Offending behaviour in antisocial youths: Psychological causes and practical implications.

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Ph.D. Thesis

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December 2008

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Summary of Thesis

The aim of this thesis was to examine the role of biobehavioural and social variables in explaining adolescent antisocial behaviour. One study examined neuropsychological functioning in 115 young offenders. A more extensive second study was carried out on a sub-sample of the original young offender group, consisting of 48 participants. This second study used more detailed neuropsychological assessments and assessed participants' responses to emotional stimuli. Emotional functioning was assessed in 3 ways: by recording electrodermal responses during a fear conditioning task, by recording the eye-blink startle reflex while participants passively viewed different types of affective pictures, and by examining facial affect recognition.

It was expected, first, that antisocial teenagers would be characterised by a sensation-seeking personality, neuropsychological impairments as evidenced by executive functioning tasks, low IQ, poor electrodermal fear conditioning, and reduced startle amplitudes, compared to age and sex matched controls. Second, it was expected that biobehavioural risk factors would interact with social risk factors in explaining ASB, and that social factors would moderate the biobehavioural – ASB relationship.

We found that young offenders differed from matched controls in terms of personality traits, and neuropsychological and emotional functioning. With respect to the second hypothesis, it was found that biobehavioural risk factors did not interact with social variables in explaining different types of offending behaviour, contrary to previous studies.

Specifically, the research findings indicated that young offenders were characterised by lower IQ and specific neuropsychological deficits in terms of working memory, planning and decision-making. Additionally, they had problems with the learning, processing, and recognition of emotions. Finally, we showed that different risk factors were associated with different types of offending, with both social and biobehavioural variables predicting prolific and persistent offending, and only biobehavioural factors predicting severe offending. The implications of these findings for policy and practitioners working with young offenders were discussed.

Acknowledgements

This thesis was undertaken at the School of Psychology at Cardiff University and was funded by a Ph.D. bursary from the School of Psychology.

First and foremost, I would like to thank my supervisors, Prof. Stephanie van Goozen and Dr. Simon Moore, for their invaluable advice, guidance, and support throughout these 3 years. I would also like to thank Dr. Justin Savage for his help and advice. Many thanks go to my parents, my brother and my family for always being there, for their continuous encouragement and for their emotional support during all the difficult days. I am also very grateful to Ioannis Vaxevanos for his constant support and care, for providing me with determination throughout, and for making this experience much easier.

Last but not least, a big thank you goes to all the young people who participated in my studies and to the Cardiff Youth Offending Team without whom this research would not have been possible.

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1.1. Introduction

1.1.1. Aim of PhD Thesis

There is increasing evidence that early biobehavioural factors are important in explaining individual differences in antisocial behaviour (ASB). Poor autonomic fear conditioning (Raine, 1997), physiological underarousal (van Goozen, Fairchild, Snoek, & Harold, 2007), reduced orienting (Raine, Venables, & Williams, 1990a), fearlessness and stimulation-seeking temperaments (Raine, Reynolds, Venables, Mednick, & Farrington, 1998), neuropsychological and cognitive functioning (Moffitt, 1993; Raine, et al., 2005) for example, each has been found to be risk factors for later aggressive and violent behaviour. However, to date, very few studies have integrated these multiple processes in explaining ASB in one study. Additionally, it is believed that social and biobehavioural factors interact in predisposing to the development of aggressive and violent behaviour, but there have been relatively few studies examining biobehavioural and social risk factors in relation to adolescent ASB. Even though studies have examined a range of these risk factors, these have mainly been investigated in isolation. Biosocial interactions, even though more informative (e.g. Raine, Brennan, & Mednick, 1994; Raine, 2002b), have only become the focus of research recently. Thus there is a need to clarify how these factors interact in the aetiology of antisocial behaviour.

Additionally, studies on risk factors for ASB have mostly focused on adults, with studies in children and teenagers badly needed. Moreover, many of these studies have used clinical samples, incarcerated offenders or psychopaths. Community-based samples are of interest, as they can capture the development of problem behaviours and aid in understanding the factors which lead to continuity or discontinuity of ASB.

Antisocial behaviour has been investigated from different perspectives. Criminological research takes its perspective from the criminal justice system, looking at antisocial behaviours defined by official offences records. Historically, the criminological perspective has focused more on psychosocial indicators of ASB, with a more recent focus in the last decades on the additive influence of biological factors (Buikhuisen & Mednick, 1988). On the other hand, because psychological studies have a longer history in explaining individual differences in behaviour, they have incorporated a wider array of factors in the search of how ASB emerges. Psychological studies have also focused more on clinically defined populations, such as individuals with Conduct Disorder (CD), and other disorders relating to antisociality. The current study combines these approaches and adds to the existing literature by examining *both* social and individual factors, and by investigating what best explains different types of antisocial behaviours (i.e., prolific, severe, and persistent offending) defined by the criminal justice system.

For these reasons, the goal of my research is to provide a more thorough understanding of the characteristics of youths within the legal/judicial field who present with ASB. The specific aims of this PhD thesis are as follows:

- First Aim: To assess the extent to which biobehavioural risk factors are involved in ASB shown by young offenders.
- Second Aim: To examine the moderating effects of social adversity on the association between early biobehavioural deficits and ASB.

First, a definition of antisocial behaviour will be given and a distinction between aggressive subtypes will be made. Then each of the aims outlined above will be discussed in more detail, by reflecting on previous research. In this way, the reasons for carrying out this PhD research will be elucidated.

1.1.2. Definition of antisocial behaviour

Antisocial behaviour is typically defined in two ways; first, in terms of clinical syndromes, and second, with reference to the legal/judicial field, which encompasses the concepts of delinquency and criminality (Morgan & Lilienfeld, 2000). Clinical definitions are informed by research on clinical conditions, such as conduct disorder (CD), antisocial personality disorder (ASPD), as defined by the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; American Psychiatric Association, 2000), and psychopathy (as defined by Hare and colleagues, 1999). Legal/judicial definitions are informed by research on delinquent and criminal behaviour (Seguin, Sylver, & Lilienfeld, 2007) where criminal and delinquent behaviours are usually determined via self-report measures and criminal records. Finally, aggressive behaviour is generally accepted as a form of ASB (Rhee & Waldman, 2002). Aggressive behaviours relate to both the clinical and legal/judicial fields; for example, they have been part of clinical definitions as some criteria for a diagnosis of CD involve aggressive acts (e.g. initiating physical fights, using a weapon that can cause serious physical harm). Aggression also relates to the legal/judicial field in that childhood aggression has been found to predict adult criminality (Pulkkinen & Pitkänen, 1993). Aggressive behaviours have been typically assessed with self-report questionnaires, such as the Child Behavior Checklist (Achenbach & Edelbrock, 1983) and with observational measures.

