathy and either domain of intelligence, but lower VIQ and PIQ were associated with higher scores on the second factor of psychopathy. Further analyses revealed that the effect sizes were moderately, to highly, heterogeneous for Factors 1 and 2 of psychopathy with intelligence and its facets. The I^2 values ranged from 66% (for Factor 2 and FSIQ) to 94% (for Factor 2 and VIQ) (see Table 4). Therefore, moderator analyses were conducted and are presented below (see Table 5).

INSERT TABLE 5

Moderator analyses

The association between Factor 1 and FSIQ was moderated by one variable, gender (Q_B = 10.18, p= .006). The strongest effect size was found for females (r= -.17), whereas a weak, but significant, and *positive* effect was found for males (r= .05). It is noteworthy that males and females displayed opposing correlations. Thus, perhaps unsurprisingly, mixed samples yielded no significant association (r= .001). The association between Factor 2 and FSIQ was moderated by two variables. First, effect sizes significantly differed across age groups (Q_B = 7.88, p= .02). More specifically, the effect size was strongest when full-scale intelligence was measured in children (r = -.20), compared with adolescents (r= .02) and adults (r= -.11). However, it is important to realize that the effect size for children was based on a single study and the effect size for adolescents was non-significant.

Second, the region in which studies were conducted was also a significant moderator (Q_B = 6.06, p= .05). The strongest effect size was obtained for European samples (r= -.16), whereas North American samples such as from the U.S. and Canada showed a weaker, yet still significant, effect size (r= -.07). Studies from New Zealand and Australia yielded a non-significant, small effect size (r= -.12). The association between Factor 1 psychopathy and VIQ was not moderated by any of the nine moderators tested. Conversely, the age of the sample (Q_B = 18.38, p= .001), as well as the measures used to assess psychopathy and intelligence (Q_B = 4.72, p= .03 and Q_B = 3.95, p= .05, respectively), moderated the association between Factor 2 and VIQ.

With regards to sample age, both adults (r= -.21) and adolescents (r= -.19) yielded significant moderate correlations, while samples consisting of children yielded no overall effect. For assessment of psychopathy, measures derived from the PCL yielded a moderate significant effect size (r= -.22), whereas other measures of psychopathy showed a weaker, but significant, effect size (r= -.09). Third, analysis of studies using the Wechsler scales yielded a moderate effect size (r= -.20), whereas analysis of studies using other IQ measures evinced a very weak and non-significant effect size (r= -.02).

When examining effect sizes for the relationship between psychopathy and performance IQ, sample age was the only significant moderator of the association between Factor 1 and PIQ (Q_B = 9.54, p= .008). Only adolescent samples showed a small, significant overall effect size (r= -.14). Children evinced a non-significant effect, whereas adults demonstrated a non-significant, negative effect. With regards to Factor 2 psychopathy and PIQ, the age of the sample (Q_B = 40.03, p= .001) and recruitment site (Q_B = 20.50, p= .001) were significant moderators. Adolescents yielded a moderate, negative effect size (r = -.22) and adults a small, negative effect size (r= -.10), whereas children showed a small but positive effect size (r = .09). Second, the strongest effect size was found for the clinical

sample (r= -.24) compared to the institutional sample (r= -.12) and the community sample (r= .04, *ns*). Meta-regression analysis revealed that the effect sizes for Factor 1 and Factor 2 with VIQ and PIQ were not significantly associated with the publication year (*B*= -.003, SE= .003, p= .27).

Sensitivity analyses

In order to examine the robustness of the results obtained in the current study, we examined the potential influence of publication bias using "Trim and Fill" analysis (Duval & Tweedy, 2000) and Egger´s regression test. Briefly, the "Trim and Fill" technique assesses the degree of asymmetry in a body of findings by visually presenting the data in a funnel plot (Duval & Tweedy, 2000). As others have noted, if a body of research is generally free from publication bias, it would be expected that the effect sizes reported by the various studies would be relatively normally distributed around the overall effect size (Duval & Tweedy, 2000). Any asymmetry in the funnel plot, however, can indicate possible publication bias.

Once the degree of asymmetry is assessed, the "Trim and Fill" technique is used to systematically trim the most extreme small studies from the positive side until the plot becomes symmetrical around a new, adjusted effect size. Trimmed studies are added back in using an algorithm (the "fill" aspect of the procedure; Duval & Tweedy, 2000) to visually represent the approximate values of the effect sizes that could be missing, owing to publication bias (for additional detail, see Duval & Tweedie, 1998; 2000). As an attempt to quantify the amount of bias present in a given funnel plot, Egger's regression functions by regressing an estimate's standard normal deviate (SND; the odds ratio divided by the standard error) onto its precision (which we don't discuss in detail, but which is calculated by taking the inverse of the standard error) (for in-depth discussions, see Egger et al., 1997).

The random effects "Trim and Fill" analysis for each of the antisocial disorders (ASPD, CD and ODD) and psychopathy, determined that zero studies had to be added on

either the right or the left side to be symmetrical (see Figures 2A-2D). In other words, the "Trim and Fill" analysis uncovered little evidence to suggest that there might be studies missing due to publication bias for any of the constructs. When further assessing the antisocial disorders using Egger's regression test, we found a significant slope coefficient for CD (*B*= -3.04, SE= 1.30, *p*= .029), but not for ASPD or ODD. For psychopathy, the Egger´s regression test did not report a significant slope coefficient (*B*= -0.47, SE= 0.43, *p*= .28). In sum, evidence from the tests for publication bias suggest there may be some bias in the literature with regards to studies on intelligence and conduct disorder, but there does not seem to be evidence of publication bias for studies on intelligence and other antisocial disorders (ASPD or ODD), or for intelligence and psychopathy. We caution again, however, that the analyses for ODD are based on only three studies.

INSERT FIGURE 2

As a second test of robustness, we also evaluated the impact of potential influence of outlier studies. First, we assessed the effect of four studies (Ford, et al. 2007; Hofvander et al. 2011; Masten et al. 1999; and Nomura et al., 2008) that used antisocial behaviour questionnaires that were not associated with a specific psychiatric diagnosis. These studies were included because the items were similar to those associated with diagnostic criteria, and removing them from our analyses had no effect on the results.

When examining extreme values, we found one study to be an outlier for psychopathy and intelligence. Specifically, Nestor et al. (2002) reported the strongest positive correlation between psychopathy and intelligence and a high standard error (*r*= .47, SE= .32 *N*= 13). For ASPD, we similarly found one study, Pera-Guardiola et al. (2016) that reported a negative effect size that was fairly strong with an accompanying high standard error (*r*= -.34, SE= .32, N=13). Exclusion of these extreme values did not have an impact on their respective

summary effect sizes (psychopathy: r= -.07, p= .03; ASPD: r= -.12, p= .001), which is likely due to the small sample sizes of the two outlier studies.

Discussion

The current meta-analysis presents the most up-to-date and comprehensive statistical evaluation of the association between intelligence and psychopathy, as well as intelligence and various antisocial disorders and antisocial traits. Despite being statistically significant, our analyses revealed only a very weak negative association between indicators of intelligence and psychopathy (r = -.07), as well as a slightly larger inverse link between indicators of intelligence and ASPD (r = -.13) and CD (r = -.11). In other words, individuals who score higher on measures of psychopathic traits, ASPD, and CD traits tend to score lower on measures of intelligence. Finer grained analysis of intelligence as measures of verbal and performance IQ, revealed that only CD (among antisocial traits), demonstrated a significant association (inverse and with both VIQ and PIQ). Similarly, psychopathy was significantly and negatively associated with both VIQ and PIQ, which is somewhat in contrast with prior research suggesting that verbal IQ is the primary, or even sole, aspect of intelligence associated with psychopathic traits (e.g., Kavish, Bailey, Sharp, & Venta, 2017; Salekin, Neumann, Leistico, & Zalot, 2004).

Additionally, we sought to examine if, and to what extent, aspects of psychopathy were associated with intelligence. The interpersonal and affective (Factor 1) aspects of psychopathy were statistically unrelated to intelligence (FSIQ, VIQ, & PIQ), but the antisocial and impulsive Factor 2 was associated with lower scores on FSIQ and both of its facets. These findings suggest that lower intelligence is particularly associated with the behavioral problems observed in those who score highly on measures of psychopathy or are diagnosed with antisocial disorders, and is in line with findings suggesting that intelligence is negatively related to criminal offending (Schwartz et al., 2015), aggression (Kennedy,

Burnett, & Edmonds, 2011), and impulsivity (Petkovsek et al.., 2017; Lynam, Moffitt, & Stouthamer-Loeber, 1993).

