Sex differences in impulsivity: A meta-analysis

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ABSTRACT

Men are over-represented in socially problematic behaviors, such as aggression and criminal behavior, which have been linked to impulsivity. We organize our review of impulsivity around the tripartite theoretical distinction between reward hypersensitivity, punishment hyposensitivity, and inadequate effortful control. Drawing on evolutionary, criminological, developmental, and personality theories, we predicted that sex differences would be most pronounced in risky activities with men demonstrating greater sensation seeking, greater reward sensitivity and lower punishment sensitivity. We predicted a small female advantage in effortful control. We analyzed 741 effect sizes from 277 studies, including psychometric and behavioral measures. Women were consistently more punishment sensitive ($d = -.33$), but men did not show greater reward sensitivity ($d = .01$). Men showed significantly higher sensation seeking on questionnaire measures ($d = .41$) and on a behavioral risk taking task ($d = .36$). Questionnaire measures of deficits in effortful control showed a very modest effect size in the male direction ($d = .08$). Sex differences were not found on delay discounting or executive function tasks. The results indicate a stronger sex difference in motivational rather than effortful or executive forms of behavior control. Specifically, they support evolutionary and biological theories of risk taking predicated on sex differences in punishment sensitivity. A clearer understanding of sex differences in impulsivity depends upon recognizing important distinctions between sensation seeking and impulsivity, between executive and effortful forms of control, and between impulsivity as a deficit and as a trait.

Keywords: impulsivity, sex, sensation seeking, effortful control, reinforcement sensitivity

Men engage in impulsive and risky behaviors more frequently than women. They die younger than women and the higher male:female mortality ratio is particularly pronounced for deaths from external causes (Kruger & Nesse, 2006). Men drive more recklessly with fully 97 percent of dangerous driving offences committed by men (Beattie, 2008; Norris, Matthews & Riad, 2000). Men also have a significantly higher death rate from non-vehicle accidents such as falls, drowning, choking, electrocution, firearm accidents, and fires (Pampel, 2001). Violence-precipitated visits to hospital accident and emergency services are higher among men (Shepherd, 1990). Men are more physically and verbally aggressive than women across data sources and nations (Archer, 2004, 2009; Bettencourt & Miller, 1996; Eagly & Steffen, 1986; Hyde, 1986; Knight, Fabes & Higgins, 1996; Knight, Guthrie, Page & Fabes, 2002). Men constitute 76 percent of all criminal arrests in the United States, committing 89 percent of homicides and 82 percent of all violent crime (US Department of Justice, n.d.). Worldwide, men use drugs (alcohol, tobacco, cannabis and cocaine) more than women (Degenhardt et al., 2008). They participate more often in extreme sports, such as sky diving and mountain climbing (Harris, Jenkins & Glaser, 2006; Robinson, 2008). Men are also more likely than women to suffer from a range of psychopathologies characterized by externalizing and impulsive behaviors such as antisocial personality disorder, conduct disorder, attention deficit hyperactivity disorder, and intermittent explosive disorder (American Psychiatric Association, 2000; Frank, 2000; Gershon & Gershon, 2002; Kessler et al., 2006; Moffitt, Caspi & Rutter, 2001).

In all of these domains, impulsivity has been invoked as an explanatory variable. Sometimes impulsivity is embedded in a theory or model, but more often it appears as an independent variable in regression analyses along with other plausible explanatory candidates. It is surprisingly rare, however, that sex differences in social and psychological pathologies have been considered in relation to sex differences in impulsivity in society at large. The present study uses meta-analysis to examine whether there are average sex differences in unselected community samples across a range of psychometric and behavioral measures of impulsivity. We also examine whether, in these samples, variance in men's impulsivity scores is greater than women's. Such a finding could explain men's over-representation in extreme and problematic impulsive behaviors. (Though men would also be over-represented at the left as well as the right tail of the distribution, low levels of impulsivity are unlikely to attract attention from educational, medical or judicial systems.)

Impulsivity: Models, measures, and sex differences.

A terse, broad, and widely-accepted definition of impulsivity is a "tendency to act spontaneously and without deliberation" (Carver, 2005, p. 313). However, the trait is far from unitary and Depue and Collins (1999, p.495) note that "impulsivity comprises a heterogeneous cluster of lower-order traits". There have been a bewildering number of attempts to disaggregate impulsivity into more specific subtypes such as failure to plan (Patton, Stanford & Barratt, 1995), lack of perseverance (Whiteside & Lynam, 2001), venturesomeness (Eysenck & Eysenck, 1985), poor self-discipline (Costa & McCrae, 1992) and novelty seeking (Cloninger, 1987).

In organizing our review of the literature, we focus on theoretical approaches to impulsivity highlighting the extent to which they emphasize over-attraction to reward (strong approach motivation), under-sensitivity to punishment (weak avoidance motivation) or problems with effortful or higher-order control. In an automotive analogy, these can be thought of as a problem with a stuck accelerator, a problem of faulty brakes, or a problem of poor judgment by the driver. Many theoretical approaches to impulsivity explicitly invoke this distinction between approach, avoidance, and higher-order cognitive systems (Carver 2005; Cloninger, 1987*;* Depue & Collins, 1999; Fowles, 1987; Gray, 1982; Nigg, 2001; Rothbart, Ahadi & Evans, 2000). This tripartite distinction also dovetails with proposals made by evolutionary, developmental, personality, criminological and clinical psychologists about the source of sex differences in impulsivity. In this brief overview, we describe the various theoretical orientations and formulate predictions of likely sex differences. We also note measures that have been developed to assess the constructs that are included in our meta-analysis. These are summarized in Table 1. Some theorists have been explicit in their recognition and explanation of sex differences in impulsivity. In other cases, we have inferred sex differences via theorists' proposed explanations of psychopathologies that are more prevalent in one sex than the other.

Reward sensitivity and approach motivation.

Evolutionary theory. Aggressive behavior, as we have noted, is considerably more frequent and serious among men. Evolutionary approaches have been quite explicit in their predictions of sex differences in aggression. Across many species including our own, asymmetries of parental investment exert a significant impact on those aspects of psychology that have consequences for inclusive fitness. To the extent that effective polygyny was characteristic of hominid evolution (Archer, 2009; Larsen, 2003; Plavcan, 2001), men have had very high incentives for establishing intra-sexual dominance as a means of securing a large number of mates and increasing their reproductive success (Daly & Wilson, 1983). This competition can take the form of direct aggression, with correspondingly increased rates of homicide and decreased life expectancy, especially among men who are young and unmarried (Daly & Wilson, 1988; Wilson & Daly, 1997). Wilson and Daly (1985) suggested that the psychological mechanism underlying this male-on-male aggression is an increased 'taste for risk' among young men, a taste that also manifests itself in riskier decision-making, gambling, dangerous driving and drug use. This formulation suggests that sex differences should be most marked in those impulsivity measures that include a component of sensation seeking or risk taking. In emphasizing the appetitive nature of motivation (the positive attractions of risk), it also predicts sex differences in the sensitivity to reward associated with such risky enterprises.

Sensation seeking. Zuckerman's definition of sensation seeking as "the need for varied, novel, and complex sensations and experiences and the willingness to take physical and social risks for the sake of such experience" highlights the compelling attraction of novel experiences—an attraction of such intensity that the individual is willing to tolerate risks in their pursuit. Zuckerman and Kuhlman (2000, p. 1001) argue that "The approach gradient is higher and the avoidance gradient (anticipated anxiety) is lower in high sensation seekers than in low sensation seekers over the range of novel risk taking activities". Sex differences have been found consistently on Zuckerman's Sensation Seeking Scale (SSS-V) (Zuckerman, 1994). These appear on the Thrill and Adventure, Boredom Susceptibility and Disinhibition subscales but are absent on the Experience Seeking subscale which measures preferences for new experiences that are not marked by risk (e.g. eating exotic food). A newer measure, the Impulsive Sensation Seeking (ImpSS) scale of the Zuckerman Kuhlman Personality Questionnaire (ZKPQ), also shows sex differences

(McDaniel & Zuckerman, 2003; Zuckerman, Kuhlman, Joireman, Teta & Kraft, 1993). Sex differences in a range of risky behaviors were found to be completely mediated by the sex difference in ImpSS (Zuckerman & Kuhlman, 2000).

Zuckerman (1989, 1994, 2006) has suggested that men's role in mate competition and hunting is the distal factor driving this desire for risk. Testosterone levels are correlated with sensation seeking, as well as with prioritization of short-term goals, impulsivity, dominance, competition and sexual arousal (Archer, 2006). In terms of central nervous system action, ImpSS is proposed to result from the balance between the attraction of excitement and the avoidance of danger associated specifically with risky behaviors. The explanatory approach is biological: dopamine is involved in reward and approach behavior, while serotonin mediates restraint. Dopamine accelerates risky behavior because, when faced with danger, high sensation seekers experience stronger attraction than low sensation-seekers. Men's greater sensation seeking chiefly results from a more reactive dopaminergic system (Zuckerman & Kuhlman, 2000). Zuckerman also acknowledges the relevance of inhibition mediated by the serotonergic system but his chief emphasis is on the attractions of risk taking among men.

Criminology. Gottfredson and Hirschi (1990), in their General Theory of Crime, argued that the attractions of antisocial behavior are powerful, immediate, and evident. It is criminal desistance rather than involvement that requires explanation. They proposed that criminal behavior results from the interaction between attractive criminal opportunities and low self-control. The effect size for low self-control on crime (d = .41), in twenty-one empirical studies with 49,727 participants, ranks as "one of the strongest known correlates of crime" (Pratt & Cullen, 2000, p.952).

Noting the ubiquitous sex differences in criminal behavior, Gottfredson and Hirschi (1990, p. 147) argued that greater self-control among women resulted from internalization of the stronger external and familial control exercised over daughters, rather than sons. Rejecting the need for sex-specific explanations of crime, they argued that self-control was equally relevant to offending by men and women, and this has been substantiated (Blackwell & Piquero, 2005; Burton, Cullen, Evans, Alarid & Dunaway, 1998; Keane, Maxim & Teevan, 1993; Piquero & Rosay, 1998; Pratt & Cullen, 2000; Tittle, Ward & Grasmick, 2003). Women have greater self-control than men (Keane et al., 1993; Nakhaie, Silverman & LaGrange, 2000; Tittle et al., 2003) and a strong hypothesis from the general theory of crime is that, when self-control is controlled, sex differences in criminal or delinquent involvement should become non-significant. This has been found in some studies (Burton et al, 1998; Tittle et al., 2003) and, even where it has not eliminated the effect of sex, it has reduced it substantially (La Grange & Silverman, 1999; Nakhaie et al., 2000).

Low self-control has been measured as a combination of impulsivity, risk-seeking, preference for simple tasks and physical activities, temper and self-centeredness (Grasmick, Tittle, Bursik & Arneklev, 1993). However, a number of researchers have found the impulsivity and risk-seeking subscales to be almost as predictive as the full scale (Arneklev, Grasmick, Tittle & Bursik, 1993; Deschenes & Esbensen 1999; Longshore, Turner & Stein, 1996; Nakhaie et al., 2000; Piquero & Rosay, 1998; Wood, Pfefferbaum & Areneklev, 1993). Of the two traits, risk-seeking shows the stronger association with crime (Nakhaie et al, 2000; LaGrange & Silverman, 1999). It is for this reason, together with Gottfredson and Hirschi's (1990, p.89) emphasis upon the implicit attractions of crime ("money without work, sex without courtship, revenge without court delays"), that we discuss this theory as representing an approach orientation to impulsivity.

Three factor theories. Cloninger (1987) has advanced a biopsychological model of personality in the field of psychiatry. He originally postulated three genetically-based independent dimensions of personality: Novelty Seeking, Harm Avoidance, and Reward Dependence. The original measure of these traits was the Tridimensional Personality Questionnaire (TPQ) which was subsequently modified and renamed the Temperament and Character Inventory (TCI). Variations in the balance of these sensitivities have been used to explain a range of mental illnesses. Cloninger uses the term Novelty Seeking as an alternative to 'impulsivity,' clearly identifying its appetitive motivation (Cloninger, 1986). Novelty seeking is associated with activity in the dopaminergic reward system and is expressed as a tendency to respond to novel stimuli with excitement. The scale is comprised of four facets: Exploratory Excitability, Impulsiveness, Extravagance, and Disorderliness. This form of impulsivity bears a strong resemblance to sensation seeking: Not only does it correlate highly (r = .68) with the Zuckerman's ImpSS scale, but both scales correlate negatively with monoamine oxidase levels suggesting a common biological basis (Zuckerman & Cloninger, 1996). However, unlike sensation seeking, no sex difference was found for Novelty Seeking (d = -.04) in a recent meta-analysis (Miettunen, Veijola, Lauronen, Kantojarvi & Joukamaa, 2007).

Eysenck and Eysenck's (1968) early two-factor personality theory identified impulsivity as a component of Extraversion, linked to low cortical arousal and a consequent need for stimulation (resulting in sensation seeking). Impulsivity was later disaggregated into two components: Impulsiveness (poor impulse control); and

Venturesomeness (stimulus hunger). The I7 inventory was developed to measure Impulsiveness and Venturesomeness as distinct traits (Eysenck, 1993).

Venturesomeness shares the original quality of stimulus hunger, reflecting approach motivation, and hence Eysenck aligned it with Extraversion. However, evidence suggests it is more closely associated with the Psychoticism (P) dimension of tough-mindedness, hostility and non-conformity. Indeed Zuckerman (1989) suggested that the P factor really represents his dimension of impulsive sensation seeking. In support of this, the ImpSS scale loads strongly on a psychoticism factor whose best marker is Eysenck's P scale (Zuckerman et al., 1993). In terms of item content, the Venturesomesness scale resembles sensation seeking, rather than impulsiveness (Zuckerman 1989). Men score higher than women on Venturesomeness (Eysenck, Pearson, Easting & Allsopp, 1985), and it is positively correlated with the male hormone testosterone (Aluja & Torrubia, 2004; Coccaro, Beresford, Minar, Kaskow & Geracioti, 2007; Daitzman & Zuckerman, 1980). As with Zuckerman's sensation seeking, we anticipate Venturesomeness will show a sex difference in the male direction.

Reinforcement Sensitivity Theory. Gray (1970, 1982), a former student of Eysenck, proposed that extraversion and neuroticism should be rotated to form two new dimensions reflecting sensitivity to punishment (anxiety, associated with introversion and neuroticism) and sensitivity to reward (impulsivity, associated with extraversion and neuroticism). These new dimensions came to be called respectively the behavioral inhibition system (BIS) and the behavior approach system (BAS).

Approach motivation is controlled by BAS which is sensitive to signals of unconditioned and conditioned reward, non-punishment, and escape from punishment. Gray labeled the personality manifestation of the BAS dimension as 'impulsivity', indicating that heightened reward sensitivity was viewed as the key source of impulsive behavior. Note that Gray's reward sensitivity is not restricted to reward associated with sensation seeking or other risky enterprises: Activity in the BAS causes movement toward goals more generally. Emotionally, this system generates feelings of hope, elation, and satisfaction. Dopaminergic pathways, especially between the ventral tegmental area of the midbrain and the nucleus accumbens, are implicated in its functioning. Gray made no specific predictions in his theory regarding sex differences although, like Eysenck, his formulation addressed clinical disorders where sex differences are well established. Gray's theory has been studied extensively in relation to psychopathy, a predominantly male disorder (Cale & Lilienfeld, 2002). Patterson and Newman (1993) argued that psychopaths' over-sensitivity to reward results in hyper-arousal and a consequent failure to pause and reflect when reinforcers are withdrawn. This results in dysfunctional perseveration in mixed-incentive situations.

Measures of reward sensitivity and approach motivation. Carver and White's (1994) BIS/BAS psychometric scales have been widely used to assess Gray's two dimensions of temperament. The BAS scale factors into three subscales: Reward Responsiveness (emotional enjoyment of reward), Drive (the pursuit of appetitive goals), and Fun Seeking (the tendency to seek out new, potentially rewarding, experiences). Clearly this last scale overlaps considerably with aspects of sensation seeking and some work suggests that, unlike the other two BAS scales, it loads on a separate factor that has been called 'rash impulsiveness' (Dawe, Gullo & Loxton, 2004; Franken & Muris, 2006; Quilty & Oakman, 2004). Torrubia, Avila, Molto and Caseras (2001) developed another pair of scales to measure Gray's two dimensions, the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ).

SPSRQ Sensitivity to Reward is correlated with Eysenck's I7 Impulsiveness, Zuckerman's SSS and with Excitement Seeking in the Five Factor model (Mitchell, Kimbrel, Hundt, Cobb, Nelson-Gray & Lootens, 2007). The Reward scale from the Generalized Reward and Punishment Expectancy Scales (GRAPES; Ball & Zuckerman, 1990) has also been used, and shows a positive correlation with sensation seeking. A recent meta-analysis found that women scored higher than men (d = -.63: Miettunen et al., 2007) on the Reward Dependency scale of the Cloninger's TCI (although there are important differences in item content between this and the other reward dependence measures which will be discussed later).

The two most widely used measures of sensation seeking and risk taking are Eysenck's I7 Venturesomeness scale and Zuckerman's Sensation Seeking Scale. The Monotony Avoidance scale of the Karolinska Scales of Personality also captures the intolerance of boredom that corresponds to the SSS-Boredom Susceptibility subscale. The more recent Zuckerman Kuhlman Personality Questionnaire (ZKPQ) contains a scale of Impulsive Sensation Seeking (ImpSS). Dickman (1990) distinguished between Dysfunctional Impulsivity (a tendency to act with less foresight than others leading the individual into difficult situations) and Functional Impulsivity (a tendency to respond quickly when the situation is optimal, such as taking advantages of unexpected opportunities). These form separate scales on the Dickman Impulsivity Inventory (DII). Those who score high on Functional Impulsivity are characterized as "enthusiastic, active individuals who are willing to take risks" (Dickman, 1990, p.98). This suggests, and data confirm, that Functional Impulsivity is closely aligned with sensation seeking: We therefore consider it with other sensation seeking measures. Other measures of sensation seeking include the UPPS Sensation Seeking scale, which resulted from Whiteside and Lynam's factor analysis of 21 impulsivity scales. Tellegen’s (1982) Multidimensional Personality Questionnaire (MPQ) contains a subscale of Harm Avoidance, the items and structure of which correspond to reversed sensation seeking and we analyze it together with other sensation seeking measures (See Table 1).

Punishment insensitivity and avoidance motivation.

Here we consider approaches to impulsivity that highlight a hyposensitivity to the negative consequences of impulsive acts. These are distinguished from approaches which view impulsivity as a failure of effortful control (which we discuss later) by virtue of the fact that they deal with deficits in reactive or motivational, rather than cognitive, control.

Evolutionary theory. Campbell (1999, 2002) proposed an evolutionary account, complementary to that of Daly and Wilson (1988), that focuses on female disincentives for risk. Women’s reproductive success depends to a greater extent than men’s upon avoiding injury and death. This results from infants’ greater dependence on the mother than on the father, women’s higher parental investment in each offspring, and the limited number of offspring that a woman can bear in a lifetime. Hence women should be more sensitive to and more avoidant of danger than men, an effect which is mediated by higher levels of fear about physical injury or death. Cross-culturally, fear is experienced more intensely and frequently by women than by men (Brebner, 2003; Fischer & Manstead, 2000). As with Daly and Wilson’s formulation, the prediction is that sex differences will be manifest in those impulsivity inventories that contain an element of risk. But because Campbell’s proposed mediating variable is fear, her account predicts greater harm avoidance in women than in men, and possibly greater sensitivity to punishment reflected in higher BIS scores.

Three factor theories. In Cloninger's tripartite theory, Harm avoidance is mediated by activity in a serotonergic punishment system and is manifest in a tendency to respond strongly to signals of aversive stimuli by inhibiting ongoing behavior. High scorers are "cautious, tense, apprehensive, fearful, inhibited, shy, easily fatigable, and apprehensive worriers" (Cloninger, 1987, p. 576). A recent meta-analysis (Miettunen et al., 2007) reported a small-to-moderate effect size favoring women on Harm Avoidance (d = -.33).

When Eysenck disaggregated impulsivity, he aligned Impulsiveness with Psychoticism, a dimension characterized by insensitivity to punishment,poor impulse control , and a tendency to respond without regard to interpersonal consequences (Eysenck & Gudjonsson, 1989). However, Impulsiveness is not associated with testosterone as would be expected of a facet of Psychoticism (Aluja & Torrubia, 2004; Coccaro et al., 2007; Daitzman & Zuckerman, 1980), and norms for impulsiveness show no sex differences (Eysenck et al., 1985).

Reinforcement sensitivity theory. Gray's (1970) theory proposed that behavior was governed by the balance between three motivational systems. He identified the BAS system, described earlier, as the basis for impulsivity. The behavioral avoidance system (BIS) is an aversive motivational system which is sensitive to signals of punishment, non-reward and novelty. Activity in the BIS inhibits behavior. Emotionally, the system is associated with feelings of fear, anxiety, and frustration. BIS has been localized to the right anterior cortex. Gray also argued for a third flight/fight system (FFS) sensitive to innately aversive stimuli and associated with Eysenck's third dimension of Psychoticism.

In a subsequent revision of the theory (Gray & McNoughton, 2000), the FFS, associated with fear, became responsible for avoidance as well as escape behaviors. The BIS, associated with anxiety, became responsible for resolving motivational conflicts between approach and avoidance. The BAS remained relatively unaltered. However these revisions, including the distinction between fear- and anxiety-related avoidance processes and the new role of the BIS, have not been reflected in personality inventories used to assess punishment sensitivity (but see Heym, Ferguson & Lawrence, 2008; Perkins & Corr, 2006). Most researchers continue to work with Gray's original formulation (Bijttebier, Beck, Claes & Vandereycken, 2009; Smillie, 2008).

As noted, Gray's work has been applied to psychopathy. Although Gray proposed that overactive BAS was the source of impulsivity, Lykken (1957) suggested that psychopaths' lack of fear resulted in a failure to form classically conditioned associations between fear and rule breaking. Thus psychopaths lack the normal negative reinforcer (fear reduction) required for active and passive avoidance learning. Fowles (1988) suggested that psychopaths have a weak behavioral inhibition system (BIS) and hence perform particularly poorly where passive avoidance (inhibition of a response) is required. A distinction has been made between primary and secondary psychopathy that may unite these different positions. Primary psychopaths, who correspond to the popular stereotype of the disorder, experience low levels of anxiety (weak BIS) which give rise to their antisocial actions (Lykken, 1995). Secondary psychopaths experience heightened negative emotions and are hyper-responsive to opportunities for reward reflected in stronger BAS (but normal BIS) reactivity. This proposal has recently received empirical support (Newman, MacCoon, Vaughn & Sadeh, 2005; Ross, Molto, Poy, Segarra, Pastor & Montanes, 2007; Wallace, Malterer & Newman, 2009).

In sharp contrast to psychopathy, anxiety disorders are found more often in women than in men (Frank, 2000), and anxiety was the original focus of Gray's (1982) BIS punishment hypersensitivity formulation. A considerable body of work has established that anxiety is associated with preferential attention to threatening stimuli. Orienting responses occur before the nature or meaning of the stimuli is consciously registered, and this indicates the engagement of low-level reactive processes which are automatic, unintentional, and unconscious (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg & van Ijzendoorn, 2007). This attentional bias has been shown both in patients suffering from a range of anxiety disorders (Barlow, 2002) and in non-clinical samples high in trait anxiety (Mogg, Bradley, Dixon, Fisher, Twelftree & McWilliams, 2000). Among people suffering from depression, women and girls more frequently ruminate about negative life events, which both exacerbates depressive symptoms and indicates an attentional preoccupation with punishment (Rood, Roelofs, Bogels, Nolen-Hoeksema & Schouten, 2009). Given women's higher levels of sub-clinical anxiety and depression (Costa, Terracciano & McCrae, 2001), we expect women to be particularly sensitive to cues of punishment.

Measures of punishment sensitivity. Carver and White's (1994) BIS/BAS psychometric scales include a single BIS scale which measures sensitivity to signals of punishment. This scale correlates with measures of negative affectivity, negative temperament, and anxiety. Torrubia et al.'s (2001) SPSRQ Sensitivity to Punishment scale is correlated with Carver and White's BIS, and with harm avoidance and anxiety (see also Caseras, Avila & Torrubia, 2003). Punishment sensitivity as measured by GRAPES correlates significantly with the BIS scale and anxiety (Gomez & Gomez, 2005). The TPQ/TCI measure of Harm Avoidance assesses an individual's tendency to respond intensively to signals of aversive stimuli by inhibiting or stopping behavior (Cloninger, 1987). We include it as a measure of punishment sensitivity. (Note that the identically named scale from the MPQ measures reversed sensation seeking, see Table 1).

Effortful control.

Effortful control describes the “ability to choose a course of action under conditions of conflict, to plan for the future, and to detect errors” (Rothbart 2007, p.207). Behaviorally, it is defined as the ability to inhibit a dominant response and perform a subdominant response. It is a major form of self regulation manifested as conscious or effortful decision-making in the service of longer-term objectives. It is the planfulness and executive nature of this ability that distinguishes it from the reactive or motivational theories that we have previously described.

