Title: On the relationship between psychopathy and general intelligence: A meta-analytic review

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Abstract

Over recent 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 behavior (including avoiding contact with the criminal justice system). The findings to date regarding the association of the two traits, however, have been somewhat inconsistent. Thus, there remains a need for a more systematic investigation of the extant empirical literature. The current study reports a meta-analysis conducted to evaluate the direction and overall effect size of the relationship between these two constructs. Our analyses revealed a small, but significant, negative effect of intelligence on psychopathy. The results and impact of possible moderating variables such as type of intelligence test used are discussed. Finally, the study limitations, and possible directions for further research on this issue are detailed prior to concluding.

Keywords: psychopathy; general intelligence; cognitive ability

Introduction

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 (Carrol, 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 also psychometrically robust, and research continues to shed light on its etiology and development across the life course.

Of particular interest to the current study, however, is a more recent line of research examining the association of general intelligence with indicators of psychopathy. The last decade or so has seen a sharp increase in studies examining the effect of general intelligence on psychopathy, with some evidence suggesting that lower IQ scores are associated 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 evidence of an inverse relationship between the two variables, and other failing to find such an effect). Thus, the goal of the current study is to systematically review the literature in order to better understand the pattern of findings emerging in the literature to date. To the extent that psychopathy covaries with intelligence (regardless of the direction of the effect), it may provide insight into the development of both outcomes. Prior to progressing to the results, 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 & Vertommen, 1991). The traits most often associated with psychopathy are callousness, remorselessness, lack of empathy, grandiosity, impulsivity, deceitfulness, and manipulativeness (Blair, 2007; Cleckley, 1941; Hare & Vertommen, 1991). Additionally, the Psychopathy Checklist-Revised Edition (PCL-R; Hare & Vertommen, 1991), generally viewed as the best diagnostic tool for measuring psychopathy, includes the previously mentioned traits plus superficial charm, pathological lying, failure to accept responsibility, need for stimulation, parasitic lifestyle, early behavior problems, lack of long term planning or goals, and promiscuous sexual behavior (Hare & Vertommen, 1991; Cooke & Michie, 2001).

While some debate remains, the general consensus among scholars is that psychopathy represents a confluence of traits that predict a host of antisocial outcomes (Cooke & Michie, 2001; Hare, 1996; Patrick et al., 2006). Because some of the studies being analyzed also look at Antisocial Personality Disorder (ASPD) it is noted that while psychopathy and ASPD do correlate, they are not fungible. ASPD is a clinical disorder with specific diagnostic criteria, whereas psychopathy is a non-clinical construct generally measured on a continuum.

Intelligence

General intelligence, commonly referred to as *g*, is arguably the best measured trait in all of psychology and research from across 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 a specific ability (e.g. verbal ability) (Gottfredson, 1997; 2002).

Intelligence is a (relatively) stable trait (Plomin & Deary, 2015). Yet, some mental abilities do change over time. Research into the stability of intelligence often divides the construct into two categories: fluid intelligence and crystallized intelligence. Fluid intelligence, which broadly contains abilities such as memory for novel and abstract information as well as processing speed, has been found to decline with age (Salthouse, 2004; Schaie, 2005). Crystallized intelligence, on the other hand, consists of abilities such as vocabulary and general knowledge and shows significantly less decline with age, even persisting into the early stages of dementia (McGurn et al., 2004). Nevertheless, differences in cognitive ability become stable across childhood (Gottfried, Gottfried, & Guerin, 2009) and remain stable throughout most of adulthood (Deary et al., 2000). In fact, Deary and colleagues (2000) found that scores on one measure of intelligence at age 11 correlated at about 0.73 with scores on the same test at age 77.

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; 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). In other words, having a high IQ has been found to be a predictor 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) predict differences in per capita GSP and GDP, respectively.

With regards to health and longevity, higher levels of *g* have been found to correlate with lower levels of a wide variety of physical and mental health problems as well as levels of intentional injury. For instance, Hart and colleagues (2004) found that an IQ score 1 SD below the mean was linked to an 11% increase in the risk of hospitalization or death. Additionally, Gale, Batty, Tynelius, Deary, and Rasmussen (2010) found in a longitudinal study of more than 1 million men that lower intelligence was associated with an increased risk for all psychiatric disorders, increased rates of psychiatric hospital admissions, and greater rates of comorbid disorders. Higher levels of intelligence on the other hand, have been found to correlate with better health and longevity, with a 1 SD advantage on IQ being linked to about a 50% decrease in risk for homicide victimization (Batty, Deary, Tengstrom, & Rasmussen, 2008).

Intelligence and Psychopathy

Intelligence and personality researchers have often explored the possibility that IQ might be related to personality traits (Furnham, Moutafi, & Chamorro-Premuzic, 2005; Higgins, Peterson, Pihl, & Lee, 2007). The results of such research have been mixed and what correlations have been found are often very small. Higgins and colleagues (2007) found only a small positive correlation between Openness and IQ (r=.28), while another study found a small negative relationship between intelligence and conscientiousness (r=-.21) (Furnham, Moutafi, & Chamorro-Premuzic, 2005). Other researchers have found a positive relationship between intelligence and extroversion (r=.08) and openness (r=.33; Ackerman & Heggestad, 1997).

Despite a rather ambiguous relationship between intelligence and other broad personality traits, researchers have uncovered a somewhat consistent phenotypic link between intelligence and psychopathic personality styles. One of the largest behavioral overlaps between psychopathy and low intelligence is the increased propensity to 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). As might be expected based on the stability of intelligence over time, the relationship between intelligence and antisocial behavior continues into adulthood with lower IQ being a significant risk factor for criminal behavior (Hernstein & C. Murray, 1994; J. Murray et al., 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 IQ and crime found that higher IQ was a protective factor against offending (Ttofi et al., 2016).

Similarly, psychopathy has been repeatedly associated with antisocial behavior 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 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 low 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 many non-significant results, several of which suggested a positive relationship between intelligence and psychopathy (Hare & Jutai, 1988; Pham, Philippot, & Rime, 2000). Others found non-significant negative relationships (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.

Aims

The aim of this meta-analytic review is twofold: first, synthesize and analyze the empirical evidence (published and unpublished) on whether intellectual functioning (IQ) relates to psychopathy and antisocial personality disorder (ASPD) using the meta-analytical technique; and second to identify which variables moderate this association to understand the current divergent results in the literature.

METHOD

Inclusion criteria

To be included in this meta-analysis, the studies had to meet all the following criteria to assure the quality of the study and that sufficient information would be provided to allow the calculation of the effect sizes and to avoid publication biases: (1) the studies had to be written in English, published in a peer-reviewed journal, or published as a dissertation; (2) a psychometric instrument for psychopathy or ASPD had to be administered (e.g. the PCL- R (Psychopathy Checklist—revised), the PPI-R (Psychopathic Personality Inventory-Revised for psychopathy, and the ICD-9, ICD-10,

DSM-III, DSM-III-R, DSM-IV or DSM-V for the ASPD); (3) measures of premorbid-full, verbal and performance IQ (e.g. WAIS, SILS, NART) had to be included; (4) and studies had to include a control group or a measure of correlation between IQ and psychopathy or ASPD. Neuroimaging studies that included an IQ measure were also included. Conversely, studies that used factorial analyses were excluded; (5) the antisocial sample included psychopathy and antisocial personality disorder, also in their violent form (see search strategy); (6) we limited our search to male adults. Studies that included mixed samples (males and females) without splitting the groups were excluded in order to reduce heterogeneity.

Case reports, or patients with antisocial symptoms were excluded. Participants were not selected from populations systematically diagnosed with mental illness (psychosis and depression) or substance related disorders (alcohol, drugs). The decision for inclusion was taken by consensus between authors.

Moderator analyses

We assumed that the individual effect sizes were not likely to be homogeneous so we estimated a series of moderator analyses. Meta-regression was used as quality analysis, that is, to investigate moderating factors that might interfere with the results. Thus we investigated the relationship of years of education, age, and number of participants with the magnitude of the effect size of intellectual functioning. Conversely, we used subgroup analyses for examining the publication type, use of PCL-R, settings, group of comparison, data used to calculate the effect sizes and IQ measures. For all categorical variables, moderator analyses were conducted using the analog to the ANOVA (with random effects), whereas the moderator analyses for the continuous variables were investigated by using fixed effect regression.

Search strategy

The search for candidate studies to be included in the meta-analysis was conducted using keywords relevant to antisocial behavior AND IQ/intelligence (see Appendix 1) in four electronic indices (PubMed, PsycINFO, ISI Web of Science, Google Scholar) for published English language studies and dissertations between January 1941 and June 2015. 1941 was selected as starting date because Cleckley was the first author who listed 16 criteria for psychopathy in his book "*The Mask of Sanity*" in 1941. In addition, all of the reference lists of the studies included for analysis, as well as several review articles on the relation of cognition to psychopathy and antisocial behavior were reviewed (e.g. Brennan & Raine, 1997; Fitzgerald & Demakis, 2007; Kiehl, 2006; Maes & Brazil, 2013; Morgan & Lilienfeld, 2000; Ogilvie et al. 2011; Reidy et al. 2011).