These different definitions are related to each other; criminality and delinquency have been found to be associated with psychopathy and the clinical syndromes of CD and ASPD (Moffitt, 1988). Furthermore, CD and criminality are part of a diagnosis of ASPD, whilst aggression and delinquency are used for a CD diagnosis (Rhee & Waldman, 2002). Thus studies which incorporate these different

operationalisations have been considered empirically relevant for inclusion in this PhD thesis.

1.1.3. Antisocial behaviour and aggressive subtypes

Aggression has been defined as an intentional behaviour with the aim of causing "physical and/or psychological damage on persons or property" (van Goozen, et al., 2007, p.150). There are two basic assumptions in this definition: first, that an aggressive act occurs with the intent to cause harm, and second, that this act occurs whilst the victim is motivated to avoid it (Geen, 2001). Thus, malicious gossip with the intent to ruin someone's reputation is an indirect form of aggression, whilst damaging or destroying another person's property similarly serves as an aggressive act. There are two types of aggression: an impulsive-affective-reactive-hostile subtype, and a controlled-instrumental-proactive-premeditated subtype. The former is often the result of a frustrating or threatening event, sometimes accompanied by anger, and without the prospect of an impending goal, while the latter is used with the purpose to achieve a specific goal (Blair, Mitchell, & Blair, 2005). It has also been suggested that these two subtypes activate different neurocognitive systems and are characterised by distinguishable neurobiological features. For example, there has been some support for high levels of emotional arousal in impulsive or emotional aggression, and low levels of emotional arousal in instrumental or proactive aggression (Scarpa & Raine, 1997; Scarpa & Raine, 2000). Moreover, the distinction between these two subtypes was already made in 18th century U.S. legislation according to which impulsive and premeditated murders are treated differently (Bushman & Anderson, 2001).

Even though the two aggression subtypes, reactive and premeditated, may vary in their aetiology, a main criticism with differentiating impulsive from

instrumental aggression has been that many aggressive acts often depend on multiple motives (Bushman & Anderson, 2001). According to Bushman and Anderson (2001), a dichotomous view on hostile or instrumental aggression encounters three major difficulties in terms of differences between the two subtypes: (a) the primary goal of the behaviour, (b) the incidence of anger, and (c) the amount of planning involved. Difficulties arise because the two subtypes (a) are often motivated by many different goals in real-life, making a distinction problematic, (b) even though the presence of anger is only involved in hostile aggression, it is often the case that a well-planned act (instrumental aggression) often originates from anger, but the actual act occurs later in time, (c) hostile aggression is impulsive and ill-planned, whilst instrumental aggression involves more careful planning and consideration of the behavioural consequences. However, the amount of planning involved in an aggressive act might not always be clear, making the distinction arbitrary. Another problem with the hostile-instrumental distinction is that questionnaire research often fails to reliably distinguish between these two constructs (Polman, Orobio de Castro, Koops, van Boxtel, & Merk, 2007). Given that these distinctions are rather arbitrary and not clear-cut the use of these two subtypes is questionable (Bushman & Anderson, 2001). The current research will therefore not distinguish between these two aggressive subtypes. However, it should be noted that the distinction between the two subtypes depends on the method used to measure them (Polman et al., 2007) and that empirical studies have also successfully used these subtypes (see also Blair et al., 2005, on information for a model of reactive aggression and accounts of psychopathy based on these distinctions).

1.1.4. Previous research and scope of PhD thesis

First Aim of PhD: To assess the extent to which biobehavioural risk factors are involved in the ASB as shown by young offenders.

1.1.4.1. Psychophysiology and antisocial behaviour

Reviews of the psychophysiology of adult violent/antisocial behaviour highlight low autonomic nervous system (ANS) arousal, reduced ANS orienting, and reduced ANS fear conditioning (Patrick & Verona, 2007; Raine, 1993a; Volavka, 1995) as risk factors for ASB. A recent, major review of the field has argued that low physiological arousal predisposes to risk-taking or stimulation-seeking behaviour and to impairments in fear conditioning in aggressive children (van Goozen et al., 2007). The concept of fearlessness has been one of the central features of theories on the origin of ASB (Raine, 1993a). According to the fearlessness theory (Raine, 1993a), low levels of arousal during mildly stressful paradigms are an indication of low levels of fear. Fearlessness would indeed be required for certain antisocial acts (e.g., assaults, violent crimes) to occur and an inability to learn from punishments in childhood due to low arousal, would result in poor fear conditioning and unsuccessful moral socialisation (Blair et al., 2005; Raine, 2002a). In support of these notions, poor ANS fear conditioning is a well-replicated correlate of antisocial and violent offenders (Hare, 1978; Raine, 1997). In contrast to these results from adults, findings in children and teenagers are less well-established.

Low physiological arousal has been a prominent route in identifying the biological underpinnings of antisocial behavior through research focusing on the premise that antisocial groups are characterised by emotional impairments, originating from amygdala dysfunction (Blair et al., 2005). The amygdala, part of the limbic system of the brain, is involved in memory for emotional significance of experiences

(Pinel, 2000) and emotional learning (Everitt, Cardinal, Parkinson, & Robbins, 2003); it is also the centre of the defence system, implicated in both the expression and acquisition of conditioned fear (Lang, Davis, & Öhman, 2000). Studies confirm that a dysfunctional amygdala relates to both fear recognition impairments and ASB. Neuropsychological studies have shown that patients with amygdala damage present with deficits in the recognition of fear (Adolphs, Tranel, Damasio, & Damasio, 1994). Moreover, neuroimaging studies in conduct disordered (CD) children suggest that grey matter volume in the left amygdala is reduced in CD patients compared to age-, sex-, and intelligence-matched healthy control participants, (Sterzer, Stadler, Poustka, & Kleinschmidt, 2007) and have found that activity in the left amygdala is reduced while viewing negative pictures, only when co-morbid anxiety and depression were controlled for (Sterzer, Stadler, Krebs, Kleinschmidt, & Poustka, 2005). Furthermore, amygdala hypoactivity to fearful faces has been found in children and adolescents with conduct problems and callous-unemotional traits (Jones, Laurens, Herba, Barker, & Viding, 2009; Marsh et al., 2008).