Importantly, our results also uncovered a high degree of heterogeneity between studies, suggesting that moderating variables may explain differences across studies. Indeed, moderator analyses revealed that the measure of psychopathic traits, the measure of intelligence, region from which the sample was recruited, age, and sex were conditioning many of the associations being tested, often in unexpected ways. With regards to psychopathy, moderator analyses suggested that the gender and age of the samples affected the strength of the relationship between FSIQ and psychopathy. Surprisingly, female samples demonstrated a moderate inverse relationship between intelligence and psychopathy, while male samples demonstrated no overall relationship and mixed samples produced a weak, inverse relationship. Most research has found that males score higher than females, on average, on measures of psychopathy (Cale & Lilienfeld, 2002), raising the possibility that hypothesized characteristics of a so-called "male brain" (see Baron-Cohen, 2002; Baron-Cohen & Hammer, 1997) result in less variability of psychopathic traits in males. However, this is speculative and remains an open question. When examining differences by age, intelligence and psychopathy were weakly, inversely related in adults. No association, however, was found for children or adolescents. Sensitivity analyses confirmed that although the effect sizes were small, they appeared to be robust and unaffected by either publication bias (for psychopathy, ASPD, and ODD) or the inclusion of outliers (for both psychopathy and all three antisocial disorders).

Overall, the existence of an inverse relationship between these constructs may prompt the assumption that lower intelligence *causes* individuals to evince more psychopathic traits. While this is not beyond the realm of possibility, it is important to remember that we are only examining correlational data, and strong causal inferences must be avoided. Previous

researchers, moreover, have suggested that intelligence might act as a moderator between psychopathic traits and antisocial behaviour (Muñoz et al., 2008; Salekin et al., 2010). Kandel et al. (1988) found that higher intelligence, additionally, acts a protective factor against offending generally (i.e. not looking specifically at psychopaths). Conversely, Muñoz et al. (2008) found higher intelligence to be a risk factor for increased violent offending among psychopaths. Yet, Salekin and colleagues (2010) found no relationship between IQ and offending among psychopaths.

It is also plausible that *if* some causal connection exists, it might be that if higher levels of psychopathic traits ultimately serve as a barrier to environmental exposures that could increase levels of intelligence. For example, if psychopathic individuals miss more school due to truancy, suspension, or incarceration, or ultimately complete fewer years of education, then they may fail to reap the modest intelligence boosting effects of education (Ritchie & Tucker-Drob, 2017 preprint). Importantly, a similar scenario might be posited for intelligence and ASPD and conduct disorder. Genetic confounding, too, might play an important role, such that pleiotropic genetic influences might both increase psychopathic tendencies, while also lowering cognitive ability (and a similar possibility exists for intelligence and antisocial disorders) (Barnes et al., 2014). However, genetically sensitive designs will be required to further examine this interesting possibility, and more work is needed in general to fully unpack causal pathways.

Limitations and Future Directions

Prior to concluding, there are some important limitations in the current study that will require attention in future research. To begin, collapsing various models of psychopathy within Factor 1 and Factor 2 of Hare´s Checklist is convenient, but also controversial. Some research has argued for the existence of a four-factor model of psychopathy, and found differential associations between the four factors and IQ (Vitacco, Neumann, & Jackson,

2005). Furthermore, research has shown that alternative measures of psychopathy are often based on different conceptualizations of psychopathy, which demonstrate both commonalities and divergences (Copestake et al. 2011; Drislane, Patrick & Arsal, 2014; Venables et al. 2014). Additionally, although boldness has been reported as a distinctive feature of psychopathy that distinguishes it from ASPD (Venables et al. 2014), boundaries between psychopathy and antisocial personality disorder—despite existing—are not universally agreed upon (see Decuyper et al. 2009).

Similar to the limitation of collapsing together psychopathy measures, we also must reiterate that all non-Wechsler intelligence measures were collapsed together into a very broad "other" category. While this was done in order to streamline an already hulking analysis, it is admittedly not ideal given that these measures tap in to slightly different aspects of general intelligence. At the same time, it can be reasonably assumed that each measure loads on the same underlying construct and are all measuring aspects of the same trait (Ritchie, 2015), yet collapsing them as we did is not the same thing as creating a global construct of general intelligence. It is entirely possible, then, that effects may vary from measure to measure. Additional work will be needed to further dissect whether, and to what extent, effects of non-Wechsler based tests differ when predicting the outcomes tested herein.

Another limitation, at least in some regard, of the current study is the focus on bivariate effects as opposed to multivariate effects. We opted to approach the study in this fashion, in part because we made no assumptions about causal effects between intelligence and the outcomes of interest. Rather, the goal was to simply unpack if, and to what extent, a correlation exists between the traits. What emerged were correlations of generally small magnitude. To the extent that any of the effects are causal, or whether intervention on one phenotype might improve functioning in the other, is interesting but beyond the scope of our study. Moreover, if the meager bivariate effects contained herein are any indication, causal

effects seem unlikely, and if they do exist, would seem to be substantively small in nature. Finally, it is important to note that all studies were coded by a single author on the study. Any discrepancies or questions that arose, however, were resolved by consulting among all three authors.

As we mentioned above, the mechanism underpinning the development of psychopathy is not yet well-understood. For example, differences across sample types (institutional, clinical and community) suggest distinct developmental pathways for psychopathy. Finally, we could not include biological factors as moderators. Although, evidence shows that both intelligence and psychopathy are impacted by genes (Deary, 2013; Ferguson, 2010; Gunter, Vaughn & Philibert, 2010; Plomin & Deary, 2015), it remains a challenge to identify the (numerous) genes responsible for the heritability of psychopathy (Viding et al. 2013) and their association with the many genes that influence IQ.

Overall, we found small, inverse associations between intelligence and psychopathy, as well as between intelligence and antisocial disorders and conduct disorder (with the exception of ODD). However, these relationships were significantly moderated by certain variables, such as age and sex, the measures utilized, and the facets of each construct being examined. Future research should seek to further unpack the neurobiological and genetic underpinnings and covariation among these constructs. Given the ongoing disagreements over the precise conceptualization of each construct, especially psychopathy, future research should also examine these associations at the trait level (e.g., callousness, superficial charm). Nonetheless, our study adds to the body of knowledge regarding intelligence, psychopathy, and various antisocial personality styles.

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Table 1: Characteristics of studies included in the meta-analysis

Study	N (on which relevant analyses were based)	Age group	Gender (%male)	CD/ODD/ASPD/Psychopathy instrument (on which relevant analyses were based)	Cognitive ability measure	Recruitment	Region	Covariates	Published data
Kipnis (1965)	193	Adults	Male	Insolence scale 1 and 2	GCT	Community	North America	No	Yes
Welsh (1967)	350 416 527 622	Adolescents	Male (46%) Female	MMPI-Pd	D-48 CMT	Community	North America	No	Yes
Ruff et al. (1977)	66	Adults	Male	MMPI-Pd	WAIS/ Digit Span	Institutional	North America	No	Yes
Holland et al. (1981)	390	Adults	Male	MMPI-Pd+Ma+F	Army General Classification Test	Institutional	North America	No	Yes
Raine (1987)	36	Adults	Male	Hare's Checklist for Psychopathy	WAIS/Full-scale , Verbal, Performance	Institutional	European	No	Yes
Moffitt & Silva (1988)	109	Adolescents	Mix (56%)	RBPC-CD/Antisocial RCSB-CD/Antisocial	WISC-R	Community	Australia/New Zealand	No	Yes
Schonfeld et al. (1988)	94	Adolescents	Male	DSM-III	WISC WAIS	Community	European	No	Yes
Kosson et al. (1990)	106	Adults	Male	PCL	SILS	Institutional	North America	No	Yes
Frick et al. (1994)	64	Children	Mix (81%)	PSD/ICP, CU	WISC-R/Full-scale , Verbal, Performance	Clinical	North America	Yes	Yes

Table 1 (continued)