Evolutionary. MacDonald (2008) argued that although evolution has shaped dedicated psychological modules (adaptations) to solve recurrent evolutionary problems, the effortful control system can inhibit such ‘automatic’ evolved responses and thereby reduce impulsivity. MacDonald argued for sex differences in impulsivity based on strong sexual selection for male intrasexual competition which makes approach tendencies less amenable to override by effortful control: “Males are thus expected to be higher on behavioral approach systems (sensation seeking, impulsivity, reward seeking, aggression) and therefore on average be less prone to control prepotent approach responses” (MacDonald, 2008, p. 1018). This sex difference should be particularly marked during adolescence and young adulthood when reproductive and competitive drives are strongest. In addition, future discounting (a preference for immediate rather than delayed reward) may be adaptive for individuals growing up in highly stressful environments and may underlie the sex difference in risk taking (Kruger & Nesse, 2006; Wilson & Daly, 1997).

Bjorklund and Kipp's (1996) proposal of evolved sex differences in impulsivity was not restricted to the domains of aggression and risk taking. They argued that inhibitory ability was especially critical to women's reproductive success in relation to mate choice and offspring care. Because women contribute the lion's share of parental investment, selectivity in mate choice is more important to women. This makes the ability to conceal sexual interest advantageous in the service of evaluating long-term mate prospects. Women can gain additional genetic and material resources from clandestine copulations and here again inhibitory control over the 'leaked' expression of sexual interest in other men would be beneficial in securing the commitment of a long-term partner. In addition, the protracted dependency of offspring places strain on a mother's self-control. She must prioritize the infant's needs over her own, inhibit aggressive impulses toward it and delay her own gratification— all of which would be aided by improved inhibitory control. Bjorklund and Kipp proposed that women's advantage in inhibition would be relatively domain-specific, and evident only in those tasks that assayed social and emotional restraint. Their narrative review supported this hypothesis, concluding that women's greater inhibition was evident in the social domain (e.g. facial and bodily concealment of feelings), present though less strong in the behavioral domain (e.g. resistance to temptation), and absent in cognitive inhibition (e.g. Stroop test, memory interference, selective attention). This proposal predicts a female advantage in inhibitory control specifically in interpersonal domains.

Developmental. Rothbart and co-workers explored the concept of effortful control as a form of self-regulation from a developmental perspective (Rothbart & Bates, 2006; Rothbart & Derryberry, 1981; Rothbart & Posner, 2006). Their model includes lower-level motivational approaches but is distinguished by its emphasis on the child's acquisition of higher-level cognitive control of impulsivity. In the early months, infants are primarily reactive to events and the two dimensions that capture variation in their temperamental responses map onto Gray's BIS and BAS systems (Rothbart, 2007; Rothbart et al., 2000). These have been measured by scales assessing Negative Affectivity and Extraversion/Surgency, corresponding to BIS and BAS respectively. Together these two systems modulate avoidance and approach behavior. With increasing age the child develops effortful control, a form of self-regulatory executive control in the affective domain (MacDonald, 2008). This system is superordinate to the more primitive motivational systems and it allows the individual to suppress reactive tendencies in the service of longer-term objectives. Attention shifting and behavioral inhibition allow the child to suppress prepotent but inappropriate behavior. The likely site of these processes is the ventromedial prefrontal cortex, particularly the orbitofrontal cortex and the ventral anterior cingulated cortex (MacDonald, 2008; Posner & Rothbart, 2009).

Lower- and higher-level systems are not wholly independent because "the motivational circuits can function as specialized learning mechanisms, guiding the development of cortical representations in light of underlying appetitive and defensive needs" (Derryberry & Rothbart, 1997, p.639). Cross-lagged correlations have been reported between early fear and later effortful control (e.g. Kochanska & Knaack, 2003). This association is attributed to the greater amenability of more fearful children to parental socialization practices (Derryberry & Rothbart, 1997). Girls are more fearful than boys (Else-Quest, Hyde, Goldsmith & Van Hulle, 2006; Hsu, Soong, Stigler, Hong, & Liang, 1981; Maziade, Boudreault, Thivierge, Caperaa & Cote, 1984) and this suggests that girls may exceed boys in effortful control. Else-Quest et al.'s (2006) meta-analysis of childhood temperament differences revealed a large effect size favoring girls for effortful control, d = -1.01. However, this dimension is a composite of scales from the Child Behavior Questionnaire reflecting an easy-going, low-demand temperament which is apparently more characteristic of girls than boys. Impulsivity is measured separately as a subscale of the Extroversion/Surgency dimension (broadly corresponding to BAS or approach motivation) and this showed a smaller effect size in the male direction (d = .18).

The development of the prefrontal cortex that mediates effortful control continues through adolescence and into adulthood (Casey, Getz & Galvan, 2008; Sternberg, 2007). Although impulsive behavior in childhood may result from the balance between the two lower-level reactive systems, in adulthood it is likely to be associated with weak or ineffective effortful control (Posner & Rothbart, 2009). Baumeister and colleagues (Baumeister, Vohs & Tice, 2007; Muraven & Baumeister, 2000) use the term ‘self-control’ to refer to control over thoughts, emotions, performance and impulses. Self-control bears a strong similarity to effortful control and indeed Baumeister et al. (2007; p.351) describe it as a “deliberate, conscious, effortful subset of self-regulation”. It is assessed as an amalgam of self-discipline, deliberate/non-impulsive action, reliability, healthy habits, and work ethic (Tangney, Baumeister & Boone, 2004). Although sex differences have not been the focus of research, R. Baumeister (personal communication, February 18, 2010) has suggested a likely female advantage in self-control as a result of men’s stronger impulses, especially in the domains of sex and aggression.

Measuring effortful control: Behavioral tasks. Effortful control has been studied using laboratory tasks (see Table 2 for a summary of tasks included in the present analysis). The range of tasks has been wide and the specific processes on which they depend underspecified. In some cases, the conceptual link to impulsivity seems tenuous. Post hoc attempts to classify them empirically have not produced consistent findings, probably as a result of the different tasks selected for inclusion in the analyses (e.g. Kindlon, Mezzacappa, & Earls, 1995; Lane, Cherek, Rhodes, Pietras & Tcheremissine, 2003; Meda et al., 2009; Reynolds, Ortengren, Richards & de Wit, 2006; Reynolds, Penfold & Patak, 2008). It is generally agreed that effortful control has two important characteristics: it involves the conscious suppression of a prepotent or dominant response, and it permits individuals to take a longer time perspective with regard to their actions. The distinction between these forms of control has been supported in factor analytic studies of behavioral tasks (Lane et al., 2003; Reynolds et al., 2008; Reynolds, Ortengren et al., 2006) and by neuroimaging studies which implicate different neural pathways for the two processes (Band & van Boxtel, 1999; McClure, Laibson, Loewenstein, & Cohen, 2004).

Four tasks have been widely interpreted as assessing the ability to suppress a dominant or prepotent response, which we will refer to as *executive response inhibition* (Conners, 2000; Kindlon et al., 1995; Lane et al., 2003; Reynolds et al., 2008; Reynolds, Richards, & de Wit, 2006; Nigg, 2001). These are the Go/No-Go task, the Stop Signal task, the Stroop test, and the Continuous Performance task. These tasks may also be sensitive to failure of interference protection and to inattention (Dougherty et al., 2009; Reynolds et al., 2008).

A second quality of effortful control is the ability to select actions by taking into account their long-term rather than immediate consequences. Individual differences in time horizons have been assessed chiefly by behavioral tasks where a choice must be made between a larger long-term and a smaller short-term reward (Lane et al., 2003; Reynolds et al., 2008). The most popular measures are the *Delay Discounting Task* and its variants. More impulsive individuals are believed to show a steeper rate of discounting. The *Iowa Gambling Task* (IGT) has also been interpreted as assessing time perspectives with regard to reward (Bechara, Damasio, Tranel & Damasio, 1997). More impulsive individuals persist in their attraction to short-term higher rewards despite the long-term loss to which this strategy leads. The *Balloon Analogue Risk Task* (BART) assesses a participant's willingness to risk loss in the service of winning a higher monetary reward (Lejuez et al., 2002) and has been found to load on a common factor with delay discounting (Reynolds, Ortengren, et al., 2006; but see Meda et al., 2009). These three tasks are distinguished from lower-level 'automatic' responses to reward or punishment on the basis that the tasks require a conscious and deliberate decision.

Other tasks used to assess impulsivity do not clearly align themselves with the distinction between behavioral disinhibition and time horizons. We refer to these as *visual-cognitive tasks* because they are united by their use of visual attention paradigms to explore various aspects of executive function including planning, set formation and switching, and motor control. Most infer impulsivity from the number of errors made on the task, based the assumption that impulsive individuals tend to trade speed for accuracy, although this proposal has been controversial (Block, Block & Harrington, 1974; Dickman & Meyer, 1988; Malle & Neubauer, 1991; Quiroga et al., 2007; Wilding, Pankhania & Williams, 2007).

Measuring effortful control: Psychometric measures. The two cardinal aspects of impulsivity, failure to inhibit a prepotent response (e.g. "I say things without thinking") and short time horizons (e.g. "I plan trips well ahead of time") also appear as items in psychometric inventories. However, the two components are not always distinguished as separate scales. The two most commonly used inventories of general impulsivity are the Eysenck's Impulsiveness questionnaires (I5, I6, I7 and the EPI) and the total score from the Barratt Impulsiveness scale. We also consider the Impulsivity scale of the Karolinska Scales of Personality as a general measure of impulsivity.

In addition to these global measures, there is an arsenal of measures for assessing subtypes of impulsivity. Many of these have been derived from factor analyses of novel or extant items and scales. Because the factor solution depends on the selection of scales included, there is little consensus on the fundamental dimensions of impulsivity. We now briefly describe some of the major conceptual distinctions which we include as measures of specific impulsivity.

The Barratt Impulsiveness Scale (most recent version BIS-11, see Patton et al., 1995; Stanford et al., 2009) distinguishes between; Attentional/Cognitive Impulsiveness (easily distracted and has difficulty in controlling thoughts); Motor Impulsiveness (acts without thinking and lacks perseverance); and Non-planning Impulsiveness (fails to make plans and is bored by cognitive complexity). The latter two scales correspond broadly to response disinhibition and short time horizon. A recent psychometric evaluation indicated no sex differences on any of the scales (Stanford et al., 2009).

Whiteside and Lynam (2001) included many existing impulsivity scales (as well as the Big Five personality traits) in a factor analysis from which they derived their four UPPS measures. Lack of Premeditation (a failure to delay action in order to think or plan) incorporates the components of response disinhibition and time horizons. Lack of Perseverance captures poor self-discipline resulting in an inability to resist boredom and remain with a task until completion. Urgency is the tendency to act rashly when experiencing strong negative affect. (Their fourth subscale, Sensation Seeking, is considered separately under sensation seeking measures.)

Dickman's (1990) Dysfunctional Impulsivity scale reflects failure of deliberation and response inhibition, and we consider it as a subtype of impulsivity. We treat the Functional Impulsivity scale as a measure of sensation seeking, as discussed earlier.

Other measures of impulsivity are factors or scales taken from global personality inventories. Tellegen's (1982) Multidimensional Personality Questionnaire (MPQ) contains a facet scale of Control vs. Impulsiveness. We include this facet in preference to the higher-order factor of Constraint which aggregates Control vs. Impulsiveness with Harm Avoidance and Traditionalism. We also include the Impulsivity/Carelessness scale from the Social Problem Solving Inventory (D'Zurilla, Nezu & Maydeu-Olivares, 1996).

In the NEO-PI-R, Costa and McCrae (1992) identified three forms of impulsivity. They employed the term Impulsiveness narrowly for a facet of Neuroticism defined as the 'inability to control cravings and urges" (suggesting commonality with Whiteside and Lynam's Urgency scale). Women score significantly higher with effect sizes of d = -.23 in the US and d = -.11 in other cultures (Costa et al. 2001). The authors explicitly note this facet "should not be confused with spontaneity, risk taking or rapid decision time". This latter quality, which corresponds more closely with other researchers' definitions, appears to be measured by Deliberation ("the tendency to think carefully before acting") and perhaps by Self-Discipline ("the ability to begin tasks and carry them through to completion despite boredom and other distractions"). Both of these are facets of Conscientiousness and sex differences are non- significant on both scales (Costa et al., 2001).

Despite these distinctions between subtypes, there is considerable similarity between items that belong to different scales and load on different factors. Consider for example two items: ‘I am a steady thinker’ and ‘I am a careful thinker’. Both are from the BIS-11 but the first assesses Attentional Impulsiveness and the second Motor Impulsiveness. The following three items again seem to have similar meanings but come from different scales and inventories : ‘I have trouble controlling my impulses’ (UPPS Urgency); ‘I act on impulse’ (BIS Motor Impulsiveness) and ‘I often make up my mind without taking the time to consider the situation from all angles’ (Dickman Dysfunctional Impulsivity). The various scales include a mixture of items reflecting poor inhibition of behavior, over-fast decision-making, restlessness, inattention, low anxiety and failure of long-term planning. Many rely on general statements such as “I am an impulsive person” where the respondent must effectively employ their own understanding of impulsivity to formulate an answer.

In studies where psychometric and behavioral measures are both employed, weak or non-significant correlation between them are typically reported (Crean, de Wit & Richards, 2000; Gerbing, Ahadi, & Patton, 1987; Helmers, Young & Pihl, 1995; Lane et al., 2003; Malle & Neubauer, 1991; Milich & Kramer, 1984; Paulsen & Johnson, 1980; Mitchell, 1999; Reynolds et al., 2008; Reynolds, Ortengren, et al., 2006; Reynolds, Richards, et al., 2006; White et al. 1994). Those significant correlations that do emerge do not appear to be differentially identified with behavioral and trait measures where congruence might be expected (Kirby, Petry & Bickel, 1999; Mobini, Grant, Kass & Yeomans, 2007; Swann, Bjork, Moeller & Dougherty, 2002).

Overview of the study.

As the preceding discussion indicates, there is a wide range of measures designed to assess impulsivity based on disparate theoretical approaches and operationalisations. A researcher wishing to use impulsivity as an explanatory variable might use any one of these, depending on his or her definition of impulsivity and reason for wanting to measure it. Part of the aim of the present analysis was to demonstrate the variety of ways that psychologists measure impulsivity and to examine the extent to which significant sex differences depend upon the choice of measure and conceptual approach. We therefore begin our analysis by computing effect sizes separately for each measure of impulsivity. Following this, we group the measures into domains based on differences in the conceptualisation and measurement of impulsivity.

Six domains of impulsivity measurement.

We group the measures into the following six domains (See Table 1 for an overview): (1) Reward Sensitivity, (2) Punishment Sensitivity, (3) Sensation Seeking and Risk Taking, (4) General Impulsivity (5) Specific Forms of Impulsivity, and (6) Behavioral Measures of impulsivity. What follows is a brief outline of each domain.

Reward and Punishment Sensitivity are included as two distinct domains to address the suggestion that impulsivity might be explained by oversensitivity to reward or by deficiencies in sensitivity to punishment. *Sensation Seeking and Risk Taking* measures are distinguishable from impulsivity measures by their greater emphasis on risk, sensation and danger than on the impulsiveness of the action. Such inventories clearly identify themselves as concerned with sensation seeking or subtypes thereof.

General Impulsivity includes inventories which pose questions at a general level (e.g. “I am an impulsive person”) rather than specifying contexts or distinguishing psychological functions. Impulsivity is generally assessed here as a global construct as opposed to subtypes (e.g. motor impulsiveness). Studies reporting total scores derived from summing or averaging specific subscales are analyzed here. *Specific Forms* of impulsivity assess impulsivity in specific psychological processes or contexts. Specific measures stem from factor analytic studies indicating that impulsivity is multidimensional. (Note that UPPS Sensation Seeking and Dickman Functional Impulsivity are included in the Sensation Seeking category rather than Specific Forms.) *Behavioral Measures* are included as a separate domain to maintain the distinction between psychometric self-report measures and behavioral tasks. This domain includes: Executive Response Inhibition tasks (e.g. the Stop Task); Visual-cognitive tasks (e.g. the Matching Familiar Figures Test); The Iowa Gambling Task; Delay Discounting; and the Balloon Analogue Risk Task. (For a description of these tasks, see Table 2.)

Hypothesised sex differences

Men are expected to score higher on *Sensation Seeking and Risk Taking measures*. At an evolutionary level, this expectation derives from men's lower parental investment and the consequent reproductive benefits associated with risk taking in the service of mate competition and hunting. This male advantage, to the extent that it derives from an evolved module, is likely to occur at a motivational level and to be resistant to conscious or strategic control (MacDonald, 2008). Most theorists attribute men's greater sensation seeking to a strong appetitive motivation and thus predict that men should demonstrate higher BAS or sensitivity to reward than women. We therefore predict a male advantage on measures of *Reward Sensitivity*. However, Campbell argues from an evolutionary perspective that women's aversion to sensation seeking results from their lower threshold for experiencing fear. Similarly Cloninger, from a proximal genetic and neurochemical basis, argues for greater Harm Avoidance by women. Women's higher levels of anxiety and depression suggest a greater sensitivity to threatening stimuli. We expect this to be reflected in higher BIS and sensitivity to punishment scores among women. We therefore predict a female advantage on measures of *Punishment Sensitivity*

Effortful control is represented in three of our measurement domains: *General Impulsivity, Specific Forms* of impulsivity*, and Behavioral Measures* of impulsivity. Developmental studies have shown a large effect size favoring girls for effortful control (Else-Quest et al., 2006) and, in their narrative review, Bjorklund and Kipp (1996) claimed a female advantage in social and behavioral tasks in line with their evolutionary hypothesis. Several researchers have proposed that the greater strength of male drives makes them harder to hold in check (MacDonald, 2008; Zuckerman, 1994). All of this suggests that effortful control will be stronger in women than in men.

When we consider effortful control conceptualizations of impulsivity, however, sex differences are likely to depend on the inventory or task used (Costa et al., 2001; Feingold, 1994; McCrae et al., 2005). Different *Behavioral Measures* appear to assess very different components of impulsivity ranging from errors in spatial navigation to a tendency to favor immediate over delayed reward. Psychometrically measured *Specific Forms* of impulsivity also cover a broad range of behaviors from an inability to resist food when depressed to a tendency not to plan tasks carefully. Furthermore, the general wording of some *General Impulsivity* measures (e.g. “I act on impulse”) may result in men and women tending spontaneously to think of different sex-typical contexts. This would diminish the power to detect consistent sex differences. Therefore, while we tentatively predict that women will demonstrate greater effortful control than men, we expect considerable inconsistency in the domains of *Behavioral Measures* and *Specific Forms of Impulsivity* and only a modest effect of sex on *General Measures*.

Variance ratios

In addition to examining sex differences in central tendency, we also compute male:female variance ratios for different measures of impulsivity. A male-biased variance ratio has been found for a number of physical and psychological traits (Hedges & Nowell, 1995; Lehre, Lehre, Laake & Danbolt, 2009). From an evolutionary perspective, Archer and Mehdikhani (2003) proposed that men are freer than women to vary in their levels of parental investment, giving rise to greater male variability on sexually selected traits. Their analysis bore this out for measures of physical aggression and mate choice. The present data afford the opportunity to extend this proposal of greater male variance, as well as a higher male mean, to impulsivity — a trait that has also been argued to be sexually selected (Daly & Wilson, 1988).

Method

Sample of studies

The initial search was conducted using the database PsycINFO which has a broad coverage of psychology and social science journals as well as unpublished dissertations. Search terms included the key words ‘impulsivity’ and ‘impulsiveness’ but not ‘sex’ or ‘gender’ in order to prevent selection bias. Specific inventories were not searched for because the aim was to identify the range of measures used for assessing impulsivity. This was especially important due to historic variations in the conceptualization and operationalizaton of this concept. The following search limits were imposed: (1) Human populations only, (2) English language only, (3) Male and female populations, (4) Age groups above the age of 10, and (5) Articles published between 1980 and 2008. The search yielded 3,156 abstracts.

Abstracts were screened and any articles failing to meet the following criteria were removed: (1) The study was empirical. (2) The sample included a minimum of 10 males and 10 females. (3) Data from normative samples were reported (defined as samples with no specified a priori selection factors regarding traits or behaviors). For example, samples of alcoholics or children of alcoholics were excluded whilst studies of the drinking habits of normative student populations were included. Where clinical studies were examined, data were only recorded from normative control groups. (4) Self-reported, psychometric and/or behavioral measures were used. (5) Impulsivity was measured as an independent construct. For instance, some common ADHD checklists amalgamate hyperactivity and impulsivity into a single dimension and report a single combined measure. Such scales were excluded. (6) Data were presented or potentially available from which a sex difference could be calculated. Where abstracts did not provide sufficient information to establish whether they met the inclusion criteria, they were included in the next stage of the selection process.

One thousand and sixty five articles were downloaded or requested through interlibrary loan and 70 unpublished dissertations were downloaded via the ProQuest database. If an article met the inclusion criteria but lacked sufficient data for an effect size to be computed, authors were contacted by email if the article had been published within the last 5 years. Two hundred and three such requests were made with 75 usable responses. In twelve cases, authors provided additional data from studies not identified in the initial search.

Two hundred and forty four articles and 33 unpublished studies were included in the meta-analysis, giving a total of 277 studies with 310 samples. From these, 741 d values were calculated (See Appendix 1 in conjunction with the references for a listing of all studies included in the analysis).

Coding the studies.

For each study, the following information was coded: (1) All statistics relevant to the magnitude of the sex difference (means, standard deviations, correlations, t and F tests), (2) The number of male and female participants, (3) The measure(s) of impulsivity employed in the study, (4) The population studied (university, community, schools or colleges), (5) The age of the sample (mean, standard deviation, or range), (6) The nationality of the sample, (7) The publication status of the study, and (8) The sex of the first author. The coding of categorical variables was undertaken by two coders. Cohen's kappa was calculated as a measure of interrater agreement and ranged from .83 (age) to 1.00 (publication status). Discrepancies were checked and resolved by agreement between the two coders. Across all measures, 741 effect sizes were analyzed with a total sample size of 149,496 participants from 27 different countries (see Table 3).

Grouping by category and domain.

Effect sizes were grouped into forty measurement categories (see Table 1). Of these, thirty five represented established measures. Some studies, however, used measures created specifically for their study, unpublished measures, or measures that did not appear more than twice in the whole sample of studies. These were placed into one of five general categories: General Impulsivity Other Measures, Sensation Seeking Other Measures, Risk Taking, Impulse Control, and Visual-Cognitive tasks.

Measures were also grouped into six domains of impulsivity, as outlined in the Introduction (see Table 1). Given the lack of consensus about the dimensionality and conceptualization of impulsivity, some researchers may disagree with these groupings. Results are therefore presented to allow examination on both a category-by-category basis and by domain.

Statistical Analysis

Statistical Independence. The requirement of independence of observations means that the same sample could not be included multiple times when computing an aggregate effect size. Many studies used multiple measures of impulsivity. Aggregating studies by measure does not violate this requirement of independence. However in the domain-level analysis, where multiple measures from a sample were grouped in the same domain, the mean of the d values for the measures were included. Effect sizes and variance ratios were calculated for all categories and domains.

Mean difference effect sizes. Formulae for calculating effect sizes were taken from Lipsey & Wilson (2001). For reported measures, Cohen's d was calculated (by dividing the difference between male and female means by an estimate of the pooled standard deviation).

$$d = \frac{\bar{x}_{male} - \bar{x}_{female}}{sd_{pooled}}$$

Four effect sizes were reported by the authors. Where d values were not reported, d was calculated either by converting existing parametric statistics such as F (15 effect sizes), t (12 effect sizes), or r values (72 effect sizes), or directly from published or provided means and standard deviations (559 effect sizes). Seventy-nine values were estimated as 0 where non-significant gender differences were reported but no relevant statistics could be located. In the Results section, summary effect sizes including and excluding these conservatively estimated d values are reported. Following convention, female means were subtracted from male means so that positive d values represent higher male than female scores.

Outliers, heterogeneity and moderator analysis. Outliers were identified on a category-by-category basis as follows. Cases where the effect size was estimated as 0 due to insufficient data were removed. Z-scores were calculated for the remaining d values. Values of d with z scores outside the range of -2.5 and 2.5 were classified as outliers and subsequently removed from analysis. Results are reported both including and omitting outliers.

The heterogeneity statistic, Q, was calculated for each analysis. Q statistics test for equality of effect sizes within each analysis, and follow a chi square distribution with k -1 degrees of freedom (Hedges & Olkin, 1985). A simplified formula is as follows:

$$Q = \sum_{i=1}^{k} w(d_i - \bar{d})^2$$

Where $w = \frac{1}{v}$, $= \frac{N_{male} + N_{female}}{N_{total}} + \frac{d^2}{2(N_{total})}$, and k is the number of effect sizes.

Significant Q statistics are indicative of the presence of a non-heterogeneous dispersion between effect sizes, but not its magnitude. Q can be sensitive to sample size (Higgins & Thompson, 2002; Hardy & Thompson, 1998), and its significance is expected when analyzing considerable numbers of studies (Higgins, 2008). Heterogeneity is incorporated into estimates of effect size via random effects models.

Random Effects Model. Random effects models make the assumption that the variation between studies is attributable not only to sampling differences between studies, but other, unspecified influences within studies. It assumes effect size parameters to be randomly sampled and estimates these parameters based on the population (but see Schulze, 2004). The random effects model is particularly appropriate when effect sizes are significantly heterogeneous. The conceptual background of this study suggested that heterogeneity within the various measures and domains was likely and so a random effects model was implemented a priori.