Amygdala dysfunction has also been supported by indirect evidence, showing reduced psychophysiological responses in ASB participants while they perform affective tasks. Antisocial individuals have been found to present with lower levels of central nervous system (CNS) arousal and autonomic nervous system (ANS) arousal (for reviews see Scarpa & Raine, 1997; Scarpa & Raine, 2000; van Goozen et al., 2007), as revealed by electrodermal, cardiovascular, and cortical psychophysiological response systems (Raine, Venables, & Williams, 1990b).

Electrodermal responses have been measured using the galvanic skin conductance response (SCR). Although SCRs are elicited by a wide range of events, in experiments mostly a classical conditioning paradigm is used. In classical conditioning, a neutral stimulus (the conditioned stimulus or CS) is typically paired

with an aversive loud sound (the unconditioned stimulus or US). A CS is typically a neutral stimulus that does not result in an explicit behavioural response. On the contrary, the US is typically a stimulus that would induce an innate, often reflexive, response, called the unconditioned response (UR). After repeated associations of the CS with the US participants are expected to learn to produce a conditioned response (CR) to the US. In case of electrodermal responding this would mean heightened SCRs only to the CS (Yaralian & Raine, 2001). One consequence of the inability to form conditioned emotional responses in reaction to punishment cues could be the development of poor conscience, a risk factor for antisocial behaviour (Scarpa & Raine, 2000). Similarly, unsuccessful moral socialisation has been proposed as an explanation for the development of a psychopathic personality (Blair et al., 2005). Blair et al. (2005) argue that if moral socialisation is learned via empathy induction, then psychopathic individuals will be unresponsive to distress cues (Blair, Jones, Clark, & Smith, 1997).

If we think in terms of a classical conditioning process, punishment (US) would elicit an unconditioned response (UR) of feelings of distress in normally developing children. In this sense, an antisocial act associated with the US of punishment would result in the UR of feeling distressed, and thus someone with good conditioning ability would learn to avoid it. However, in the case of poor conditioning this association would not occur, and thus negative emotional responses would not be experienced, which would result in desistance from committing an antisocial act. With regard to electrodermal responding, lower SCRs serve as an index of poor conditioning, and larger amplitudes indicate better conditioning ability (Yaralian & Raine, 2001).

Reviews of skin conductance studies on antisocial populations provide evidence for SC underarousal and poor conditioning in different antisocial groups

(Scarpa & Raine, 1997). Skin conductance underarousal has mainly been observed in nonviolent forms of crime (Scarpa & Raine, 2000), whilst poorer conditioning has particularly been found in individuals from high social classes (Raine & Venables, 1981) and good homes (Hemming, 1981). Evidence of reduced autonomic responses to distress cues has also been found in psychopathic individuals (Blair et al., 1997; Viding, 2004). Blair et al. (1997) found a selective impairment, as indexed by reduced SCRs, to distress cues in psychopathic individuals, as compared to incarcerated non-psychopaths. This pattern was observed by comparing participants' SCRs to threatening and neutral stimuli. Even though SCRs to distress cues were significantly higher than those to neutral slides, the two groups did not differ in their responding to either threatening or neutral stimuli, providing evidence of impaired empathy mechanisms in psychopathic populations.

Another system investigated mainly in adult psychopaths (Patrick, Bradley, & Lang, 1993), but more recently in younger antisocial groups (Fairchild, van Goozen, Stollery, & Goodyer, 2008; van Goozen, Snoek, Matthys, van Rossum, & van Engeland, 2004) is the affective modulation of the eye-blink startle reflex to an acoustic probe. The startle reflex has been used in antisocial populations because of its relevance to fear/defence systems (Lang et al., 2000). Fear retains a defensive function in promoting the survival of species in threatening and aversive situations. The fear behaviour system has the amygdala as a neural basis (Misslin, 2003). The central nucleus of the amygdala projects to brain circuits consisting of the midbrain periaqueductal gray (PAG), the hypothalamus and the brainstem where a range of defensive responses take place (Misslin, 2003). Fight and flight behaviours, freezing, avoidance reactions, and autonomic arousal are part of the defence system reactions. The startle reflex is part of the preparatory phase of the defence system, when the organism is in an alert state ready to take action when threatened (Lang et al., 2000).

Amygdala damage has been associated with emotion modulation impairments and impairments in the startle reflex (Angrilli et al., 1996).

Both electrodermal responding in a fear conditioning paradigm and startle reflex in response to emotional stimuli will be investigated in the adolescent group of young offenders who took part in the current study. It is expected that the young offender group will show lower responses to both tasks compared to a normal control group of participants.

1.1.4.2. Sensation-seeking and fearlessness

With respect to personality traits involved in antisocial and aggressive behaviour attention has focused on attributes such as being impulsive, a sensation seeker, and being callous and unemotional. Personality characteristics can be investigated via self-reports, but also via certain behavioural measures, neuropsychological tasks, and psychophysiological assessments, all of which will be used in the present research.

Some studies have linked early personality characteristics, specifically sensation-seeking, fearlessness and lack of anxiety, with current or later aggressive behaviour. Sensation-seeking encompasses the sociability and exploration aspects of disinhibition, while fearlessness encompasses the lack of distress and reactivity in novel situations. For example, a study of kindergarten children by Tremblay, Pihl, Vitaro, and Dobkin (1994) showed that children with reduced anxiety, reduced reward dependence and higher impulsivity were at risk for delinquency. Findings from the Dunedin Multidisciplinary Health and Development study also inform several of the relationships between personality characteristics and antisocial behaviour. Participants in the Dunedin study in New Zealand have been repeatedly assessed from ages 3 to 21 in order to examine predictors and development of health and behaviour outcomes

(Moffitt, Caspi, Rutter, & Silva, 2001). The results concerning children's temperamental characteristics show that children scoring lower on social control scales at age 3 years were more likely to have externalising than internalising behaviour problems at age 15 years (Caspi, Henry, McGee, Moffitt, & Silva, 1995), to have higher scores on aggression at age 18 years (Caspi & Silva, 1995), to have more convictions for violent offences at age 18 years (Henry, Caspi, Moffitt, & Silva, 1996), to meet criteria for antisocial personality at age 21 years and to be involved in crime (Caspi, Moffitt, Newman & Silva, 1996). It has also been reported that aggressive children at age 11 years were characterised by increased fearlessness and stimulation-seeking at age 3 years (Raine, et al., 1998). However, it is unknown to what extent fearlessness and sensation-seeking play a role in adolescent offenders, and whether variations in these traits can explain differences in the severity and/or frequency of offending behaviour. The present study will test the hypothesis that adolescent offenders exhibit sensation-seeking and fearlessness when compared to controls, as indexed by self-report questionnaire measures and reduced skin conductance responses during a fear conditioning paradigm.