Study	N (on which relevant analyses were based)	Age group	Gender (%male)	CD/ODD/ASPD/Psychopathy instrument (on which relevant analyses were based)	Cognitive ability measure	Recruitment	Region	Covariates	Published data
Goodman et al. (1995)	407 374	Adolescents	Mix (46%)	Rutter A2/Total Rutter B2/Total	WISC-R	Community	European	No	Yes
Moriconi & Martinez (1995)	71	Adults	Mix (80%)	MMPI-2-ASP	Otis-Lennon Mental Ability Test	Community	North America	No	Yes
Giancola et al. (1996)	101	Children	Male	K-SADS-E/ODD K-SADS-E/CD	W ISC-R/Verbal	Clinical	North America	Yes	Yes
O'Kane et al. (1996)	40	Adults	Male	PCL-R/Total, Factor 1, Factor 2 SHAPS/Factor 1, Factor 2	NART	Institutional	European	No	Yes
Rispens et al. (1997)	465	Adolescents	Mix (75%)	CBCL/Total	WISC-RN (the Dutch version of the WISC-R)	Clinical	European	No	Yes
Giancola et al. (1998)	150	Adolescents	Female	K-SADS-E/aggressive, non aggressive	WISC-R & WAIS-R/Vocabulary	Clinical	North America	Yes	Yes
Masten et al. (1999)	189	Children Adolescents	Mix (44%)	Interview (antisocial behavior)	WISC-R	Community	North America	No	Yes

Table 1 (continued)

Study	N (on which relevant analyses were based)	Age group	Gender (%male)	CD/ODD/ASPD/Psychopathy instrument (on which relevant analyses were based)	Cognitive ability measure	Recruitment	Region	Covariates	Published data
Williams (2002)	114	Adults	Mix (36%)	SRP-II	Wonderlic Personnel Test-Form IV/ Total, verbal, non-verbal	Community	North America	No	No
Lahey et al. (2002)	73	Children	Male	DSM-III-R	WISC-R/Verbal, Performance	Clinical	North America	Yes	Yes
Nestor et al. (2002)	13	Adults	Male	PCL-R	WAIS-R/Picture arrangement	Institutional	North America	Yes	Yes
Vitale et al. (2002)	528	Adults	Female	SRPS	SILS	Institutional	North America	No	Yes
Benning et al. (2003)	315	Adolescents	Male	PPI/I, II	WAIS-R/Vocabulary	Community	North America	No	Yes
Loney et al. (2003)	60	Adolescents	Male	APSD/Total, I–CP, CU	K–BIT	Clinical	North America	No	Yes
Stevens et al. (2003)	25 34	Adults	Male	DMS-III-R/CD DMS-III-R/ASPD	WAIS/ Total, Verbal	Community	North America	No	Yes
Wodushek (2003)	100	Adults	Male	PCL:SV/ADI, DAE	WASI	Institutional	North America	No	No
Finn & Hall (2004)	303	Adults	Mix (42%)	MMPI-2-Pd CPI-So	SILS	Community	North America	No	Yes

Table 1 (continued)

Study	N (on which relevant analyses were based)	Age group	Gender (%male)	CD/ODD/ASPD/Psychopathy instrument (on which relevant analyses were based)	Cognitive ability measure	Recruitment	Region	Covariates	Published data
Gretton et al. (2004)	157	Adolescents	Male	PCL:YV	WAIS/Performance	Clinical	North America	No	Yes
Lösel & Schmucker (2004)	49	Adults	Male	PCL-R/Total, Factor 1, Factor 2	Reduced version of WIP	Institutional	European	No	Yes
Salekin et al. (2004)	122	Adolescents	Mix (65%)	PCL–YV/Total, ADI, DAE, IIB	K–BIT/ Total, Verbal, Matrices STAT/ Total	Institutional	North America	No	Yes
Snowden et al. (2004)	120	Adults	Male	PCL-R/Total, Factor 1, Factor 2	NART	Institutional	European	No	No
Weizmann-Henelius et al. (2004)	58	Adults	Female	PCL-R/Total, Factor 1, Factor 2	WAIS/Total, Verbal, Performance	Institutional	European	No	Yes
Arseneault et al. (2005)	1875	Children	Mix (49%)	BPI	WPPSI-R	Community	European	No	Yes
Morrisey et al. (2005)	195	Adults	Male	PCL-R/ Total, Factor 1, Factor 2	WAIS-III-(R)	Institutional	European	No	Yes
Vitacco et al. (2005)	840	Adults	Mix (57%)	PCL:SV/Interpersonal, Affective, Lifestyle, Antisocial	WAIS-R/Vocabulary	Clinical	North America	No	Yes
Epstein et al. (2006)	52 85	Adults	Male (38%) Female	SRPS/ Total, Factor 1, Factor 2	K-BIT	Institutional	North America	No	Yes
Koenen et al. (2006)	2206	Children	Mix (49%)	CBCL/Aggression, delinquency scales	WPPSI–R	Community	European	No	Yes
Burke et al. (2007)	163	Adults	Male	PCL-R/Factor 1, Factor 2	WISC-R	Clinical	North America	Yes	Yes

Table 1 (continued)

Study	N (on which relevant analyses were based)	Age group	Gender (%male)	CD/ODD/ASPD/Psychopathy instrument (on which relevant analyses were based)	Cognitive ability measure	Recruitment	Region	Covariates	Published data
Ford et al. (2007)	115	Adolescents	Mix (43%)	TRF/Rule breaking and aggression scales (externalizing behaviors)	WPPSI-R	Community	North America	No	Yes
Kennealy et al. (2007)	226	Adults	Female	PCL-R/ Total, Factor 1, Factor 2	SILS/Total, Verbal, Abstraction	Institutional	North America	No	Yes
Koolhof et al. (2007)	428	Adolescents	Male	CPS/Empathy CBCL/Guilt	WISC-R/Total, Verbal, Performance	Community	North America	No	Yes
Sellbom & Verona (2007)	95	Adults	Mix (53%)	PPI/Total, I, II	SILS	Community	North America	No	Yes
Beggs et al. (2008)	216	Adults	Male	PCL-R	WASI	Institutional	Australia/New Zealand	No	Yes
Fontaine et al. (2008)	2168 2545	Children	Male (46%) Female	APSD/Callous-Unemotional, Narcissism, Impulsivity SDQ/Antisocial	WISC–III-PI/Verbal CAT3/No verbal	Community	European	No	Yes
Gray et al. (2008)	996	Adults	Male	PCL:SV/Total, Factor 1, Factor 2	WAIS	Institutional	European	No	No
Mahmut et al. (2008)	101	Adults	Mix (27%)	SRP-III/Total, Affective, Interpersonal, Lifestyle, Antisocial	NART	Community	Australia/New Zealand	No	Yes
Malterer et al. (2008)	88	Adults	Male	PCL-R/ Total, Factor 1, Factor 2	SILS	Institutional	North America	No	Yes
Neumann & Hare (2008)	196 318	Adults	Male (38%) Female	PCL: SV/ Affective, Interpersonal, Lifestyle, Antisocial	WAIS/Vocabulary	Community	North America	No	Yes
Nomura et al. (2008)	1689	Children	Mix (54%)	Interview for antisocial behaviour / Run away from home, play hooky, in trouble at school for fighting, (threaten to) hit a friend,suspension from school, misbehaving at school	Stanford–Binet	Community	North America	No	Yes

Table 1 (continued)