Moderator analyses were performed for each measure, the purpose being to explore study variables potentially accounting for variability in effect sizes. Significant Q statistics were not considered prerequisites for running a moderator analysis (see Rosenthal & DiMatteo, 2002). The moderator variables tested were as follows: age (grouped by mean age into five levels: 10-15 years, 15-18 years, 18-21 years, 21-30 years, 30-40 years, 40 years and over); population (grouped into three categories: university students, community samples, school samples); geographical area (grouped into three categories: USA, Canada & Central America; UK, Europe, Australia & New Zealand; Asia, Africa, & the Middle East); sex of first author; and publication status of the study. The test statistic for the moderator analysis is Q_B, which is analogous to the F statistic in ANOVA (Hedges & Pigott, 2004). A significant Q_B denotes that the effect sizes for the different subgroups in the analysis differ significantly.

Publication bias. In many of the studies retrieved for this meta-analysis, sex was not a variable of interest. This makes publication bias less likely. Nevertheless, the possibility of publication bias was explored where possible. Two methods were employed. First, a moderator analyses was run to determine if effect sizes for published studies significantly differed from unpublished studies. Second, following Begg and Mazumdar (1994), the rank correlation between standard error (largely a function of sample size) and effect size for studies within domains was calculated.

This is a statistical analogue of a funnel plot. The assessment of publication bias by any means is unreliable where the number of studies is small (Borenstein, Hedges, Higgins, & Rothstein, 2009), therefore this test was implemented only for categories with at least 20 studies. The results of tests for publication bias are presented in Table 11.

Variance Ratios. These were calculated wherever sufficient data were available, resulting in 475 values. Ratios were computed by dividing the male variance by the female variance. Greater male than female variability is therefore reflected in values greater than one. Following previous authors (Else-Quest et al., 2006), ratios were transformed via base-10 log before calculating category means. Untransformed ratios are presented in Tables 4-8.

Statistical Software. d values and Q statistics were calculated using SPSS; while the random effects models, moderator analyses, and tests for publication bias were run using CMA Version 2 (Biostat Inc., 2008).

Results

Tables 4 to 7 report effect sizes by measure and associated statistics, as well as the overall effect size for the impulsivity domains to which they have been assigned: *Reward Sensitivity, Punishment Sensitivity Sensation Seeking and Risk Taking, and General Impulsivity.* We do not aggregate the results from *Specific Forms of Impulsivity* and *Behavioral Measures of Impulsivity* because, in these domains, aggregation would violate the distinctiveness of the measures. Results from these domains are presented in Tables 8 and 9, respectively. For a complete list of effect sizes and variance ratios for all studies, see the Appendix. This Appendix also identifies the authors of the study, the N of males and females, moderator variables coded (age, population, geographical area, sex of first author, published or unpublished source) and the impulsivity measures used.

Table 10 shows the significant moderator variables for each measure. All moderators significant at $p<.05$ are reported in these tables but, because of the large number of analyses run and the consequent inflated likelihood of Type 1 errors, only those that were significant at $p < .01$ are discussed in the text. We also restrict our discussion of significant *variance ratios* to those where $p < .01$.

Reward sensitivity

Overall effect sizes. For the domain general analysis, there were 18 effect sizes, all but one of which were computed (Table 4). The overall effect size was negligible and non-significant (d = .01). However, there was marked variation in the direction and magnitude of effect sizes for specific measures.

The effect size for the BAS Total score was non-significant but slightly favored women (d = -.13). This was chiefly due to women's significantly higher scores on the BAS Reward subscale (d = -.27). The BAS Reward scale poses questions about emotional responsiveness (e.g. 'When good things happen to me, it affects me strongly'). Women outscored men even more strongly on the TCI scale of Reward Dependence (d = -.56). This scale, despite its name, is composed of subscales specifically assessing "sentimentality, social sensitivity, attachment and dependence on approval by others" (Center for Wellbeing, n.d.). These are areas where past research suggests women should score highly (Cross & Madsen 1997).

The female advantage on these scales stands in contrast to the sex difference favoring men on the SPSRQ and GRAPES Reward scales (d = .44). These latter two scales contain many items that oriented to competitive success and ambition (e.g. SPSRQ: "Are you interested in money to the point of being able to do risky jobs?";

GRAPES: “I expect that I will rise to the top of any field of work I am or will be engaging in”). Thus there appeared to be differences in the conceptualization and contextualization of reward that are potentially confounded with masculinity and femininity.

The remaining two BAS scales (Drive, $d = .06$ and Fun, $d = .08$) were non-significant. Again, this might be related to the way in which the constructs are operationalized. While the Drive scale appears to have an appetitive component reflecting ambition, it differs from the SPSRQ in that it does not refer specifically to money or status. Instead, the item wording is again very general (e.g. “I go out of my way to get things I want”). The Fun scale contains items that appear to tap impulsivity (e.g. ‘I often act on the spur of the moment’). It is therefore perhaps unsurprising that the modest effect sizes on these two scales were very much in line with that found for the domain of General Impulsivity (see *General Impulsivity*).

Moderator analysis. Only the BAS Total and the BAS Reward scale showed significant heterogeneity. Moderator analyses were performed on all measures (see Table 10). Only one was significant at $p < .01$: Age moderated the sex difference in BAS Reward, with the sex difference being smaller for samples aged 18-21 years ($d = -.16$) than for the 21-30 age group ($d = -.54$).

Variance ratios. Mean anti-log variance ratios can be found in Table 4. None are significantly different from 1.

Punishment sensitivity

Overall effect sizes. For the domain general analysis, there were 18 independent effect sizes, all but one of which were computed (Table 5). There was a significant, small-to-moderate, effect size favoring women ($d = -.33$) although, once again, there was variation in the magnitude as a function of the measure used.

All three measures showed a difference in favor of women, two of which were significant. TCI Harm Avoidance (d = -.43) assesses feelings of anxiety in unpredictable situations (e.g. “Usually I am more worried than most people that something might go wrong in the future”). The gist of the item content is very similar to that of the BIS, on which there was a moderate to large sex difference (d = -.63). BIS items are also concerned with anxiety in the face of failure (e.g. ‘I feel worried when I think I have done poorly at something important’, ‘If I think something unpleasant is going to happen I usually get pretty "worked up”’.) Both TCI Harm Avoidance and the BIS therefore assess emotional responses to actual or anticipated punishment.

The aggregated effect size for SPSRQ and GRAPES measures was again in the female direction but only approached significance (d = -.12). Many of the GRAPES items appear to tap pessimism and anticipatory worry in a similar way to the above scales (e.g. “When there is a disease going around, I worry about getting it”, “In light of all the crime in the world. I expect to be the victim of a mugging or an assault at some point during my life.”). However the SPSRQ items seem to capture social assertiveness versus shyness (e.g. (“Would you be bothered if you had to return to a store when you noticed you were given the wrong change?”, ‘Do you generally avoid speaking in public?’) The content therefore appears to be more associated with extraversion-introversion, on which we would not expect a marked sex difference (Costa et al., 2001; Schmitt, Realo, Voracek, & Allik, 2008).

Moderator analysis. Only the effect sizes for punishment sensitivity as measured by the SPSRQ or GRAPES scales showed significant heterogeneity. Moderator analyses were performed on all categories. Age moderated the sex difference on the BAS Reward Scale, such that the sex difference was more pronounced in the 21-30 age group (d = -.54) than the 18-21 age group (d = -.16).

Variance ratios. Mean anti-log variance ratios can be found in Table 5. None are significantly different from 1.

Sensation seeking and risk taking

Overall effect sizes. Table 6 reports effect sizes for the aggregated domain of sensation seeking and risk taking and the 13 measures which it subsumes. For the domain general analysis, there were 130 independent effect sizes, of which five were estimated as zero. d values for MPQ Harm Avoidance were reverse scored before being combined with the other measures in this domain. The overall effect size was small to moderate in size with significantly higher sensation seeking and risk taking among men (d = .41).

Turning to the measures subsumed in this domain, ten of the thirteen measures had significant sex differences and all reflected greater sensation seeking by men. The largest effect size was for MPQ and Personality Research Form (PRF; Jackson, 1994) measures of Harm Avoidance (d = -.78). The MPQ Harm Avoidance questionnaire offers respondents a choice between two somewhat aversive activities from which they select the one that they would least like to undertake (e.g. ‘Having to walk around all day on a blistered foot’ or ‘Sleeping out on a camping trip in an area where there are rattlesnakes’). High scorers prefer safer activities even if they are tedious and do not enjoy the excitement of adventure (Tellegen, 1982). This scale appeared to magnify the sex differences found on the similarly structured SSS Thrill & Adventure which differs in offering a positive choice between two alternatives (e.g. ‘I would like to try surfboard riding’ or ‘I would not like to try surfboard riding’).

Four of the measures showed moderate sex differences including I7 Venturesomeness (d = .51); SSS Total (d = .50); SSS Disinhibition (d = .57); SSS Thrill & Adventure Seeking (d = .41); and UPPS Sensation Seeking (d = .49). Slightly lower effect sizes were found for Risk Taking (d = .38); Dickman Functional Impulsivity (d = .24); and Sensation Seeking Other Measures (d = .22). The ZKPQ ImpSS scale includes items separately assessing impulsivity and sensation seeking and the effect size of .19 was non-significant with high heterogeneity (based on 4 studies). The two scales measuring intolerance of monotony showed quite small effect sizes; SSS Boredom Susceptibility (d = .20) and KSP Monotony Avoidance (d = .15). SSS Experience Seeking, which captures a desire for novel but safe activities, showed a non-significant effect size of .01. This provides more evidence that it is reference to risk taking which produces sex differences.

Moderator analysis. For most of the measures within the domain of sensation seeking and risk taking, there was significant heterogeneity. The exceptions were: SSS Total, Risk Taking, KSP Monotony Avoidance and MPQ/PRF Harm Avoidance. Moderator analyses were performed for all measures (see Table 10).

The sex difference on Eysenck's I7 Venturesomeness scale appears to be moderated by age. With the exception of a small number of samples aged 30-40 (d = .84), the largest effect sizes are present in the 15-18 (d = .63) and the 18-21 (d = .54) age groups, with effect sizes in the other age groups ranging from .37 to .46. This suggests that, in general, the sex difference in Venturesomeness is largest in young adults. No other moderators were significant in this domain.

Variance ratios. Mean anti-log variance ratios can be found in Table 6. Only the variance ratio for SSS Disinhibition is significantly larger than 1 ($p < .01$), indicating greater male variability on this measure. There is little evidence for greater male then female variability in general within this domain.

Measures of general impulsivity

Overall effect sizes. Although the domain general effect size (from 206 independent effect sizes, 180 of which were computed) was significant, it was extremely small in magnitude ($d = .08$), indicating slightly higher levels of impulsivity in men.

Table 7 shows the mean weighted effect sizes for each of the four measures included in this domain. There was no significant sex difference on Eysenck-based measures of impulsiveness. The Karolinska Scales of Personality (KSP) impulsivity scale was also non-significant. While the sex differences on the BIS-11 Total, ($d = .12$), and on Impulsivity Other Measures, ($d = .13$), showed men to be significantly more impulsive, the effect sizes were again small in magnitude.

Moderator analysis. For all measures within the domain of general impulsivity except the KSP Impulsivity measure, there was significant heterogeneity. Moderator analyses were performed on all measures (see Table 10). Population moderated the sex difference in KSP impulsivity. The two community samples showed a small but significant sex difference in the female direction ($d = -.18$), while there was no sex difference in University samples.

Variance ratios. Mean anti-log variance ratios can be found in Table 7. None of them are significantly different from one at $p < .01$.

Specific forms of impulsivity

Overall effect sizes. Nine measures of specific forms of impulsivity were analyzed, with a total of 128 independent effect sizes (111 of which were computed) from 56 studies. Table 8 shows the mean weighted effect sizes for these measures.

For most of the measures, there was no sex difference. There were significant but small sex differences in the male direction on: BIS-11 Cognitive Impulsivity (d = .13), indicating men's greater difficulty in concentrating and focusing attention; on BIS-11 Non-Planning (d = .15), suggesting men's lesser tendency to consider the future; and on Dickman's Dysfunctional Impulsivity (d = .12), which captures a failure of premeditation resulting in negative consequences. There was a small to moderate effect size on Impulsivity / Carelessness in the Social Problem Solving Inventory (SPSI, d = .32), indicating that men are more likely than women to rush into ill-considered 'solutions' to interpersonal problems. There was also a small but significant sex difference in the female direction on UPPS Urgency (d = -.10), indicating that women are more likely to report that their impulse control is disrupted by negative affect, or that they feel regret for their impulsive actions. The overall picture is that there are weak, inconsistent sex differences in these specific forms of impulsivity.

Moderator analysis. For most of the specific measures of impulsivity, there was significant heterogeneity in the effect sizes. The exceptions were: UPPS Premeditation, UPPS Urgency, Dickman Dysfunctional Impulsivity, and the SPSI. Moderator analyses were performed for all measures. Table 10 presents those categorical variables that were found to have a significant moderating effect on the sex difference.

The sex difference in BIS Non-Planning was moderated by geographical area, with samples from the US, Canada, and Central America showing a moderate sex difference in the male direction (d =.30), and samples from the UK, Europe, Australia, and New Zealand showing no sex difference. The sex difference in UPPS Lack of Perseverance was moderated by age: the sex difference in the male direction appears only in samples aged over 21 (d = .38). In UPPS Urgency, age also moderated the magnitude of the sex difference in an inconsistent fashion. Here, an effect size in favor of women was confined to the age 15-18 age group (d = -.31). The significant moderation by population sampled may be an artifact of this age effect; the effect size was significant and in the female direction for the school samples, (d = -.26), but not for undergraduate samples.

The sex difference in Impulse Control also appears to be moderated by age, but in an inconsistent fashion. The two samples aged 15-18 show roughly equal sex differences in opposite directions, resulting in an overall null result, samples aged 18-21 show a sex difference in the male direction (d = .40), while samples aged over 21 show a small sex difference in the female direction (d= -.17). Geographical area also appears to moderate the sex difference in impulse control: the two samples from the UK, Europe, Australia and New Zealand show a substantial sex difference in the female direction (d = - .55), while those from the US, Canada, and Central America show a small sex difference in the male direction (d = .17).

Variance ratios. Mean anti-log variance ratios can be found in Table 8. None were significantly different from 1.

Behavioral measures of impulsivity

Overall effect sizes. The 48 studies in this domain produced 64 independent effect sizes, of which 43 were computed. Effect sizes are presented in Table 9. A significant sex difference, moderate in size and in the male direction, was found on the BART (d = .36). This suggests that men are willing to continue the pursuit of a reward in the face of increasing risk for longer than women. Since the BART is a measure of risk taking, it is not surprising that the significant sex difference is consistent with those found in the general domain of sensation seeking and risk taking.

On the IGT, men were found to perform significantly better (i.e. less impulsively) than women (d = -.34). This, in contradiction to developmental and evolutionary predictions relating to effortful control, suggests that women are less able than men to resist a monetary reward in the short term in order to avoid a greater monetary loss later. However, it should be noted that the IGT was not designed to assess impulsivity but decision making. Bechara, Damasio, Damasio, and Anderson (1994: 8) noted that a patient who performed poorly on the IGT due to damage to the prefrontal cortex was “not perseverative, nor is he impulsive”. Men’s superior performance on this task may actually be the consequence of women’s greater punishment sensitivity: there is evidence that women prefer an IGT strategy which minimizes the frequency of punishment, even though this may be disadvantageous in the long run (Goudriaan, Grekin, Sher, 2007). This raises questions about the validity of attributing poor performance on this task uniquely to impulsivity. Delay discounting, also used as a measure of the propensity to resist small short-term rewards as part of a long-term strategy, showed no sex difference. Although this is consistent with our finding that general measures of impulsivity did not differ between the sexes, it should be noted that delay discounting measures only one of the many facets thought to be subsumed by the construct of impulsivity (Smith & Hantula, 2008). Correlations between delay discounting and psychometric measures of impulsivity are typically weak (Reynolds et al., 2006; Smith & Hantula, 2008)

Where impulsivity is inferred from errors on visual-cognitive tasks, a sex difference in the female direction is found (d = -.26). The use of visuospatial tasks to infer impulsivity also raises problems of validity. These measures were not developed as measures of impulsivity but as tests of, among other things: spatial ability (the SODT-R; Quiroga et al, 2007); intelligence (The Porteus Maze; Porteus, 1950; The Tower of London Test; Shallice, 1982); and visual attention (the Trail Making Test; Reitan, 1958). Although the MFFT was developed to measure a form of impulsivity, concerns about its construct validity have been raised before (Block et al, 1974). Attributing errors on visuospatial tasks to impulsivity may be particularly misleading where sex differences are of interest: the sex difference in visuospatial ability is one of the most robust in the literature (Voyer, Voyer, & Bryden, 1995), so a sex difference on these tasks might well be due to this difference in ability rather than impulsivity.

Consistent with Bjorklund and Kipp's (1996) review, no sex differences were found where impulsivity assessment was based on Executive Response Inhibition Tasks. As outlined in previous sections, these included Stroop tasks, the Stop task, and the Go/no-go task. These tasks are not direct measures of impulsivity but of attention (MacLeod, 1991); inhibitory motor control (Band & van Boxtel, 1999); and passive avoidance learning (Newman, Widom, & Nathan, 1985), respectively. Correlations between these measures and psychometric measures of impulsivity are often weak or absent (Casillas, 2006: Enticott et al, 2006; Reynolds, Ortengren, et al, 2006; Reynolds, Richards, et al, 2006; Rodriguez-Fornells, Lorenzo-Seva, & Andres-Pueyo, 2002; but see Logan, Schachar, & Tannock, 1997). It has been suggested that performance on the Stop task may only be impaired when trait impulsivity is exceptionally high (Enticott et al., 2006) so that using it to infer impulsivity in normal populations may be problematic.

Moderator analysis. Moderator analyses were run for the BART, delay discounting, and Executive Response Inhibition (there were too few studies to run moderator analyses for the IGT or the visuospatial tasks). The results are presented in Table 10. Although small numbers of studies mean that these results must be interpreted with caution, both the analysis by age and the analysis by population suggest that the sex difference in measures of impulsivity based on Executive Response Inhibition is moderated by age. A sex difference in the male direction is present in younger samples (age 10-15 years, d = .71; school samples, d = .62), while older samples (21-30 years) show no significant sex difference, or a small sex difference in the female direction (community samples, d = -.18). This suggests that, on these tasks, boys may lag behind girls in their ability to inhibit prepotent responses earlier in life, before catching up later on.

Variance ratios. Mean anti-log variance ratios can be found in Table 9. Men were found to vary more widely than women on Stroop-related tasks. No other variance ratios were significantly different from 1.

Publication bias.

Sex differences were not the object of study in most of the studies retrieved for this meta-analysis and the likelihood of publication bias is therefore reduced. Moderator analysis using publication status as a moderator variable found no evidence that effect sizes differed between published and unpublished studies. Furthermore, rank correlations between standard error and effect size were not significant (see Table 11). Although in some domains there were insufficient studies to test for publiaction bias, the tests that could be conducted revealed no evidence for publication bias.

Discussion

We organize our discussion in terms of the theoretical distinction made in the Introduction between lower-order (reward and punishment sensitivity) and higher-order (effortful control) theories of impulsivity. We then consider sex differences in variance ratios. We end with a summary and suggestions for future developments in the field.

Reward and Punishment Sensitivity in relation to Sensation Seeking.

The aggregate measure of *reward sensitivity* showed no significant sex difference. However it appears that the various measures within this domain are measuring very different constructs. On the TCI, items refer specifically to social sensitivity and attachment, and the effect size favoring women probably reflects the greater salience of this domain to women. This is also true of the BAS Reward Scale, where much emphasis is placed on the strength of emotional responses to positive events. There is evidence that women experience emotions more intensely than men and are more willing to articulate them (Brebner, 2003: Vigil, 2009), which may account for women's higher scores. In contrast, the SPSRQ/GRAPES scales emphasize strong pursuit of reward, particularly in the form of money or status, and here a sex difference favoring men is observed. This sex difference fits well with the predictions outlined in the introduction regarding men's greater approach motivation in the pursuit of dominance.

Where sex differences in reward sensitivity are of theoretical interest, the choice of reward sensitivity measure is crucial. It is essential to consider what, if any, particular form of reward is most relevant. It must also be made clear whether 'sensitivity' to reward refers to the extent to which reward is *liked*, or the extent to which reward is *pursued*. Our data suggest that this subtle difference in operationalizing 'sensitivity' can lead to sex differences in opposite directions.

Measures of *punishment sensitivity* were consistently in the female direction. Although the differences between measures were less dramatic than for reward sensitivity, we found again that measures with a stronger emphasis on emotion produced larger sex differences in the female direction. This suggests that the extent to which we observe sex differences in punishment sensitivity depends on the extent to which measures refer specifically to fear and anxiety, rather than to general dislike or avoidance. As with reward sensitivity, the selection of the appropriate instrument to measure punishment sensitivity will depend on the context of the research.

Explanations of *sensation seeking and risk taking* have drawn on these lower order theories in terms of affective and neurochemical responses to prospective reward and punishment. It is in the domain of sensation seeking that sex differences were most marked. Sensation seeking is a trait characterized by strong affective motivation — unlike impulsivity, where the presence of affective motivation is ambiguous. We propose that sensation seeking —and its cousins novelty seeking, risk taking, fun seeking, venturesomeness, and reversed harm avoidance — constitute a distinctive trait that should not be subsumed under the general concept of impulsivity. At a conceptual level, Zuckerman's definition of sensation seeking makes no reference to acting without deliberation. Zuckerman himself has noted that parachute jumpers do not jump from planes on impulse; they plan carefully, checking their equipment, drop site, parachute, and timings. As operationalised in most self-report questionnaires, sensation seeking items do not make reference to the failure of deliberation which is the hallmark of impulsive action. Empirically, impulsivity and sensation seeking frequently appear as distinct factors in multivariate analyses.

Depue and Collins (1999), reviewing 11 factor analytic studies of major personality scales, found that sensation seeking, novelty seeking, and risk taking scales showed a distinct clustering and were only loosely associated with scales measuring ‘non-affective’ impulsivity. Several other studies using a range of impulsivity scales have also identified a factor of sensation seeking distinct from other aspects of impulsivity (Flory, Harvey, Mitropoulou, New, Silverman, Siever et al., 2006; Magid & Colder, 2007; Miller, Joseph & Tudway, 2004; Smith et al., 2007; Whiteside & Lynam, 2001; Zelenski & Larsen, 1999). The fact that sensation seeking loads on a distinct dimension argues as much for its statistical and conceptual distinctiveness as it does for its status as a facet of impulsivity. In the present analysis, it was noticeable that sex differences were considerably weaker on the ZKPQ ImpSS than on the SSS-V. When factor analyzed, ImpSS splits into its two constituent factors of impulsivity and sensation seeking (Zuckerman and Kuhlman, n.d.). This may account for the dilution of the effect size on this measure with weaker sex differences in impulsivity counteracting the stronger sex differences in sensation seeking.

Within the domain of sensation seeking and risk taking, we found some encouraging evidence of consistency between psychometric and behavioral measures. The BART task was developed as a measure of risk taking (Lejuez, Read, Kahler, Richards, Ramsey, Stuart, et al, 2002), and there is good evidence for its construct validity (Aklin, Lejuez, Zvolensky, Kahler, & Gwadz, 2005; Hunt, Hopko, Bare, Lejuez, & Robinson, 2005). It is not surprising that this task shows a significant sex difference in the male direction. Unlike the behavioral tasks which measured a failure to inhibit a pre-potent response, the BART measures the active pursuit of reward. In a factor analytic study, the BART has been found to be distinct from executive inhibition tasks (Reynolds, Ortengren et al., 2006). This adds to the empirical evidence for a distinction between impulsivity and risk taking.

Evolutionary theories, predicated on differential parental investment, predict higher risk taking by males and these are supported by the current review. Greater male risk taking is not unique to our species, and such a conserved and sex-specific evolutionary adaptation is likely to be instantiated at a relatively low level in terms of neural structure. Emotional and motivational factors are sufficient to generate individual differences in appetite for and aversion to risk. Within the evolutionary framework, a distinction can be drawn between Campbell's argument that women are more sensitized than men to negative outcomes (punishment sensitivity) and Daly and Wilson's argument that men experience a greater positive attraction to risk (reward sensitivity).

Campbell's position is supported by our finding that women were consistently higher in measures of punishment sensitivity. Women's risk aversion was evident also in their markedly higher scores on MPQ Harm Avoidance. On this measure, in which respondents choose the less objectionable of two aversive activities, the effect size (d = -.78) is almost twice as big as that found on the SSS Thrill & Adventure scale (d = .41), which offers an appetitive choice regarding engagement in risky activities. This suggests that women may be even more prone to avoid risky activities than men are to seek them out.

In a meta-analysis of sex differences in risk taking, Byrnes et al. (1999) found greater risk taking by men over a range of paradigms but these were most marked in studies involving real rather than hypothetical risk. In reference to the distinction between higher-level cognitive and lower-level motivational processes, they note "…the processes involved in the transition of cognitions to behaviors (e.g. fear responses) may explain gender differences in risk taking more adequately than the cognitive processes involved in the reflective evaluation of options" (Byrnes et al., 1999, p.378). They propose that these lower-level motivational factors may play as strong a role as cognition in risky decision making. This "risk as feelings" idea was developed by Loewenstein et al. (2001), who noted that emotional reactions to risk can and frequently do occur without cognitive intervention, and that sex differences in fear and anxiety underlie women's more cautious, risk-averse decisions (Lerner & Keltner, 2000). In the areas of health maintenance and extreme sports (Harris, Jenkins & Glaser 2006), which present real threats to physical integrity, the sex difference in risk taking is best explained by women's greater anticipation of negative consequences and by their higher ratings of the severity of those negative consequences should they occur.