Coding the studies

The following information was extracted from each study. Moderator variables are noted with an asterisk: (1) reference data (i.e. first name of the author and year of publication or dissertation); (2) publication type*; (3) sample type and size*; (4) age of the sample*; (5) IQ measures*; (6) assessment method criteria for psychopathy and ASPD*; (7) psychopathy cut off; (8) establishment recruitment*; (9) data reported to calculate the effect size* and (10) effect size and its significance (see Table 1). One investigator independently coded each eligible study. There was no double coding of categories because they were objective.

Meta-analysis procedure

Meta-analyses were performed using Comprehensive Meta-Analysis, Version 3, Biostat, Englewood NJ (Borenstein et al., 2005). The majority of the studies provided the means and standard deviations necessary for calculating the effect sizes, however at times *t*-values, *f*-values, *p*-values, and *r*-values were used to calculate effect sizes (see

Lipsey & Wilson, 2001 for effect sizes calculations). The effect size used was Cohen´s *d* (defined as the difference between means divided by the pooled standard deviation (see Lipsey & Wilson, 2001). This has been proposed as the most appropriate measure for neuropsychological research because it accounts for the variability observed in patients with neuropsychological disorders (Zakzanis, 2001). Negative effect sizes in the present meta-analysis mean that the control group (non-antisocial) had higher scores in the IQ tests than antisocial groups.

Initially, a single effect size for all IQ measures within a study was calculated, that is, a weighted mean effect size for all tests was computed within a study to be entered in the meta-analysis. When two dependent variables were indicators of IQ, a pooled effect size was computed. For instance, a combined *d* value was computed in the overall analysis for the same studies that reported information on different tests. If a test reported two dependent variables (e.g. verbal score and performance score), both were considered separately. Furthermore, in studies where data was reported for several subgroups (e.g., violent ASPD and, or low/high anxiety criminals and low/high anxiety psychopaths), data were considered separately to compute the effect size for each subgroup instead of being pooled. Finally, extreme group contrasts were used to calculate effect sizes (i.e. the low and high group scores).

For each meta-analysis, homogeneity (*Q* and I^2) tests were performed to determine whether the studies can reasonably be described as sharing a common effect size, that is, the variation among study outcomes was due to random chance (*Q t*est) and the percentage of variation across the studies due to significant heterogeneity (I^2 test) (Hedges and Olkin, 1985, Higgins et al., 2003). Generally, I^2 up to 40% represents relatively inconsequential, 30%-60% moderate, 50%-90% substantial, and 75%-100% considerable heterogeneity (Higgins et al., 2003). A random effects model was

considered due to diversity of methods of measurement used in each analysis. According to the classification adopted by Cohen, small, medium and large effect sizes were defined by Cohen's *d* values of 0.2, 0.5, and 0.8, respectively (Cohen, 1988). Publication bias was assessed using both Egger's regression (Egger et al., 1997) and the Fail-Safe N tests to evaluate whether the available literature was biased towards non-published studies.

RESULTS

Literature search

Following an initial identification of over 7,179 hits[1] (this number is the total hits from database searches (7,095) + 84 records identified through other sources), we sorted through the titles and abstracts and removed any that were inconsistent with the inclusion criteria. This process reduced the number of potentially relevant studies to 187 studies. These 187 studies were thoroughly reviewed and final coding decisions were made as to whether the study conformed to each of the inclusion criteria. Ninety studies were excluded because of the inclusion of females in the sample, inclusion of other neuropsychological domains, antisocial personality disorder was mixed with other personality disorders, did not report the measures of psychopathy but just violent offenders, did not report data for IQ, the sample was youth or psychiatric patients or the papers were not accessible or in another language (see also Figure 1).

Insert Figure 1 about here

Characteristics of Studies Included in Meta-Analysis

Table 1 present a series of descriptive statistics characterizing the 97 included studies, as well as the procedures used to narrow down eligible studies. Ninety one percent of the studies were published in peer-reviewed journals and 37% were non-

[1] This search included other cognitive/neuropsychological domains (e.g., Iowa Gambling Task), which will be presented in a different article (in progress) (see Appendix I). Here we only considered the IQ domain.

published dissertations. A total of 9,010 participants were included in the analysis (4,321 antisocial and 4,689 control) with a mean age of 32.2 (SD=7.64) for antisocial groups and 31.7 (SD=7.61) for control groups. The antisocial group was mainly composed of criminal psychopaths (57%) and anxious/non-anxious psychopaths (12%), whereas 9% were diagnosed with ASPD and 5% were a combination of ASPD and psychopaths/non-psychopaths. Other studies used specific samples such as violent psychopaths (4%), violent ASPD (8%), and successful/unsuccessful psychopaths (3%). Most of the psychopaths and ASPD were recruited from prisons (62%) and high security hospitals (16%) or a combination of both (9%). A small proportion of studies recruited the antisocial group from forensic centers (5%), and temporary employment agencies and universities (6%). The antisocial groups were mainly compared to criminal non-psychopaths (47%) and the general population (16%). The other half of the studies used high/low anxious non-psychopaths (12%) and a combination of several control groups (16%) including general population/non-violent schizophrenics/violent schizophrenics; non-psychopaths/general population; drug users/general population; and violent offenders/non-violent offenders/non-psychopaths/ criminals drug users/criminal non-drug users. Only two studies (2%) used mental disorders and one study (1%) used patients with and without frontal dysfunction as control groups. Furthermore, five studies (5%) did not report a control group because they simply examined the correlation between psychopathy and intellectual functioning.

The majority of the studies (83%) used the PCL-R score to assess psychopathy and subjects receiving a score of 30, 25, 18 or higher were classified as psychopaths in 48%, 6% and 4% of the studies, respectively. Twenty one percent of the studies used diverse cut offs such as 26, 17, 19, 23.63, 33, 28.5, 31.5, 12, 28 and 23, whereas 12% of the studies did not report cut offs. Conversely, 13% of the studies used clinical

assessment, the DSM-IV and other scales to assess the antisocial groups. The measures to assess the intellectual functioning of these participants were mainly the full score of the WAIS (27.08%), the SILS (25%), the NART (10.4%) and the Raven´s Progressive Matrices (8.3%). Fifteen percent of studies used a combination of tests such as the NART and the WAIS or the NART and the Quick Test. Effect sizes were computed by calculating Cohen's d from the available information, which were predominantly means and standard deviations (84.5%), whereas 5% was the correlation and sample size, 4% was the t-value, 2% was the mean and p-value, d and variance; and 1% was the correlation. The last column of the Table 1 shows the Cohen´s *d* for individual effect sizes in each study and its statistical significance. Twelve studies (12%) reported a significant small and medium effect size (range: -0.28 to -0.75). There were three studies which reported outliers (-1.66, -0.93, 0.93) (see sensitivity analysis) and one out of five correlations was significant (0.36). Keeping in mind that most of these studies used IQ to match the samples, it appears that the effect of the association between psychopathy and intellectual functioning was robust.

Insert Table 1 about here

Types of groups

The summary effect size yielded by the meta-analysis was d = -0.15, 95% CI: -0.21, -0.09; $p < .001$, indicating that antisocial groups show small but significant impairment in intellectual functioning. Consistent with our first assumption, we used a random-effects analytic approach, as the *Q* test rejected the null hypothesis of homogeneity of variance $Q_{Total}(205) = 455.80$, $p < .001$. The I^2 test indicate moderate heterogeneity ($I^2 = 55.02$). As seen in Table 2, when splitting those with ASPD from psychopaths, effect sizes were significantly negative (d=-0.40 and d=-0.12, respectively), suggesting that these two groups performed worse than controls on the

measures of IQ. Both the ASPD and psychopathy groups had significant heterogeneity, but the psychopathy group (I^2 = 30.40) had lower heterogeneity than the ASPD group (I^2 = 78.72). Importantly, neither violent groups nor the combination of ASPD and psychopathy reported significant impairments, which might may be due to the small number of comparisons in the case of violent psychopaths (*k*=6) and violent ASPD combined with psychopathy (*k*=1).

Insert Table 2 about here

Type of comparisons

Studies used both different antisocial groups and comparison groups. In this meta-analysis we wanted to examine two things: the differences between several comparisons, and if the level of homogeneity increased. As seen in Table 3 most of the studies employed criminal psychopaths compared to criminal non-psychopaths (*k*=67) followed by antisocial personality disorder with the general population (*k*=21). The significant negative effect size (*d*=-0.11) showed that criminal psychopaths obtained lower IQ scores than criminal non-psychopaths. The effect size was larger for the comparison of those with ASPD to the general population (*d*=-0.53). Additionally, other comparisons reported significant small and medium negative effect sizes: ASPD+psychopathy/general population (GP) (*d*=-0.24); Violent ASPD-psychopathy/GP (*d*=-0.29); Successful psychopaths/GP (*d*=-0.43); Unsuccessful psychopaths/GP (d=-0.55); Psychopaths/Criminal Non-Drugs Users (*d*=-0.58); Violent ASPD/GP (*d*=-0.62); High negative affective psychopathy/High negative affective non-psychopaths (*d*=-0.64); Violent ASPD+psyschopathy/GP (*d*=-0.58); Psychopathy/Non-violent offenders (*d*=-0.63). The ASPD/Personality disorders group was the only group with a large effect size (*d*=-1.86). However, some of these effects must be viewed cautiously since they are based on only one study.