Study	N (on which relevant analyses were based)	Age group	Gender (%male)	CD/ODD/ASPD/Psychopathy instrument (on which relevant analyses were based)	Cognitive ability measure	Recruitment	Region	Covariates	Published data
Sreenivasan et al. (2008)	126	Adults	Male	PCL-R	WAIS/Information	Institutional	North America	No	Yes
Vitacco et al. (2008)	100	Adults	Male	PCL:SV/Interpersonal, Affective, Lifestyle, Antisocial	WASI	Institutional	North America	Yes	Yes
Andrade (2009)	272 174	Adults	Male (61%) Female	PCL:SV	WAIS-R/Vocabulary	Institutional	North America	Yes	Yes
Fowler et al. (2009)	91 87 85 77	Adults	Male	PCL/Total, Factor 1, Factor 2 PPI/I, II IM-P DSM-IV/ASPD	SILS	Institutional	North America	No	No
Gladden et al. (2009)	100	Adults	Mix (40%)	PPI-SF	APM-18	Community	North America	No	Yes
Lynam et al. (2009)	338	Adolescents	Male	CPS CBCL	WISC-R/Verbal	Clinical	North America	No	Yes
Nijman et al. (2009)	133	Adults	Male	PCL-R/Total, Factor 1, Factor 2	WAIS-R & III/Total, Verbal, Performance	Institutional	European	No	Yes
Oscar-Berman et al. (2009)	343	Adults	Mix (50%)	DIS-III-R/DSM-III-R	WAIS/ Digit Symbol, Block Design, Picture Arrangement	Community	North America	No	Yes
Unsworth et al. (2009)	138	Adults	Mix (38%)	PDQ-4 of DSM-IV: ASPD	Raven Progressive Matrices, Number Series	Community	North America	Yes	Yes
Wright et al. (2009)	250	Children	Mix (49%)	PPI/Total, Machiavellian Egocentricity, Social Potency, Fearlessness, Impulsive Nonconformity, Blame Externalization, Carefree Nonplanfulness	WRAT-3/Reading, Arithmetic	Community	North America	Yes	Yes

Table 1 (continued)

Study	N (on which relevant analyses were based)	Age group	Gender (%male)	CD/ODD/ASPD/Psychopathy instrument (on which relevant analyses were based)	Cognitive ability measure	Recruitment	Region	Covariates	Published data
Ermer & Kiehl (2010)	67	Adults	Male	PCL-R/Total, Factor 1, Factor 2	WAIS/Full-scale , Verbal, Performance	Institutional	North America	No	Yes
DeLisi et al. (2010)	840	Adults	Mix (57.5%)	PCL: SV DSM-III-R checklist	WAIS-R/Vocabulary	Institutional	North America	Yes No	Yes
Salekin et al. (2010)	140	Adolescents	Mix (66%)	CPS/Total, Interpersonal, Affective, Behavioral	K-BIT/Total, Verbal, Matrices	Institutional	North America	Yes	Yes
Heinzen et al. (2011)	313	Adults	Male	PCL:SV/Factor 2, Lifestyle	CFT 20-R	Institutional	European	Yes	Yes
Hofvander et al. (2011)	270	Adults	Mix (68%)	LHA/Antisocial behavior	WAIS-R/Total, Verbal, Performance	Clinical	European	No	Yes
Pousset et al. (2011)	539	Adults	Male	DSM-IV/Mini International Neuropsychiatric Interview	WAIS/Similarities	Institutional	European	No	Yes
Vaughn et al. (2011)	432	Adolescents	Mix (57%)	ICU/Total, Callous, Uncaring, Unemotional YPI/Total, Behavior, Interpersonal, Affective	KBIT-2	Community	North America	No	Yes
Anton et al. (2012)	84	Adults	Female	PCL-R DSM-IV/ASPD	SILS	Institutional	North America	No	Yes
Goodwin et al. (2012)	39	Adults	Male	PCL-R GSS	WASI	Institutional	European	No	Yes
Klika et al. (2012)	457	Children Adolescents Adults	Mix (54%)	CBCL National Youth Survey/Antisocial behavior	WISC-R	Clinical	North America	No	Yes
May & Beaver (2012)	1364	Children	Mix (52%)	YPI	Bayley Mental Developmental Index, Bracken Basic Concepts Scale, Reynell Developmental Language scale, The MacArthur Communicative	Community	North America	Yes	Yes

					Developmental Inventories				

Table 1 (continued)

Study	N (on which relevant analyses were based)	Age group	Gender (%male)	CD/ODD/ASPD/Psychopathy instrument (on which relevant analyses were based)	Cognitive ability measure	Recruitment	Region	Covariates	Published data
Young-Lundquist et al. (2012)	83	Adults	Male	PPI-R/Total, Self-Centered Impulsivity, Fearless Dominance, Coldheartedness	WTAR	Institutional	North America	No	Yes
Allen et al. (2013)	361	Adolescents	Male	APSD/CU, Narcissism, Impulsivity SDQ/Antisocial	WASI/Verbal, Performance	Institutional	European	No	Yes
O´Boyle et al. (2013)	2950 (10 studies)[1]	Adults	Mix	Dark Triad/Psychopathy (several)	Several	Community	North America, Malaysia	No	Yes
Copestake et al. (2013)	57	Adults	Male	PCL-R/Total, Factor 1, Factor 2 PPI-R/Total, Self-Centered Impulsivity, Fearless Dominance,	WASI-R/Total, Verbal, Performance	Institutional	European	No	Yes
Spironelli et al. (2013)	54	Adults	Female	PCL-R/ Total, Factor 1, Factor 2	Raven's Progressive Matrices	Institutional	European	Yes	Yes
Wall et al. (2013)	372	Adults	Mix (24%)	PPI-R/Total, Fearless-Dominance, Self-Centered Impulsivity, Coldheartedness ABQ	SILS-2/ Total, Verbal, Abstract	Community	North America	No	Yes
Bagshaw et al. (2014)	28	Adults	Male	PCL-R/Total, Factor 1, Factor 2	WASI/Total, Verbal, Performance	Institutional	European	No	No
Bate et al. (2014)	50	Adults	Mix (NR)	LSRP/Factor 1, Factor 2	Raven's Standard Progressive Matrices	Community	European	No	Yes
de Tribolet-Hardy et al. (2014)	90	Adults	Male	PCL-R/Factor 1, Factor 2	WIP/Verbal, Performance	Institutional	European	No Yes	Yes

Table 1 (continued)

Study	N (on which relevant analyses were based)	Age group	Gender (%male)	CD/ODD/ASPD/Psychopathy instrument (on which relevant analyses were based)	Cognitive ability measure	Recruitment	Region	Covariates	Published data
Hampton et al. (2014)	1354	Adolescents	Male	PCL:YV/Total, Factor 1, Factor 2	WASI	Clinical	North America	No	Yes
Hengartner et al. (2014)	196	Adults	Mix (43%)	DSM-IV/ADP-IV	WAIS-III/Digit symbol	Clinical	European	Yes	Yes
Wilson et al. (2014)	262	Adults	Mix (77%)	PCL:SV/Total, Factor 1, Factor 2	Raven's Progressive Matrices	Community	European	No Yes	Yes
Young & Widom (2014)	547	Adults	Mix (42.2% male)	PCL-R	QT	Clinical	North America	No	Yes
Baskin-Sommers et al. (2015)	377	Adults	Male	PCL-R/Factor1, Factor2 PPI/ Fearless dominance, Impulsive antisociality	WAIS-III	Institutional	North America	No	Yes
Brislin et al (2015)	103	Adults	Male	MPQ-Tri/ Boldness, Meanness, Disinhibition	SILS/Total, Verbal, Abstract	Institutional	North America	No	Yes
Demakis et al. (2015)	92	Adults	Mix (23%)	PPI-SF	WTAR	Community	North America	No	Yes
Evans et al. (2015)	871	Adults	Mix (58%)	PCL:SV/Factor 1, Factor 2	WAIS-R/Vocabulary	Institutional	North America	No	Yes
Jezior et al. (2015)	188	Children	Mix (69%)	APSD DBD DISC-IV	WISC	Community	North America	No	Yes
Strohmaier (2015)	47	Adults	Male	PPI-R:SF/ Total	WASI-II	Community	North America	No	No
Vieira et al. (2015)	35	Adults	Mix (43%)	TriPM/ Total, Boldness, Meanness, Disinhibition	K-BIT	Community	North America	No	Yes
Walters & Kiehl (2015)	178	Adolescents	Male	PCL:YV/Fearlessness, Disinhibition	WAIS	Institutional	North America	No	Yes
Pera-Guardiola et al. (2016)	13 77	Adults	Male	DSM-IV/ASPD PCL-R/Total, Factor 1, Factor 2	WAIS/Total, Verbal, Performance	Institutional	European	No	No

Table 1 (continued)