Although Campbell originally predicted women's greater fear specifically in the context of prospective physical injury, many studies have now demonstrated greater fear and anxiety in women across a range of contexts (see Campbell, 2006). Women exceed men cross-culturally on the Vulnerability ($d = -.43$) and Anxiety facets ($d = -.36$) of the NEO-R (Costa et al., 2001). Anxiety is strongly linked to a lower threshold for detecting and attending to threat, and experimental studies demonstrate this threshold to be lower in women than in men (McLean & Anderson, 2009).

Daly and Wilson's (1988) complementary thesis emphasizes men's greater attraction to risk. In this view, men engage in more dangerous activities as a result of the inherent attractions of the activities (e.g. scuba-diving, parachute jumping). Though it is evident why potentially life-threatening activities might promote fear and avoidance, it is less clear why some individuals should find them inherently attractive. Daly and Wilson argue that men use such activities to advertise their courage as part of intrasexual competition, thus gaining greater reproductive success; this masculine taste-for-risk therefore represents an evolved module. Consistent with this is Zuckerman's argument that the physiological arousal resulting from such activities signals reward in the brain. Although measures of reward sensitivity do not provide unanimous support for this appetitive view, we note that men's scores do exceed women's where questionnaire items focus on competitive dominance striving.

The attraction of risky activities to men, however, need not depend upon heightened male sensitivity to reward but can be explained in terms of their lower punishment sensitivity as follows (Campbell, 2002). Typically an inverted U-shaped function describes the relationship between the arousal (low - high) generated by an activity and its subjective hedonic valence to the actor (pleasant - unpleasant). If men have a higher fear threshold, their function will be right-displaced relative to women's. Hence a higher degree of arousal will be necessary to generate the same degree of pleasure. Men will show a shift from enjoyment to excitement (and from apprehension to fear) at higher levels of arousal compared to women. Hence a high-speed car ride that is unpleasant (aversive) to women could be exciting (attractive) to men.

Effortful control.

We consider *general measures, specific forms of impulsivity* and *behavioral measures* as assessing higher-order or effortful control since they presuppose an explicit, conscious decision with regard to action or inaction. The sex difference in *general measures of impulsivity*, although statistically significant, was small in magnitude. The most widely used psychometric measure of general impulsivity, Eysenck's I7 Impulsiveness questionnaire, showed no significant sex difference. The analysis of *specific measures* added to the picture of weak, inconsistent sex differences in impulsivity. Measures of *behavioral impulsivity* were very inconsistent, with some suggesting greater female impulsivity, some suggesting greater male impulsivity, and some showing no sex difference. This inconsistency is likely to be due to variation in the constructs measured by these tasks. Within the domain of higher order processes, it is relevant to highlight the distinction between 'hot' effortful control and 'cool' executive function control (Ardila, 2008; Happanay, Zelazo & Stuss, 2004; MacDonald 2008). Both are higher order processes governing subcortical processes.

Executive function governs cognition in emotionally neutral conditions and has been localized to the dorsolateral prefrontal cortex (Cummings 1993; Fuster, 1997). Many of the behavioral tasks included in our analysis assess this kind of inhibition, where impulsivity is manifested in an inability to inhibit motor responses, maintain attention, develop and execute a plan, or switch to a new dimensional set. Executive functions of this kind are correlated with general intelligence, where sex differences are likely to be minimal (Jensen, 1998). Our analysis indicates that sex differences are non-significant on these 'cool', executive function tasks (Stroop, Go/No-Go, Stop, CPT). The Delay Discounting Task also showed no sex difference. Although this task involves monetary incentives and might, therefore, be considered an affective task, we suggest that it relies primarily on the 'cooler' executive form of decision-making. In most studies, participants' choices are entirely hypothetical, since the high sums involved (e.g. $1,000) make it impossible to honor their choices. In other studies, participants are told there is a small (e.g. 10%) probability that one of their choices might be honored (e.g. McLeish & Oxoby 2007), or one trial is randomly selected for payment (e.g. Reynolds, Richards et al., 2006). Given that participants make as many as 400 sequential choices, it is clear that the task has a strong hypothetical component. Hypothetical decisions draw on 'cooler' cognitive forms of decision-making which are assumed to be based on rationality and expected utility theory (Loewenstein, Weber, Hsee, & Welch, 2001; Madden, Begotka, Raiff & Kastern, 2003). In their meta-analysis, Byrnes, Miller, and Schafer (1999) found a very small tendency for men to make riskier decisions in these hypothetical choice-dilemma tasks (d = .07).

Although women demonstrated higher 'impulsivity' in visual-cognitive tasks, this result should be treated with caution. Most of these tasks were not originally designed to assess impulsivity. By employing number of errors as the measure of impulsive responding, they conflate men's established superior visual spatial abilities with lower impulsivity (Voyer, Voyer, & Bryden, 1995). The findings from the IGT should also be treated with caution since, as we have noted, this was not originally designed as an impulsivity measure (Bechara et al., 1994) and the sex difference may reflect women's greater punishment sensitivity (Goudriaan et al., 2007).

'Hot' forms of inhibition refer to control over social and affective processes; the effortful control system. It has been localized to the orbitofrontal region of the prefrontal cortex which has bidirectional connections with limbic systems structures, notably the amygdala (Davidson, Putnam & Larson, 2000; Rolls, 2000). There is suggestive, though not yet conclusive, evidence that women may have an advantage in affective inhibition: women have greater binding potential for serotonin in several regions including the amygdala and orbitofrontal cortex (Parsey et al., 2002). They also have greater orbitofrontal volume (Goldstein et al., 2001; Wood, Heitmiller, Andreason & Nopoulos, 2008) and greater functional connectivity between the OFC and the amygdala (Meyer-Lindenberg, Buckholtz, Kolachana, Hariri, Pezawas, Wabnitz et al., 2006). Following MacDonald and Baumeister's argument that men's stronger appetitive impulses are less amenable to cortical over-ride, we anticipated sex differences in effortful control

The weak sex difference that we found (d = .08) begs the question of the extent to which psychometric impulsivity measures are accessing hot versus cold inhibitory control. This is not easy to determine. Questions of the kind "I am an impulsive person" do not indicate whether the relevant context is affectively loaded or neutral. Some respondents might interpret this item as referring to affectively 'hot' contexts such as a love affair or an argument; while others might think of a 'cool' context such as an ill-considered chess move. Any tendency for men to interpret items in one way and women in another could distort or obscure sex differences. Future studies could usefully examine whether sex differences are systematically moderated by the requirement for hot — as opposed to cool — behavior control. This would entail clearer exposition of the factors that render a decision 'affective' rather than emotionally neutral. Consider an item such as "I plan tasks carefully". A negative response to this item might reflect a deficit in the 'cool' executive ability to plan or a social-affective 'hot' preference for spontaneity over predictability.

That said, the management of social interactions appears to be a strong candidate for affective effortful control. In accord with Bjorklund and Kipp's (1996) proposal, men are more impulsive than women in social problem solving. While this may, as Bjorklund and Kipp suggest, derive from the evolutionary advantages accruing to women who could suppress and conceal emotion toward others, it is also consistent with women's greater interpersonal interests. Women have been credited with more sensitive social skills and with a stronger interpersonal orientation than men (Cross & Madson, 1997; Hall, 1984; Horgan, Mast, Hall & Carter, 2004; Su, Rounds & Armstrong, 2009). It may be that their superior performance results from a stronger dependence on, and motivation to sustain, social relationships. This might derive from evolutionary pressures associated with survival and childcare (Taylor, Klein, Lewis, Gruenewald, Gurung & Updegraff, 2000).

The distinction between executive function and effortful control might reflect more than simply the presence or absence of an affective component. Performance on executive function tasks is often referred to in terms of ‘ability’ or ‘deficit’, implying degrees of competence; impulsive actions are seen as 'failures' of effortful control. As with intelligence, more executive function is better than less. According to this view, sex differences in effortful control will produce male overrepresentation in problem behavior due to men’s greater propensity for ‘failure’ to act in a controlled manner. It is not clear, however, that effortful control should be viewed in this way. An overly strong effortful control system is associated with internalizing behavior problems (Murray & Kochanska, 2002). Rather than a competence, effortful control might be best conceptualized as a personality style. In this case, actions which we construe as impulsive represent a preference which might in some circumstances be beneficial (Carver, 2005; Dickman, 1991; MacDonald, 2008). Stable individual differences will exist in the tendency to make a particular kind of choice, such as spontaneity versus restraint. As with other personality traits (Penke, Denissen, & Miller, 2007), effortful control may be neither an unalloyed good nor an absolute hindrance; it may simply be something that varies between people. According to this trait view of effortful control, a sex difference in effortful control could account for both the overrepresentation of men and boys in externalizing pathologies and the overrepresentation of women and girls in internalizing ones. Understanding whether sex differences in effortful control represent competency failures or personality traits is important in addressing sex-linked social problems including aggression, substance misuse, and accidental deaths.

Our weak and inconsistent results for effortful control contrast with the very marked sex difference found in children (Else-Quest et al., 2006). Effortful control in children is measured with the Child Behavior Questionnaire (Rothbart et al., 2001) by summing five scales which appear to asses ‘cool’ executive functions and avoidance of high sensory stimulation. In the former domain, effect sizes were small for the measures of attention focus (d = -.16) and attention shifting (d = -.31). Effect sizes reflecting tolerance for low levels of sensation were somewhat higher; perceptual sensitivity (detection of slight, low intensity stimuli, d = -.38), low intensity pleasure (enjoyment of situations involving low stimulus intensity d = -.29), and inhibitory control (capacity to suppress approach responses in uncertain situations or when instructed, d = -.41). These latter measures appear to capture aspects of (reversed) sensation hunger. It may be that the aggregated effortful control value (d = -1.01) disproportionately reflects these sex differences in sensation seeking and, if this is the case, is somewhat more consistent with our findings for adults. As noted previously, the Child Behavior Questionnaire assesses Impulsiveness separately from effortful control as speed of response initiation (a facet of Extraversion / Surgency). Here, the effect size of d =.18 is only slightly larger than our adult values for several Impulsivity measures. Alternatively, differences in data sources may explain the apparent convergence of the sexes with age. In Else-Quest et al.’s (2006) meta-analysis, the vast majority of the data came from parents’ or teachers’ ratings of child behavior. The larger sex difference they report might reflect gender stereotyping effects associated with third party reports, a possibility considered by the authors.

To the extent that sex differences in impulsivity do indeed narrow with age, differential neuronal maturation may be a candidate explanation. Both sexes acquire stronger inhibitory control as they move toward adulthood and this may be tied to the late maturation of prefrontal areas — especially the dorsolateral and ventromedial regions (Hooper, Luviana, Conklin & Yarger, 2004). Girls show an earlier maturation peak in frontal lobe areas but, during adolescence, boys show a sharper increase in grey matter reduction and white matter development (Giedd et al., 2006). There is also evidence that boys and girls may recruit different neuronal circuits to solve the same inhibitory control problem (Christakou et al., 2009): This could be usefully investigated in future work.

Variance ratios.

Archer & Mehdikhani (2003) proposed that traits which reflect sexually selected characteristics should show significantly greater variance among males than among females. This proposal stems from the fact that men have more freedom to vary in their sexual strategy in terms of offering high or low levels of paternal investment. Greater male variance, therefore, stems from the retention of both male strategies in the gene pool. Women, as a sex, are more constrained in the levels of maternal investment they must make, which results in lower intrasexual variance. Greater male than female variance has been found on a number of physical (Lehre et al., 2009) and psychological (Archer & Mehdikhani, 2003; Hedges & Nowell, 1995) measures. Operationally, sexual selection is inferred when the sexes vary in central tendency. Sensation seeking and punishment sensitivity are therefore candidates for examining Archer and Mehdikhani's thesis. Variance ratios did not differ significantly from 1 here or on other impulsivity measures, except on the SSS Disinhibition scale. This is surprising given that sex differences in risk taking are thought to arise from differential parental investment (Daly & Wilson, 1988). Furthermore, differences in central tendency strongly suggest the action of sexual selection. The exclusion criteria of the current analysis might account for this null finding. For reasons outlined in the preceding sections, we excluded clinical and incarcerated samples. This places a constraint on the observed variability. Given the overrepresentation of men and boys in pathological and criminal behavior in which risk taking is a factor, it is not unreasonable to suggest that this constraint may affect the male variance more than the female variance, leading to a null result here. Our observation of equal variance is therefore inconclusive, rather than contradictory to Archer and Mehdikhani's thesis.

Summary and suggestions

Our results suggest that sex differences are most evident in low-level motivational responses captured by punishment and reward sensitivity, risk taking, and sensation seeking. Where human behavioral sex differences mirror those found in other species, the most likely neural sites are lower-level limbic system processes that are phylogenetically conserved. Greater risk taking by males is characteristic of a number of mammalian species (Daly & Wilson, 1983). For example, male common chimpanzees are more reckless, impulsive, and active than females (King, Weiss & Sisco, 2008). The present results suggest that it may be women's greater sensitivity to — and anxiety about — the punishing consequences of risky action that deters them from the same level of engagement as men.

Sex differences are much smaller for effortful control and this suggests that it has been less subject to sexual selection. The ability to control the expression of emotions is key to sustaining the stable social groups on which both sexes depend (Barklay, 2001; MacDonald, 2008). The enlargement of the human neocortex has been attributed to the need for fast and flexible behavioral adjustment to unpredictable changes within the lifetime of the individual (Plotkin, 1997). Such demands have been as great for men as for women and, where selection acts equally on both sexes, sex differences are not expected. The marked over-representation of men in aggressive and sexual social pathologies may tell us more about the strength of sexual selection acting on male sexuality and aggression than the natural selection pressures operating on impulse restraint.

We end with three lessons that we have learned from undertaking this analysis which we hope will be helpful in guiding future research.

Impulsivity is not unitary. In our introduction, we highlighted the distinctly non-unitary nature of impulsivity as a construct. Attempts to integrate various psychometric and behavioral measures into a coherent and replicable set of dimensions have not been entirely successful. This may be due to a heavy reliance on factor analysis: The pool of measures entered into the analyses vary between studies, so different results are produced. Elucidating the dimensionality of impulsivity requires convergent evidence: one promising route might be through imaging studies where the neural structures and circuits associated with different forms of impulsivity may indicate their distinctiveness (e.g. Dalley, Mar, Economidou & Robbins, 2008; Davidson, Jackson, & Kalin, 2000; Llewellyn, 2008; Meyer-Lindenberg et al., 2006; Smillie, 2008). Until such clarity is achieved, we can only urge caution. Our analysis shows that sex differences depend very much on the inventory or task that is employed. Generalizations from a specific measure to impulsivity more generally must be made tentatively and must acknowledge the multifaceted nature of the construct.

Impulsivity may be both 'hot' and 'cool'. An important distinction within impulsivity is between different forms of higher-order control. Executive function is primarily concerned with cognitive aspects of impulsivity manifested in failures of attention maintenance and switching, and the establishment and reorganization of dimensional sets. These rely on different neural structures (dorsolateral prefrontal cortex) than those recruited in effortful control over emotional and affective states (orbitofrontal prefrontal cortex). We find no sex differences in the former and evidence of small differences in the latter. These conclusions must remain tentative until we have a clearer understanding of the extent to which various tasks and measures uniquely assess one system rather than the other. Behavioral tasks vary greatly in which system they engage and it is often unclear whether a given task is being processed affectively or cognitively. For example, there has been a tendency to assume that the use of monetary incentives is sufficient to render a task affective. It would be helpful to have this confirmed by neuroimaging studies, especially in regard to possible sex differences. The corresponding ambiguity in psychometric inventories arises from the use of non-specific item wording: "'I often act without thinking" can be interpreted to apply to cool executive disinhibition (e.g. careless mistakes in solving a mathematical problem) or to an override of affective effortful control (e.g. insulting your boss).

Impulsivity is not sensation seeking. There is a clear conceptual and empirical distinction between sensation seeking and impulsivity. Though there is little unanimity on the definition of impulsivity, it has been variously described as acting without deliberation, failure to inhibit a prepotent response, lack of planning, and failure of perseverance. None of these characteristics applies to sensation seeking activities. We suggest that sensation seeking should be recognized as a dimension of personality distinct from impulsivity, rather than a trait subsumed by it. Our results provide support for this: they clearly indicate that sex differences are small for impulsivity but considerably more marked for sensation seeking. Using the two constructs interchangeably may produce misleading results with regard to sex differences.

Many impulsive actions are harmless: hugging someone out of happiness, buying a treat on the spur of the moment, or opting for a new dish at a restaurant are hardly dangerous. Parachuting, rock-climbing, or skiing, although risky, are not impulsive --- they require planning, training, and a measured consideration of the risk. Clearly, some actions may be both impulsive and risky: running across a road, having sex with a stranger, or accepting an offer of drink or drugs, for example (Campbell & Muncer, 2009). The assessment of actions which are both risky and impulsive is an area in need of attention. We believe that it is this form of impulsive risk taking — *risky impulsivity* — which is most likely to underlie aggressive and criminal behavior.

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Table 1:

Summary of measurement categories by domain

Category	Measure(s)
	Reward Sensitivity
SPSRQ/GRAPES	Sensitivity to Reward and Sensitivity to Punishment Questionnaire (Torrubia, Avila, Molto & Caseras, 2001): Reward scale Generalized Reward and Punishment Expectancy Scales (Ball & Zuckerman, 1990): Reward scale
TPQ/TCI Reward Dependence	Tridimensional Personality Questionnaire (Cloninger, 1986): Reward scale. Temperament and Character Inventory (Center for Wellbeing, n.d.): Reward scale
BAS Total	Behavioral Activation Scale (Carver & White, 1994): Total score
BAS Drive	Behavioral Activation Scale (Carver & White, 1994): Drive scale
BAS Fun	Behavioral Activation Scale (Carver & White, 1994): Fun Seeking scale
BAS Reward	Behavioral Activation Scale (Carver & White, 1994): Reward scale
	Punishment Sensitivity
SPSRQ/GRAPES	Sensitivity to Reward and Sensitivity to Punishment Questionnaire (Torrubia, Avila, Molto & Caseras,

	2001): Punishment scale
	Generalized Reward and Punishment Expectancy Scales (Ball & Zuckerman, 1990): Punishment scale
TPQ/TCI Harm Avoidance	Tridimensional Personality Questionnaire (Cloninger, 1986): Harm Avoidance scale
	Temperament and Character Inventory (Center for Wellbeing, n.d.): Harm Avoidance scale
BIS (BIS/BAS)	Behavioral Inhibition Scale (Carver & White, 1994)
Sensation Seeking and Risk Taking	
Venturesomeness	I5 (Eysenck & Eysenck, 1978), or I6/I7 (Eysenck, Pearson, Easting, & Allsopp, 1985): Venturesomeness Scale
Sensation Seeking Scale (SSS) Total	Sensation Seeking Scale Form II (Zuckerman, Kolin, Price, & Zoob, 1964), IV (Zuckerman, 1971), or V (Zuckerman, Eysenck, & Eysenck, 1978): Total score
SSS – Thrill & Adventure Seeking	Sensation Seeking Scale Form IV (Zuckerman, 1971), V (Zuckerman, Eysenck, & Eysenck, 1978), or VI (Zuckerman, 1984): Thrill and Adventure Seeking Subscale
SSS – Experience Seeking	Sensation Seeking Scale Form IV (Zuckerman, 1971) or V (Zuckerman, Eysenck, & Eysenck, 1978): Experience Seeking Subscale
SSS - Disinhibition	Sensation Seeking Scale Form IV (Zuckerman, 1971), V (Zuckerman, Eysenck, & Eysenck, 1978), or VI (Zuckerman, 1984): Disinhibition Subscale

SSS – Boredom Susceptibility	Sensation Seeking Scale Form IV (Zuckerman, 1971) or V (Zuckerman, Eysenck, & Eysenck, 1978): Boredom Susceptibility Subscale
UPPS Sensation Seeking	UPPS Impulsive Behavior Scale (Whiteside & Lynam, 2001): Sensation Seeking scale
Dickman Functional Impulsivity	Dickman Impulsivity Inventory (Dickman, 1990): Functional Impulsivity scale
Risk Taking	All measures of risk taking including: The Jackson Personality Inventory (Jackson, 1994): Risk-Taking scale; Risky Impulsivity (Campbell & Muncer, 2009); and any measures developed for specific studies
ZKPQ Impulsive Sensation Seeking	Zuckerman-Kuhlman Personality Questionnaire (ZKPQ; Zuckerman & Kuhlman, n.d.): Impulsive Sensation Seeking scale
KSP Monotony Avoidance	Karolinska Scales of Personality (KSP Schalling, 1978): Monotony Avoidance scale
MPQ/PRF Harm Avoidance	Multidimensional Personality Questionnaire (MPQ; Tellegen, 1982), or Personality Research Form (PRF; Jackson, 1994): Harm Avoidance scale
Sensation Seeking (Other measures)	Any measure of sensation seeking not specified elsewhere, including: the Tridimensional Personality Questionnaire (Cloninger, 1986): Novelty Seeking scale, the Arnett Inventory of Sensation Seeking (Arnett, 1994), and any measures developed for specific studies

Effortful Control: General Measures of impulsivity	
Eysenck measures of impulsiveness	I5 (Eysenck & Eysenck, 1978), or I6/I7 (Eysenck, Pearson, Easting, & Allsopp, 1985;), Eysenck Personality Inventory (EPI; Eysenck & Eysenck, 1968): Impulsiveness scale
BIS Total	Barratt Impulsiveness Scale (BIS-10; Barratt, 1985; BIS -11; Patton, Stanford, & Barratt, 1995)[a]: Total score
KSP Impulsivity	Karolinska Scales of Personality (KSP; Schalling, 1978): Impulsivity scale
Other measures	Any measure of impulsivity not specified elsewhere, including: Personality Research Form (PRF; Jackson, 1994): Impulsivity scale, Revised NEO Personality Inventory (NEO PI-R; Costa & McCrae, 1992): Impulsivity facet, Self-discipline and Deliberation scales, and any measures developed for specific studies in the review
Effortful Control: Specific forms of impulsivity	
BIS Cognitive	Barratt Impulsiveness Scale (BIS-10; Barratt, 1985; BIS -11; Patton, Stanford, & Barratt, 1995)[a]: Cognitive/Attentional Impulsiveness scale
BIS Motor	Barratt Impulsiveness Scale (BIS-10; Barratt, 1985; BIS -11; Patton, Stanford, & Barratt, 1995)[a]: Motor Impulsiveness scale

BIS Non-planning	Barratt Impulsiveness Scale (BIS-10; Barratt, 1985; BIS -11; Patton, Stanford, & Barratt, 1995)[a]: Non-Planning Impulsiveness scale
UPPS Perseverance	UPPS Impulsive Behavior Scale (Whiteside & Lynam, 2001): Lack of Perseverance scale
UPPS Premeditation	UPPS Impulsive Behavior Scale (Whiteside & Lynam, 2001): Lack of Premeditation scale
UPPS Urgency	UPPS Impulsive Behavior Scale (Whiteside & Lynam, 2001): Urgency scale
Dickman Dysfunctional Impulsivity	Dickman Impulsivity Inventory (Dickman, 1990): Dysfunctional Impulsivity scale
Impulse Control	Any measure of impulse control, including: the Offer Self-Image Questionnaire (Offer, Ostrov, & Howard, 1982): Impulse Control subscale, Multidimensional Personality Questionnaire (MPQ; Tellegen, 1982) Control scale, and any measures developed for specific studies in the review
Social Problem Solving Inventory	Social Problem-Solving Inventory-Revised (SPSI-R; D'Zurilla, Nezu, & Maydeu-Olivares, 1996)[a]: Impulsive/Careless style scale
Effortful Control: Behavioral Measures	
BART	Balloon Analogue Risk-Taking Task (BART; Lejuez et al., 2002)
Delay Discounting	Any delay discounting task (see, e.g. Mazur, 1987, Richards, Zhang, Mitchell, & de Wit, 1999) using real

	or hypothetical rewards including money, sweets, and cigarettes.
Executive Response Inhibition	The Stop Task (Logan, Schachar, & Tannock,1997), the Go/No-Go task (Newman, Widom, & Nathan, 1985), any Stroop-based task (Stroop, 1935), the Continuous Performance Test (Conners, 2000), and the Inhibitory Reach task (Enticott, Ogloff, & Bradshaw, 2006)
Iowa Gambling Task	The Iowa Gambling Task (IGT, Bechara, 1994)
Visual-cognitive Tasks	Matching Familiar Figures Test (MFFT, Kagan, Rosman, Day, Albert, & Phillips, 1964), Intradimensional/Extradimensional learning task (IDED; Roberts, Robbins,& Everitt, 1988), Tower of London Task (ToL; Shallice, 1982), Porteus Maze (Porteus, 1950), Trail-Making Test (Reitan, 1958), Visual Comparison Task (VCT; Dickman & Meyer, 1988), and Spatial Orientation Dynamic Test-Revised (SODT-R, Colom, Contreras, Shih, & Santacreu, 2003)

[a] Includes versions translated into other languages

Table2. Summary of behavioural tasks of impulsivity.

Executive response inhibition tasks	
Go/No-go	Two randomly alternating stimuli are presented (e.g. a car and a house). The respondent is instructed to respond selectively to one but not the other by pressing a button. One stimulus is presented more frequently to establish a prepotent response. Commission errors index impulsivity.
Stop signal	Similar to the Go/No-Go task but on some trials a signal (usually auditory) is given immediately after the critical target stimulus. On these trials, the respondent must inhibit their response. The delay between the onset of the stimulus and the onset of the signal to stop is varied until participants successfully inhibit their go responses on 50% of trials. At this point, stop-signal reaction time (SSRT) is estimated as the difference between the stop-signal delay and the mean go reaction time.Longer SSRTs index higher impulsivity.
Continuous performance task	Letters appear one at a time on a screen. The respondent must press a button when a particular sequential configuration (e.g. C followed by A) is shown. Commission errors index impulsivity.
Stroop	In the control condition, the respondent names aloud the ink colour of a row of XXXX as quickly as possible.