1.1.4.3. Neuropsychological functioning

Moffitt (1993) argues for the importance of examining the role of neuropsychological variables in explaining antisocial behavior. Moffitt (1993) distinguished between two types of individual who engage in antisocial behaviour: on the one hand, a small group of individuals who engage *in life-course-persistent* antisocial behaviour; on the other hand, a larger *adolescence-limited* antisocial group. According to Moffitt, individuals who follow an antisocial path over their life course are characterised by neuropsychological impairments, ranging from emotional reactivity (e.g., impulsivity) to cognitive functioning (e.g., memory, language, and

reasoning abilities). These deficits interact with adverse social environments in contributing to the continuity of ASB. Conversely, it has been proposed that individuals on the adolescence-limited path only engage in antisocial behaviour as part of their normative development. This occurs in an effort to minimise the "maturity gap" (Moffitt, 1993, p.687), which is created by a discrepancy between biological and social age, that is between what adolescents actually want to do and what they are allowed to do. In addition, adolescence-limited delinquents might get involved in delinquent acts by imitating life-course-persistent individuals, or in an attempt to become independent. Support for the notion of neurocognitive impairments in life-course persistent individuals has been provided by Raine et al. (2005). In addition, poor scores on neuropsychological tests at age 13 have been found to predict delinquency five years later, and were related to both the early onset and persistence of delinquency (Moffitt, Lynam & Silva, 1994).

Different methodologies, including both neuropsychological and brain imaging studies, suggest a frontal lobe dysfunction in individuals presenting with antisocial behaviour (Blair et al., 2005). Neuropsychological assessments typically involve the administration of tests, which have been validated by lesion, brain electrophysiological, or brain imaging studies (Seguin et al., 2007), as reliable tests of the functionality of specific brain regions. In the case of aggressive and antisocial behaviour, a frontal lobe dysfunction, and more specifically a prefrontal cortex dysfunction, has been identified as a potential risk factor (Blair, et al., 2005; Raine, 2002a). Executive function (EF) deficits, although they are usually, but not always, associated with a prefrontal lobe dysfunction, have been observed in different developmental psychopathologies (Pennington & Ozonoff, 1996). In a review of studies by Pennington and Ozonoff (1996) evidence for EF deficits was found only when Conduct Disorder (CD) was comorbid with Attention Deficit Hyperactivity

Disorder (ADHD) and not in CD alone. Thus an emphasis should be given to controlling for ADHD in studies assessing EF in antisocial groups. However, evidence for neuropsychological impairments, as assessed by an executive dysfunction, has been reported in a meta-analysis by Morgan and Lilienfeld (2000), where antisocial groups were found to perform worse than control groups on EF tests. Thirty-nine studies were reviewed, yielding effect sizes in the medium to large range. Effect sizes were greater for studies of criminality and delinquency than for other antisocial groups. The contrasting findings between the meta-analyses by Pennington and Ozonoff (1996) and Morgan and Lilienfeld (2000) might be due to the use of different EF measures. In the latter paper the analyses were restricted to well-validated EF measures, although ADHD was not taken into account. Evidence for EF deficits also comes from an increasing number of brain imaging studies (Raine, 2002b). This is a vital step in overcoming the difficulties concerning the ambiguity in specificity of some EF measures in assessing frontal lobe damage (Pennington & Ozonoff, 1996).

Even though the role of neuropsychological impairments in antisocial behavior has been recognised, problems still arise due to the failure to take ADHD and IQ into account (Seguin et al., 2007). In addition, there are gaps in the available research. Firstly, different forms of executive functioning have rarely been distinguished, with more research needed using tasks that assess more specific regions of the prefrontal cortex, e.g., orbitofrontal cortex. Secondly, few studies have examined neurocognitive functioning in younger antisocial groups. It was expected that the ASB young offender group taking part in the present study would exhibit neuropsychological functioning deficits, demonstrated in tasks requiring executive functioning, compared to controls.

1.1.4.4. Intellectual Functioning (IQ)

Cognitive functioning impairments are associated with antisocial and aggressive behaviour. It has generally been found that delinquents score about one-half of a standard deviation (approximately eight IQ points) lower than non-antisocial groups (Moffitt, 1990). Furthermore, it has been reported that ASB groups are characterised by lower verbal IQ scores (Wolff, Waber, Bauermeister, Cohen, & Ferber, 1982), with verbal IQ (VIQ) lower than performance IQ (PIQ) by approximately 8-12 IQ points mainly in aggressive and psychopathic individuals (Yaralian & Raine, 2001). However, there have also been studies suggesting spatial IQ deficits in ASB groups. For example, one study has shown that life-course persistent antisocials from ages 7 to 17 years are characterised by low verbal and spatial IQ (Raine et al., 2005). It has also been found that low spatial IQ at age 3 years predicted life-course persistent antisocial behaviour from ages 8 to 17 (Raine, Yaralian, Reynolds, Venables, & Mednick, 2002). This finding suggests that spatial IQ may reflect an early vulnerability factor, while poor verbal ability is acquired over time in antisocial children. Furthermore, it has been argued that high IQ acts as a protective factor, preventing a predisposed child from becoming antisocial (e.g., Losel & Bliesener, 1994). In order to examine whether young offenders who participated in the present study were characterised by cognitive impairments, an IQ assessment was carried out, consisting of both a verbal and a spatial component. The IQ assessment was also of interest because lower IQ could of course influence performance on neuropsychological and self-report tests. It was hypothesised that young offenders would show lower IQ than controls.

I now turn to the second aim of PhD, to examine the moderating effects of social adversity on the association between early biobehavioural deficits and ASB.