Overall it seems that when antisocial groups (i.e. antisocial personality disorder, antisocial personality disorder with psychopathy, successful and unsuccessful psychopaths, and violent antisocial personality disorder with and without psychopathy) are compared to the general population the effect size is larger than when they are compared to non-psychopathic offenders. Conversely, the comparison between psychopaths and non-violent offenders (P/NVO) showed a larger significant negative effect size but is based on only one study.

The heterogeneity between the studies was significant ($Q_{between}$=138.77, p< .001) indicating that the type of comparison has a significant effect on results. The largest heterogeneity was reported for ASPD/Personality disorders (Q (4) = 75.12, p <.001, I^2 =94.67) followed by ASPD/GP (Q (21) = 61.93, p <.001, I^2 =67.70). This is unsurprising since the control group in these studies was comprised of participants with mental/personality disorders and included a diverse array of disorders such as schizophrenia, borderline personality disorder, narcissistic personality disorder, etc. However, some significant comparisons showed low levels of heterogeneity such as incarcerated Psychopaths/Non-Psychopaths (I^2 =1.08) and ASPD/Violent schizophrenics (I^2 =15.61). Finally, some heterogeneity was accounted for by the type of comparison used across studies, which in turn moderated the association between the key variables ($Q_{between}$ = 138.77, p< .001).

Insert Table 3 about here

Type of IQ measures

Although, it is assumed that IQ measures correlate, it is worth examining whether some of the heterogeneity is due to different IQ measures used across the studies. As seen in Table 4, most of the studies employed the full score of the WAIS (k=54) and the SILS (k=51). Both reported similar effect sizes (d=-0.12 and -0.07,

respectively). Similarly, the NART and the Quick Test reported similar effect sizes (*d*=-0.21 and -0.24, respectively), but the effects were larger than for the WAIS and SILS. Furthermore, the Quick Test was used in fewer studies (*k*=12) than the NART (*k*=45). Conversely, the Raven´s Progressive Matrices, which measures abstract reasoning and the non-verbal aspect of fluid intelligence, did not show a significant effect. Finally, the largest effect size was for the CFT20-R (*d*=-0.42) but was based on two comparisons.

With regards to the subtests, none of them reported significant effects, except for the verbal and performance score of the WAIS. The former showed a very large significant effect (*d*=-1.03), whereas the latter showed a small but significant effect (*d*=-0.37), larger than full scores of the SILS, WAIS and Quick Test. This very large effect size might be due to the effect of an outlier. Importantly, the information subscale of the WAIS was the only significant positive effect size (*d*=0.36), indicating that psychopaths performed better than controls. However, it is only based on a single study.

The heterogeneity test was significant for the WAIS (Q (53) = 148.99, $p < .001$) and the verbal subscale combination of measures (Q (6) = 140.01, $p < .001$), whereas the rest of the measures remain homogenous. However, the type of intelligence measure used across the studies was an important moderator since the results of the analog to the ANOVA analyses were significant ($Q_{between} = 38.39$, $p < .001$).

Insert Table 4 about here

Moderator analyses

Due to the significant heterogeneity of the effect sizes, we explore potential moderating variables. We selected a number of potential categorical moderators that may be particularly relevant including: whether the study was published (yes/no), whether the study used the PCL-R to assess psychopathy (yes/no), whether the

antisocial group was recruited from: prisons, in maximum security hospitals, both, universities or temporary employment agencies or forensic assessments units; the control group used (criminal no psychopaths, general population, violent mental disordered, non-violent mental disordered, no control group/correlation, other), and data reported (mean/SD, correlation, t value, sample size/p value, d/variance). The results of the ANOVA analyses (with random effects) investigating possible moderators of the IQ effect sizes reported that the publication type ($Q_{between}$ (1)= 1.19, p=0.16) and settings ($Q_{between}$ (4) = 3.91, p=0.41) did not affect the effect sizes, whereas the use of PCL-R score of the antisocial sample ($Q_{between}$ (1) = 5.71, p=0.01), the control group ($Q_{between}$ (5) = 47.95, p=0.0001) (violent groups positive vs GP), IQ measure ($Q_{between}$ (15) = 38.39, p=0.001) and the type of data reported ($Q_{between}$ (1) = 7.75, p=0.005) moderated the effect size.

We also included two continuous measures as moderators: sample size and age of the participants. There were not enough studies that reported level of education of the sample to include education as a moderator. The analyses of fixed-effect regression showed that effect size was not moderated by the sample size (b = -0.0006, p=0.20) or the age of the participants (b = 0.01, p=0.20).

Sensitivity analysis

In addition to moderator analyses, we carried out an outlier analysis to test the robustness of the results. Few studies (Dolan & Anderson, 2002; Kiehl et al. 2000; Kumari et al. 2006; Raine & Venables, 1988) contained extreme effect sizes. However, the exclusion of these outliers slightly decreased the overall effect size (d = -0.12, 95%CI: -0.16, -0.07, p=.0001), but the model remained significantly negative. Therefore, this difference is small, and suggests that our overall effect is robust.

Publication bias

In consonance with the moderator analysis, the Egger's tests showed no indication of significant publication bias (d= 0.11, 95%CI: -0.66, 0.42; p=0.67), as well as the Fail-Safe N test. The result for this test was that 2,953 studies would have been required to render the mean effect statistically non-significant. It is highly unlikely that in our literature search we may have overlooked that large amount of studies.

Discussion

The results of the current meta-analysis produced a small, but significant effect size (d = -0.15) suggesting that individuals who score higher on measures of psychopathic traits tend to score lower on measures of IQ. Moderator analyses determined that the type of control group, type of IQ test, and type of data reported did moderate the effect size. For instance, the effect size is larger when psychopaths are compared to a general population sample than when they are compared to non-psychopathic offenders. However, fixed effect analyses of the age of participant and sample size did not moderate the relationship. Additionally, sensitivity analyses confirmed that although the effect size is small, it appeared to be robust. The IQ-Psychopathy relationship varied by measure of IQ, with the WAIS verbal score exhibiting the strongest relationship (d = -1.03) in line with previous research suggesting that low verbal intelligence is particularly related to psychopathic traits (DeLisi, Vaughn, Beaver, & Wright, 2010).

It is noted that a relatively large number of studies reported non-significant effect sizes including a few in the opposite direction of the overall effect size. The results demonstrated that heterogeneity in aspects of intelligence and especially in psychopathy may play a role in dampening the effect. While there is a substantial body of empirical support for the concept of general intelligence and scores on various measures of intelligence (e.g. verbal, working memory, processing speed, etc) are

highly correlated, the correlations are not perfect and as shown in the moderator analyses the type of IQ test utilized did moderate the relationship.

In fact, there seems to be an interaction between the facet of IQ being measured and the facet of psychopathy being measured. As demonstrated by the moderator analyses, and in line with previous research, verbal intelligence tests seem to show the strongest relationship of any intelligence type with overall scores on measures of psychopathy (DeLisi et al., 2010). However, numerous studies have found that the relationship between verbal intelligence and psychopathy is highly variable when examining the facets that comprise psychopathy. Salekin and colleagues (2004) found that individuals exhibiting higher scores in the superficial and deceitful interpersonal style facet of psychopathy actually possessed greater ability in the verbal domain. Vitacco, Neumann and Jackson (2005) also found a positive relationship between verbal IQ and the interpersonal facet of psychopathy. Interestingly, they found a negative relationship between verbal IQ and the behaviour and lifestyle components (Vitacco, Neumann, & Jackson, 2005).

It is becoming increasingly clear that both general intelligence and psychopathy are highly complex traits that contain a large degree of heterogeneity. Psychopathy in particular, has been divided into a variety of subtypes in recent research. These subtypes, while they have not been fully adopted by the psychopathy researcher community, have received a degree of empirical support. The two most common subdivisions are into primary and secondary psychopathy and successful and unsuccessful psychopathy. Research that has utilized such subtypes has found support for discrete differences between groups and raises the possibility that each subtype might be differentially related to intelligence and other important traits.

Despite a lack of agreement over the exact definition of primary and secondary subtypes, there is significant evidence that both are captured under the umbrella of psychopathy, yet exhibit distinct patterns of traits (Ross et al., 2007; Vaughn et al., 2009). Ross and colleagues found evidence to suggest differences between primary and secondary psychopaths' behavioral inhibition systems (BIS). Primary psychopathy was negatively associated with the BIS (i.e. displayed less sensitivity to punishment, less anxiety, and reduced behavioral inhibition), while secondary psychopathy was not significantly associated with the BIS. In a sample of incarcerated juveniles, Vaughn and associates (2009) found that secondary psychopathy was associated with higher levels of depression, anxiety, and suicidal ideation whereas primary psychopathy was associated with lower levels of distress, similar to the level of non-psychopathic controls.