	In the interference condition which follows, the respondent must name aloud the ink colour in which a series of words is written: Each word is a colour name (e.g. red) that is different from the ink colour (e.g. blue) used to print it. The two conditions are compared and the disparity between them is a measure of the time taken to resolve the conflict between an automatic, non-desired response (word reading) and a non-automatic, desired response (colour naming). Hence, a larger value indexes lower effortful control. Some researchers also use errors or time taken in the interference condition.
Visual cognitive tasks	
Matching familiar figures task (MFFT)	A target design is presented together with a number of similar designs. The task is to match the target with its identical version. Speed and errors reflect impulsivity.
Visual comparison task	Similar to MFFT but the respondent is presented with two very similar figures and makes a 'same' or 'different' decision.
Trailmaking	The respondent draws lines joining 25 circles distributed over a sheet of paper. In Part A, the circles are numbered 1 – 25, and the respondent connects the numbers in ascending order. In Part B, the circles

	include both numbers (1 – 13) and letters (A – L). The respondent is asked to alternate between numbers and letters (i.e., 1-A-2-B-3-C, etc.). The respondent is instructed to work quickly and not to lift the pen from the paper. Errors are pointed out to the respondent and correction is allowed. Errors affect the score by increasing the time taken to complete the task. The time taken for Part A is subtracted from the time taken for Part B. A smaller value reflects impulsivity.
Porteus maze	This is a graded set of paper forms on which the respondent traces the way from a starting point to an exit, avoiding blind alleys. There are no time limits. The mazes vary in complexity from simple diamond shapes to intricate labyrinths. The Q score, used to index impulsivity, is obtained by measuring the number of times the pencil is lifted, touches the boundary, etc.
Circle tracing	Respondents are asked to trace over a 9 inch circle as slowly as they can. The start and stop position are clearly marked on the circle in bright letters. Impulsivity is indexed by time taken to perform the task on the second trial.
Spatial orientation dynamic task (R)	A computerised task in which participants move a red and a blue dot toward a specific destination. The program sets a course for the two dots that can be modified by pressing arrow buttons for each of the dots. The dependent measure is the mean deviation (in degrees) between the course of each of the moving dots at the end of the trial and the course it should have taken to reach its destination. Impulsivity is

	indexed as a high mean deviation.
Tower of London	A board presents coloured discs or beads arranged on three vertical pegs. These form a target array which the participant must try to replicate on their own board where the discs or beads are arrayed differently across the three pegs. Measures include preplanning time (time between seeing the discs and making the first move), errors on the first move, average move time (time spent on executing the plan), trials solved in the minimum number of possible moves or within a specified time limit, and excess moves (number of moves in excess of the minimum necessary to complete the task).
Intradimensional extradimensional shift	Two dimensions (colour filled shapes and white lines) are used. Simple stimuli use only one of these dimensions, whereas compound stimuli are made up of both (e.g. white lines overlaying colour-filled shapes). The subject starts by seeing two simple colour-filled shapes, and must learn which one is correct by touching it. Through feedback, the respondent learns which stimulus is correct. After six correct responses, the stimuli and/or rules are changed. These shifts are initially intra-dimensional (e.g. colour-filled shapes remain the only relevant dimension), then extra-dimensional (white lines become the only relevant dimension). The test has a number of outcome measures (including errors, and numbers of trials and stages completed) which index impulsivity.

Delay discounting
The participant makes a series of dichotomous choices between a 'standard' (e.g. $10 available after one of six delays: 0, 7, 30, 90, 180, 365 days) and an 'alternative' sum of money available immediately (e.g. 23 values between $0.01 and $10.50), resulting, in this case, in 137 choices. The choices are presented in random order. The *indifference point* or *switch point* (the point at which the participant prefers the immediate to the delayed reward) is determined for each level of the standards. This can be used to calculate k, the rate at which the standard of $10 is discounted as a function of delay. Impulsive individuals show lower switch points and a higher value of k (a steeper rate of discounting) than less impulsive individuals. Variations on this task include probability discounting task (which uses probabilistic rather than delayed rewards) and the experiential delay task (in which participants choose between a probabilistic delayed sum and a smaller sum that is immediate and certain).
The Iowa Gambling Task
The participant is shown four decks of cards. Each card informs them of a win, or a simultaneous win and loss of money. Two 'disadvantageous' card decks (A and B) yield high monetary rewards but higher occasional losses. Two 'advantageous' decks (C and D) yield low rewards but lower occasional penalties. Impulsive individuals continue to choose from the disadvantageous decks despite the long-term loss to which this strategy leads. The outcome measure is normally the number of draws from

disadvantageous packs (A and B) subtracted from advantageous packs (C and D). This is taken as a measure of impulsivity manifest in a preference for short–term gains in spite of long-term losses.
The Balloon Analogue Risk Task (BART)
A computer screen shows a balloon and pump. Each click on the pump inflates the balloon and, with each pump, 5 cents are earned in an invisible temporary reserve. Participants are told that at some point each balloon will explode. When a balloon is pumped past its explosion point, an audible "pop" signals that all the money in the temporary reserve is lost. At any point during a trial, the participant can stop pumping the balloon and transfer the money in the reserve to the permanent bank. After each balloon explosion or money transfer, a new balloon appears. The dependent measure is normally the average number of pumps excluding balloons that exploded (i.e., the average number of pumps on each balloon prior to money collection). This reflects a tendency to continue with balloon inflation despite the risk of losing the money already won on that trial.

Table 3

Summary statistics for all samples included in the analysis

Category	k	Male N	Female N
Age			
11-15	34	13215	14032
15-18	42	21395	22333
18-21	84	12492	18856
21-30	76	8964	11516
30-40	29	5239	7489
40 +	19	3605	4050
Age not specified/wide age range	26	2911	3400
Geographical area			
US, Canada, & Central America	184	41467	46807
UK, Europe, Australia & New Zealand	115	23525	31838
Asia, Africa, & Middle East	11	2830	3030
Population			
Schools (up to age 18)	51	29264	30019
University/College students	147	17203	27107
Community	89	16073	18388
Mixed/not specified	23	5282	6162
Publication status			
Published	275	61220	74898
Unpublished	35	6601	6777
Domain			
General measures of impulsivity	206	50805	62428

Category	k	Male N	Female N
Specific measures of impulsivity	62	7873	10891
Sensation seeking and risk taking	130	23402	28914
Reward sensitivity	18	2380	3598
Punishment sensitivity	19	2698	4212
Behavioural measures	50	3746	3753
Grand total	310	67821	81675

Note: k = number of samples

Table 4

Sex differences (d) in measures of reward sensitivity

Measure	*d*	95% CI	*k*	N men	N women	*Q*	VR (*k*)
SPSRQ/GRAPES							
All studies	.42	.33/.52	9	1091	2443	13.57	1.05 (9)
Computed only[a]	.44	.36/.53	8	1068	2358	9.83	
TPQ/TCI Reward Dependence							
All studies	-.56	-.68/-.44	4	437	841	2.22	1.08 (4)
BAS Total							
All studies	-.13	-.38/.12	4	420	537	9.13*	0.80 (4)
BAS Drive							
All studies	.06	-.04/.15	9	1201	1372	9.19	0.96 (9)
BAS Fun							
All studies	.08	-.01/.17	9	1201	1372	8.71	1.08 (9)
BAS Reward							
All studies	-.27	-.41/-.13	9	1201	1372	19.35*	0.95 (9)
Total of reward sensitivity measures							
All studies	.01	-.17/.19	18	2380	3598	340.90***	
Computed only[a]	.01	-.18/.20	17	2357	3513	340.86***	1.03 (44)

Note: Effect sizes are in the male direction if positive and in the female direction if negative.

[a]Removed: Avila & Parcet (2000)

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

d = mean effect size weighted by sample size; CI = confidence interval; *k* = number of samples; *Q* = homogeneity statistic; VR (*k*) = mean variance ratio (number of sample sizes from which variance ratios could be calculated)

Table 5

Sex differences (d) in measures of punishment sensitivity

Category	*d*	CI	*k*	N men	N women	*Q*	VR (*k*)
SPSRQ/GRAPES							
All studies	-.11	-.23/.00	9	1136	2563	18.50*	0.97 (9)
Computed only[a]	-.12	-.24/.01	8	1113	2478	18.31*	
TPQ/TCI Harm avoidance							
All studies	-.43	-.52/-.33	5	784	1391	4.43	1.08 (4)
BIS of BIS/BAS							
All studies	-.63	-.74/-.52	8	1026	1197	8.65	1.14 (8)
Total of punishment sensitivity measures							
All studies	-.32	-.45/-.19	18	2598	4091	119.46***	1.05 (21)
Computed only[a]	-.33	-.47/-.20	17	2575	4006	117.63***	

Note: Effect sizes are in the male direction if positive and in the female direction if negative.

[a]Removed: Avila & Parcet (2000)

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

d = mean effect size weighted by sample size; CI = confidence interval; *k* = number of samples; *Q* = homogeneity statistic; VR (*k*) = mean variance ratio (number of sample sizes from which variance ratios could be calculated)

Table 6

Sex differences (d) in measures of sensation seeking and risk-taking

Measure	*d*	95% CI	*K*	N men	N women	*Q*	VR (*k*)
Eysenck Venturesomeness							
All studies	.49	.43/.56	49	7443	10553	160.99 ***	0.91* (41)
Computed only[a]	.51	.44/.57	47	7349	10395	146.80 ***	0.91* (41)
Outliers removed[b]	.53	.47/.59	45	7267	10232	118.02***	0.91* (39)
SSS Total							
All studies	.48	.41/.56	22	2563	3072	31.56	0.95 (17)
Computed only[c]	.50	.43/.56	21	2541	2992	27.36	0.95 (17)
SSS Thrill & Adventure Seeking							
All studies	.41	.29/.54	16	2761	3498	69.39 ***	0.85 (14)
SSS Experience Seeking							
All studies	.01	-.11/.12	10	1406	2021	18.27*	1.04(8)
Computed only[d]	.01	-.11/.12	9	1385	1998	18.27*	1.04(8)
SSS Disinhibition							
All studies	.52	.40/.65	15	2286	3007	52.02***	1.26 (13)
Computed only[d]	.54	.42/.66	14	2265	2984	48.73 ***	1.26 (13)
Outliers removed[e]	.57	.46/.69	13	2204	2965	38.93 ***	1.37** (12)
SSS Boredom Susceptibility							
All studies	.20	.09/.31	14	1922	2764	36.58***	1.07 (11)
UPPS Sensation Seeking							
All studies	.48	.33/.63	15	1566	2284	62.44 ***	0.95 (11)
Computed only[f]	.49	.34/.65	14	1552	2262	60.39 ***	

Dickman Functional Impulsivity							
All studies	.24	.08/.39	11	935	1346	27.59 **	1.04 (9)
ZKPQ Impulsive Sensation Seeking							
All studies	.19	-.22/.60	4	623	706	58.30 ***	1.21(4)
KSP Monotony Avoidance							
All studies	.15	-.00/.29	4	269	510	0.27	0.85 (4)
MPQ/PRF Harm Avoidance							
All studies	-.78	-.92/-.64	3	334	528	0.11	0.91 (3)
Risk Taking							
All studies	.36	.29/.44	11	3739	3330	25.66*	
Computed only[g]	.38	.31/.44	10	3659	3250	20.00	1.10* (7)
Sensation Seeking Other Measures							
All studies	.21	.11/.30	24	5694	6748	236.92***	1.08 (23)
Computed only[h]	.22	.13/.32	22	5432	6428	229.67***	
Total of sensation seeking measures[i]							
All studies	.39	.35/.43	130	23402	28914	578.23***	0.99 (169)
Computed only[j]	.41	.37/.45	125	22952	28334	607.19***	
Outliers removed[k]	.41	.37/.45	123	22815	28154	274.42***	1.00 (164)

Note: Effect sizes are in the male direction if positive and in the female direction if negative.

[a]Removed: Leshem & Glicksohn (2007); Reynolds et al. (2006a).

[b]Removed (in order): Clarke (2004); Rim (1994).

[c]Removed: Lennings (1991)

[d]Removed: Lundahl (1995)

[e]Removed: Curran (2006)

[f]Removed: Verdejo-Garcia et al. (2007)

[g]Removed: Sahoo (1985)

[h]Removed: Lennings (1991); Overman et al. (2004)

[i]Includes MPQ/PRF Harm Avoidance, reverse scored

[j]Removed: Lennings (1991); Leshem & Glicksohn (2007); Lundahl (1995); Overman et al. (2004); Reynolds et al (2006a); Sahoo (1985); Verdejo-Garcia et al. (2007).

[k]Removed (in order): Copping (2007); Curran (2006: Sensation Seeking Scale - Experience Seeking and Boredom Susceptibility; ZKPQ Impulsive Sensation Seeking); Lundahl (1995: Sensation Seeking Scale – Thrill and Adventure Seeking); McAllister et al. (2005); Weyers et al. (1995: age 27: TPQ Novelty Seeking).

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

d = mean effect size weighted by sample size; CI = confidence interval; *k* = number of samples; *Q* = homogeneity statistic; VR (k′) = mean variance ratio (number of effects from which variance ratios could be calculated).

Table 7

Sex differences (d) in general measures of impulsivity

Measure	*d*	95% CI	*K*	N men	N women	*Q*	VR (*k*)
Eysenck Impulsiveness							
All studies	.03	-.00/.07	100	14425	19680	222.72***	1.00 (74)
Computed only[a]	.04	-.00/.08	88	13603	18768	222.27***	1.00 (74)
Outliers removed[b]	.03	-.01/.07	82	13427	18584	183.63***	0.97 (68)
BIS Total							
All studies	.11	.05/.16	58	6296	8452	115.14***	0.99 (42)
Computed only[c]	.12	.06/.19	48	5729	7561	110.68***	0.99 (42)
Outliers removed[d]	.12	.06/.18	47	5702	7548	105.88***	1.01 (41)
KSP Impulsivity							
All studies	-.06	-.19/.07	7	826	4452	8.83	0.79* (5)
Computed only[e]	-.06	-.21/.10	5	789	4318	8.38	0.79* (5)
Impulsivity Other Measures							
All studies	.12	.07/.17	54	30040	31403	345.60***	1.02 (38)
Computed only[f]	.13	.08/.19	47	29379	30575	344.99***	1.02 (38)
Outliers removed[g]	.14	.08/.19	46	29354	30535	338.78***	1.02 (38)
Total of general impulsivity measures							
All studies	.07	.05/.10	206	50805	62428	244.52***	1.00 (159)
Computed only[h]	.08	05/.11	180	48862	59859	359.28***	
Outliers removed[i]	.08	.05/.11	173	48688	59683	131.42*	0.98 (153)

Note: Effect sizes are in the male direction if positive and in the female direction if negative.

[a]Removed: Allen et al. (1998); Brown et al. (2006); Deffenbacher et al. (2003); Doran et al. (2007a); Keilp et al. (2005); Ketzenberger & Forrest (2000); Leshem & Glicksohn (2007); Reynolds et al. (2006a); Reynolds et al. (2007); Van den Broek et al. (1992).

[b]Removed (in order): Weyers et al. (1995: age 50); Saklofske & Eysenck (1983: age 15); Weller (2001); Starrett (1983: Senior high); Corr et al. (1995); Lopez Viets (2001).

[c]Removed: Allen et al. (1998); Chung & Martin (2002); Dinn et al. (2002); Hulsey (2000); Jack & Ronan (1998); Leshem & Glicksohn (2007); Nagoshi et al. (1994); Neubauer (1992); Patock-Peckham et al. (1998); Reynolds et al. (2006a); Rigby et al. (1992); Van den Broek et al. (1992).

[d]Removed: Clark et al. (2005).

[e]Removed: Lennings (1991); Lennngs & Burns (1998).

[f]Removed: Allen et al. (1998); Bembenutty & Karabenick (1998); McMahon & Washburn (2003); Overman et al. (2004); Plouffe & Grawelle (1989); Rhyff et al. (1983); Schweizer (2002).

[g]Removed: Malle & Neubauer (1991).

[h]Removed: Allen et al. (1998); Bembenutty & Karabenick (1998); Brown et al. (2006); Chung & Martin (2002); Deffenbacher et al (2003); Dinn et al. (2002); Doran et al. (2007a); Hulsey (2000); Jack & Ronan (1998); Keilp et al. (2005); Ketzenberger & Forrest (2000); Lennings (1991); Lennngs & Burns (1998); Leshem & Glicksohn (2007); McMahon & Washburn (2003); Nagoshi et al. (1994); Neubauer (1992); Overman et al. (2004); Patock-Peckham et al. (1998); Plouffe & Grawelle (1989); Reynolds et al. (2006a); Reynolds et al. (2007); Rhyff et al. (1983); Rigby et al. (1992); Schweizer (2002); Van den Broek et al. (1992).

[i]Removed (in order): Weyers et al. (1995; 50-year olds); Clark et al. (2005); Saklofske & Eysenck (1983: 15-year olds); Malle & Neubauer (1991); Weller (2001); Starrett (1983: Senior High sample); Corr et al. (1995).

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

d = mean effect size weighted by sample size; CI = confidence interval; *k* = number of samples; *Q* = homogeneity statistic; VR (k′) = mean variance ratio (number of effects from which variance ratios could be calculated).

Table 8

Sex differences (d) in measures of specific forms of impulsivity

Category	d	95% CI	k	N men	N women	Q	VR (k)
BIS Cognitive							
All studies	.13	.00/.26	18	1776	2372	56.79***	0.92 (16)
BIS Motor							
All studies	.08	-.00/.17	19	2990	3620	34.09*	1.04 (13)
BIS Non-planning							
All studies	.15	.06/.24	20	3187	3839	43.31 **	0.96 (17)
UPPS Perseverance							
All studies	.05	-.07/.17	14	1449	2111	34.27**	0.93 (12)
Computed only[a]	.05	-.08/.17	13	1435	2089	34.26***	
UPPS Premeditation							
All studies	-.01	-.08/.06	14	1449	2111	7.77	1.06 (12)
Computed only[a]	-.01	-.08/.06	13	1435	2089	7.77	
Outliers removed[b]	-.00	-.07/.07	12	1423	2031	3.40	1.00 (11)
UPPS Urgency							
All studies	-.10	-.19/-.01	14	1449	2111	19.15	.94 (12)
Computed only[a]	-.10	-.19/-.01	13	1435	2089	19.06	
Dickman Dysfunctional Impulsivity							
All studies	.12	.02/.23	12	1107	1518	16.58	.91 (10)
Impulse Control							
All studies	.02	-.22/.25	11	1303	1767	92.15***	0.85 (9)
Computed only[c]	.02	-.23/.26	10	1277	1743	92.09***	

Category	d	95% CI	k	N men	N women	Q	VR (k)
Social Problem Solving Inventory (SPSI)							
All studies	.23	.09/.37	6	990	1850	11.37*	1.05 (5)
Computed only[d]	.32	.23/.41	5	869	1199	2.80	

Note: Effect sizes are in the male direction if positive and in the female direction if negative.

[a]Removed: Verdejo-Garcia et al. (2007).

[b]Removed: Anestis et al. (2007).

[c]Removed: Fox et al. (2007).

[d]Removed: Maydeu-Olivares et al. (2000)

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

d = mean effect size weighted by sample size; CI = confidence interval; *k* = number of samples; *Q* = homogeneity statistic; VR (*k*) = mean variance ratio (number of sample sizes from which variance ratios could be calculated)

Table 9

Sex differences (d) in behavioural measures of impulsivity

Category	d	95% CI	k	N men	N women	Q	VR (k′)
Executive response inhibition							
All studies	.13	-.04/.30	19	863	974	84.54***	0.94 (19)
Computed values only[a]	.21	-.06/.48	10	592	647	83.21***	0.94 (19)
Visual-cognitive tasks							
All studies	-.20	-.37/-.04	7	1558	1408	172.46***	0.92 (8)
Computed values only[b]	-.26	-.43/-.08	6	1499	1285	156.43***	0.92 (8)
Iowa Gambling Task							
All studies	-.19	-.35/-.03	7	602	725	15.56*	-
Computed values only[c]	-.34	-.48/-.20	4	380	420	4.31	-
Delay Discounting							
All studies	-.08	-.19/.02	21	905	882	40.52	0.95 (17)
Computed values only[d]	-.07	-.22/.07	15	783	751	39.70*	0.95 (17)
BART							
All studies	.30	.11/.49	10	265	311	21.12*	1.37 (3)
Computed values only[e]	.36	.16/.57	8	220	266	18.93*	1.37 (3)

Note: Effect sizes are in the male direction if positive and in the female direction if negative.

[a]Removed: Acheson et al. (2007); Brown et al. (2006); de Wit et al. (2002); Feldman (1999); Keilp et al. (2005); Marczinski et al. (2007); Reynolds et al. (2006a); Tinius (2003); Walderhaug (2007).

[b]Removed: Leshem & Glicksohn (2007).

[c]Removed: Davis et al. (2007); Goudriaan et al. (2007); Jollant et al. (2005).

[d]Removed: Acheson et al (2007); Allen et al. (1998); de Wit et al. (2002); Kollins (2003).

[e]Removed: Acheson et al (2007); Reynolds (2003); Reynolds et al. (2004); Reynolds et al. (2006a).

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

d = mean effect size weighted by sample size; CI = confidence interval; *k* = number of samples; *Q* = homogeneity statistic; VR (k′) = mean variance ratio (number of effects from which variance ratios could be calculated).

Table 10

Categorical analysis of all measures, grouped by domain

Measure and category	d (95% CI)	Q_w	k	Q_B
		General Impulsivity Measures		
Eysenck Impulsiveness				
Age				12.77*
10-15 years	.07 (-.01/.15)	13.88	12	
15-18 years	.06 (-.09/.20)	40.90 ***	11	
18-21 years	.03 (-.02/.09)	45.51*	27	
21-30 years	.09 (.02/.16)	37.52*	23	
30-40 years	-.06 (-.34/.23)	14.14 **	5	
40+ years	-.21 (-.37/-.05)	7.79	5	
BIS Total				
Geographical Area				6.71*
US, Canada & Central America	.18 (.09/.26)	68.46 ***	32	
UK, Europe & Aus/NZ	.05 (-.04/.13)	17.01	13	
Asia, Africa, Middle East	.04 (-.03/.11)	0.64	3	
KSP Impulsivity				
Population				7.26 **
University Students	.07 (-.09/.23)	0.86	4	
Community	-.18 (-.27/-.09)	0.69	2	
Geographical area				6.56*
US, Canada & Central America	.09 (-.09/.26)	0.69	2	
UK, Europe & Aus/NZ	-.17 (-.25/-.08)	1.59	5	

Measure and category	d (95% CI)	Q_W	k	Q_B
	Specific Measures of Impulsivity			
BIS Non-planning				
Geographical Area				17.26 ***
US, Canada & Central America	.30 (.20/.40)	11.11	11	
UK, Europe & Aus/NZ	.02 (-.07/.11)	7.80	8	
UPPS Perseverence				
Age				13.99 **
15-18 years	-.03 (-.16/.11)	0.48	2	
18-21 years	-.01 (-.18/.15)	15.12*	7	
UPPS Urgency				
Population				6.85**
University Students	-.03 (-.14/.07)	10.38	9	
Schools (up to age 18)	-.26 (-.14/.07)	0.18	2	
Age				15.62 ***
15-18 years	-.31 (-.45/-.17)	0.56	2	
18-21 years	.02 (-.07/.12)	1.88	7	
21-30 years	-.14 (-.32/.04)	0.41	3	
Geographical area				6.66*
US, Canada & Central America	-.04 (-.14/.07)	10.42	9	
UK, Europe & Aus/NZ	-.24 (-.36/-.12)	0.85	4	
Sex of first author				5.93*
Female	-.02 (-.14/.10)	9.55	7	
Male	-.22 (-.33/-.11)	1.71	6	

Measure and category	d (95% CI)	Q_w	k	Q_B
Impulse control				
Age				21.98 ***
15-18 years	.00 (-.74/.74)	26.33 ***	2	
18-21 years	.40 (.27/.54)	2.43	3	
21-30 years	-.17 (-.36/.03)	0.36	2	
Geographical Area				9.18 **
US, Canada & Central America	.17 (-.02/.35)	32.40 ***	8	
UK, Europe & Aus/NZ	-.55 (-.98/-.13)	4.19*	2	
Sensation Seeking and Risk-taking				
I7 Venturesomeness				
Age				26.12 ***
10-15 years	.46 (.35/.58)	18.84*	9	
15-18 years	.63 (.44/.81)	0.82	3	
18-21 years	.54 (.43/.65)	27.99 **	11	
21-30 years	.46 (.33/.58)	51.37 ***	60	
30-40 years	.84 (.70/.98)	1.33	3	
40+	.37 (.21/.53)	4.29	4	
Reward and Punishment Sensitivity				
BAS Reward				
Age				9.75**
18-21 years	-.16 (-.29/-.04)	6.35	5	
21-30 years	-.54 (-.73/-.34)	0.02	2	

Measure and category	d (95% CI)	Q_w	k	Q_B
Behavioural Measures of Impulsivity				
BART				
Age				6.65*
10-15 years	.43 (.02/.85)	1.15	2	
18-21 years	.57 (.30/.85)	0.12	3	
21-30 years	.02 (-.30/.34)	0.65	3	
Executive Response Inhibition				
Population				17.37 ***
Community	-.17 (-.40/.06)	0.82	4	
Schools (up to age 18)	.62 (.46/.78)	7.58	4	
University Students	.05 (-.18/.28)	0.35	2	
Age				30.69 ***
10-15 years	.71 (.51/.92)	0.22	2	
15-18 years	.32 (-.36/1.01)	5.34*	2	
21-30 years	-.19 (-.44/.05)	0.47	3	

Note: Only significant moderators are shown.