1.1.4.5. The effect of psychosocial factors

Psychosocial influences ranging from dysfunctional parenting practices to economic problems in the household (Moffitt & Caspi, 2001) are important in the explanation of ASB. Some of the environmental influences most frequently studied are low socioeconomic status and living in a high-crime neighbourhood (Farrington, 1998), parents' criminality (Farrington, 2000), family conflict (Wells & Rankin, 1991), poor parenting practices (Patterson, Reid, & Dishion, 1992; Simons, Wu, Conger, & Lorenz, 1994), associating with deviant peers (Ary, Duncan, Duncan, & Hops, 1999), and academic underachievement (Maguin & Loeber, 1996). However, the role of these variables has often been investigated in community-based samples, with antisocial behaviour as a later outcome (e.g., Fergusson, Horwood, & Lynskey, 1992) or in clinically defined antisocial groups (e.g., Holmes, Slaughter, & Kashani, 2001), while the present research used a community-based antisocial group for reasons explained in more detail in Chapter Three. Studies also suggest that biobehavioural deficits, such as verbal and memory deficits, account for delinquency over and above the effect of social disadvantage (Moffitt & Silva, 1988). The current study recruited an adolescent group of young offenders, and examined not only a combination of psychosocial variables not previously assessed in an adolescent community antisocial group, but also the combined effect of these psychosocial variables and biobehavioural deficits in ASB, for reasons explained in the following section.

1.1.4.6. Environment × Biobehavioural interaction

Although the interaction between psychosocial contexts and brain processes is one of the most exciting areas in the study of aggressive behaviour, it is also one of the least understood and least researched issues. Biosocial interactions are critically

important for two reasons. First, interaction effects can provide important clues about which factors protect against the development of violence, thereby pointing the way for new prevention studies. Second, it is suspected that only in relatively rare instances do biological and genetic factors give rise to ASB directly; research identifying biological risk factors for ASB is only the first of a two-stage approach, with the second, important stage being the identification of how these factors interact with the social context in giving rise to ASB (Raine, 2002b; van Goozen et al., 2007).

One striking example of a biological risk factor interacting with psychosocial influences involves the association between poor fear conditioning and aggression. Some studies have shown that social background moderates the conditioning – ASB relationship (Raine, 2002b). For example, Hemming (1981) tried to minimise the effect of environmental factors on the conditioning – ASB relationship, and compared a prison sample from good home environments with a student control sample. Less discriminant conditioning was observed among criminals from relatively good social backgrounds. Similarly, Raine and Venables (1981) found poor conditioning in antisocial children from higher social class, but not in antisocial children from lower social classes. Additionally, Raine and Venables (1981) found that antisocials from lower social classes showed relatively good conditioning. These biosocial interactions are not isolated findings, with an early review noting 39 empirical examples from the areas of genetics, psychophysiology, obstetrics, brain imaging, neuropsychology, neurology, neuroendocrinology, neurotransmitters, and environmental toxins (Raine, 2002b). Consequently, we believe it is important that attempts to understand and predict aggression and violence should include biosocial interaction effects in statistical prediction models. A theoretical model arguing for the importance of both environmental and biobehavioural influences on childhood antisocial behaviour has been proposed by van Goozen et al. (2007). According to this model, a biosocial

approach is essential in view of the complex nature of ASB, and the possibility that a social variable can influence behaviour via a biological predisposition and vice versa.

In a review of all biosocial interaction effects on antisocial behaviour, two main themes emerged (Raine, 2002b). First, when biological and social factors are grouping variables and when antisocial behaviour is the outcome, then the presence of both risk factors exponentially increases rates of antisocial and violent behaviour (e.g., Raine et al., 1994). In addition, however, when the biological measure is the dependent variable, social factors are found to moderate the relationship between neurobiological/genetic factors and antisocial/violent behaviour, such that these relationships are strongest in those from benign home backgrounds – the "social push perspective" (Raine, 2002b, p. 314). According to this perspective, the relation between antisocial behaviour and biological risk factors is stronger when adverse social circumstances are absent; in those cases since the influence of social variables is minimised, biological predispositions can better explain why someone will engage in antisocial behaviour. On the other hand, when adverse conditions in the close environment are present, a socially driven explanation may emerge. For example, prior studies have shown that antisocial children from high (not low) social class homes show low autonomic arousal (Raine, 1997), poor fear conditioning (Raine, 2002a), and reduced orienting (Raine, 1997). In the present study we will test the hypotheses that (1) biobehavioural risk factors interact with social risk factors in predicting aggression and violence, over and above the main effects of these classes of risk factors; and (2) biobehavioural risk factors will better predict aggression and violence in individuals who lack social risk factors.

1.1.4.7. Related variables

Appropriate measures for this study were selected on the basis of previous literature on the topic of antisocial and violent behaviour. Apart from the social/environmental, neuropsychological and psychophysiological measurements described in detail in the following chapters, cognitive and personality assessments were conducted in order to provide descriptive information about our sample.

Psychopathic tendencies were assessed because it has been apparent from previous research that psychopathic traits could play a role in explaining ASB behaviour (Blair et al., 2005). Psychopaths display both callous and unemotional personality characteristics, and antisocial/impulsive characteristics (Blair et al., 2005). Both emotional processing impairments and neuropsychological deficits, particularly in the orbitofrontal lobe area (LaPierre, Braun, & Hodgins, 1995) are found in these populations. Consequently, examining the presence of psychopathic traits in our sample is of critical importance, because they might account for any impairment in the emotional domain or with regard to neuropsychological features.

Finally, behavioural problems, such as aggressive behaviour, conduct disorder symptoms, attention deficit hyperactivity (ADHD) symptoms, etc., reflecting the DSM-IV criteria, were assessed by a self-report measure, the Youth Self Report (YSR; Achenbach, 1991). In this way, an accurate description of the characteristics of the young offender group and some potential confounding factors (e.g., ADHD symptoms) was obtained.

By researching a young offender group, the present study is believed to make a contribution to the literature on the effect of social adversity and biobehavioural risk factors on antisocial behaviour, not only because there is a lack of research examining the interaction between these different factors, but also because there is a need for

research focusing on younger antisocial groups. This is important because the early onset of delinquent behaviour is related to both the stability and the seriousness of offending (Moffitt et al., 1994). An additional benefit of the sample used in the current study is that data from multiple sources were available, including self-report measurements, official records, and biobehavioural data.

1.1.5. Hypotheses

The overarching aim of the PhD study is to examine how several biobehavioural risk factors combine with social adversity to play a role in adolescent ASB.

The specific hypotheses are as follows:

a) Hypothesis 1. ASB teenagers will be characterised by poor electrodermal fear conditioning, reduced startle amplitude, sensation-seeking temperaments, neuropsychological impairments as evidenced by executive functioning tasks tapping into the ventromedial prefrontal cortex, and low IQ, compared to a normal control group.

b) Hypothesis 2. Biobehavioural risk factors will interact with social risk factors in explaining ASB, over and above the main effects of both classes of risk factors.