Study	N (on which relevant analyses were based)	Age group	Gender (%male)	CD/ODD/ASPD/Psychopathy instrument (on which relevant analyses were based)	Cognitive ability measure	Recruitment	Region	Covariates	Published data
Watts et al. (2016)	1257	Adults	Mix (30%)	PPI/ Total, Fearless Dominance, Self-Centered Impulsivity, Coldheartedness PAI-ANTscale/Total, Antisocial Behaviours, Egocentricity, Stimulus Seeking	SILS/Verbal, Abstract STAT/ Analytical, Creative, Practical	Community	North America	No	Yes
Witt (2016)	61 164	Adults	Males Females	LSRPS/Factor 1, Factor 2	WAIS/Verbal, Performance	Community	North America	No	No
Kavish et al. (2017)	67 102	Adolescent	Male (40%) Female	YPI/Total, Interpersonal, Affective, Lifestyle	WISC-IV,WAIS-IV/Total, Verbal, Perceptual-Reasoning	Clinical	North America	No	Yes
Keyes et al. (2016)	10073	Adolescents	Mix (51%)	World Health Organization Composite International Diagnostic Interview/CD, ODD	K-BIT	Community	North America	Yes	Yes
Vitacco & Kosson (2010)	684	Adults	Male	IM-P/Dominance, Grandiosity, Boundary Violation	SILS/Total, Verbal, Abstract	Institutional	North America	No	Yes

Note. ABQ: Antisocial Behavior Questionnaire (Loeber, Stouthamer-Loeber, Van Kammern, & Farrington, 1989); ADI: Arrogant and Deceitful Interpersonal Style; ADP-IV: Personality Disorders Questionnaire (Schotte & de Doncker, 1994); ADP/APSD: Antisocial Process Screening Device (Frick & Hare, 2001); APM-18: Advanced Progressive Matrices-18 (Sefcek, 2007); The Bracken Basic Concepts Scale (Bracken, 1984); The Bayley Mental Developmental Index (Bayley, 1969); BPI: Berkeley Puppet Interview (Measelle et al., 1998); CA: Callous Affect Facet; CAT3: Cognitive Abilities Test 3 (Smith, Fernandes, & Strand, 2001); CBCL: Child Behavior Checklist (CBCL; Achenbach, 1991); CBQ: Childrens Behavior Questionnaire (Rutter, 1967; Venables et al., 1983); CD: Conduct Disorder, CMT: Terman Concept Mastery Test (Terman, 1956); CFT 20-R: Culture Fair Test-Revised (Weiss & Weiss, 2006); CPI-So: California Psychological Inventory—Socialization scale (Gough, 1969); CPS: Childhood Psychopathy Scale (Lynam, 1997); CU: Callous/Unemotional; D-48 (Welsh, 1966); DAE = Deficient Affective Experience; DBD: Disruptive Behavior Disorders Rating Scale (Pelham, Gnagy, Greenslade, & Milich, 1992); DIS-IV: Diagnostic Interview Schedule for the DSM-IV (American Psychiatric Association, 1994); DISC-IV: Diagnostic Interview Schedule for Children, 4th edition (Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000); DSM (III-R, IV): Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 1980, 1987, 1993, 1994); ICU: Inventory of Callous-Unemotional traits (teacher rated, Frick, unpublished); IIB = Impulsive and Irresponsible Behavioral style (Forth, Kosson, & Hare, 2003); IM-P: Interpersonal Measure of Psychopathy (Kosson, Steuerwald, Forth, & Kirkhart, 1997); GCT= General Clarification Test (Navy's Basic Test Battery); GSS: Gough Socialisation Scale (Gough, 1960); K-BIT(2): Kaufman's Brief Intelligence Test (2nd edition) (Kaufman & Kaufman,1990, 2004); K-SADS-E/ODD & CD: Kiddie-Schedule for Affective Disorders and Schizophrenia-Expanded for Oppositional Defiant Disorder & Conduct Disorder (Orvaschel et al., 1982); LHA: Life History of Aggression (Coccaro et al., 1997); LSRP: Levenson Self-Report Psychopathy Scale (Levenson, Kiehl, & Fitzpatrick,1995); The MacArthur Communicative Developmental Inventories (Feldman et al. 2000; Fenson, 1993); MMPI-Pd+Ma+F: Minnesota Multiphasic Personality Inventory - Psychopathic Deviate+Hypomania+Validity subscales (Hathaway & McKinley, 1991); MMPI-2-ASP: Minnesota Multiphasic Personality Inventory-Antisocial Practices (Hathaway & McKinley, 1991); N: sample size; NART: National Adult Reading Test (Nelson, 1982); ODD: Oppositional Defiant Disorder; Otis-Lennon Mental Ability Test (Otis & Lennon, 1967); PAI-ANT (see Watts et al. 2016); PCL-R: Hare's Checklist for Psychopathy-Revised (Hare, 1980, 1985, 2003); PCL-YV: Psychopathy Checklist–Youth Version (Forth et al., 2003); PCL:SV: Psychopathy Checklist:Screening Version (Hart et al., 1995); PPI-R(SF): Psychopathic Personality Inventory (Short Form) (Lilienfeld & Andrews, 1996; R-Lilienfeld & Widows, 2005, SF- Lilienfeld & Hess, 2001); PSD: Psychopathy Screening Device (Frick & Hare, in press); QT: Quick

Test (Ammons & Ammons, 1962); Raven´s Progressive Matrices (Raven, 1938, 1999); RBPC-CD: Revised Behaviour Problem Checklist-Conduct Disorder scale for parents (Quay & Peterson, 1987); RCSB-CD: Rutter Child Scale B (Rutter, Tizard, & Whitmore, 1970); The Reynell Developmental Language scale (Reynell, 1990); Rutter A2 & B2: Rutter Questionnaire for parents and teachers (Rutter et al. 1970), SDQ: Strengths and Difficulties Questionnaire (Goodman, 2001), SHAPS: Special Hospitals Assessment of Personality and Socialization (Blackburn, 1982); SILS: Shipley Institute of Living Scale (Shipley, 1940; Zachary, 1986); SILS-2: Shipley Institute of Living Scale (Shipley et al. 2009); SRP-II: Self-Report Psychopathy-Scale II, III (Hare, 1985); SRPS: Self-Report Psychopathy Scale (Levenson et al., 1995); Stanford–Binet IQ (Thorndike, 1972); STAT: Sternberg's Triarchic Abilities Test (Sternberg, 1985, 1993); TriPM: Triarchic Psychopathy Measure (Patrick, 2010); TRF: Achenbach System of Empirically Based Assessment Teacher's Report Form (Achenbach, 2005); WAIS-R-III: Wechsler Adult Intelligence Scale (Wechsler, 1981, 2000); WIP: Reduzierter Wechsler—Intelligenztest (Dahl, 1972) German version of WAIS; WISC-R: Wechsler Intelligence Scale for Children-Revised (Wechsler, 1972); WASI (II): Wechsler Abbreviated Scale of Intelligence (Wechsler, 1999; Wechsler, 2011); WIP: German short version (Dahl, 1968) of the WAIS; WISC-III-PI: Wechsler Intelligence Scale for Children–Third Edition (Kaplan, Fein, Kramer, Delis, & Morris, 1999); WPPSI-R: Wechsler Preschool and Primary Scale of Intelligence Revised (Wechsler, 1967); Wonderlic Personnel Test-Form IV (Wonderlic, 1979), WRAT(3); Wide Range Achievement Test (Jastak & Jastak,1965; Wilkinson, 1993); WTAR: Wechsler Test of Adult Reading (Wechsler, 2001); YPI: Youth Psychopathic Traits Inventory (Andershed, Kerr, Stattin, Levander, 2002).

[1] Includes: Benning et al. (2003), Blunt (1982), Brummel (2008), Hess (1972), Mowery (2010), Paulhus and Williams (2002), Rounds (1989), Sellbom and Verona (2007), Welsh (1967), Williams (2002) (see O´Boyle et al. 2013). Additionally, Benning et al. (2003), and Sellbom and Verona (2007) were included in the meta-analysis for psychopathy facets and VIQ, PIQ.