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

Q_W = total within-group variance. Q_B = variance between contrasted categories.

Table 11

Evaluation of evidence for publication bias using moderator analysis by publication status and rank correlation between standard error and effect size.

Domain/measure	Effect size (95% CI) by publication status					Rank Correlation[a]	k	Evidence for publication bias
	Published	K	unpublished	k	Q_B			
General impulsivity								
Whole domain	.07 (.04/.10)	159	.14 (.04/.25)	21	1.61	0.01 (p = .45)	180	None
I7 Impulsiveness	.03 (-.01/.08)	80	.11 (-.04/.26)	8	0.92	0.02 (p = .39)	88	None
BIS Total	.12 (.06/.19)	44	.06 (-.13/.25)	4	0.43	0.10 (p = .16)	48	None
Impulsivity Other Measures	.12 (.06/.18)	38	.19 (.04/.34)	9	0.67	-0.01 (p = .44)	47	None
Specific measures of Impulsivity								
BIS Non-planning	Insufficient studies for analysis by group					0.06 (p = .36)	20	None
Sensation Seeking and Risk-Taking								
Whole domain	.39 (.34/.44)	107	.37 (.22/.53)	17	0.05	-0.05 (p = .20)	127	None
I7 Venturesomeness	.51 (.44/.57)	44	.58 (.03/1.13)	3	0.07	-0.01 (p = .45)	49	None
SSS Total	.52 (.44/.60)	16	.45 (.31/.60)	4	0.64	-0.09 (p = .29)	20	None
Sensation Seeking Other Measures	Insufficient studies for analysis					-0.09 (p = .26)	23	None

Domain/measure	Effect size (95% CI) by publication status					Rank Correlation[a]	k	Evidence for publication bias
	Published	K	unpublished	k	Q_B			
Reward Sensitivity	Categories too small to evaluate							
Punishment Sensitivity	Categories too small to evaluate							
Behavioural Measures	Categories too small to evaluate							

[a]Gives the rank order correlation between standard error and effect size. All p values are one-tailed.

Appendix 1:

List of all effect sizes included in the analysis by study, category and domain.

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Acheson et al (2007)	B	0_a		10	10	4	1	0	1	1	3
Acheson et al (2007)	B	0_a		10	10	4	1	0	1	1	15
Acheson et al (2007)	B	0_a		10	10	4	1	0	1	1	39
Aklin et al (2005)	B	0.22		26	25	1	1	0	1	1	3
Aklin et al (2005)	B	0.20		26	25	1	1	0	1	1	27
Allen et al (1998)	B	0_a		16	10	4	1	0	1	1	15
Baker et al (2003)	B	-0.31		51	39	5	1	0	1	1	15
Bare (2006)	B	-0.41		41	51	4	1	0	0	0	3
Bare (2006)	B	0.24		41	51	4	1	0	0	0	3
Berlin et al (2005)	B	0.61	2.21	10	29	6	0	0	1	1	38

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Berlin et al (2005)	B	0.03	1.51	10	29	6	0	0	1	1	38
Berlin et al (2005)	B	-0.34	0.60	10	29	6	0	0	1	1	38
Berlin et al (2005)	B	-0.11	0.47	10	29	6	0	0	1	1	38
Bjork et al (2004)	B	0.32		27	14	5	1	0	1	1	15
Brown et al (2006)	B	0_a		21	37	6	0	0	1	1	39
Casillas (2006)	B	0.26		84	125	4	1	0	1	0	27
Casillas (2006)	B	-0.35		84	125	4	1	0	1	0	38
Casillas (2006)	B	-0.47		84	125	4	1	0	1	0	39
Casillas (2006)	B	-0.04		84	125	4	1	0	1	0	39
Casillas (2006)	B	-0.24		84	125	4	1	0	1	0	39
Clark et al (2005)	B	-0.20	2.97	27	13	4	1	1	1	1	39
Clark et al (2005)	B	-0.16	0.12	27	13	4	1	1	1	1	39
Davis et al (2007)	B	0_a		81	164	5	0	0	1	1	27
de Wit et al (2007)	B	-0.21	1.41	303	303	6	0	0	1	1	15

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
de Wit et al (2002)	B	0_a		18	18	4	0	0	2	1	15
de Wit et al (2002)	B	0_a		18	18	4	0	0	2	1	15
de Wit et al (2002)	B	0_a		18	18	4	0	0	2	1	39
de Wit et al (2002)	B	0_a		18	18	4	0	0	2	1	39
Enticott et al (2006)	B	0.56	2.82	14	17	5	1	1	1	1	39
Enticott et al (2006)	B	-0.36	0.67	14	17	5	1	1	1	1	39
Enticott et al (2006)	B	-0.17	0.62	14	17	5	1	1	1	1	39
Enticott et al (2006)	B	0.24	1.89	14	17	5	1	1	1	1	39

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Enticott et al (2006)	B	-0.11	1.00	14	17	5	1	1	1	1	39
Epstein, Erkanli, et al (2003)	B	0.66	0.97	84	94	1	1	0	3	1	39
Epstein, Erkanli, et al (2003)	B	0.64	0.72	98	97	2	1	0	3	1	39
Epstein, Erkanli, et al (2003)	B	0.76	0.67	115	89	1	1	0	3	1	39
Epstein, Richards, et al (2003)	B	0.11		32	46	5	1	0	1	1	15
Epstein, Richards, et al (2003)	B	0.31		32	46	5	1	0	1	1	15
Feldman (1999)	B	-0.47		92	108	3	1	0	0	0	38
Feldman (1999)	B	-0.44		92	108	3	1	0	0	0	38
Feldman (1999)	B	0		92	108	3	1	0	0	0	38

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Feldman (1999)	B	0		92	108	3	1	0	0	0	39
Gargallo (1993)	B	0.06	1.07	107	94	1	1	1	3	1	38
Gargallo (1993)	B	0	0.82	107	94	1	1	1	3	1	38
Goudriaan et al (2007)	B	0_a		100	100	3	0	0	0	1	27
Heerey et al (2007)	B	-0.60	0.69	12	17	6	0	1	1	1	15
Herba et al (2006)	B	-0.47	1.32	29	28	2	0	1	3	1	39
Herba et al (2006)	B	0.07	0.66	29	28	2	0	1	3	1	39
Herba et al (2006)	B	-0.08	0.39	29	28	2	0	1	3	1	39
Herba et al (2006)	B	-0.06	1.78	28	28	2	0	1	3	1	39
Herba et al (2006)	B	0.22	1.42	28	28	2	0	1	3	1	39
Hunt et al (2005)	B	0.52	1.23	22	58	3	0	0	0	1	3
Johnson et al (2007)	B	-0.10	1.65	17	13	5	1	0	1	1	15
Johnson et al	B	0.66	1.63	17	13	5	1	0	1	1	15

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(2007)											
Johnson et al (2007)	B	-0.04	1.28	17	13	5	1	0	1	1	15
Johnson et al (2007)	B	0.71	1.19	17	13	5	1	0	1	1	15
Johnson et al (2007)	B	0.41	1.07	17	13	5	1	0	1	1	15
Johnson et al (2007)	B	0.24	0.98	17	13	4	1	0	1	1	15
Johnson et al (2007)	B	-0.23	0.81	17	13	5	1	0	1	1	15
Johnson et al (2007)	B	-0.14	0.38	17	13	4	1	0	1	1	15
Johnson et al (2007)	B	-0.37	0.29	17	13	4	1	0	1	1	15
Jollant et al	B	0[a]		41	41	0	1	1	1	1	27

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(2005)											
Keilp et al (2005)	B	0_a		21	37	5	1	0	1	1	39
Kirby & Petry (2004)	B	0.02	1.27	33	27	5	1	0	1	1	15
Kirby et al (2002)	B	-0.23		72.5	72.5	0	1	0	1	1	15
Kirby et al (2002)	B	-0.16		72.5	72.5	0	1	0	1	1	15
Kirby et al (2002)	B	-0.17		73	81	3	1	0	0	1	15
Kollins (2003)	B	0_a		14	28	3	1	0	0	1	15
Lejuez et al (2002)	B	0.63		43	43	3	1	0	1	1	3
Lejuez et al (2003)	B	0.47		30	30	3	1	0	0	1	3
Lejuez et al (2003)	B	0.49		30	30	3	1	0	0	1	3
Lejuez et al (2003)	B	0.68		30	30	3	1	0	0	1	3

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Lejuez et al (2003)	B	-0.72		30	30	3	1	0	0	1	27
Lejuez et al (2003)	B	-0.68		30	30	3	1	0	0	1	27
Lejuez et al (2003)	B	-0.49		30	30	3	1	0	0	1	27
Leshem & Glicksohn (2007)	B	0_a		59	123	0	1	2	3	1	38
Leshem & Glicksohn (2007)	B	0_a		59	123	0	1	2	3	1	38
Leshem & Glicksohn (2007)	B	0_a		59	123	0	1	2	3	1	38
Leshem & Glicksohn (2007)	B	0_a		59	123	0	1	2	3	1	38
Maras et al (2006)	B	0.64		29	27	1	0	1	3	1	3
Marczinski et al	B	0_a		16	16	4	0	0	0	1	39

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(2007)											
Mcleish & Oxoby (2007)	B	-0.43	1.16	50	32	3	0	0	0	1	15
Mcleish & Oxoby (2007)	B	-0.59	0.77	50	32	3	0	0	0	1	15
Mcleish & Oxoby (2007)	B	0.14	0.59	50	32	3	0	0	0	1	15
Overman et al (2004)	B	0.35		240	240	0	1	0	2	1	27
Paaver et al (2007)	B	-0.07	1.35	222	261	2	0	1	1	1	38
Petry et al (2002)	B	0.61		32	32	4	0	0	1	1	15
Quiroga et al (2007)	B	0.02		984	668	4	0	1	1	1	38
Quiroga et al (2007)	B	-0.79	0.48	984	668	4	0	1	1	1	38

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Reynolds (2003)	B	0_a		35	40	2	1	0	3	0	15
Reynolds et al (2004)	B	0_a		29	25	3	1	0	1	1	15
Reynolds et al (2004)	B	0_a		29	25	3	1	0	1	1	15
Reynolds, Ortengren, et al (2006)	B	0_a		35	35	4	1	0	1	1	3
Reynolds, Ortengren, et al (2006)	B	-0.26	1.24	35	35	4	1	0	1	1	15
Reynolds, Ortengren, et al (2006)	B	0_a		35	35	4	1	0	1	1	39
Reynolds,	B	0_a		35	35	4	1	0	1	1	39

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Ortengren, et al (2006)											
Reynolds, Richards, et al (2006)	B	0.19	2.20	11	13	4	1	0	1	1	3
Reynolds, Richards, et al (2006)	B	0.24	0.28	11	13	4	1	0	1	1	15
Reynolds, Richards, et al (2006)	B	-0.12	1.77	11	13	4	1	0	1	1	39
Reynolds, Richards, et al (2006)	B	-0.41	0.38	11	13	4	1	0	1	1	39

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Stoltenberg et al (2006)	B	0.11	0.85	80	98	4	1	0	0	1	39
Taylor (2005)	B	-0.03	1.72	50	73	0	0	0	0	1	39
Tinius (2003)	B	0_a		19	22	0	1	0	1	1	39
Walderhaug (2007)	B	0_a		39	44	4	1	1	1	1	39
White et al (2007)	B	0.18	0.96	18	19	4	0	0	1	1	3
Abramowitz & Berenbaum (2007)	GI	-0.14		66	123	3	0	0	0	1	29
Adams et al (1997)	GI	0.07	1.19	420	489	1	0	0	2	1	10
Aidman & Kollaras-Mitsinikos (2006)	GI	-0.11	0.32	10	14	5	1	1	1	1	4
Aklin et al (2005)	GI	-0.10		26	25	1	1	0	1	1	4

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Alexander et al (2004)	GI	0.47	0.98	82	87	2	0	1	0	1	10
Allen et al (1998)	GI	0[a]		16	10	4	1	0	1	1	4
Allen et al (1998)	GI	0[a]		16	10	4	1	0	1	1	10
Allen et al (1998)	GI	0[a]		16	10	4	1	0	1	1	29
Alter (2001)	GI	0.39	0.86	26	39	1	0	0	3	0	10
Aluja & Blanch (2007)	GI	0.10	0.94	742	1075	4	1	1	2	1	4
Anderson (1986)	GI	0.31		60	135	5	0	0	2	1	10
Antonowicz (2002)	GI	0.02	1.13	106	106	3	1	0	0	0	29
Archer & Webb (2006)	GI	0.14	0.99	88	219	4	1	1	0	1	29
Archer et al (1995)	GI	0.23	1.18	160	160	0	1	1	0	1	10
Baca-Garcia et al	GI	-0.11	0.97	193	124	0	1	1	1	1	29

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(2006)											
Baca-Garcia et al (2006)	GI	-0.05	0.95	44	37	0	1	0	1	1	29
Baca-Garcia et al (2004)	GI	-0.05	0.91	124	99	0	1	1	1	1	29
Bagge et al (2004)	GI	-0.04		156	195	2	0	0	0	1	10
Baker & Yardley (2002)	GI	0.57	1.00	193	227	2	1	0	3	1	10
Balodis et al (2007)	GI	0.14	0.76	29	37	4	0	0	0	1	29
Bare (2006)	GI	-0.08		41	51	4	1	0	0	0	29
Bazargan-Hejazi et al (2007)	GI	0.34	1.30	243	169	4	0	0	1	1	4
Bembenutty & Karabenick	GI	0[a]		148	221	3	1	0	0	1	10

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(1998)											
Berlin et al (2005)	GI	-0.12	0.73	10	29	6	0	0	1	1	29
Bjork et al (2004)	GI	0.01	1.39	27	14	5	1	0	1	1	29
Brezo et al (2006)	GI	0.40		496	648	4	0	0	1	1	29
Brown et al (2006)	GI	0[a]		21	37	6	0	0	1	1	29
Caci et al (2003b)	GI	0.11	1.15	197	364	4	1	1	0	1	4
Camatla et al (1995)	GI	-0.36	0.64	47	86	3	0	0	0	1	4
Case (2007)	GI	0.26	1.20	727	588	1	1	1	3	1	10
Caseras et al (2003)	GI	0.28	1.09	117	421	3	1	1	0	1	4
Caseras et al (2003)	GI	-0.16	0.99	117	421	3	1	1	0	1	10
Casillas (2006)	GI	-0.18		84	125	4	1	0	1	0	10
Casillas (2006)	GI	0.14		84	125	4	1	0	1	0	10

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Chabrol et al (2004)	GI	0.25		435	181	2	1	1	3	1	10
Chen et al (2007)	GI	-0.17		29	29	4	1	0	1	1	29
Chung & Martin (2002)	GI	0_a		119	54	2	0	0	1	1	4
Clark et al (2005)	GI	0.89	0.48	27	13	4	1	1	1	1	29
Clarke (2004)	GI	0.23	1.10	29	118	4	1	1	0	1	4
Clarke (2006)	GI	0.29	1.02	33	136	4	1	1	0	1	4
Clift et al (1993)	GI	-0.04	0.89	176	333	4	1	1	1	1	4
Colder & Stice (1998)	GI	-0.41		164	207	2	1	0	0	1	10
Colom et al (2007)	GI	0.07	0.67	68	67	1	1	1	3	1	10
Compton & Kaslow (2005)	GI	0.43	1.92	49	50	5	1	0	1	1	29
Cooper et al	GI	0.12		783	883	4	0	0	1	1	4

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(2000)											
Cooper et al											
(2003)	GI	0.04		981	997	2	0	0	1	1	10
Corr et al (1995)	GI	0.66	1.02	15	14	0	1	1	0	1	4
Corulla (1987)	GI	0.06	1.22	92	215	4	1	1	0	1	4
Curry & Piquero											
(2003)	GI	-0.17	1.03	286	172	3	1	0	0	1	10
Cyders et al											
(2007)	GI	0	1.62	175	175	3	0	0	0	1	10
Cyders et al											
(2007)	GI	0.14	1.31	43	165	3	0	0	0	1	10
Cyders et al											
(2007)	GI	0.14	1.19	168	147	3	0	0	0	1	10
Dahlen et al											
(2004)	GI	-0.18	0.99	67	157	3	1	0	0	1	29
Davelaar et al	GI	0.26	1.17	22	64	0	2	0	0	1	10

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(2008)											
Davelaar et al (2008)	GI	0.08	0.76	19	78	0	2	0	0	1	10
Davelaar et al (2008)	GI	0.36	0.56	20	68	0	2	0	0	1	10
Davis et al (2007)	GI	0.41	0.80	81	164	5	0	0	1	1	29
De Flores et al (1986)	GI	-0.01	1.15	94	122	3	1	1	0	1	4
Deffenbacher et al (2003)	GI	0[a]		137	233	3	1	0	0	1	29
DePasquale et al (2001)	GI	-0.06		41	55	2	1	0	0	1	4
Dhuse (2006)	GI	0.14		104	230	3	0	0	0	0	4
Diaz & Pickering (1993)	GI	-0.04	1.50	89	82	4	0	1	1	1	4
Dinn et al (2002)	GI	0[a]		28	75	3	1	0	0	1	4

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Doran, McChargue, et al (2007)	GI	0_a		87	115	3	1	0	0	1	29
Doran, Spring, et al (2007)	GI	0.39	1.94	30	30	5	1	0	2	1	29
Durante (2002)	GI	0		271	103	5	0	0	1	0	10
Enticott et al (2006)	GI	-0.20	0.83	14	17	5	1	1	1	1	29
Eysenck & Abdel-Khalik (1992)	GI	-0.11	1.02	476	486	3	0	2	0	1	4
Eysenck & Abdel-Khalik (1992)	GI	0.05	0.89	147	179	3	0	1	0	1	4
Eysenck & Jamieson (1986)	GI	0.07	0.87	523	529	1	0	0	3	1	4
Eysenck & Jamieson (1986)	GI	0.07	0.85	533	777	1	0	1	3	1	4

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Eysenck (1981)	GI	0.22	1.21	118	309	1	0	1	3	1	4
Eysenck et al (1985)	GI	-0.21	1.00	559	761	6	0	1	1	1	4
Eysenck et al (1985)	GI	0.14	0.94	383	206	4	0	1	1	1	4
Eysenck et al (1990)	GI	-0.16	0.98	239	184	5	0	1	1	1	4
Eysenck et al (1990)	GI	-0.41	0.91	175	214	5	0	1	1	1	4
Fallgatter & Herrmann (2001)	GI	0.23	0.84	12	10	6	1	1	1	1	4
Fingeret et al (2005)	GI	0.02	1.28	42	49	4	0	0	1	1	29
Flora (2007)	GI	0.22		125	263	3	0	0	0	0	10
Flory et al (2006)	GI	0.36	0.99	154	197	6	0	0	1	1	29
Ford (1995)	GI	-0.01	0.92	220	252	3	0	0	0	0	4

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Fossati et al (2001)	GI	-0.07	1.01	273	490	4	0	1	0	1	29
Fossati et al (2002)	GI	0.17	1.30	209	354	2	0	1	3	1	29
Fu et al (2007)	GI	0.04	1.04	1214	1248	3	2	2	0	1	29
Galanti et al (2007)	GI	0.54		28	65	6	0	0	1	1	29
Giancola & Parrott (2005)	GI	-0.06	0.89	164	166	4	1	0	1	1	29
Glicksohn & Nahari (2007)	GI	0.24	0.93	105	127	2	1	2	0	1	4
Glicksohn & Nahari (2007)	GI	-0.06	1.00	105	127	2	1	2	0	1	29
Grano et al (2007)	GI	-0.19	0.71	520	3808	5	1	1	1	1	28
Green (1995)	GI	0.02		48	76	4	1	0	0	0	4
Gudjonsson et al	GI	0.02	1.00	683	861	3	0	1	2	1	4

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(2006)											
Gupta & Gupta (1998)	GI	0.47	1.29	100	100	4	0	2	0	1	4
Hawton et al (2002)	GI	-0.09	1.08	2911	2374	2	1	1	3	1	10
Heaven (1989)	GI	-0.11	0.92	69	100	2	1	1	3	1	4
Heaven (1991)	GI	-0.37	1.09	70	100	2	1	1	3	1	4
Henle (2005)	GI	0.35		70	81	4	0	0	0	1	10
Hewlett & Smith (2006)	GI	0.17	1.09	120	164	4	1	1	1	1	4
Hulsey (2001)	GI	0_a		107	99	4	1	0	0	0	4
Hunt et al (2005)	GI	0.45	0.68	22	58	3	0	0	0	1	29
Jack & Ronan (1998)	GI	0_a		119	47	4	0	1	1	1	4
Jackson & Matthews (1988)	GI	0.34	1.28	30	58	5	1	1	0	1	4

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
January (2003)	GI	0.22		34	84	3	0	0	2	0	10
Justus et al (2001)	GI	0.25	0.96	87	103	4	0	0	0	1	4
Kazemi (2007)	GI	0.42	1.73	14	24	2	0	0	0	0	29
Kazemi (2007)	GI	0.16	0.78	28	89	2	0	0	0	0	29
Keilp et al (2005)	GI	0[a]		21	37	5	1	0	1	1	29
Ketzenberger & Forrest (2000)	GI	0[a]		148	257	6	0	0	1	1	29
Kirby & Petry (2004)	GI	0.33	1.24	33	27	5	1	0	1	1	4
Klinteberg et al (1987)	GI	-0.22	0.62	29	32	2	0	1	3	1	4
Klinteberg et al (1987)	GI	-0.15	0.66	29	32	2	0	1	3	1	28
Krueger et al (2007)	GI	0.20	1.14	435.5	435.5	3	1	0	0	1	10

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Krueger et al (2007)	GI	-0.03	0.92	435.5	435.5	3	1	0	0	1	10
Krueger et al (2007)	GI	-0.03	0.87	435.5	435.5	3	1	0	0	1	10
Lejuez et al (2002)	GI	0.43		43	43	3	1	0	1	1	4
Lejuez et al (2002)	GI	0.52		43	43	3	1	0	1	1	29
Lejuez et al (2003)	GI	-0.20		30	30	3	1	0	0	1	4
Lennings (1991)	GI	0_a		22	80	4	1	1	0	1	28
Lennings & Burns (1998)	GI	0_a		15	54	4	1	1	0	1	28
Leshem & Glicksohn (2007)	GI	0_a		59	123	2	1	2	3	1	4
Leshem &	GI	0_a		59	123	2	1	2	3	1	29

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Glicksohn (2007)											
Li & Chen (2007)	GI	0.06	1.00	353	367	2	1	2	3	1	29
Lijffijit et al (2005)	GI	0.10	1.14	193	855	3	0	1	0	1	4
Llorenet & Torrubia (1988)	GI	0.22	1.12	121	61	3	1	1	0	1	4
Lopez Viets (2001)	GI	0.64	0.97	54	61	3	0	0	0	0	4
Luengo et al (1990)	GI	-0.01	1.13	55	252	4	1	1	0	1	4
Luengo et al (1990)	GI	-0.04	0.89	55	252	4	1	1	0	1	29
Lyke & Spinella (2004)	GI	0.39	1.25	32	80	4	0	0	1	1	29
Macpherson et al (1996)	GI	-0.04	0.77	22	19	0	0	0	0	1	4
Macpherson et al	GI	-0.17	0.68	22	22	0	0	0	0	1	4

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(1996)											
Magid et al (2007)	GI	0.15	0.85	111	199	3	0	0	0	1	28
Malle & Neubauer (1991)	GI	-0.61		25	40	4	1	1	0	1	10
Mallet & Vignoli (2007)	GI	-0.23	0.85	235	401	2	1	1	3	1	4
Manuck et al (1998)	GI	-0.17	0.65	59	60	6	1	0	1	1	29
McCrae & Costa (1985)	GI	-0.21	1.10	423	129	6	1	0	1	1	4
McFatter (1998)	GI	0.18	0.97	578	932	2	1	0	0	1	4
Mcleish & Oxoby (2007)	GI	-0.20	0.86	50	32	3	0	0	0	1	29
McMahon & Washburn (2003)	GI	0_a		56	100	1	0	0	3	1	10
Meadows (1995)	GI	0.24	0.70	262	336	0	1	0	0	0	10

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Mehrabian (2000)	GI	0.28		107	195	3	1	0	2	1	10
Mejia et al (2006)	GI	0.33	1.10	473	644	1	1	0	3	1	10
Molto et al (1993)	GI	-0.02	0.66	347	448	3	1	1	0	1	4
Nagoshi (1999)	GI	0.04	0.93	52	71	3	1	0	0	1	4
Nagoshi et al (1994)	GI	0_a		99	91	3	1	0	0	1	4
Neal & Carey (2007)	GI	0.23	1.11	75	131	3	1	0	0	1	4
Neal & Carey (2007)	GI	0.12	0.99	75	131	3	1	0	0	1	10
Neubauer (1992)	GI	0_a		32	81	5	1	1	0	1	4
Nietfeld & Bosme (2003)	GI	-0.41		30	29	4	1	0	0	1	4
Nower et al (2004)	GI	-0.10	1.20	101	150	3	0	0	0	0	4
Nower et al	GI	0.01	1.03	462	523	3	0	0	0	0	4