Psychopathy has also been subdivided between those who have been involved in the criminal justice system ("unsuccessful" or "criminal" psychopaths) and those who have managed to avoid legal troubles ("successful" psychopaths; Cleckley, 1941; Gao & Raine, 2010). Successful psychopaths exhibit the same core features of the psychopathic personality, but owing to other traits manage to avoid contact with the criminal justice system. They are thought to be prevalent in higher numbers in certain professions such as business (Babiak & Hare, 2006) where psychopathic traits such as manipulativeness and a lack of empathy can be particularly beneficial. Unsuccessful psychopaths on the other hand, have the core features of psychopathy, but are more impaired than their successful counterparts leading to more criminal behavior and easier detection by law enforcement. Despite the growing popularity of subdividing psychopathic samples into primary/secondary and successful/unsuccessful, researchers have rarely distinguished between such subtypes in studies of how psychopathy is

related to intelligence. Future research will need to be mindful of the growing evidence for heterogeneity when assessing psychopathy and its correlates.

The current study analyzed research examining bivariate relations between psychopathy and intelligence, yet other researchers have found intelligence to be a mediator between psychopathic traits and antisocial behavior (Muñoz et al., 2008; Salekin et al., 2010). Kandel et al. (1988) found that higher intelligence is 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. Salekin and colleagues (2010) found no relationship between IQ and offending among psychopaths. Thus, it remains unclear how much of a role intelligence plays as a mediator of behavior in psychopathy, however, these studies and the small effect sizes found in the meta-analysis suggest a degree of heterogeneity of intelligence within psychopathy. Nevertheless, the existence of a significant overall effect size suggests that there is a degree of overlap between intelligence and psychopathy.

Limitations and Future Directions

The studies available for analysis were not without limitation. As mentioned earlier in the discussion, there is a paucity of research on the psychopathy/intelligence relationship that examined how different factors of psychopathy are related to IQ and how different facets of IQ are related to psychopathy. Another limitation is that the majority of the studies used inmate samples. Additional research is needed to further elucidate which facets of each of the two constructs drives the relationship and to further examine the relationship in non-incarcerated populations, women, and adolescents. Finally, some studies included in this review were correlational, that is to say they lacked a control group.

One of the most important gaps in the literature to date concerns the degree to which psychopathy and intelligence share etiological factors. Neuroscience research has already provided some evidence of shared neuroanatomical and neuroconnective abnormalities between psychopathy and low intelligence. Specifically, similar deficits in the volume and connectivity of the prefrontal cortex have been reported in both psychopathy (Yang et al., 2005; Motzkin et al., 2011) as well as instances of lower intelligence (Cole et al., 2012; Haier et al., 2004; Thompson et al., 2001; Toga & Thompson, 2005). Genetically sensitive methods (e.g. twin studies) are needed to evaluate the degree to which common genetic and environmental factors overlap between psychopathy and IQ. Overall, psychopathy and intelligence will continue to be important constructs in the behavioral sciences. Further understanding the nature of the connection between the two traits remains an important endeavour for psychological research.

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

Author(s) (publication year)	**Publication**	**Group comparison**	**Sample size (n)**	**Age Mean (SD)**	**IQ measure**	**Psychopathy (structural clinical assessment vs. checklists)**	**Psychopathy cut off**	**Settings**	**Data reported**	**ES (p-value)**
Arnett et al. 1993	Published	HAP/HANP LAP/LANP	16/12 13/16	27.4(6.4)/26.2(5.9) 27.0(3.9)/28.8(5.1)	SILS	PCL-R total score	≥ 30	Prison	Mean/SD	0.10 (ns)
Arnett et al. 1997	Published	HAP/HANP LAP/LANP	16/10 13/19	24.8(4.2)/25.3(5.9) 25.3(3.9)/26.9(4.9)	SILS	PCL-R total score	≥ 30	Prison	Mean/SD	0.14 (ns)
Bagshaw et al. 2014	Published	P	28	35.14 (6.86)	WASI	PCL-R total score	NR	Prison	Correlation, N	-0.08 (ns)
Bagley et al. 2009	Published	ASPD/NP HAP/NP LAP/NP	24/30 19/30 29/30	22.35(4.14)/24.59(6.80) 28(5.80)/24.59(6.80) 24.58(5.84)/24.59(6.80)	SILS	PCL-R total scores Structured Clinical Interview for DSM–IV Axis I Disorders (SCID-I)	≥ 30	Prison	Mean/SD	-0.18 (ns)
Barkataki et al. 2008	Published	VASPD/GP VASPD/VSCZ VASPD/NVSCZ	14/14 14/12 14/12	33.5(10.45)/32.14(7.75) 33.5(10.45)/34.83(4.97) 33.5(10.45)/34.92(7.60)	WAIS	DSM-IV	N/A	Security hospital	Mean/SD	0.30 (ns)
Barkataki et al. 2006	Published	VASPD/GP VASPD/NVSCZ VASPD/VSCZ	13/15 13/13 13/15	31.62(8.03)/32.13(7.47) 31.62(8.03)/34.46(4.94) 31.62(8.03)/34.47(7.49)	NART WAIS	Structured Clinical Interview for DSM-IVAxis I and II disorder(SCID and SCIDII)	N/A	Security hospital	Mean/SD	-0.10 (ns)

Table 1 cont.

Author(s) (publication year)	Publication	Group comparison	Sample size (n)	Age Mean (SD)	IQ measures	Psychopathy and ASPD measures	Psychopathy cut off score	Settings	Data reported	ES (p-value)
Barkataki al. 2005	Published	VASPD/GP VASPD/NVSCZ VASPD/VSCZ	14/15 14/13 14/15	33.5(10.45)/32.1(7.47) 33.5(10.45)/34.5(4.94) 33.5(10.45)/34.5(7.49)	NART WAIS	PCL: SV SCID II DSM IV	NR	Security hospital	Mean/SD	-0.08 (ns)
Beggs & Grace, 2008	Published	PCM psychoschild molester	216	NR	WASI	PCL-R	≥ 25	Prison	Correlation, N	-0.40 (.004)
Blair, 1995	Published	VP/NP	10/10	33.3(7.7)/37.5(9.43)	WAIS Raven´s	PCL-R	NR	Special hospital	Mean/SD	-0.01 (ns)
Blair, Sellars et al. 1995	Published	P/NP	25/25	33.33(7.32)/32.96(9.61)	WAIS	PCL-R	≥ 30	Special hospital Prison	Mean/SD	0.12 (ns)
Blair et al. 1996	Published	P/NP	25/25	31.60(6.73)/33.12(9.48)	WAIS	PCL-R	≥ 30	Special hospital Prison	Mean/SD	-0.22 (ns)
Blair et al. 1997	Published	P/NP	18/18	32.67(6.93)/31.89(9.66)	NR	PCL-R	≥ 30	Special hospital Prison	Mean/SD	-0.07 (ns)
Blair et al. 2002	Published	P/NP	19/20	34.47(9.07)/31.45(7.9)	Raven´s	PCL-R	≥ 30	Prison	Mean/SD	-0.40 (ns)
Blair et al. 2004	Published	P/NP	19/21	38.00(12.45)/38.76(6.64)	Raven´s	PCL-R	≥ 30	Prison	Mean/SD	0.05 (ns)
Blair, Mitchell et al. 2004	Published	P/NP	19/19	33.58(9.17)/30.63(7.20)	Raven´s	PCL-R	≥ 30	Prison	Mean/SD	-0.41 (ns)
Blair, Mitchell et al. 2006	Published	P/NP P/NP	17/19 19/18	36.59(10.27)/36.89(9.61) 35.47(7.65)/ 31.50(8.26)	NART Raven´s	PCL-R	≥ 30	Prison	Mean/SD	-0.06 (ns)
Blair, Ritchell et al. 2006	Published	P/NP P/NP	24/20 18/18	35.24(9.78)/32.35(9.21) 37.22 (8.01)/32.00(9.16)	NART Raven´s	PCL-R	≥ 30	Prison	Mean/SD	-0.21 (ns)

Blair, Morton et al. 2006	Published	P/NP	21/19	36.71 (7.52)/32.16(9.13)	NART	PCL-R	≥ 30	Prison	Mean/SD	0.09 (ns)
Brinkley et al. 2005	Published	HAP/HANP LAP/LANP	21/13 11/24	NR	SILS	PCL-R	≥ 30	Prison	Mean/p value	-0.52 (.04)
Budhani et al. 2006	Published	P/NP	20/17	37.80(7.64)/34.53(10.59)	Raven´s	PCL-R	≥ 30	Prison	Mean/SD	0.02 (ns)
de Brito et al. 2013	Published	VASPD+P/GP VASPD-P/GP	17/21 28/21	40.0(9.0)/35.0 (8.2) 35.8 (8.4)/35.0 (8.2)	WAIS	PCL-R the Structural Clinical Interview for DSM-IV, I and II, (SCID)	≥ 25	National Probation Service	Mean/SD	-0.42 (.05)
de Tribolet-Hardy et al. 2014	Published	VP/Factor 1 VP/Factor 2	90	48.8(12.0)	WIP/WAIS verbal WIP/WAIS spatial	PCL-R	NR	Prison Security hospital	Correlation, N	0.03 (ns)
Cima et al. 2010	Published	P/NP	7/13	36.66 (6.56)/40.95(9.77)	WAIS	PCL-R	≥ 26	Forensic psychiatric centre	Mean/SD	-0.65 (ns)
Craig et al. 2009	Published	P/GP	9/9	34(12)/37(9)	WAIS	PCL-R ICD-10	≥ 25	Forensic inpatient units	Mean/SD	0.46 (ns)

Table 1cont.