Table 2. Meta-analysis of the relationship between antisocial personality traits, psychopathy and intelligence

	Psychopathy				**ASPD**				**CD**				**ODD**			
	k	*r*	95%CI	I^2	*k*	*r*	95%CI	I^2	*k*	*r*	95%CI	I^2	*k*	*r*	95%CI	I^2
FSIQ	105	-.07***	(-.10, -.04)	83%	14	-.13***	(-.19, -.06)	76%	23	-.11***	(-.18, -.04)	95%	3	.06***	(.04, .08)	0%
VIQ	39	-.11***	(-.16, -.07)	85%	4	-.01	(-.09, .06)	0%	7	-.17***	(-.26, -.07)	86%	1	.09	(-.11, .28)	0%
PIQ	28	-.05**	(-.09, -.01)	65%	3	-.007	(-.09, .08)	13%	4	-.16*	(-.29, -.02)	94%	-	-	-	-

Note: k = number of correlations; 95%CI = confidence interval; I^2 = I^2 statistic for heterogeneity; FSIQ = Full-scale intelligence; VIQ[1] = Verbal IQ (included K-BIT, SILS, Wechsler, Wechsler-Vocabulary scale); PIQ[1] = Performance IQ (included CAT3/Reasoning, K-BIT/Matrices, SILS/Abstract, Wechsler/Performance, WISC/Perceptual-Reasoning); ASPD= Antisocial Personality Disorder; CD= Conduct Disorder; ODD = Oppositional Defiant Disorder.
* $p < .05$ ** $p < .01$ *** $p < .001$

Table 3. Results of categorical moderator analyses for ASPD, CD, ODD, and psychopathy

	ASPD			CD			Psychopathy		
Moderator	*k*	*r* (95%CI)	Q_B *(p-value)*	*k*	*r (95%CI)*	Q_B *(p-value)*	*k*	*r* (95%CI)	Q_B *(p-value)*
Gender			0.20 (.90)			0.22 (.89)			13.12 (.001)
Male	3	-.10 (-.30, .09)		7	-.12 (-.26, .03)		51	-.03 (-.07, .01)	
Female	1	-.07 (-.37, .24)		2	-.06 (-.30, .20)		14	-.19*** (-.26, -.11)	
Mixed	10	-.13*** (-.21, -.05)		14	-.12** (-.21, -.02)		40	-.07** (-.11, -.02)	
Age Group			2.67 (.26)			1.75 (.42)			6.03 (.05)
Child	1	-.27** (-.46, .06)		11	-.06 (-.17, .05)		5	.05 (-.06, .16)	
Adolescent	1	-.03 (-.24, .18)		12	-.16** (-.26, -.06)		20	-.05 (-.10, .007)	
Adult	12	-.12*** (-.19, -.05)		-	-		80	-.08*** (-.11, -.05)	
Antisocial Personality Measure			0.00 (.99)			2.14 (.14)			1.44 (.23)
ASPD inventory	5	-.13* (-.23, -.01)		15	-.15*** (-.23, -.06)		64	-.08*** (-.12, -.05)	
PCL (any version)									
Interview	9	-.13** (-.22, -.03)		8	-.04 (-.16, .08)		-	-	
Other inventories for psychopathy	-	-		-	-		41	-.05* (-.09, -.006)	

IQ Measure			0.14 (.70)			5.64 (.02)			0.00 (.99)
Wechsler scales	10	-.12** (-.20, -.04)		20	-.14*** (-.20, -.08)		51	-.07*** (-.11, -.03)	
Other	4	-.15* (-.28, -.009)		3	.05 (-.10, .19)		54	-.07*** (-.10, -.03)	

Table 3 (continued)

	ASPD			CD			Psychopathy		
Moderator	*k*	*r* (95%CI)	Q_B *(p-value)*	*k*	*r* (95%CI)	Q_B *(p-value)*	*k*	*r* (95%CI)	Q_B *(p-value)*
Recruitment			3.10 (.21)			4.87 (.09)			0.99 (.61)
Clinical	5	-.07 (-.18, .03)		6	-.16** (-.29, -.03)		10	-.04 (-.13, .05)	
Institutional	4	-.09 (-.24, .06)		1	-.38** (-.61, -.10)		56	-. 08*** (-.12, -.04)	
Community	5	-.21*** (-.31, -.09)		16	-.08* (-.15, .001)		39	-.06** (-.10, -.02)	
Covariates			0.56 (.45)			0.02 (.90)			0.12 (.72)
Yes	1	-.03 (-.28, .22)		6	-.11 (-.25, .04)		16	-.08* (-.15, -.007)	
No	13	-.13*** (-.20, -.06)		17	-.12** (-.20, -.03)		89	-.07*** (-.10, -.03)	

Country			2.51 (.11)			3.75 (.15)			2.67 (.26)
North American	10	-.16*** (-.23, -.08)		12	-.04 (-.14, .05)		75	-.06*** (-.09, -.02)	
European	4	-.04 (-.16, .09)		9	-.17*** (-.27, -.07)		28	-.10*** (-.15, -.04)	
Australia/New Zealand	-	-		2	-.21 (-.43, .03)		2	-.18 (-.37, .02)	
Publication type			0.15 (.70)			-			1.27 (.26)
Published data	12	-.12* (-.19, -.05)		-	-		92	-.07*** (-.10, -.04)	
Unpublished data	2	-.18 (-.43, .10)		-	-		13	-.02 (-.11, .07)	

* $p < .05$ ** $p < .01$ *** $p < .001$

Note. ASPD = Antisocial Personality Disorder; CD= Conduct Disorder; ODD= Oppositional Defiant Disorder; k = number of correlations; 95%CI= 95% Confidence Interval; Q_B = between studies heterogeneity coefficient; - = there is only one variable

Table 4. Results of psychopathy sub-types and intelligence sub-types based on random effects model

	FSIQ			VIQ			PIQ		
	k	*r* (95%CI)	I^2	*k*	*r* (95%CI)	I^2	*k*	*r* (95%CI)	I^2
Factor 1 (Interpersonal/affective)	73	.005 (-.03, .04)	82%	42	-.04 (-.09, .01)	91%	34	-.04 (-.08, .01)	87%
Factor 2 (Lifestyle/antisocial)	59	-.09*** (-.12, -.06)	66%	33	-.16*** (-.23, -.09)	94%	27	-.08** (-.14, -.02)	90%

* $p < .05$ ** $p < .01$ *** $p < .001$

Note. FSIQ = Total score of intelligence; VIQ= Verbal score of intelligence; PIQ= Performance score of intelligence; k= number of correlations; 95%CI= confidence interval; I^2 = I^2 statistic for heterogeneity

Table 5. Results of categorical moderator analyses under the random effects model for Factor 1 and 2 of psychopathy and subtypes of intelligence

	FSIQ			VIQ			PIQ		
Moderator	*k*	*r* (95%CI)	Q_B *(p-value)*	*k*	*r* (95%CI)	Q_B *(p-value)*	*k*	*r* (95%CI)	Q_B *(p-value)*
Psychopathy Factor 1									
Gender			10.18 (.006)			5.26 (.07)			1.46 (.50)
Male	32	.05 (-.01, .10)		23	-.001 (-.08, .08)		18	-.02 (-.10, .06)	
Female	7	-.17* (-.29, -.05)		8	-.17** (-.29, -.05)		6	-.10 (-.22, .02)	
Mixed	34	.001 (-.05, .05)		11	-.02 (-.12, .07)		10	-.02 (-.11, .06)	
Age group			2.20 (.33)			4.03 (.13)			9.54 (.008)
Child	1	.02 (-.32, .36)		5	.06 (-.07, .18)		5	.07 (-.02, .16)	
Adolescent	14	.06 (-.02, .13)		7	-.12* (-.23, -.002)		6	-.14** (-.24, -.05)	
Adult	58	-.01 (-.05, .03)		30	-.04 (-.10, .01)		23	-.04 (-.09, .02)	
Psychopathy Measure			1.05 (.59)			0.04 (.83)			0.01 (.90)
PCL	46	-.009 (-.06, .04)		23	-.04 (-.11, .04)		16	-.03 (-.11, .05)	
Other inventory	26	.02 (-.03, .08)		19	-.05 (-.12, .02)		18	-.03 (-.10, .02)	

Interview	1	.10 (-.23, .41)		-	-		-	-	
IQ Measure			0.00 (.99)			1.76 (.18)			0.71 (.40)
Wechsler scales	28	.005 (-.06, .07)		30	-.07* (-.13, .00)		22	-.05 (-.12, .01)	
Other	45	.005 (-.04, .05)		12	.01 (-.08, .11)		12	-.01 (-.08, .07)	

Table 5 (continued)