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(2004)											
Oas (1984)	GI	0.27		66	48	2	1	0	1	1	10
Overman et al (2004)	GI	0_a		240	240	3	1	0	2	1	10
Owsley (2003)	GI	-0.05	1.08	135	129	6	0	0	1	1	4
Paaver et al (2007)	GI	0.03	0.88	222	261	2	0	1	1	1	29
Patock-Peckham & Morgan-lopez (2006)	GI	0.13	0.94	215	206	2	0	0	0	1	4
Patock-Peckham et al (1998)	GI	0_a		142	222	3	0	0	0	1	4
Patton et al (1995)	GI	0.16	1.01	130	279	2	1	0	0	1	29
Pearson et al (1986)	GI	-0.10		279	290	1	1	1	3	1	4

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Peluso et al (2007)	GI	-0.21	0.53	17	34	5	1	0	1	1	29
Penas-Lledo et al (2004)	GI	0.61	1.30	49	72	1	0	1	0	1	10
Plouffe & Gravelle (1989)	GI	0_a		40	40	6	0	0	1	1	10
Pompili et al (2007)	GI	0.25	0.87	141	159	4	1	1	0	1	10
Pompili et al (2007)	GI	-0.03	0.76	141	159	4	1	1	0	1	10
Pompili et al (2007)	GI	0.18	0.82	141	159	4	1	1	0	1	29
Pontzer (2007)	GI	0.01		258	269	0	1	0	0	0	10
Ramadan & McMurran (2005)	GI	0.29	1.13	39	69	3	0	1	0	1	29
Rawlings (1984)	GI	0.06		18	17	0	1	1	0	1	4

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Reynolds, Ortengren, et al (2006)	GI	0_a		35	35	4	1	0	1	1	4
Reynolds, Ortengren, et al (2006)	GI	0_a		35	35	4	1	0	1	1	29
Reynolds, Richards, et al (2006)	GI	0.37	1.35	11	13	4	1	0	1	1	29
Reynolds et al (2007)	GI	0_a		25	26	1	1	0	1	1	29
Rhyff et al (1983)	GI	0_a		135	135	3	0	0	0	1	10
Rigby et al (1989)	GI	0.33	1.00	56	59	1	1	1	3	1	4
Rigby et al (1992)	GI	0_a		48	57	1	1	1	3	1	4
Rim (1994)	GI	-0.16	1.38	53	45	4	3	2	0	1	4
Robinson (1990)	GI	-0.26		69	125	3	1	0	0	1	4

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Romero et al (2001)	GI	0.08		435	529	2	0	1	3	1	4
Rowe et al (1995)	GI	0.41		407	425	1	1	0	1	1	10
Sahoo (1985)	GI	0.49		80	80	2	1	2	3	1	4
Saklofske & Eysenck (1983)	GI	-0.69		20	11	1	1	0	3	1	4
Saklofske & Eysenck (1983)	GI	0.09	1.08	84	76	1	1	0	3	1	4
Saklofske & Eysenck (1983)	GI	0.01	0.96	69	68	1	1	0	3	1	4
Saklofske & Eysenck (1983)	GI	0.22	0.79	61	70	1	1	0	3	1	4
Saklofske & Eysenck (1983)	GI	0.21	0.73	74	61	1	1	0	3	1	4
Sasaki & Kanachi (2005)	GI	0.32	0.90	54	40	4	1	2	0	1	10

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Schaughency et al (1994)	GI	0.16	1.41	425	413	1	0	1	1	1	10
Schwartz (2007)	GI	0.27	1.21	55	168	3	1	0	0	1	10
Schweizer (2002)	GI	0_a		26	82	4	1	1	2	1	10
Schweizer (2002)	GI	0_a		26	82	4	1	1	2	1	10
Schweizer (2002)	GI	0_a		26	82	4	1	1	2	1	10
Schweizer (2002)	GI	0_a		26	82	4	1	1	2	1	10
Sigurdsson et al (2006)	GI	-0.02	0.91	191	242	3	1	1	0	1	4
Simons & Carey (2006)	GI	0.04	1.11	272	549	3	1	0	0	1	4
Simons (2003)	GI	0.15	1.22	97	206	3	1	0	0	1	4
Simons et al (2005)	GI	0.19	1.05	253	578	3	1	0	0	1	10
Smith et al (2006)	GI	0.02	2.64	87	98	4	1	1	0	1	29
Smith et al (2006)	GI	-0.07	0.72	44	62	4	1	1	1	1	29

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Soloff et al (2003)	GI	0.24	0.90	36	21	4	1	0	1	1	29
Spence et al (1991)	GI	-0.15	0.68	183	292	3	0	0	0	1	4
Stanford et al (1995)	GI	0.12	0.88	60	154	4	1	0	0	1	29
Stanford et al (1996)	GI	0.17	1.05	278	287	2	1	0	3	1	29
Stanford et al (1996)	GI	0.34	1.04	226	356	4	1	0	0	1	29
Starrett (1983)	GI	0.67	1.18	17	28	2	1	0	3	1	4
Starrett (1983)	GI	0.17	1.03	19	46	3	1	0	0	1	4
Starrett (1983)	GI	-0.05	0.58	26	27	1	1	0	3	1	4
Stoltenberg et al (2006)	GI	-0.38	0.81	111	87	3	1	0	0	1	10
Stoltenberg et al (2006)	GI	0.61	0.78	111	87	3	1	0	0	1	10

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Stoltenberg et al (2006)	GI	0.01	0.70	111	87	3	1	0	0	1	10
Stoltenberg et al (2008)	GI	0.59	0.87	72	120	4	1	0	0	1	29
Thompson et al (2007)	GI	0	1.10	7416	7611	1	0	0	3	1	10
Torrubia et al (2001)	GI	0.03	0.96	240	491	3	1	1	0	1	4
Torrubia et al (2001)	GI	0.12	0.87	43	119	3	1	1	0	1	4
Torrubia et al (2001)	GI	-0.05	0.86	117	223	3	1	1	0	1	4
Toyer (1999)	GI	0.45	1.44	805	815	2	1	0	3	0	10
Van den Broek et al (1992)	GI	0_a		18	18	4	2	1	1	1	4
Van den Broek et	GI	0_a		18	18	4	2	1	1	1	29

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
al (1992)											
Vazsonyi et al (2006)	GI	-0.02	1.03	10041	10193	2	1	0	3	1	10
Vigil-Colet & Cordorniu-Raga (2004)	GI	0.48	1.76	16	68	4	1	1	0	1	4
Vigil-Colet (2007)	GI	-0.18	1.10	18	77	4	1	1	0	1	4
Von Knorring et al (1987)	GI	-0.04	0.88	56	81	5	1	1	1	1	28
Weller (2001)	GI	0.76		30	30	0	0	0	2	0	4
Weyers et al (1995)	GI	-0.45	1.39	40	40	4	1	1	0	1	4
Weyers et al (1995)	GI	-0.73	0.86	40	40	6	1	1	0	1	4
Wingo (2002)	GI	0.19	1.60	30	25	2	0	0	1	0	10
Zawacki (2002)	GI	-0.04		90	90	4	0	0	0	0	4

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Zimmerman et al (2004)	GI	-0.12	0.81	50	170	4	1	1	0	1	4
Zimmerman et al (2005)	GI	-0.13	0.59	26	110	4	1	1	0	1	4
Zuckerman et al (1988)	GI	-0.12	1.42	73	198	0	1	0	0	1	10
Zuckerman et al (1988)	GI	-0.13	1.00	73	198	0	1	0	0	1	10
Zuckerman et al (1988)	GI	0	0.86	73	198	0	1	0	0	1	28
Avila & Parcet (2000)	PS	0_a		23	85	3	1	1	0	1	13
Bjork et al (2004)	PS	-0.51	1.13	27	14	5	1	0	1	1	19
Caci et al (2007)	PS	-0.25	0.67	36	100	2	1	1	0	1	13
Caci et al (2007)	PS	-0.74	0.87	35	109	2	1	1	0	1	19
Caseras et al	PS	-0.11	0.97	117	421	3	1	1	0	1	13

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(2003)											
Caseras et al (2003)	PS	-0.16	0.93	117	421	3	1	1	0	1	13
Caseras et al (2003)	PS	-0.56	1.44	117	421	3	1	1	0	1	19
Caseras et al (2003)	PS	-0.44	1.05	117	421	3	1	1	0	1	36
Davis et al (2007)	PS	0.13	1.04	81	164	5	0	0	1	1	13
Li et al (2007)	PS	0.02	1.09	235	313	3	2	2	0	1	13
Nijs et al (2007)	PS	-0.18	1.13	20	24	4	0	1	1	1	19
Pang & Schultheiss (2005)	PS	-0.45	1.56	154	172	3	0	0	0	1	19
Segarra et al (2007)	PS	-0.45	0.89	79	114	3	0	1	0	1	13
Segarra et al	PS	-0.84	0.98	79	114	3	0	1	0	1	19

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(2007)											
Smillie et al (2006)	PS	-0.68	0.93	427	116	4	1	1	2	1	19
Stewart et al (2004)	PS	-0.37	1.15	347	550	3	0	1	0	1	36
Torrubia et al (2001)	PS	-0.24	1.12	96	276	3	1	1	0	1	13
Torrubia et al (2001)	PS	0.05	1.12	240	491	3	1	1	0	1	13
Torrubia et al (2001)	PS	-0.21	0.98	229	599	3	1	1	0	1	13
Uzieblo et al (2007)	PS	-0.73	1.27	167	227	3	0	1	0	1	19
van den bree et al (2006)	PS	-0.55	0.92	240	340	2	0	0	1	1	36
Weyers et al	PS	-0.38	1.19	40	40	4	1	1	0	1	36

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(1995)											
Weyers et al (1995)	PS	-0.14	1.10	40	40	6	1	1	0	1	36
Avila & Parcet (2000)	RS	0_a		23	85	3	1	1	0	1	14
Bjork et al (2004)	RS	-0.25	1.23	27	14	5	1	0	1	1	16
Bjork et al (2004)	RS	0.18	1.00	27	14	5	1	0	1	1	17
Bjork et al (2004)	RS	-0.59	0.45	27	14	5	1	0	1	1	18
Caci et al (2007)	RS	0.08	0.52	36	100	2	1	1	0	1	14
Caci et al (2007)	RS	0.09	0.92	35	109	2	1	1	0	1	16
Caci et al (2007)	RS	-0.14	1.40	35	109	2	1	1	0	1	17
Caci et al (2007)	RS	-0.42	1.26	35	109	2	1	1	0	1	18
Caseras et al (2003)	RS	0.60	1.45	117	421	3	1	1	0	1	14
Caseras et al (2003)	RS	0.53	0.86	117	421	3	1	1	0	1	14

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Caseras et al (2003)	RS	0.14	0.98	117	421	3	1	1	0	1	16
Caseras et al (2003)	RS	0.13	1.06	117	421	3	1	1	0	1	17
Caseras et al (2003)	RS	-0.11	1.18	117	421	3	1	1	0	1	18
Caseras et al (2003)	RS	-0.48	0.95	117	421	3	1	1	0	1	32
Cyders et al (2007)	RS	0.03	1.19	175	175	3	0	0	0	1	16
Cyders et al (2007)	RS	0.05	1.18	175	175	3	0	0	0	1	17
Cyders et al (2007)	RS	-0.12	0.87	175	175	3	0	0	0	1	18
Davis et al (2007)	RS	0.46	1.16	81	164	5	0	0	1	1	14
Li et al (2007)	RS	0.31	1.11	235	313	3	2	2	0	1	14

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Nijs et al (2007)	RS	-0.68	0.57	20	24	4	0	1	1	1	16
Nijs et al (2007)	RS	-0.37	0.85	20	24	4	0	1	1	1	17
Nijs et al (2007)	RS	-0.49	1.13	20	24	4	0	1	1	1	18
Nijs et al (2007)	RS	-0.70	0.72	20	24	4	0	1	1	1	31
Pang & Schultheiss (2005)	RS	0.15	1.38	154	172	3	0	0	0	1	16
Pang & Schultheiss (2005)	RS	0.15	0.98	154	172	3	0	0	0	1	17
Pang & Schultheiss (2005)	RS	0.01	1.06	154	172	3	0	0	0	1	18
Pang & Schultheiss (2005)	RS	0.15	1.12	154	172	3	0	0	0	1	31

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Segarra et al (2007)	RS	0.49	1.14	79	114	3	0	1	0	1	14
Segarra et al (2007)	RS	0.01	1.47	79	114	3	0	1	0	1	16
Segarra et al (2007)	RS	-0.11	1.08	79	114	3	0	1	0	1	17
Segarra et al (2007)	RS	-0.34	0.97	79	114	3	0	1	0	1	18
Segarra et al (2007)	RS	-0.20	0.98	79	114	3	0	1	0	1	31
Smillie et al (2006)	RS	0.14	1.18	427	116	4	1	1	2	1	16
Smillie et al (2006)	RS	0.25	0.80	427	116	4	1	1	2	1	17
Smillie et al (2006)	RS	-0.54	1.11	427	116	4	1	1	2	1	18

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Torrubia et al (2001)	RS	0.53	1.45	229	599	3	1	1	0	1	14
Torrubia et al (2001)	RS	0.45	1.12	51	156	3	1	1	0	1	14
Torrubia et al (2001)	RS	0.45	1.03	240	491	3	1	1	0	1	14
Uzieblo et al (2007)	RS	-0.02	1.07	167	227	3	0	1	0	1	16
Uzieblo et al (2007)	RS	0.04	1.52	167	227	3	0	1	0	1	17
Uzieblo et al (2007)	RS	-0.31	0.81	167	227	3	0	1	0	1	18
Uzieblo et al (2007)	RS	-0.13	1.13	167	227	3	0	1	0	1	31
van den bree et al (2006)	RS	-0.61	1.40	240	340	2	0	0	1	1	32

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Weyers et al (1995)	RS	-0.75	1.10	40	40	4	1	1	0	1	32
Weyers et al (1995)	RS	-0.38	0.94	40	40	6	1	1	0	1	32
Aklin et al (2005)	SS/RT	0.14		26	25	1	1	0	1	1	12
Alexander et al (2004)	SS/RT	0.29	1.00	82	87	2	0	1	0	1	11
Alter (2001)	SS/RT	-0.74	0.67	26	39	1	0	0	3	0	33
Aluja & Blanch (2007)	SS/RT	0.52	1.14	742	1075	4	1	1	2	1	5
Anestis et al (2007)	SS/RT	0	0.83	12	58	3	1	0	0	1	9
Bates & Labouvie (1995)	SS/RT	0.56		654	654	2	0	0	2	1	21
Bazargan-Hejazi et al (2007)	SS/RT	-0.45	1.03	243	169	4	0	0	1	1	11

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Bazargan-Hejazi et al (2007)	SS/RT	0.38	1.09	243	169	4	0	0	1	1	30
Billieux et al (2008)	SS/RT	0.46	0.88	74	76	4	1	1	2	1	9
Bjork et al (2004)	SS/RT	0.60	1.43	27	14	5	1	0	1	1	20
Bjork et al (2004)	SS/RT	0.48	1.73	27	14	5	1	0	1	1	21
Bjork et al (2004)	SS/RT	0.14	1.39	27	14	5	1	0	1	1	22
Bjork et al (2004)	SS/RT	0.34	1.12	27	14	5	1	0	1	1	23
Bjork et al (2004)	SS/RT	0.49	1.57	27	14	5	1	0	1	1	30
Caci et al (2003b)	SS/RT	0.57	1.20	197	364	4	1	1	0	1	5
Caci et al (2003a)	SS/RT	0.19	0.88	201	390	4	1	1	0	1	24
Camatla et al (1995)	SS/RT	0.64	0.67	47	86	3	0	0	0	1	5
Caseras et al (2003)	SS/RT	0.04	1.00	117	421	3	1	1	0	1	12
Casillas (2006)	SS/RT	0.61		84	125	4	1	0	1	0	9

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Casillas (2006)	SS/RT	0.32		84	125	4	1	0	1	0	20
Casillas (2006)	SS/RT	0.72		84	125	4	1	0	1	0	21
Casillas (2006)	SS/RT	0.49		84	125	4	1	0	1	0	23
Cherpitel (1993)	SS/RT	-0.54		575	575	0	0	0	4	1	11
Cherpitel (1993)	SS/RT	0.30		575	575	0	0	0	4	1	11
Cherpitel (1993)	SS/RT	0.30		575	575	0	0	0	4	1	12
Claes et al (2000)	SS/RT	0.43		159	156	6	1	1	1	1	24
Clarke (2004)	SS/RT	-0.31	1.18	29	118	4	1	1	0	1	5
Clift et al (1993)	SS/RT	0.51	0.81	176	333	4	1	1	1	1	5
Colom et al (2007)	SS/RT	0.92	1.75	68	67	1	1	1	3	1	12
Cooper et al (2003)	SS/RT	0.45		981	997	2	0	0	1	1	23
Copping (2007)	SS/RT	1.16		94	104	1	1	1	3	0	9
Corulla (1987)	SS/RT	0.54	0.90	92	215	4	1	1	0	1	5
Cross (2007)	SS/RT	0.49	1.04	127	201	4	0	1	2	0	30

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Cross (2007)	SS/RT	0.22	1.30	127	201	4	0	1	2	0	11
Cross (2008)	SS/RT	0.25	1.17	50	65	5	0	1	1	0	11
Cross (2009)	SS/RT	0.34	1.03	2261	1514	5	0	1	1	0	11
Curran (2006)	SS/RT	-0.43	0.38	61	19	5	1	0	1	0	20
Curran (2006)	SS/RT	-0.27	0.47	61	19	5	1	0	1	0	21
Curran (2006)	SS/RT	-0.60	0.53	61	19	5	1	0	1	0	22
Curran (2006)	SS/RT	-0.35	0.69	61	19	5	1	0	1	0	23
Curran (2006)	SS/RT	-0.54	0.44	61	19	5	1	0	1	0	34
Curry (2005)	SS/RT	0.54		117	173	2	0	0	1	0	9
Cyders et al (2007)	SS/RT	-0.02	1.07	175	175	3	0	0	0	1	9
Cyders et al (2007)	SS/RT	0.52	0.72	43	165	3	0	0	0	1	9
Cyders et al (2007)	SS/RT	0.51	0.64	168	147	3	0	0	0	1	9
d'Acrement & Van	SS/RT	0.70	0.80	314	314	2	1	1	3	1	9

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Der Linden (2005)											
Dahlen et al (2005)	SS/RT	0.54	0.97	67	157	3	1	0	0	1	12
Dahlen et al (2005)	SS/RT	0.14	0.96	67	157	3	1	0	0	1	12
DePasquale et al (2001)	SS/RT	0.70		41	55	2	1	0	0	1	5
Dhuse (2006)	SS/RT	0.70		104	230	3	0	0	0	0	5
Diaz & Pickering (1993)	SS/RT	0.22	0.94	89	82	4	0	1	1	1	5
Driscoll et al (2006)	SS/RT	-0.77	1.24	221	386	2	0	1	3	1	33
Eysenck & Abdel-Khalik (1992)	SS/RT	0.54	0.97	476	486	3	0	2	0	1	5
Eysenck & Abdel-Khalik (1992)	SS/RT	0.55	0.66	147	179	3	0	1	0	1	5

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Eysenck & Jamieson (1986)	SS/RT	0.55	0.81	533	777	1	0	1	3	1	5
Eysenck & Jamieson (1986)	SS/RT	0.37	0.70	523	529	1	0	0	3	1	5
Eysenck (1981)	SS/RT	0.19	0.92	118	309	1	0	1	3	1	5
Eysenck et al (1985)	SS/RT	0.27	1.13	559	761	6	0	1	1	1	5
Eysenck et al (1985)	SS/RT	0.65	0.75	383	206	4	0	1	1	1	5
Eysenck et al (1990)	SS/RT	0.75	1.03	175	214	5	0	1	1	1	5
Eysenck et al (1990)	SS/RT	0.92	0.97	239	184	5	0	1	1	1	5
Fallgatter & Herrmann (2001)	SS/RT	0.28	0.72	12	10	6	1	1	1	1	5
Fischer & Smith	SS/RT	0.44		113	247	0	0	0	0	**1**	11

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(2004)											
Fischer & Smith (2004)	SS/RT	0.45		113	247	0	0	0	0	1	11
Flannery et al (1994)	SS/RT	0.29	1.27	370	369	1	1	0	3	1	12
Flannery et al (1994)	SS/RT	-0.20	1.08	144	131	1	1	0	3	1	12
Flora (2007)	SS/RT	-0.12		125	263	3	0	0	0	0	12
Flora (2007)	SS/RT	-0.08		125	263	3	0	0	0	0	20
Flory et al (2006)	SS/RT	0.13	0.77	154	197	6	0	0	1	1	12
Flory et al (2006)	SS/RT	0.40	0.99	154	197	6	0	0	1	1	20
Flory et al (2006)	SS/RT	0.76	1.53	154	197	6	0	0	1	1	21
Flory et al (2006)	SS/RT	0.19	1.02	154	197	6	0	0	1	1	22
Flory et al (2006)	SS/RT	0.44	0.77	154	197	6	0	0	1	1	23
Flory et al (2006)	SS/RT	0.54	1.06	154	197	6	0	0	1	1	30
Ford (1995)	SS/RT	0	0.87	220	252	3	0	0	0	0	20

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Ford (1995)	SS/RT	0.44	0.73	220	252	3	0	0	0	0	30
Franken et al (2005)	SS/RT	0	1.47	14	21	4	1	1	2	1	24
Garland (1999)	SS/RT	-0.05		26	35	5	1	0	1	0	30
Garland (1999)	SS/RT	-0.03	1.16	26	35	5	1	0	1	0	34
Giancola & Parrott (2005)	SS/RT	0.70	0.69	164	166	4	1	0	1	1	30
Glicksohn & Nahari (2007)	SS/RT	0.68	0.92	105	127	2	1	2	0	1	5
Green (1995)	SS/RT	0.04		48	76	4	1	0	0	0	5
Gudjonsson et al (2006)	SS/RT	0.48	0.80	699	875	3	0	1	2	1	5
Hartman & Rawson (1992)	SS/RT	0.31	1.89	26	77	3	1	0	0	1	21
Hartman & Rawson (1992)	SS/RT	0.79	1.73	29	27	3	1	0	0	1	21

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Hartman & Rawson (1992)	SS/RT	0.66	1.62	26	77	3	1	0	0	1	21
Hartman & Rawson (1992)	SS/RT	0.80	0.85	29	27	3	1	0	0	1	21
Hartman & Rawson (1992)	SS/RT	0.83	1.69	26	77	3	1	0	0	1	23
Hartman & Rawson (1992)	SS/RT	0.34	1.16	29	27	3	1	0	0	1	23
Hartman & Rawson (1992)	SS/RT	0.60	0.82	26	77	3	1	0	0	1	23
Hartman & Rawson (1992)	SS/RT	0.05	0.59	29	27	3	1	0	0	1	23
Heaven (1991)	SS/RT	0.23	1.09	70	100	2	1	1	3	1	11
Heaven (1991)	SS/RT	0.13	0.69	70	100	2	1	1	3	1	12
Heaven (1991)	SS/RT	0.51	1.05	70	100	2	1	1	3	1	5
Hutchinson et al	SS/RT	-0.09	0.79	87	116	3	1	0	0	1	5

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(1998)											
Jack & Ronan (1998)	SS/RT	0.56	0.94	119	47	4	0	1	1	1	30
Justus et al (2001)	SS/RT	0.75	0.88	87	103	4	0	0	0	1	5
Justus et al (2001)	SS/RT	0.37	1.23	87	103	4	0	0	0	1	20
Justus et al (2001)	SS/RT	0.41	0.79	87	103	4	0	0	0	1	21
Justus et al (2001)	SS/RT	0.41	0.90	87	103	4	0	0	0	1	23
Justus et al (2001)	SS/RT	-0.82	0.90	87	103	4	0	0	0	1	33
Kirby & Petry (2004)	SS/RT	0.85	0.97	33	27	5	1	0	1	1	5
Klinteberg et al	SS/RT	0.06	0.85	29	32	2	0	1	3	1	37

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(1987)											
Krueger et al (2007)	SS/RT	0.56	1.26	435.5	435.5	0	1	0	0	1	12
Krueger et al (2007)	SS/RT	0.19	1.03	435.5	435.5	0	1	0	0	1	12
Lejuez et al (2002)	SS/RT	0.70		43	43	3	1	0	1	1	5
Lejuez et al (2002)	SS/RT	0.90		43	43	3	1	0	1	1	30
Lejuez et al (2003)	SS/RT	0.26		30	30	3	1	0	0	1	30
Lennings (1991)	SS/RT	0[a]		22	80	4	1	1	0	1	12
Lennings (1991)	SS/RT	0[a]		22	80	4	1	1	0	1	30
Leshem & Glicksohn (2007)	SS/RT	0[a]		59	123	2	1	2	3	1	5
Lijffijit et al (2005)	SS/RT	0.62	0.98	193	855	3	0	1	0	1	5