In the present chapter shortcomings of existing research were reviewed and it was pointed out how the PhD research was designed to fill some of the gaps in the previous literature. The following chapter will describe the young offender sample used in this research, the procedure of recruitment and testing process, and the subgroupings used to examine different types of ASB in young offenders. Chapter Three will focus on the effect of psychosocial factors on severity and frequency of offending, while at the same time examine the effect of social adversity on ASB in a

normative population. Chapters Four and Five consider physiological arousal and emotional processing in the young offender group, compared with normal controls, while Chapter Six examines neuropsychological functioning and IQ. Chapter Seven investigates which risk factors better explain ASB in our sample, concluding with the overall findings and discussion of this PhD research in Chapter Eight, and addressing issues that future research should deal with.

2. Chapter Two – Experimental information

As outlined at the end of the Introduction chapter, this chapter explains more about the young offenders, who participated in this research, describes how recruitment took place, and the two experimental phases, during which data were collected. In addition, the procedure followed to categorise young offenders into groups with different ASB characteristics is described.

2.1.Sample

The participants were 115 young offenders, aged 12-18 years (mean age = 16.27 years, SD = 1.47), of whom 104 were male and 11 were female. Because only 9.6% of the study group consisted of female participants, their data were combined for analysis purposes. Combining data from males and females was deemed appropriate because the small number of female participants would make any between-gender differences very hard to detect.

As a group, the young offenders scored in the normal range of Attention Deficit Hyperactivity Disorder (ADHD) symptoms, as revealed by the YSR [mean = 59.6 (SD = 7.9)]. For this reason, ADHD symptoms were not used as a covariate in subsequent analyses.

Data from different control groups of participants was used for comparison purposes. The characteristics and recruitment of these control groups are described in detail in each of the subsequent chapters, and will not be reported here for the ease of the reader. Data on social background risk factors were only present for the young offender group, because information was taken from their records at the Youth Offending Team (YOT). Thus participants had to be in contact with the judicial system in order to be included in the study. Data on neuropsychological and

psychophysiological variables were compared with data from healthy, sex and age matched control participants, or with existing norms, if present.

2.2. Procedure

The study was carried out after receiving ethical approval from Cardiff University. Consistent with ethics regulations, participants gave written informed consent to take part in the study, and parent/guardian written consent forms were also provided for participants under 18 years of age. Before taking part in the study, participants were informed of the purpose of the study and the tasks they were required to complete. It was also explained that they had the right to withdraw at any time and that they could ask questions about the research at any point.

Participants first took part in a two-hour study, which was carried out at the Cardiff YOT. During the study they were asked to complete materials in the following order: Raven's Standard Progressive Matrices (Raven, Raven and Court, 2004) – later replaced by the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999); the Youth Psychopathic Inventory (YPI; Andershed, Kerr, Stattin, & Levander, 2002); the Barratt Impulsivity Scale (BIS; Patton, Stanford, & Barratt, 1995)[1]; the Decision-making computer task (CxR; Rogers et al., 2003); the Youth Self-Report (YSR; Achenbach 1991); the Card Playing task (CPT; Newman, Patterson, & Kosson, 1987); the Sensation-Seeking scale (SSS; Zuckerman, 1994); and the Wisconsin Card Sorting Task (WCST; Heaton, 2005). The questionnaires assessed psychopathic tendencies, impulsivity, behavioural problems, and personality dimensions such as sensation seeking, while the computer-based tasks assessed executive inhibitory control, sensitivity to reward and punishment, and risk-taking behaviour (for further details see the Methodology sections of subsequent chapters). At the end of this

[1] This questionnaire was administered but not analysed, for the purpose of restricting the number of predictors in subsequent analyses.

session, participants were asked whether they would be willing to take part in a longer session. Those who agreed took part in a more extensive study which took place at the School of Psychology at Cardiff University, during which they were asked to complete seven neuropsychological tasks from the Cambridge Neuropsychological Testing Automated Battery (CANTAB; CeNeS Ltd, Cambridge, UK), two paradigms during which psychophysiological measurements were taken, a facial recognition task, and questionnaires assessing alcohol problems, gambling problems, and hostility[2]. The CANTAB tasks used were[3]: Spatial Working Memory (SWM), Cambridge Gambling Task (CGT), Spatial Span (SSP), Affective Go/No-go (AGN), Pattern Recognition Memory (PRM), Intra-Extra Dimensional Set Shift (IED), and Stockings of Cambridge (SOC). The paradigms used to assess psychophysiological responses were an aversive fear conditioning task, during which skin conductance responses (SCR) were recorded, and the presentation of emotional pictures taken from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1997), during which the augmentation of the startle reflex was assessed. During both study sessions evidence for potential executive functioning deficits and reduced autonomic responding was collected.

Finally, participants' signed consent forms gave permission to researchers to look at their records at the Youth Offending Team in Cardiff. Information on offenders' social background variables was collected from official records. The information was put together via the ASSET interview, which had to be completed by each young person's case worker when attending the YOT. The ASSET[4] consists of

[2] These questionnaires were not analysed for the same reasons explained for the BIS and because they were administered in the sub-sample of participants, and would thus reduce the number of observations in subsequent analyses.
[3] Three CANTAB tests, SSP, AGN, and PRM were administered but not used in further analyses to reduce the number of variables in subsequent analyses and because we had no clear predictions with respect to these tests..
[4] Details are provided in Chapter 3.2.2.

12 main categories concerning young people's backgrounds. These include living arrangements, family and personal relationships, education/training/employment, neighbourhood, lifestyle, substance use, physical health, emotional and mental health, perception of self and others, thinking and behaviour, attitudes to offending, and motivation to change.

2.3. Categorising offenders into subgroups

It was within the scope of this research to explore whether different offender groups would be characterised by different sets of risk factors. For this purpose, young offenders were divided into different groups, based on (1) information from official records, and (2) questionnaire measures on behavioural problems and psychopathic tendencies. By using these different sources of information, assignment into groups was consistent with both the judicial and clinical operationalisation of antisocial behaviour (Morgan & Lilienfeld, 2000).

From the official records, frequency and severity scores for the offences young people had committed were collected from the YOT's official databases. A total frequency score was calculated by counting up the total number of offences each young person had committed. A rate variable (total number of offences divided by age) was then created taking account of participants' ages. This variable was created on the grounds that participants were aged between 12 and 18 years of age, thus younger offenders might not have had the chance to commit more crimes.