	FSIQ			VIQ			PIQ		
Moderator	*k*	*r* (95%CI)	Q_B *(p-value)*	*k*	*r* (95%CI)	Q_B *(p-value)*	*k*	*r* (95%CI)	Q_B *(p-value)*
Psychopathy Factor 1									
Recruitment			1.95 (.38)			4.75 (.09)			2.23 (.33)
Clinical	12	.03 (-.07, .12)		7	-.09 (-.21, .04)		7	-.10* (-.21, .002)	
Institutional	36	.02 (-.03, .08)		19	.03 (-.05, .11)		16	-.02 (-.09, .05)	
Community	25	-.03 (-.08, .03)		16	-.09* (-.16, .01)		11	.01 (-.08, .05)	
Covariates			2.15 (.14)			0.38 (.53)			0.27 (.60)
Yes	9	-.07 (-.17, .04)		4	.01 (-.17, .19)		3	.01 (-.16, .18)	

No	64	.01 (-.02, .05)		38	-.05 (-.10, .008)		31	-.04 (-.09, .01)	
Region			2.84 (.24)			0.66 (.42)			0.74 (.39)
North American	55	.02 (-.02, .06)		28	-.06* (-.12, -.000)		23	-.02 (-.08, .03)	
European	16	-.03 (-.12, .05)		13	.005 (-.09, .10)		11	-.05 (-.14, .03)	
Australia/New Zealand	2	-.14 (-.35, .09)		-	-		-	-	
Publication type			0.19 (.66)			0.66 (.42)			0.74 (.39)
Published data	63	.008 (-.03, .05)		37	-.03 (-.09, .02)		29	-.03 (-.08, .02)	
Unpublished data	10	-.02 (-.12, .09)		5	-.11 (-.29, .07)		3	.05 (-.19, .29)	

Table 5 (continued)

	FSIQ			VIQ			PIQ		
Moderator	*k*	*r* (95%CI)	Q_B *(p-value)*	*k*	*r* (95%CI)	Q_B *(p-value)*	*k*	*r* (95%CI)	Q_B *(p-value)*
Psychopathy Factor 2									
Gender			5.25 (.07)			2.55 (.28)			5.45 (.06)
Male	29	-.07**		19	-.19***		15	-.14***	

		(-.11, -.02)			(-.29, -.09)			(-.22, -.05)	
Female	7	-.20*** (-.30, -.10)		7	-.19* (-.34, -.03)		4	.07 (-.08, .21)	
Mixed	23	-.09*** (-.14, -.04)		7	-.04 (-.20, .12)		6	-.08 (-.20, .04)	
Age group			7.88 (.02)			18.38 (.001)			40.03 (.001)
Child	1	-.20 (-.47, .10)		5	.08 (-.04, .20)		5	.09** (.03, .15)	
Adolescent	7	.02 (-.06, .11)		5	-.19** (-.31, -.07)		4	-.22*** (-.30, -.18)	
Adult	51	-.11*** (-.14, -.07)		23	-.21*** (-.27, -.14)		16	-.10*** (-.15, -.05)	
Psychopathy Measure			0.36 (.55)			4.72 (.03)			2.06 (.15)
PCL	36	-.10*** (-.14, -.06)		18	-.22*** (-.30, -.14)		13	-.14** (-.23, -.04)	
Other inventory	23	-.08** (-.13, -.02)		13	-.09* (-.17, -.003)		12	-.05 (-.13, .03)	
IQ Measure			0.69 (.41)			3.95 (.05)			0.18 (.67)
Wechsler scales	24	-.07** (-.13, -.02)		26	-.20*** (-.28, -.11)		18	-.09** (-.16, -.02)	
Other	35	-.10*** (-.15, -.06)		7	-.02 (-.18, .13)		7	-.06* (-.17, .04)	

Table 5 (continued)

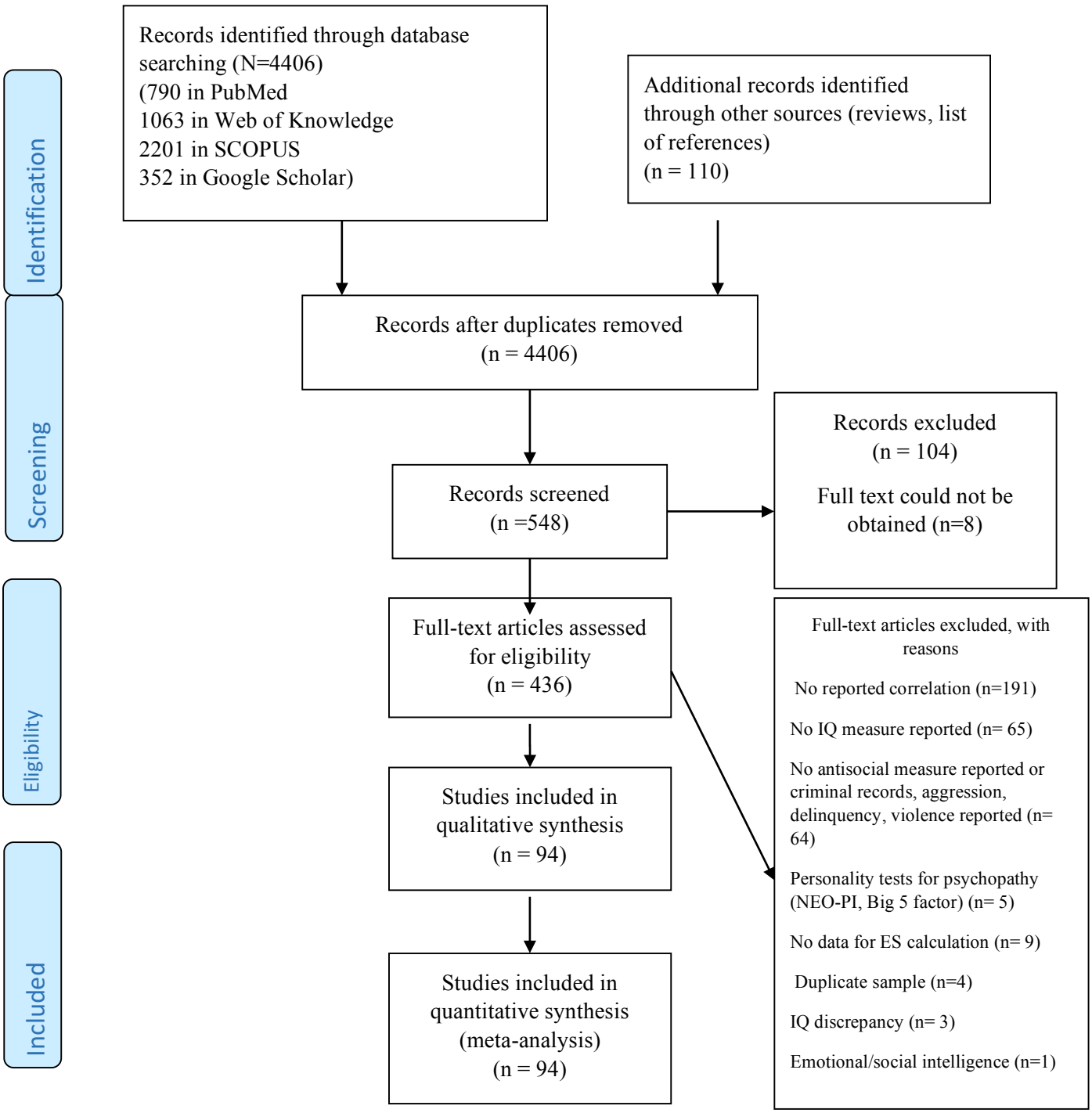
	FSIQ			VIQ			PIQ		
Moderator	*k*	*r* (95%CI)	Q_B *(p-value)*	*k*	*r* (95%CI)	Q_B *(p-value)*	*k*	*r* (95%CI)	Q_B *(p-value)*
Psychopathy Factor 2									
Recruitment			0.26 (.88)			4.01 (.13)			20.50 (.001)
Clinical	9	-.07 (-.16, .02)		5	-.28*** (-.42, -.13)		5	-.24*** (-.34, -.14)	
Institutional	33	-.09*** (-.14, -.04)		14	-.17** (-.27, -.07)		13	-.12** (-.20, -.05)	
Community	17	-.10** (-.16, -.04)		14	-.10* (-.19, -.02)		7	.04 (-.03, .11)	
Covariates			.007 (.93)			2.11 (.15)			0.05 (.82)
Yes	9	-.09* (-.18, -.009)		2	.06 (-.24, .35)		2	-.11 (-.34, .13)	
No	50	-.09*** (-.13, -.05)		31	-.17*** (-.24, -.10)		23	-.08** (-.15, -.02)	
Region			6.06 (.05)			2.96 (.08)			1.32 (.25)
North American	40	-.07*** (-.10, -.03)		22	-.19*** (-.27, -.12)		13	-.11** (-.19, -.03)	
European	17	-.16*** (-.22, -.09)		11	-.08 (-.19, .03)		12	-.05 (-.13, .03)	
Australia/New Zealand	2	-.12 (-.30, .06)		-	-		-	-	
Publication type			.003 (.95)			0.10 (.75)			.16 (.68)

Published data	51	-.09*** (-.13, -.06)	28	-.16*** (-.24, -.09)	22	-.08** (-.15, -.02)
Unpublished data	8	-.09 (-.18, .01)	5	-.13 (-.33, .09)	3	-.14 (-.37, .12)

* $p < .05$ ** $p < .01$ *** $p < .001$.