Author (s) (publication year)	Publication	Group comparison	Sample size (n)	Age Mean (SD)	IQ measures	Psychopathy and ASPD measures	Psychopathy cut off score	Settings	Data reported	ES (p-value)
Dolan & Anderson, 2002	Published	ASPD/GP ASPD/PD	51/27 51/9	29.7(6.6)/30.3(6.0)	NART WAIS WAIS p WAIS v	SCID II SHAPS/Antisocial Personality Questionnaire	High scores on the Belligerence dimension of SHAPS	Security hospitals	Mean/SD	-1.66 (.001)
Dolan & Park, 2002	Published	ASPD/GP	29/20	40.97(9.49)/37.65(7.73)	NART	DSM-IV/SCID-II	N/A	Security hospital	Mean/SD	-0.31 (ns)
Dolan et al. 2002	Published	ASPD/GP	18/19	30.44 (7.00)/30.52(6.83)	NART	DSM-III-R SHAPS/ Antisocial Personality Questionnaire	High scores on the Belligerence dimension of SHAPS	Security hospitals	Mean/SD	-0.75 (.03)
Dolan & Fullman, 2004	Published	ASPD+P/NP ASPD+P/GP	30/59 30/20	30.97(5.44)/33.03(5.7) 30.97(5.44)/31.65(7.7)	NART	PCL-R SCID for DSM-IV axis I & axis II	≥18	Security hospital Prison	Mean/SD	0.12 (ns)
Dolan & Fullman, 2005	Published	ASPD+P/GP ASPD-P/GP ASPD+P/ASPD-P	20/20 26/20	31.20 (5.90)/31.65(7.73) 34.15 (5.5)/ 31.65(7.73)	NART	DSM-IV/SCID-II PCL-SV	High >75% Medium >25-75% Low < 25%	Security hospital Prison	Mean/SD	-0.08 (ns)
Dolan & Fullman, 2006	Published	ASPD+P/GP	22/27	35.18(10.28)/32.59(9.05)	NART	ICD-10 PCL: SV	≥17	Security hospitals Prison	Mean/SD	-0.30 (ns)
Dolan, et al. 2012	Published	ASPD+P/GP ASPD-P/GP	33/49 35/49	38.79(11.42)/33.69(10.24) 37.18(10.48)/33.69(10.24)	NART	SCID-II PCL:SV	High >19 Medium 16-19 Low ≤ 19	Security hospitals Prison	Mean/SD	-0.34 (.03)
Druggie 1998	Unpublished	P/NP	13/12	36.44(9.37)/45.09(12.36)	SILS	PCL-R	≥23.63	Prison	Mean/SD	0.11 (ns)

					SILSa SILSv WAIS					
Gawda, 2008	Published	ASPD/GP	50/50	35.5(11.0)/33.5(9.8)	WAIS-R	DSM-IV-TR MMPI	Pd scores over 70 T	Prison	Mean/SD	-0.11 (ns)
Glass & Newman, 2006	Published	HAP/HANP LAP/LANP	26/27 24/27	30.69(6.91)/32.33(7.24) 34.63(6.83)/32.33(7.24)	SILS	PCL–R	≥30	Prison	Mean/SD	0.08 (ns)
Glass & Newman, 2009	Published	HAP/HANP LAP/LANP	44/75 45/75	31.85(7.39)/29.68(6.29) 31.29(8.39)/32.49(7.58)	SILS	PCL-R	≥30	Prison	Mean/SD	0.01 (ns)
Gillstrom 1995	Unpublished	P/NP	17/28	32.24(9.18)/31.25(8.4)	WAIS (b&v)	PCL-R	≥30	Prison	Mean/SD	-0.24 (ns)
Goldstein 1998	Unpublished	P/NP	47/45	27.9(6.7)/27(6.1)	SILS Raven´s	PCL –R	≥30	Prison	Mean/SD	-0.28 (.05)
Hare, 1984	Published	P/NP	14/16	30.2(8.1)/34.7(9.9)	NR	Cleckley checklist DSM-III So Scale (socialization)	≥33	Prison	Mean/SD	-0.01 (ns)
Hare & Jutai, 1988	Published	P/NP	13/13	28.9(6.1)/30.2(7.2)	WAIS	PCL-R	≥30	Prison	Mean/SD	0.04 (ns)
Hart et al. 1990	Published	P/NP	22/27	NR	WAIS b WAIS v	PCL-R	≥30	Prison	Mean/SD	0.01 (ns)
Heinzen et al. 2011	Published	AS/NP P/NP	76/110 76/110	28.6 (6.7)[1]	CFT20-R	PCL:SV	NR	Prison	Mean/SD	-0.42 (.001)
Herpertz et al. 2001	Published	ASPD/GP ASPD/PD	25/24 25/18	33.8(8.2)/32.5(10.8) 33.8(8.2)/33.3(6.9)	WAIS	PCL-R:SV	≥18	Security forensic unit	Mean/SD	0.28 (ns)
Hiatt et al. 2002	Published	HAP/HANP LAP/LANP	11/15 10/19	28.80(4.32)/28.27(5.30) 29.60(6.11)/28.89(6.24)	SILS	PCL-R	≥30	Prison	Mean/SD	-0.09 (ns)

Hiatt et al. 2004	Published	HAP/HANP/Exp.1 Exp.2 Exp.3 LAP/LANP/Exp.1 Exp.2 Exp.3	19/12 15/24 15/18 10/22 12/24 11/24	28.00(4.32)/26.83 (4.37) 27.73(5.82)/25.92(4.91) 27.60(6.61)/29.61(6.70) 27.50(5.36)/29.77(7.00) 31.08(5.99)/29.42(6.83) 27.27(4.31)/27.92(5.85)	SILS	PCL–R	≥30	Prison	Mean/SD	-0.24 (ns)
Hiatt et al. 2005	Unpublished	P/NP	53/36	NR	SILS	PCL-R	≥30	Prison	Mean/SD	-0.05 (ns)
Howard & McCullagh, 2007	Published	P/NP	17/17	32.3(4.1)/34.3(4.8)	WAIS	NIMH-QDIS PCL-SV	≥18	Prison	Mean/SD	0.06 (ns)
Ishikawa et al. 2001	Published	SP/GP UP/GP	13/26 17/26	29.62(6.13)/28.42 (6.47) 33.81(6.63)/28.42 (6.47)	WAIS	PCL-R Interpersonal Measure of Psychopathy (IM-P SCID I and II Official criminal records	NR	Temporary employment agency	Mean/SD	-0.50 (.04)
Johansson & Kerr, 2005	Published	P/NP	370[2]	32.7(NR)[1]	SRB	PCL-R	≥30	Swedish national assessment center	Sample size/t	0.18 (ns)
Kiehl et al. 2004	Published	P/GP	8/8	33.9(7.6)/ 27.9(5.0)	NART Quick Test	PCL-R	≥23.6	Prison	Mean/SD	-0.16 (ns)
Kiehl et al. 2006	Published	P/NP P/NP	25/25	32.5(NR)/32.1(NR)	NART Quick Test	PCL-R	≥25	Prison	Mean/SD	0.16 (ns)
Kiehl, Bates et al. 2006	Published	P/NP P/NP	41/39	32.3(NR)/33.8(NR)	NART Quick Test	PCL-R	≥30	Prison	Mean/SD	0.05 (ns)
Kiehl, 2000	Unpublished	P/GP P/NP	8/8 8/8	33.9(7.6)/31.9(8.4) 33.9(7.6)/27.9(5	NART Quick	PCL-R PCL:SV	≥23.6	Prison	Mean/SD	0.05 (ns)