Severity scores were taken from the YOT's databases; the nature of each offence was rated on a seriousness scale from 1-8 (see Appendix 3.1). A rating of 1 was given to minor offences, such as abusive language, littering, and urinating in a public place, while a score of 8 corresponded to murder, manslaughter, rape, and causing death by dangerous driving. None of the participants had a score at the two

severity score extremes; their scores ranged from 2-7. The highest severity score each young person had ever received for each of their offences was noted.

A median split was then performed in terms of frequency and severity of participants' offences for the purpose of classifying people into prolific/non-prolific, and serious/non-serious offenders, respectively.

Of the questionnaire measures used, the Youth Psychopathic Inventory (YPI; Andershed et al., 2002), and the Youth Self-Report (YSR; Achenbach 1991) were of particular interest. The former assesses psychopathic tendencies, while the latter assesses a range of DSM-IV behavioural problems. The most relevant subcategories of the YSR are aggressive behaviour, externalising problems, and conduct disorder problems. Variables were therefore created in order to divide participants into a high and low psychopathic group, and high and low groups in terms of the three dimensions of the YSR.

The YPI is scored on a 1-4 Likert scale, giving a sum score of 50-200. Following the procedure used by Fairchild et al. (in press), the total YPI score was divided by 50, resulting in a range of scores between 1 and 4, with 4 reflecting a higher presence of psychopathic traits. A 2.5 threshold was used, in accordance with Skeem and Cauffman (2003), to indicate that participants scoring above this threshold belonged to the high psychopathic group.

YSR divisions were made on the basis of standardised t-scores, as designated in the YSR Manual (Achenbach, 1991). A clinical/borderline group was identified, along with a group scoring in the normal range for each of those dimensions.

The different offender groups described in this section have been used in subsequent chapters, where possible, to allow for examination of within group variations in different outcome measures. The next chapter describes and discusses the effects of different psychosocial factors in explaining ASB.

3. Chapter Three – Psychosocial risk factors and ASB

3.1. Introduction

The term 'psychosocial' has been defined by the Oxford English Dictionary as 'pertaining to the influence of social factors on an individual's mind or behaviour, and to the interrelation of behavioural and social factors'. In line with this definition, psychosocial risk factors originate from dysfunctional home and social environments and have been found to be associated with the development of psychopathology in young people (e.g., Farrington, 1995). One of the outcomes resulting from adverse rearing experiences is the development of antisocial behaviour (ASB). As outlined in Chapter One, early childhood social experiences can contribute to ASB independently of genetic processes; however, the interaction between genetic mechanisms and adverse environments better explain the development of ASB (van Goozen, Fairchild, Snoek, & Harold, 2007). As the scope of this PhD research is to examine how social adversity combined with biobehavioural risk factors contributes to adolescent ASB, the present chapter focuses on investigating the effects of a range of psychosocial factors to frequency and severity of offending, with the secondary aim of examining how these factors interact with biobehavioural variables in explaining ASB in a subsequent chapter.

The present investigation is important for two reasons. First, it is important that risk factors are assessed early in life as it is in the early years when preventative practices are more effective. This is because of the poor prognosis of early onset problem behaviour; early onset offending has a high likelihood of resulting to chronic offending (Loeber & Farrington, 2000). It has been theorised that early onset ASB, even though less prevalent than late onset ASB, is stable over the life span (Moffitt, 1993). As a consequence of the greater continuity of early onset ASB, the volume of

crime can be greater in these instances, creating more problems both to the antisocial individual and the society. Thus, the current study focused on an adolescent group of offenders, who often have behavioural problems at an early stage, rather than an adult group of participants. Second, even though a number of studies have examined the potential impact of different psychosocial risk variables in the occurrence of antisocial and delinquent behaviour, most studies have used samples taken from general population households (Barnes, Welte, Hoffman, & Dintcheff, 2005), schools (Juby & Farrington, 2001; Lacourse, et al., 2006; Adalbjarnardottir & Raffnsson, 2002), and clinical samples (Holmes, Slaughter, & Kashani, 2001). Samples from the general population need to be very large in order to capture adequate variation in ASB, as many individuals may engage in ASB during their adolescent years, but only a minority of this group will persist in ASB in adulthood (Moffitt, 1993). Thus, the opportunity to assess predictors of serious offending against less serious offending and early versus late onset is limited in these instances. The present study used a community-based antisocial group, providing with the opportunity to recruit a reasonably sized group, and examine which factors were related to variations in ASB. Adolescent young offenders were chosen because their antisocial behaviour was expected to vary in seriousness and frequency meaning that the effect of psychosocial risk factors within this group could be investigated. In addition, the combination of the variables under examination has never before been explored in a group of young offenders. Even though some of these variables have been examined in conjunction with each other, these have mainly been studied in community-based normal population samples, which investigate antisocial behaviour as a later outcome. On the contrary, studies using clinically defined antisocial groups have usually examined each of these psychosocial factors on their own, as group sizes in such studies will not reach the desirable numbers to assess the effect of a multitude of variables on ASB.

The overall aim of the present study was to investigate the effect of different psychosocial factors in an adolescent antisocial group recruited from the Cardiff Youth Offending Team. These results were compared to the effect of the same range of psychosocial variables in a normative population sample. Data for the latter investigation were extracted from a large longitudinal survey, the British Household Panel Survey (BHPS). In this way, the influence of psychosocial variables in both a normative and an at-risk sample could be assessed. Accordingly, the current chapter consists of two studies. The first looks at whether psychosocial variables influence frequency of fighting and vandalism in a normative sample in an analysis of the British Household Panel Survey (BHPS), which is a survey with the aim to explore social and economic change in households in the UK and is generally regarded as one of the most comprehensive household surveys in the world. For example, its measures of household income are particularly accurate, data that would be hard to collect directly from a survey of young offenders. The second study examined whether psychosocial variables, taken from official records, played a role in frequency and severity of ASB exhibited by young offenders. The latter study served the purpose of exploring the impact of young offenders' background on their behaviour.

3.1.1. Psychosocial risk factors in the general population

With respect to the relation between ASB and its occurrence in the general population, many different surveys have been carried out in the UK, some of these with a more specific focus on offending behaviour. For example, delinquency in a normative population has been investigated in the Offending, Crime and Justice Survey (OCJS)[5], which is a self-report offending survey across England and Wales with the aim of guiding resources to intervene in reducing crime and illegal drug use.