Note. FSIQ = Total score of intelligence; VIQ= Verbal score of intelligence; PIQ= Performance score of intelligence; k= number of correlations; 95%CI= confidence interval; $I^2 = I^2$ statistic for heterogeneity; Q_B = between studies heterogeneity coefficient

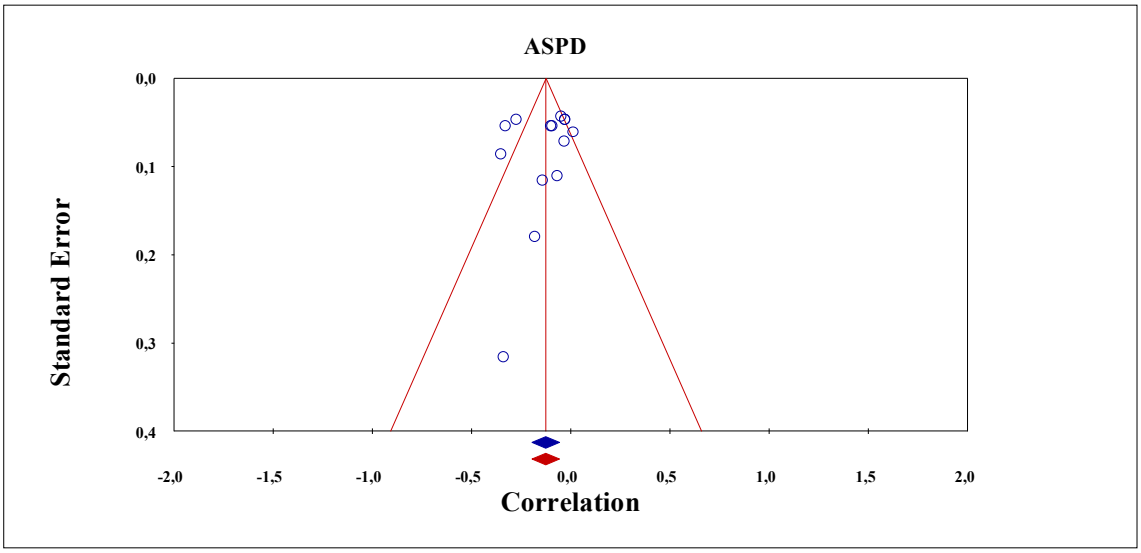
Figure 1. PRISMA Flow Diagram[3]



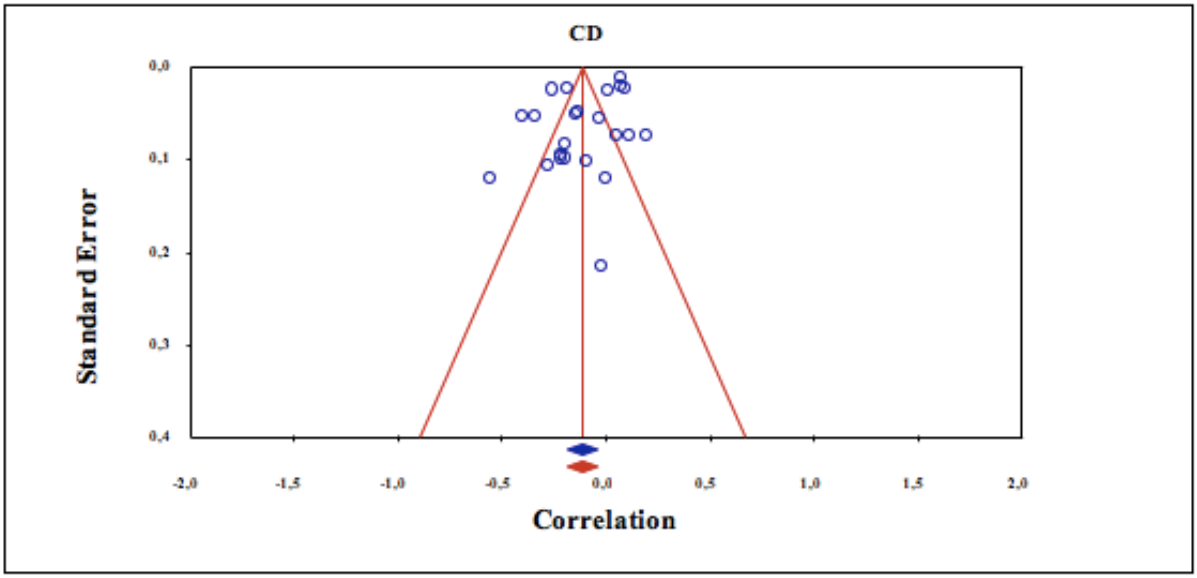
[3] From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097. For more information, visit www.prisma-statement.org.

Figure 2: Funnel plot with trim-and-fill imputations for Full-scale intelligence and antisocial disorders (ASPD, CD and ODD) and psychopathy samples.

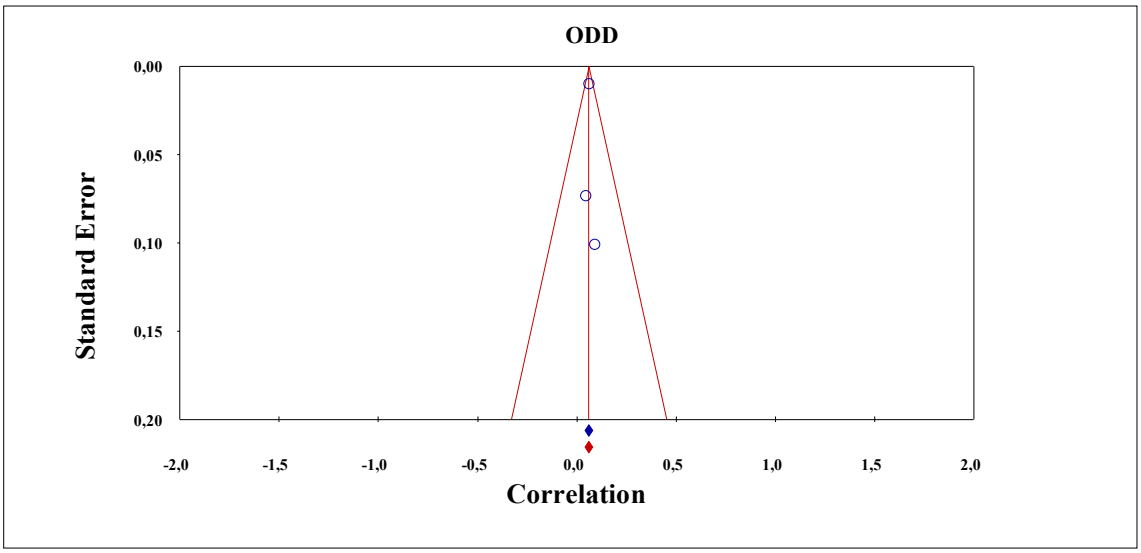
2A. Funnel Plot for correlations between IQ and ASPD.



2B. Funnel Plot for correlations between IQ and CD.



2C. Funnel Plot for correlations between IQ and ODD.



2D. Funnel Plot for correlations between IQ and psychopathy.