				)	Test					
Kiehl et al. 2001	Published	P/GP P/NP	8/8 8/8	33.9(7.6)/31.9(8.4) 33.9(7.6)/37.1(7.1)	NART Quick Test	PCL-R PCL:SV	≥23.6	Prison	Mean/SD	-0.37 (ns)
Kosson, 1996	Published	P/NP	30/30	26.0(4.77)/27.93(6.36)	SILS	PCL-R SHAPS	≥30	Prison	Mean/SD	-0.11 (ns)
Kosson, 1998	Published	P/NP	31/37	31.16(6.55)/29.68(6.29)	SILSv SILSa	PCL-R	≥28.5	Prison	Mean/SD	-0.10 (ns)
Kosson, et al. 2002	Published	P/NP	34/33	27.00(6.57)/27.00(6.46)	WAIS	PCL-R	≥30	Prison	Mean/SD	-0.21 (ns)
Kosson et al. 2007	Published	P/NP	59/57	27.54 (6.57)/27.32(7.35)	SILS	PCL-R	≥30	Prison	Mean/SD	-0.02 (ns)
Kumari et al. 2005	Published	VASPD/GP VASPD/NVSCZ VASPD/VSCZ	9/14 9/14 9/9	33.22(8.12)/35.36(8.10) 33.22(8.12)/34.79(7.67) 33.22(8.12)/34.33(5.63)	NART	DSM-IV/SCID Gunn and Robertson scale for violence	N/A	Security hospital	Mean/SD	-0.03 (ns)
Kumari et al. 2006	Published	VASPD/GP VASPD/NVSCZ VASPD/VSCZ	10/13 10/12 10/13	31.30(8.14)/33.31(6.85) 31.30(8.14)/33.85(7.57) 31.30(8.14)/34.00(4.86)	NART WAIS	SCID-I & II	N/A	Security hospital	Mean/SD	0.02 (ns)
Kumari et al. 2009	Published	VASPD/GP VASPD/NVSCZ VASPD/VSCZ	13/14 13/13 13/13	32.85(10.57)/33.14(6.6) 32.85(10.57)/34.46(4.94) 32.85(10.57)/34.31(7.3)	NART	(cluster B, DSM IV) Gunn–Robertson scale	N/A	Security hospital	Mean/SD	-0.28 (ns)
Llanes & Kosson, 2006	Published	P/NP	26/46	26.00(6.23)/26.00(6.23)	SILS	PCL-R	≥30	Prison	Mean/SD	0.18 (ns)
López et al. 2007	Published	P/NP	25/29	26.9(7.2)/25.8(6.8)	SILS	PCL-R	≥30	Prison	Mean/SD	-0.29 (ns)
Lösel & Schmucker, 2004	Published	P	49	33.24(7.03)	WIP	PCL-R	≥25	Prison	Correlation/N	0.22 (ns)

Lorenz & Newman, 2002	Published	HAP/HANP LAP/LANP	9/23 14/16	NR	SILS	PCL-R	≥30	Prison	Cohen´s d/Variance	0.02 (ns)
Mayer & Kosson, 2000	Published	P/NP	137/111	Range: 17-39	SILS	PCL-R	≥30	Prison	t value	-0.001 (ns)
Mercer et al. 2005	Published	P/CDU P/CNDU P/NP P/NVO P/VO	143/186 143/144 143/187 143/182 143/148	33.91(7.38)/34.07(7.38) 33.91(7.38)/31.27(8.82) 33.91(7.38)/32.04(8.62) 33.91(7.38)/31.58(8) 33.91(7.38)/34.41(7.28)	WAIS	PCL:SV	≥18	Prison	Mean/SD	-0.34 (.01)
Mills, 1995	Unpublished	P/NP	12/12	33.67(10.27)/28.75(3.84)	WAIS b&v	PCL-R	≥30	Prison	Mean/SD	0.21 (ns)
Mitchell et al. 2002	Published	P/NP	20/20	34.42(8.07)/31.64 (7.91)	Raven´s	PCL-R	≥30	Security hospital	Mean/SD	-0.38 (ns)
Mitchell et al. 2006	Published	P/NP	16/19	33.44(9.11)/31.16(10.02)	Raven´s	PCL-R	≥30	Security hospital	Mean/SD	-0.16 (ns)
Nestor et al. 2002	Published	P/SCZ	13/13	36.1(2.5)/33(12)	WAIS	PCL-R	NR	State hospital	Cohen´s d/ variance	0.49 (ns)
Newman et al. 1987	Published	P/NP	36/36	25.53(4.92)/26.72(6.02)	SILS	PCL-R	≥31.5	Prison	Mean/SD	0.001 (ns)
Newman et al. 1997	Published	HNAP/HNANP LNAP/LNANP	28/21 24/19	NR	SILS	PCL-R	≥30	Prison	Mean/SD	-0.15 (ns)
Nijman et al. 2009	Published	P/MD	133[2]	NR	WAIS WAISp WAISv	DSM-IV (Cluster B) PCL-SV	≥30	Security hospital	t value	0.01 (ns)
Pham et al. 2000	Published	P/NP	14/16	31.7(NR)/30.8(NR)	WAIS	PCL-R	NR	Prison	Correlation	0.63 (ns)
Pham et al. 2003	Published	P/NP	18/18	29.12(10.47)/31.89(9.77)	WAIS	PCL-R	≥25	Prison	Mean/SD	-0.35 (ns)
Raine & Venables,	Published	P/NP	14/14	32.3(8.2)	WAIS	PCL-R	NR	Prison	Sample size and p	0.93 (.01)

1988										
Raine et al. 2000	Published	ASPD/DU ASPD/GP	21/26 21/34	31.9(6.8)/30.2(6.2) 31.9(6.8)/30.4(6.7)	WAIS	SCID for Axis I and II DSM-IV PCL-R IM-P Interpersonal Measure of Psychopathy interview	PCL-R: NR	Temporary employment agencies	Mean/SD	-0.13 (ns)
Raine et al. 2003	Published	ASPD/GP	15/25	31.6(6.6)/28.8(6.5)	WAIS WAISp WAISv	SCID for Axis I and II DSM-IV PCL-R Interpersonal Measure of Psychopathy interview	PCL-R: NR	Temporary employment agencies	Mean/SD	-0.26 (ns)
Raine et al. 2004	Published	SP/GP UP/GP	12/23 16/23	29.5(6.39)/28.35(6.63) 33.81(6.62)/28.35(6.63)	WAIS	SCID for Axis I and II DSM-IV PCL-R IM-P interview	PCL-R: NR	Temporary employment agencies	Mean/SD	-0.52 (.03)
Richell et al. 2003	Published	P/NP	19/18	32.2(6.8)/33.3(8.1)	Raven´s	PCL-R	≥30	Security hospital	Mean/SD	0.08 (ns)
Ritchell et al. 2005	Published	P/NP	19/19	37.2(8.73)/31.8(10.9)	Raven´s	PCL-R	≥30	Security hospital	Mean/SD	0.20 (ns)
Schalling & Rosen, 1968	Published	P/NP	60/23	31.42(6.77)/27.65(5.81)	CVB=WAIS	Diagnostic Interview based on Cleckley	Scale 2-3 high and 0-1 low	University clinic for forensic psychiatry	Mean/SD	-0.24 (ns)
Schiffer et al. 2014	Published	VASPD/GP	21/23	35.27(8.2)/34.17(8.9)	WAIS	PCL:SV SCID for DSM-IV axis I & axis II	≥12	Prison	Mean/SD	-0.39 (ns)
Schmit	Unpubl	HAP/HAN	22/2	NR	SILS	PCL-R	≥30	Prison	Mean/S	-0.04

t, 2000	ished	P LAP/LANP	4 19/30						D	(ns)
Shamay-Tsoory et al. 2010	Published	P/dlPFC patients P/GP P/OPFC patients P/other patients	25/9 25/20 25/8 25/10	29.82(10.09)/35.55(8.56) 29.82(10.09)/27.70 (8.36) 29.82(10.09)/39.22(14.87) 29.82(10.09)/40.50(17.89)	WAIS similarities	DSM-IV TR LSRP-III SRP-II	SRP-II is scored from 1 (strongly disagree) to 7 (strongly agree)	Prison	Mean/SD	0.04 (ns)
Smith et al. 1992	Published	HAP/HANP LAP/LANP	14/19 18/18	25.3(4.1)/ 24.9(4.6) 26.5(4.3)/ 26.9(4.2)	SILS	PCL-R	≥30	Prison	Mean/SD	-0.05 (ns)
Smith, 1999	Unpublished	P/GP P/NP	8/8 8/8	33.8(7.62)/32.5(7.73) 33.8(7.62)/37.13(7.70)	NART Quick Test	PCL-R	≥28	Prison	Mean/SD	-0.93 (.001)
Snowden et al. 2004	Published	MHP/NMHP MLP/NMLP	6/17 11/40	32.5(9.8)/31.2(9.0) 36.8(8.8)/37.0(10.7)	NART	PCL-R	≥30	Prison	Mean/SD	-0.06 (ns)
Sreenivasan et al., 2008	Published	VP	126[2]	26.8(6.69)[1]	WAIS information	PCL–R	≥30	Prison	Correlation, N	0.36 (.04)
Stevens et al. 2003	Published	ASPD/GP	34/32	23.4(1.75)/22.5(1.34)	WAIS v WAIS p	DIS- III-A	N/A	General population	Mean/SD	-0.43 (ns)
Suchy & Kosson, 2005	Published	P/NP	12/19 14/13	26.00(5.64)/27.44(6.60) 26.4(5.80)/27.62(4.66)	SILS	PCL–R	≥30	Prison	Mean/SD	-0.27 (ns)
Suchy & Kosson, 2006	Published	P/NP	23/21	26.96(7.13)/24.90 (6.69)	SILS	PCL-R	≥30	Prison	Mean/SD	0.01 (ns)
Sutker et al. 1983	Published	P/NP	44/14	29.09(NR)	SILS	The Psychopathic Deviate (*Pd*) Scale of the MMPI	T score ≥70	Prison	Mean/SD	-0.21 (ns)
Swogger, 2006	Unpublished	P/NP	47/38	30.17(6.93)/26.71(7.05)	SILS	PCL-R	≥30	Prison	Mean/SD	-0.26 (ns)
Völlm, 2010	Published	ASPD/GP	25/25	42.1(NR)/30.5(NR)	Quick Test	SCID for DSM-IV axis I & axis II	N/A	Forensic psychiatric hospita	Mean, p value	-0.48 (ns)

								l, open prison		
Yang et al. 2005	Published	SP/GP UP/GP	13/23 16/23	29.62(6.13)/28.35(6.63) 33.81(6.62)/28.35(6.63)	WAIS	PCL-R IMP SCID for DSM-IV axis I & axis II	≥23 "success"= evading detection for crimes	Temporary employment agencies	Mean/SD	-0.46 (.05)
Zeier, et al. 2009	Published	HAP/HANP LAP/LANP	22/25 14/30	31.64(6.77)/33.12(7.59) 31.79(9.18)/33.47(6.96)	SILS	PCL-R	≥30	Prison	Mean/SD	-0.54 (.01)