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Lonczak et al (2007)	SS/RT	0.54	1.56	780	432	5	0	0	1	1	12
Luengo et al (1990)	SS/RT	0.57	0.85	55	252	4	1	1	0	1	5
Lundahl (1995)	SS/RT	1.12	0.66	21	23	3	0	0	0	0	5
Lundahl (1995)	SS/RT	0.66	1.94	21	23	3	0	0	0	0	20
Lundahl (1995)	SS/RT	0_a		21	23	3	0	0	0	0	21
Lundahl (1995)	SS/RT	0_a		21	23	3	0	0	0	0	22
Lundahl (1995)	SS/RT	1.20	0.35	21	23	3	0	0	0	0	23
Magid & Colder (2007)	SS/RT	0.51	0.91	131	136	3	0	0	0	1	9
Magid et al (2007)	SS/RT	0.18	0.73	111	199	3	0	0	0	1	37
Mallet & Vignoli (2007)	SS/RT	-0.30	1.07	235	401	2	1	1	3	1	12
Mallet & Vignoli (2007)	SS/RT	0.79	1.00	235	401	2	1	1	3	1	12

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Matczak (1990)	SS/RT	0.39		152.5	152.5	2	0	1	3	1	30
McAlister et al (2005)	SS/RT	-0.39		43	76	3	0	1	0	1	24
McDaniel & Zuckerman (2003)	SS/RT	0.32	1.18	347	436	6	1	0	1	1	34
Meadows (1995)	SS/RT	0.54	0.98	262	336	0	1	0	0	0	30
Nagoshi (1999)	SS/RT	0.65	0.91	52	71	3	1	0	0	1	5
Ng et al (1998)	SS/RT	0.45	0.76	101	101	1	2	2	3	1	12
Overman et al (2004)	SS/RT	0_a		240	240	3	1	0	2	1	12
Owsley (2003)	SS/RT	0.52	1.46	135	129	6	0	0	1	1	5
Pearson et al (1986)	SS/RT	0.54		279	290	1	1	1	3	1	5
Pearson et al (1986)	SS/RT	0.49		279	290	1	1	1	3	1	12

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Perez & Torrubia (1985)	SS/RT	0.61	1.47	173	176	3	1	1	0	1	30
Perez & Torrubia (1985)	SS/RT	0.30	1.31	173	176	3	1	1	0	1	20
Perez & Torrubia (1985)	SS/RT	0.94	1.62	173	176	3	1	1	0	1	21
Perez & Torrubia (1985)	SS/RT	-0.20	1.14	173	176	3	1	1	0	1	22
Perez & Torrubia (1985)	SS/RT	0.26	1.14	173	176	3	1	1	0	1	23
Pfefferbaum et al (1994)	SS/RT	0.54		148	148	3	0	0	0	1	23
Plastow (2007)	SS/RT	0.73	1.01	56	267	3	0	0	0	0	9
Ramadan & McMurran (2005)	SS/RT	0.80	0.50	39	69	3	0	1	0	1	30
Rammsayer et al	SS/RT	-0.14	0.75	25	35	4	1	1	0	1	24

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(2000)											
Rawlings (1984)	SS/RT	-0.08		18	17	0	1	1	0	1	5
Reeve (2007)	SS/RT	0.68	1.35	72	125	3	1	0	0	1	24
Reynolds, Ortengren, et al (2006)	SS/RT	0[a]		35	35	4	1	0	1	1	5
Rim (1994)	SS/RT	-0.24	0.65	53	45	4	2	2	0	1	5
Romero et al (2001)	SS/RT	0.31		435	529	2	0	1	3	1	20
Romero et al (2001)	SS/RT	0.35		435	529	2	0	1	3	1	21
Romero et al (2001)	SS/RT	0.03		435	529	2	0	1	3	1	22
Romero et al (2001)	SS/RT	0.16		435	529	2	0	1	3	1	23
Roth et al (2007)	SS/RT	0.21	1.09	1095	1244	6	1	1	1	1	12

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Roth et al (2007)	SS/RT	0.16	1.00	1095	1244	6	1	1	1	1	12
Roth et al (2007)	SS/RT	0.17	0.93	1095	1244	6	1	1	1	1	12
Sahoo (1985)	SS/RT	0_a		80	80	0	1	2	3	1	11
Saklofske & Eysenck (1983)	SS/RT	0.11	2.05	20	11	1	1	0	3	1	5
Saklofske & Eysenck (1983)	SS/RT	0.29	0.80	84	76	1	1	0	3	1	5
Saklofske & Eysenck (1983)	SS/RT	0.80	0.78	74	61	1	1	0	3	1	5
Saklofske & Eysenck (1983)	SS/RT	0.66	0.72	69	68	1	1	0	3	1	5
Saklofske & Eysenck (1983)	SS/RT	0.56	0.65	61	70	1	1	0	3	1	5
Sasaki & Kanachi (2005)	SS/RT	0.42	1.17	54	40	4	1	2	0	1	30
Sigurdsson et al	SS/RT	0.50	0.79	191	242	3	1	1	0	1	5

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(2006)											
Simo et al (1991)	SS/RT	-0.05	1.10	136	144	3	1	1	2	1	20
Simo et al (1991)	SS/RT	0.49	1.84	136	144	3	1	1	2	1	21
Simo et al (1991)	SS/RT	0.29	1.28	136	144	3	1	1	2	1	22
Simo et al (1991)	SS/RT	0.94	1.09	136	144	3	1	1	2	1	23
Simo et al (1991)	SS/RT	0.71	1.00	136	144	3	1	1	2	1	30
Spillane & Smith (2006a)	SS/RT	0.35	2.54	97	117	2	0	0	0	1	9
Spillane & Smith (2006b)	SS/RT	0.25	0.98	148	210	3	0	0	0	1	9
Spinella (2005)	SS/RT	0.76	1.05	50	51	4	1	0	1	1	12
Stewart et al (2004)	SS/RT	0.09	1.11	347	550	3	0	1	0	1	12
Torrubia et al (2001)	SS/RT	0.31	1.11	229	599	3	1	1	0	1	20
Torrubia et al	SS/RT	0.72	1.26	229	599	3	1	1	0	1	21

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(2001)											
Torrubia et al (2001)	SS/RT	0.01	1.26	229	599	3	1	1	0	1	22
Torrubia et al (2001)	SS/RT	0.13	0.97	229	599	3	1	1	0	1	23
Torrubia et al (2001)	SS/RT	0.45	1.09	229	599	3	1	1	0	1	30
van den bree et al (2006)	SS/RT	0.10	1.00	240	340	2	0	0	1	1	12
Van der Linden et al (2006)	SS/RT	0.41	0.87	39	195	4	1	1	0	1	9
Verdejo-Garcia et al (2007)	SS/RT	0_a		14	22	5	1	1	1	1	9
Vigil - Colet & Cordorniu-Raga (2004)	SS/RT	0.47	0.85	16	68	4	1	1	0	1	5

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Vigil - Colet & Cordorniu-Raga (2004)	SS/RT	0.47	1.33	16	68	4	1	1	0	1	24
Vigil-Colet & Morales-Vives (2005)	SS/RT	0.26	0.91	107	134	1	1	1	3	1	24
Vigil-Colet (2007)	SS/RT	0.23	1.33	18	77	4	1	1	0	1	5
Vigil-Colet (2007)	SS/RT	0.55	0.95	18	77	4	1	1	0	1	24
Vigil-Colet et al (in press)	SS/RT	0.14	1.02	208	114	5	1	1	1	1	24
Vigil-Colet et al (in press)	SS/RT	0.23	0.92	72	150	4	1	1	0	1	24
Von Knorrin et al (1987)	SS/RT	0.10	0.92	56	81	5	1	1	1	1	37
Weyers et al (1995)	SS/RT	0.54	1.64	40	40	6	1	1	0	1	5

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Weyers et al (1995)	SS/RT	0.88	0.92	40	40	4	1	1	0	1	5
Weyers et al (1995)	SS/RT	-0.53	2.15	40	40	4	1	1	0	1	12
Weyers et al (1995)	SS/RT	-0.32	1.15	40	40	6	1	1	0	1	12
Weyers et al (1995)	SS/RT	0.11	1.02	40	40	4	1	1	0	1	30
Weyers et al (1995)	SS/RT	0.26	0.76	40	40	6	1	1	0	1	30
Wilson & Daly (2006)	SS/RT	0.54	0.85	165	119	2	0	0	3	1	30
Yang (2002)	SS/RT	1.10		189	216	4	1	0	0	0	34
Yang (2002)	SS/RT	0.36	0.91	189	216	4	1	0	0	0	34
Zaleskiewicz (2001)	SS/RT	0.49		65	94	4	1	1	0	1	11

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Zaleskiewicz (2001)	SS/RT	0.51		65	94	4	1	1	0	1	11
Zimmerman et al (2004)	SS/RT	0.64	0.85	50	170	4	1	1	0	1	5
Zimmerman et al (2005)	SS/RT	0.84	0.88	26	110	4	1	1	0	1	5
Zuckerman et al (1978)	SS/RT	0.10	1.11	97	122	3	1	0	1	1	20
Zuckerman et al (1978)	SS/RT	0.45	0.93	97	122	3	1	0	1	1	21
Zuckerman et al (1978)	SS/RT	-0.10	0.91	97	122	3	1	0	1	1	22
Zuckerman et al (1978)	SS/RT	0.36	0.78	97	122	3	1	0	1	1	23
Zuckerman et al (1978)	SS/RT	0.32	0.75	97	122	3	1	0	1	1	30

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Zuckerman et al (1988)	SS/RT	0.65	1.09	73	198	0	1	0	0	1	11
Zuckerman et al (1988)	SS/RT	0.25	0.95	73	198	0	1	0	0	1	12
Zuckerman et al (1988)	SS/RT	0.25	1.10	73	198	0	1	0	0	1	20
Zuckerman et al (1988)	SS/RT	0.29	1.28	73	198	0	1	0	0	1	21
Zuckerman et al (1988)	SS/RT	-0.04	1.09	73	198	0	1	0	0	1	22
Zuckerman et al (1988)	SS/RT	0.54	0.66	73	198	0	1	0	0	1	23
Zuckerman et al (1988)	SS/RT	0.15	0.93	73	198	0	1	0	0	1	37
Anestis et al (2007)	SF	-0.40	1.26	12	58	3	1	0	0	1	6

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Anestis et al (2007)	SF	-0.68	1.95	12	58	3	1	0	0	1	7
Anestis et al (2007)	SF	-0.27	0.88	12	58	3	1	0	0	1	8
Baca-Garcia et al (2006)	SF	-0.10	0.86	44	37	0	1	0	1	1	0
Baca-Garcia et al (2006)	SF	-0.32	0.77	193	124	0	1	1	1	1	0
Baca-Garcia et al (2006)	SF	0.01	0.99	44	37	0	1	0	1	1	1
Baca-Garcia et al (2006)	SF	0.02	0.94	193	124	0	1	1	1	1	1
Baca-Garcia et al (2006)	SF	0.01	1.43	193	124	0	1	1	1	1	2
Baca-Garcia et al (2006)	SF	-0.03	0.97	44	37	0	1	0	1	1	2

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Baca-Garcia et al (2004)	SF	0	0.87	124	99	0	1	1	1	1	0
Baca-Garcia et al (2004)	SF	0.03	0.99	124	99	0	1	1	1	1	1
Baca-Garcia et al (2004)	SF	-0.13	0.87	124	99	0	1	1	1	1	2
Balodis et al (2007)	SF	0.06	1.00	29	37	4	0	0	0	1	0
Balodis et al (2007)	SF	0.22	0.72	29	37	4	0	0	0	1	1
Balodis et al (2007)	SF	-0.10	0.91	29	37	4	0	0	0	1	2
Berlin et al (2005)	SF	-0.17	0.96	10	29	6	0	0	1	1	0
Berlin et al (2005)	SF	0.06	1.09	10	29	6	0	0	1	1	1
Berlin et al (2005)	SF	-0.17	0.47	10	29	6	0	0	1	1	2
Billieux et al	SF	0.41	0.90	74	76	4	1	1	2	1	6

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(2008)											
Billieux et al (2008)	SF	0.09	0.90	74	76	4	1	1	2	1	7
Billieux et al (2008)	SF	-0.23	0.67	74	76	4	1	1	2	1	8
Bjork et al (2004)	SF	-0.05	1.03	27	14	5	1	0	1	1	0
Bjork et al (2004)	SF	-0.07	1.38	27	14	5	1	0	1	1	1
Bjork et al (2004)	SF	0.13	0.09	27	14	5	1	0	1	1	2
Caci et al (2003b)	SF	0.36	0.99	194	342	4	1	1	0	1	0
Caci et al (2003b)	SF	0.18	1.19	194	342	4	1	1	0	1	1
Caci et al (2003b)	SF	0.02	1.05	194	342	4	1	1	0	1	2
Caci et al (2003a)	SF	0.08	0.91	201	390	4	1	1	0	1	25
Calvete & Cardenoso (2005)	SF	0.36	0.90	365	491	2	0	1	3	1	35
Casillas (2006)	SF	0.39		84	125	4	1	0	1	1	2
Casillas (2006)	SF	0.30		84	125	4	1	0	1	0	6

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Casillas (2006)	SF	0		84	125	4	1	0	1	0	7
Casillas (2006)	SF	-0.10		84	125	4	1	0	1	0	8
Claes et al (2000)	SF	0.33		159	156	6	1	1	1	1	25
Clark et al (2005)	SF	0.75	0.90	27	13	4	1	1	1	1	0
Clark et al (2005)	SF	0.65	0.66	27	13	4	1	1	1	1	1
Clark et al (2005)	SF	0.61	0.55	27	13	4	1	1	1	1	2
Copping (2007)	SF	-0.20	0.68	94	104	1	1	1	3	0	6
Copping (2007)	SF	0	0.90	94	104	1	1	1	3	0	7
Copping (2007)	SF	-0.21	0.60	94	104	1	1	1	3	0	8
Cyders et al (2007)	SF	0.43	1.05	43	165	3	0	0	0	1	6
Cyders et al (2007)	SF	0	1.00	175	175	3	0	0	0	1	6
Cyders et al (2007)	SF	-0.14	0.76	168	147	3	0	0	0	1	6
Cyders et al	SF	-0.09	1.09	43	165	3	0	0	0	1	7

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(2007)											
Cyders et al (2007)	SF	-0.09	1.00	175	175	3	0	0	0	1	7
Cyders et al (2007)	SF	-0.07	0.83	168	147	3	0	0	0	1	7
Cyders et al (2007)	SF	0.05	1.23	175	175	3	0	0	0	1	8
Cyders et al (2007)	SF	0	1.11	168	147	3	0	0	0	1	8
Cyders et al (2007)	SF	0.15	1.00	43	165	3	0	0	0	1	8
d'Acrement & Van Der Linden (2005)	SF	0	0.99	314	314	2	1	1	3	1	6
d'Acrement & Van Der Linden (2005)	SF	0.08	0.92	314	314	2	1	1	3	1	7
d'Acrement & Van	SF	-0.28	0.82	314	314	2	1	1	3	1	8

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Der Linden (2005)											
Davis et al (2002)	SF	0.11	0.93	104	107	4	1	0	0	1	26
de Wit et al (2007)	SF	0.06	1.08	303	303	6	0	0	1	1	0
de Wit et al (2007)	SF	-0.14	1.24	303	303	6	0	0	1	1	1
de Wit et al (2007)	SF	0.29	1.03	303	303	6	0	0	1	1	2
Dhuse (2006)	SF	-0.09		104	230	3	0	0	0	0	0
Dhuse (2006)	SF	0.06		104	230	3	0	0	0	0	1
Dhuse (2006)	SF	0.38		104	230	3	0	0	0	0	2
Driscoll et al (2006)	SF	-0.37	1.02	221	386	2	0	1	3	1	26
D'zurilla et al (1998)	SF	0.32	1.03	405	499	3	1	0	2	1	35
D'zurilla et al	SF	0.10	0.98	30	70	6	1	0	2	1	35

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(1998)											
D'zurilla et al (1998)	SF	0.06	0.88	30	70	6	1	0	2	1	35
Enticott et al (2006)	SF	-0.38	0.45	14	17	5	1	1	1	1	0
Enticott et al (2006)	SF	-0.14	1.52	14	17	5	1	1	1	1	1
Enticott et al (2006)	SF	-0.02	1.23	14	17	5	1	1	1	1	2
Flory et al (2006)	SF	0.23	1.17	154	197	6	0	0	1	1	0
Flory et al (2006)	SF	0.13	1.03	154	197	6	0	0	1	1	1
Flory et al (2006)	SF	0.44	1.08	154	197	6	0	0	1	1	2
Fossati et al (2004)	SF	-0.08	0.94	265	482	4	0	1	0	1	0
Fossati et al (2004)	SF	-0.08	1.15	265	482	4	0	1	0	1	1

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Fossati et al (2004)	SF	-0.04	1.08	265	482	4	0	1	0	1	2
Fox et al (2007)	SF	0[a]		26	24	0	0	0	1	1	26
Franken et al (2005)	SF	-0.29	0.49	14	21	4	1	1	2	1	25
Fu et al (2007)	SF	0.02	1.00	1214	1248	3	2	2	0	1	1
Fu et al (2007)	SF	0.07	1.10	1214	1248	3	2	2	0	1	2
Galanti et al (2007)	SF	0.69		28	65	6	0	0	1	1	0
Galanti et al (2007)	SF	0.60		28	65	6	0	0	1	1	1
Justus et al (2001)	SF	-0.23	0.88	87	103	4	0	0	0	1	26
Kirkcaldy et al (1998)	SF	-0.81	0.72	55	56	1	1	1	3	1	26
Lehnart et al	SF	0.38	0.53	215	108	2	0	0	3	1	26

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(1994)											
Lyke & Spinella (2004)	SF	0.29	0.82	32	80	4	0	0	1	1	0
Lyke & Spinella (2004)	SF	0.38	1.45	32	80	4	0	0	1	1	1
Lyke & Spinella (2004)	SF	0.05	2.13	32	80	4	0	0	1	1	2
Magid & Colder (2007)	SF	-0.24	1.21	131	136	3	0	0	0	1	6
Magid & Colder (2007)	SF	-0.04	1.12	131	136	3	0	0	0	1	7
Magid & Colder (2007)	SF	0.07	1.19	131	136	3	0	0	0	1	8
Maydeu-Olivares et al (2000)	SF	0_a		121	651	3	1	1	0	1	35
McAlister et al	SF	0.12		43	76	3	0	1	0	1	25

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(2005)											
Pfefferbaum et al (1994)	SF	0.30		148	148	3	0	0	0	1	26
Plastow (2007)	SF	-0.05	0.98	56	267	3	0	0	0	0	6
Plastow (2007)	SF	-0.02	1.44	56	267	3	0	0	0	0	7
Plastow (2007)	SF	-0.04	0.89	56	267	3	0	0	0	0	8
Pompili et al (2007)	SF	0.22	0.99	141	159	4	1	1	0	1	2
Ramadan & McMurran (2005)	SF	0.36	1.61	39	69	3	0	1	0	1	35
Rammsayer et al (2000)	SF	-0.23	0.66	25	35	4	1	1	0	1	25
Reeve (2007)	SF	0.05	0.78	72	125	3	1	0	0	1	25
Reto et al (1993)	SF	0.05	0.59	57	126	5	0	0	0	1	26
Rose (2007)	SF	0.32	0.87	89	148	3	1	0	0	1	26
Simons et al	SF	0.50	1.02	228	363	3	1	0	0	1	26

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
(2004)											
Spillane & Smith (2006a)	SF	-0.11	1.35	97	117	2	0	0	0	1	6
Spillane & Smith (2006a)	SF	0.05	1.99	97	117	2	0	0	0	1	7
Spillane & Smith (2006a)	SF	-0.40	1.73	97	117	2	0	0	0	1	8
Spillane & Smith (2006b)	SF	0.15	0.62	148	210	3	0	0	0	1	6
Spillane & Smith (2006b)	SF	0.04	1.00	148	210	3	0	0	0	1	7
Spillane & Smith (2006b)	SF	0	0.93	148	210	3	0	0	0	1	8
Spinella (2005)	SF	0.45	0.81	49	49	4	1	0	1	1	0
Spinella (2005)	SF	-0.07	0.83	49	49	4	1	0	1	1	1
Spinella (2005)	SF	0.37	0.50	49	49	4	1	0	1	1	2

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Stoltenberg et al (2008)	SF	0.50	1.55	72	120	4	1	0	0	1	0
Stoltenberg et al (2008)	SF	0.53	0.95	72	120	4	1	0	0	1	1
Stoltenberg et al (2008)	SF	0.39	1.11	72	120	4	1	0	0	1	2
Sullivan (1997)	SF	0.35	1.53	172	172	4	0	0	1	0	25
Van der Linden et al (2006)	SF	0.45	0.67	39	195	4	1	1	0	1	6
Van der Linden et al (2006)	SF	-0.10	0.49	39	195	4	1	1	0	1	7
Van der Linden et al (2006)	SF	-0.11	0.72	39	195	4	1	1	0	1	8
Verdejo-Garcia et al (2007)	SF	0_a		14	22	5	1	1	1	1	6
Verdejo-Garcia et	SF	0_a		14	22	5	1	1	1	1	7

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
al (2007)											
Verdejo-Garcia et al (2007)	SF	0_a		14	22	5	1	1	1	1	8
Vigil - Colet & Cordorniu-Raga (2004)	SF	0.40	1.67	16	68	4	1	1	0	1	25
Vigil-Colet & Morales-Vives (2005)	SF	0.23	0.92	107	134	1	1	1	3	1	0
Vigil-Colet & Morales-Vives (2005)	SF	0.02	0.96	107	134	1	1	1	3	1	1
Vigil-Colet & Morales-Vives (2005)	SF	0	0.95	107	134	1	1	1	3	1	2
Vigil-Colet &	SF	0.03	0.98	107	134	1	1	1	3	1	25

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Morales-Vives (2005)											
Vigil-Colet (2007)	SF	-0.30	0.88	18	77	4	1	1	0	1	25
Vigil-Colet et al (2008)	SF	0.02	1.03	208	114	5	1	1	1	1	25
Vigil-Colet et al (2008)	SF	0.21	0.75	72	150	4	1	1	0	1	25
Zuckerman et al (1988)	SF	0	1.42	73	198	0	1	0	0	1	26

Note: Domain: B = Behavioral Measures, GI = General Measures of Impulsivity, PS = Punishment Sensitivity, RS = Reward Sensitivity, SS/RT = Sensation Seeking and Risk Taking, SF = Specific Forms of Impulsivity; *d* = effect size; subscript *a* = effect size estimated as zero due to insufficient information; VR = Untransformed Variance Ratio; NM = *n* males; NF = *n* females; Age: 0 = Unspecified/ Wide age range, 1 = 10-15 years old, 2 = 15-18 years old, 3 = 18-21 years old, 4 = 21-30 years old, 5 = 30-40 years old, 6 = 40+ years old; Author Sex: 0 = Female, 1 = Male, 2 = Information not found; Nationality: 0 = US, Canada & Central America, 1 = UK, Europe, Australia/New Zealand, 2 = Asia, Africa & Middle East; Population: 0 = University Students (Including

Undergraduates, College Students, and Post-Graduate Students), 1 = Community, 2 = Mixed, 3 = Schools (up to age 18), 4 = Not Specified; Published: 0 = Unpublished Study, 1 = Published Study; Category: 0 = BIS Cognitive Subscale (Barrett Impulsivity Scale), 1 = BIS Motor (Barrett Impulsivity Subscale), 2 = BIS Non Planning (Barrett Impulsivity Subscale), 3 = BART, 4 = Eysenck Impulsivity Measures (Including all versions of the Impulsivity Scale and Impulsivity from Eysenck Personality Inventory), 5 = Venturesomeness (Venturesomeness subscales from versions of the Eysenck Impulsivity Scale), 6 = UPPS Lack of Perseverance, 7 = UPPS Lack of Premeditation, 8 = UPPS Urgency, 9 = UPPS Sensation Seeking, 10 = Impulsivity Other Measures (General Impulsivity measures including study specific impulsivity measures and excluding Eysenck measures), 11 = Risk Taking (Scales representing risky behaviour or the propensity to engage in risky behaviour as well as Risky Impulsivity), 12 = Other Sensation Seeking Measures (Study specific Sensation Seeking measures or measures excluding the Zuckerman SSS and the UPPS Sensation Seeking Scale), 13 = SPSRQ/GRAPES Punishment Sensitivity, 14 = SPSRQ/GRAPES Reward Sensitivity, 15 = Delay Discounting, 16 = BAS Drive Subscale from BIS/BAS, 17 = BAS Fun Subscale from BIS/BAS, 18 = BAS Reward Subscale from BIS/BAS, 19 = BIS Total from BIS/BAS, 20= Boredom Susceptibility Subscale of Zuckerman SSS, 21 = Disinhibition Subscale of Zuckerman SSS, 22 = Experience Seeking Subscale of Zuckerman SSS, 23= Thrill and Adventure Seeking Subscale of Zuckerman SSS, 24 = Functional Impulsivity (Dickman Scales), 25 = Dysfunctional Impulsivity (Dickman Scales), 26 = Impulse Control (Measures of the ability to control impulses/urges), 27 = Iowa Gambling Task, 28 = KSP Impulsivity Subscales, 29 = Total of Barrett Impulsivity Scale (BIS Total), 30 = Total of Zuckerman SSS (SSS Total), 31 = BAS Total from BIS/BAS, 32 = TPQ/TCI Reward Dependence, 33 = MPQ/PRF Harm Avoidance, 34 = ZKPQ Impulsive Sensation Seeking (ImpSS), 35 = Social Problem

Solving Inventory (SPSI), Impulsive/Careless style score 36, TPQ/TCI Harm Avoidance, 37 = KSP Monotony Avoidance, 38 = Visual-Cognitive Tasks, 39 = Executive response inhibition tasks: Stop Task/Go-no-go task/Stroop tasks/Continuous Performance Test.

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