NOTE: ASPD/DU= antisocial personality disorder vs drug users; ASPD/GP= antisocial personality disorder vs general population; ASPD/PD= antisocial personality disorder vs personality disorders; ASPD+P/GP= antisocial personality disorder plus psychopathy vs general population; ASPD-P/GP= antisocial personality disorder without psychopathy vs general population; ASPD+P/ASPD-P= antisocial personality disorder plus psychopathy vs antisocial personality disorder without psychopathy; ASPD+P/NP= antisocial personality disorder plus psychopathy vs non pyschopaths; CFT20-R= Culture Fair Intelligence Test 20-Revised (Dutch version); DIS-III-A= Diagnostic Interview Schedule version III-A; HAP/HANP= high anxious psychopaths vs high anxious non psychopaths; HNAP/HNANP = IM-P= Interpersonal Measure of Psychopathy interview (Kosson et al. 1997); LAP/LANP= low anxious psychopaths vs low anxious non psychopaths; LSRP III= Levenson Self-Report Scale:Version III; LNAP/LNANP=; MHP/NMHP= murderers with high psychopathy vs non murderers with high psychopathy; MLP/NMLP= murderers with low psychopathy vs non murderers with low psychopathy; MMPI= Minnesota Multiphasic Personality Inventory (Hathaway and McKinley, 1940); NR= not reported; ns = not significant; P = inmates psychopaths; P/CDU= criminal psychopaths vs criminal drug users; P/CNDU= criminal psychopaths vs criminal non drug users; P/dlPFC= psychopaths vs dorsolateral prefrontal cortex patients; P/GP = psychopaths vs general population; P/NP= inmates psychopaths vs inmates non psychopaths; P/NVO= criminal psychopaths vs non-violent offenders; P/MD= Psychopaths vs mental disorders; P/OPFC= psychopaths vs orbitoprefrontal cortex patients; P/VO= criminal psychopaths vs violent offenders; PCL-R= Psychopathy Checklist-Revised (Hare, 1990); PCL:SV=Hare Psychopathy Checklist: Screening Version (Hare, 1995); PPI-R=Psychopathic Personality Inventory – Revised (Lilienfeld & Widows, 2005); Raven´s Advanced Progressive Matrices (Raven, 1976); RSRP-II=Self-Report Psychopathy scale (Hare, 1991); SCID= Structured clinical interviews for DSM-IV (SCID) axis I (First et al., 1996a) and axis II (First et al., 1996b); SHAPS=Special Hospital Assessment of Personality and Socialisation; SISL= Shipley Institute of Living Scale; SISLa= Shipley Institute of Living Scale abstract thinking subtest; SISLv= Shipley Institute of Living Scale verbal subtest; SP/GP= successful psychopaths vs general population; SRB = Synonyms, Reasoning and Block (Swedish test); UP/GP= unsuccessful psychopaths vs general population; VASPD+P/GP= violent antisocial personality disorder vs general population; VASPD-P/GP= violent antisocial personality disorder without psychopathy vs general population; VASPD/NVSCZ= violent antisocial personality disorder vs non-violent schizophrenics; VASPD/VSCZ= violent antisocial personality disorder vs violent schizophrenics; VP=violent psychopaths WAIS= full score Wechsler Adult Intelligence Scale (Wechsler, 1981); WAISb = Wechsler Adult Intelligence Scale block subtest; WAISv= Wechsler Adult Intelligence Scale verbal subtest; WAISb&v = Wechsler Adult Intelligence Scale block and verbal subtests; WAISp= Wechsler Adult Intelligence Scale performance score; WAISv= Wechsler Adult Intelligence Scale verbal score; WASI= Wechsler Abbreviated Scale of Intelligence (Wechsler, 1999); WASI= Wechsler Abbreviated Scale of Intelligence; WIP= Wechsler Adult Intelligence Scale German version; [1] , [2]= whole sample.

Table 2. Psychopathic and Antisocial Personality Disorder Effect Sizes for IQ

Random model	***K***	***d***	**95%CI lower limit**	**95%CI upper limit**	***z*** **value**	**Heterogeneity** ***Q*** **value**	**I^2**
ASPD	43	-0.40	-0.61	-0.19	-3.80***	197.39***	78.72
VASPD	11	-0.05	-0.41	0.30	-0.28	26.73*	62.58
P	103	-0.12	-0.18	-0.06	-3.83***	146.56*	30.40
VP	6	0.06	-0.33	0.47	0.32	15.95*	68.66
HA/LA P	32	-0.085	-0.19	0.02	-1.56	21.51	0
ASPD+P	6	-0.09	-0.32	0.12	-0.86	6.21	19.52
VASPD+P	1	-0.58	-1.23	0.07	-1.74	-	-

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

NOTE: *k* = number of comparisons, d= Cohen´s effect size; I^2 = heterogeneity; ASPD = antisocial personality disorder; VASPD = violent antisocial personality disorder; HA/LA P = High anxious/low anxious psychopaths; P = psychopathy; VP = violent psychopaths; ASPD+P = a combination of psychopaths and antisocial personality disorder; VASPD+P = a combination of violent antisocial personality disorder and psychopathy.

Table 3. Effect Sizes by Groups

Random model	***K***	***d***	**95%CI lower limit**	**95%CI upper limit**	***z*** **value**	**Heterogeneity** ***Q*** **value**	**I^2**
P/NP	67	-0.11	-0.18	-0.05	-3.45***	66.72	1.08
ASPD/GP	21	-0.53	-0.76	-0.30	-4,54***	61.93***	67.70
HAP/HANP	15	-0.06	-0.21	0.09	-0.79	12.45	0
LAP/LANP	15	-0.007	-0.22	0.08	-0.91	7.87	0
P/GP	12	-0.18	-0.53	0.15	-1.08	17.01	35.34
ASPD/PD	5	-1.86	-3.37	-0.34	-2.40*	75.12***	94.67
ASPD/VSZ	6	0.39	0.03	0.75	2.14*	5.92	15.61
ASPD/NVSZ	6	0.05	-0.26	0.37	0.32	4.11	0
ASPD+P/GP	4	-0.24	-0.48	-0.005	-1.99*	1.66	0
VASPD/GP	4	-0.62	-0.97	-0.26	-3.42**	0.88	0
SP/GP	3	-0.43	-0.83	-0.03	-2.13*	0.05	0
UP/GP	3	-0.55	-0.94	-0.16	-2.77**	0.01	0
ASPD-P/GP	2	-0.29	-0.64	0.05	-1.63	0.01	0
VASPD/VSZ	3	0.60	-0.04	1.25	1.81	4.00	50.07
VASPD/NVSZ	3	0.23	-0.23	0.69	0.97	2.23	10.6
P/FCP	2	0.21	-0.37	0.79	0.71	0.24	0
ASPD+P/PD	1	0.28	-0.15	0.72	1.26	-	-
VASPD+P/GP	1	-0.58	-1.23	-0.07	-1.74*	-	-
VASPD-P/GP	1	-0.30	-0.87	0.26	-1.04*	-	-
HNAP/HNANP	1	-0.64	-1.22	-0.06	-2.18*	-	-
P/NVO	1	-0.63	-0.86	-0.41	-5.56***	-	-
P/CNDU	1	-0.58	-0.81	-0.34	-4.83***	-	-
P/CDU	1	-0.08	-0.30	0.13	-0.75	-	-
VPF2	1	-0.53	-0.97	-0.10	-2.42**		
Total between (Q_b)						138.77***	

*p < .05; **p < .01; ****p < .001

NOTE: *k*=number of comparisons, d= Cohen´s d effect size, I^2=heterogeneity; P/NP=criminal psychopaths vs criminal non psychopaths; ASPD/GP=antisocial personality disorder vs general population; HAP/HANP=high anxiety psychopaths vs high anxiety non psychopaths; LAP/LANP= low anxiety psychopaths vs low anxiety non psychopaths; P/GP= psychopaths vs general population;

ASPD/PD = antisocial personality disorder vs personality disorder; ASPD/VSZ= antisocial personality disorder vs violent schizophrenic; ASPD/NVSZ= antisocial personality disorder vs non-violent schizophrenic; ASPD+P/GP= combination of antisocial personality disorder and psychopathy vs general population; VASPD/GP= antisocial personality disorder vs general population; SP/GP=successful psychopaths vs general population; UP/GP=unsuccessful psychopaths vs general population; ASPD-P/GP= antisocial personality disorder without psychopathy vs general population; VASPD/VSZ= violent antisocial personality disorder vs violent schizophrenia; VASPD/NVSZ= violent antisocial personality disorder vs non-violent schizophrenic; P/FCP = psychopaths vs frontal lobe patients; ASPD+P/PD= combination of violent antisocial personality disorder and psychopathy vs personality disorders; VASPD+P/GP= combination of violent antisocial personality disorder and psychopathy vs general population; VASPD-P/GP= violent antisocial personality disorder without psychopathy vs general population; HNAP/HNANP= high negative affectivity psychopaths vs high negative affectivity non-psychopaths; P/NVO=psychopathy vs non-violent offenders; P/CNDU = psychopathy/ criminals non drug users; P/CDU = psychopathy/ criminals drug users; VPF2 = violent psychopathy factor 2.

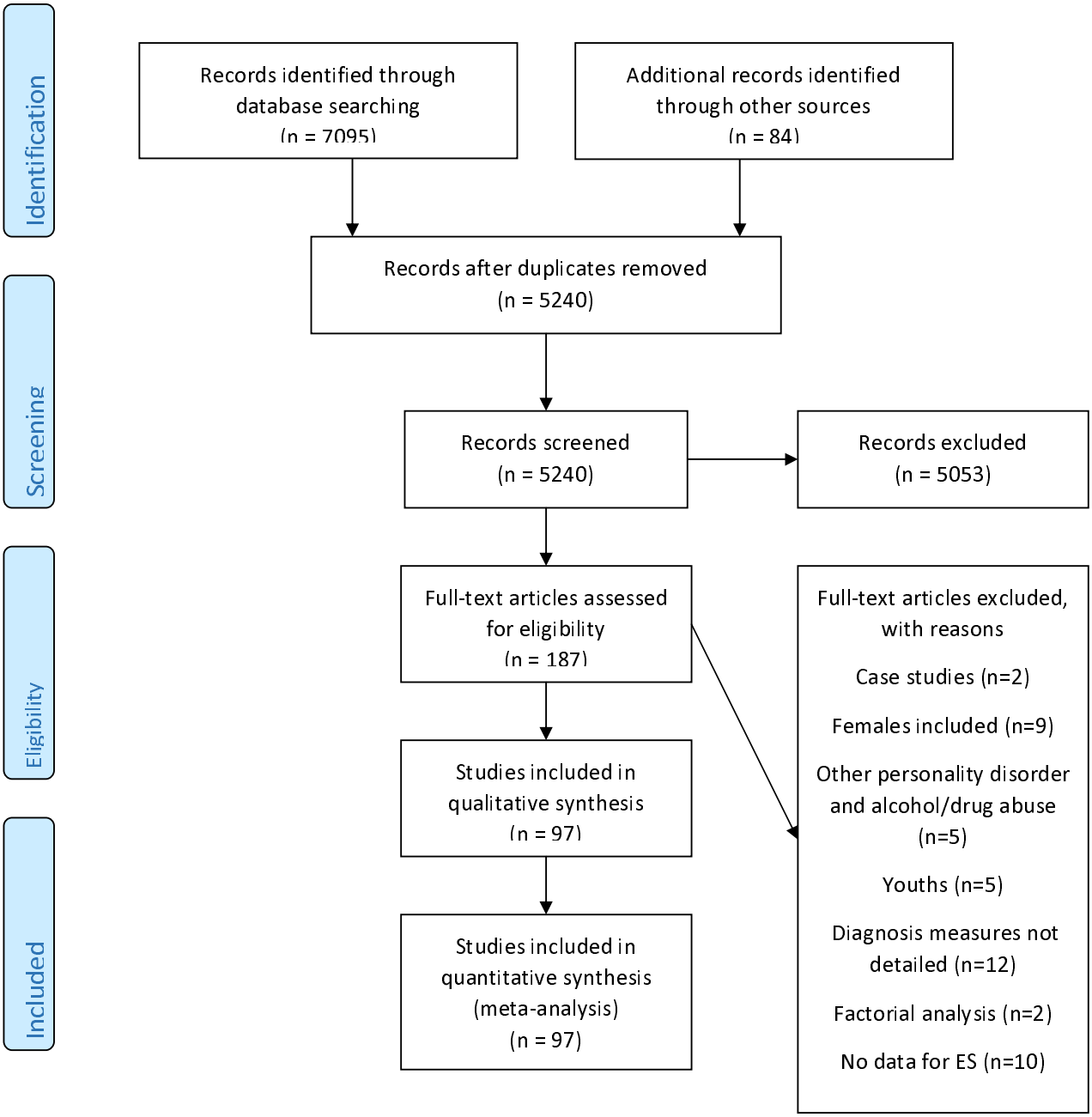
Table 4. Main Effect Sizes by Outcome Measure

Random model	***K***	***d***	**95%CI lower limit**	**95%CI upper limit**	***z*** **value**	**Heterogeneity** ***Q*** **value**	**I^2**
WAIS (full score)	54	-0.12	-0.24	-0.001	-1.97*	148.99***	64.42
SILS	51	-0.07	-0.14	-0.004	-2.07*	36.25	0
NART	45	-0.21	-0.33	-0.10	-3.63***	60.14*	26.84
Raven	15	-0.12	-0.28	0.03	-1.52	7.54	0
Quick Test	12	-0.24	-0.44	-0.04	-2.42**	7.94	0
WAIS (verbal score)	7	-1.03	-1.98	-0.08	-2.13*	140.01***	95.71
WAIS (performance score)	5	-0.37	-0.71	-0.03	-2.15*	8.85	54.81
WAIS (similarities)	4	0.04	-0.33	0.42	0.23	1.34	0
WAIS (block & verbal)	3	-0.002	-0.41	0.41	-0.01	1.21	0
CFT20-R	2	-0.42	-0.63	-0.22	-4.02***	0.46	0
SILS (abstraction)	2	0.07	-0.48	0.33	-0.35	0.73	0
SILS (verbal)	2	-0.04	-0.44	0.36	-0.19	0.006	0
WAIS (block)	1	0.08	-0.38	0.54	0.34	-	-
WAIS (information)	1	0.36	0.007	0.72	1.99*	-	-
Total between (Q_b)						38.39***	

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

NOTE: *k* = number of comparisons; d= Cohen´s effect size; I^2 = heterogeneity; SILS=Shipley Institute of Living Scale; WAIS= Wechsler Adult Intelligence Scale; CFT20-R= Culture Fair Intelligence

Figure 1. PRISMA Flow Diagram[2]



[2] *From:* Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *P*referred *R*eporting *I*tems for *S*ystematic Reviews and *M*eta-*A*nalyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

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APPENDIX I:
LITERATURE SEARCH: Keywords

- *Psychopathy and Antisocial personality disorder (ASPD)*

Antisocial personality disorder/ASPD, antisocial behavior, psychopath, psychopathy, psychopathic, violent, violence, aggressive, aggression, offender, criminal.

Terms such as violence, aggression and criminal were included because the relationship between psychopathy and instrumental violence has been well substantiated (see Reidy et al. 2011). Conversely, terms such as conduct disorder, oppositional defiant disorder, disruptive behavior disorders were not included because they refer to children and teens.

- *Cognitive domains*

Prefrontal cortex/PFC, executive functioning/EF, planning, cognitive flexibility/set shifting, motor regulation, response inhibition, decision making, abstraction, concept formation, cognitive control, frontal function, Intelligence/IQ, memory, short-term memory, long-term memory, spatial memory, verbal memory, episodic memory, explicit memory, verbal recall, visual recall, attention, sustained attention, language, verbal expression, academic skills/reading, semantic processing, knowledge.

- *Neuropsychological tests/tasks*

Stroop task, D2 test, Go-NoGo task, CPT (Continuous Performance Test), Category test, Raven´s Advanced Matrices, WAIS (Wechsler Adult Intelligence Scale), D-KEFS (The Delis-Kaplan Executive Function System), CANTAB (Cambridge Neuropsychological Test Automated Battery), NART (National Adult Reading Test), WCST (Wisconsin Card Sorting Test), TMT-A & B (Trail Making Test Part A & B), Proverbs, Porteus Maze Test, Cognitive Estimation test, verbal fluency, COWAT (Controlled Oral Word Association Test)/FAS, WMS (Wechsler Memory Scale), Digit Span, CVLT (California Verbal Learning Test) , Verbal Learning Test, RAVLT (Rey Auditory Verbal Learning Test), ToL (Tower of London), SILS (Shipley Institute of Living Scale), IGT (Iowa Gambling Task).