[5] Home Office (2003-2006). *Offending, Crime and Justice Survey (OCJS).*

The survey contains information on offending, antisocial behaviour, and drug use of young people, aged between 10 and 25, and more specifically addresses issues such as type and prevalence of offending, and prevalence and frequency of drug and alcohol abuse.

The OCJS presents data on frequency and seriousness of offending in relation to two age bands, one consisting of 10-15-year-olds, and one involving 16-25-year-olds. Some of these findings are reported in order to see how they could relate both to findings of the normative data of the BHPS and primarily to the findings in the young offender sample, as the same outcome variables were investigated, namely frequency and seriousness of offending.

Results from the OCJS (Home Office, 2003-2006), which can be accessed online, suggest that the variables under investigation in the present study have been found to be related to offending patterns in a general population sample. Specifically, parenting relations (e.g., getting on badly with at least one parent), deviant peers (e.g., having friend who have been in trouble with the police), substance use (e.g., taking any illegal drug), academic problems (e.g., being suspended or expelled from school) were all found to be related to offending in both age bands. 'Deviant peers' was related to frequency of offending for both ages, and parenting to frequency for the younger people and seriousness for the older ones. School problems were related to both frequency and seriousness of offending for the younger age band, and only seriousness for the older one. Finally, substance use was associated with both frequency and seriousness in both age bands. The types of psychosocial variables examined in the OCJS were investigated in both studies reported in the current chapter.

3.1.2. Psychosocial risk factors in antisocial groups

Within the domain of research on antisocial groups, risk factors involved in the development of child delinquency have been conceptualised as being initiated primarily by factors lying within the individual (e.g., individual differences), secondly by factors within the family, and thirdly by being influenced by peer groups and the community (Loeber & Farrington, 2000). Individual differences (e.g., impulsivity, sensitivity to reward and punishment, autonomic arousal) are going to be examined in chapters 4, 5 and 6. Risk factors originating from the family, school, and community environments are going to be inspected in this chapter.

Evidence for psychosocial influences on antisocial behaviour has been extensively documented. Disadvantageous rearing environments related to ASB include poverty (Pagani, Boulerice, Vitaro, & Tremblay, 1999), less educated mothers, early childbearing, mothers smoking during pregnancy (Tremblay et al., 2004), parental criminal and antisocial backgrounds, low socioeconomic status of the family, parents' low occupational status and employment (Farrington, Jolliffe, Loeber, Stouthamer-Loeber, & Kalb, 2001), parental alcohol or substance use (Adalbjarnardottir & Rafnsson, 2002), marital conflict (Wells & Rankin, 1991), and poor parenting practices (Patterson, Reid, & Dishion, 1992; Simons, Wu, Conger, & Lorenz, 1994). Psychosocial risk factors relating to the antisocial individual include associating with deviant peers (Ary, Duncan, Duncan, & Hops, 1999; Lacourse et al., 2006), using substances (Barnes, Welte, Hoffman, & Dintcheff, 2005), not being employed (Farrington, Gallagher, Morley, Ledger, & West, 1986) and having problems with education, such as performing poorly at school (Maguin & Loeber, 1996), being truant, or stopping before the compulsory school age.

As the existing literature on psychosocial risk factors is vast, the present paper focused on specific variables, out of a variety of different variables at our disposal. The selection of variables under investigation was made on the basis of previous literature and the availability of comparable risk factors in both studies. The risk factors selected were parenting practices, associating with deviant peers, deprivation, academic problems, and substance use, with the goal to explore their relation to antisocial behaviour in a normative and an at-risk population sample.

Parenting behaviour, for example, has been considered to play a causal role in the development of antisocial behaviour in children (Caspi et al., 2004). Harsh physical discipline and lack of parental supervision, especially during late childhood and adolescence, have been found to be associated with higher rates of ASB (Lahey, Waldman, & McBurnett, 1999). Difficult child temperaments and low parental thresholds, which predispose parents to respond in a negative way in child misbehaviours, are also supposed to relate to parenting practices. More precisely, a child with a difficult temperament is more likely to elicit harsh and inconsistent parenting behaviours, which in turn will result in the child behaving even more badly. Accordingly, antisocial and depressed parents often present with lower thresholds for reacting unfavourably to the misbehaviours of their child. Thus, parents with lower thresholds are more likely to respond in adverse ways, such that will facilitate the development of antisocial behaviour (Lahey et al., 1999).

Poor parenting practices together with associating with deviant peers has been proposed as a major influence in adolescent behaviour problems, in a model developed by Patterson and colleagues (e.g., Patterson, Reid, & Dishion, 1992). Patterson and Dishion (1985) reasoned that delinquent behaviour is the outcome of a two-stage process: the first stage involves lack of parental monitoring which leads to poor development of social and academic skills, as well as an increase in ASB. As a

result of the first stage, the second stage involves rejection by peers without behavioural problems and academic failure, and by extension leads to association with other rejected and aggressive adolescents. Associating with deviant peers ultimately results in a high likelihood of persistent antisocial behaviour, together with drug use. Ary, Duncan, Duncan, and Hops (1999) and Ary et al. (1999) found support for this model by analysing data collected from two samples in a 24-month longitudinal data set from 204 adolescents and parents in the first case, and an 18-month longitudinal data set from 523 adolescents in the second. 52% of the variance in adolescent problem behaviour was accounted for by this model in the first study and 46% in the second study. The suggested pathway to problem behaviour in youths in these two studies arose from families with high levels of conflict, which in turn were less likely to have high levels of parent–child involvement. Such conditions in the family lead to less adequate parental monitoring of adolescent behaviour, making associations with deviant peers more likely. Poor parental monitoring and associations with deviant peers predicted engagement in problem behaviour. The indirect influence of parenting in the group affiliations of young people has been supported by Brown, Mounts, Lamborn, and Steinberg (1993). Their study in high school students, aged 15-19, suggests that parenting practices are important in influencing peer affiliations in adolescence, and can cause young people to engage in specific behaviours such as drug use and academic underachievement.

It will be clear from the studies described that substance use is another domain with links to antisocial behaviour. Antisocial behaviour has been found to predict smoking and experimentation with illicit drugs (e.g., cannabis and/or amphetamines) at age 17 (Adalbjarnardottir & Rafnsson, 2002). However, there have also been studies reporting the reverse effect, namely that drug use has an impact on antisocial behaviour (Brooke, Whiteman, Finch, & Cohen, 1996). Antisocial behaviour has also

been found to relate to specific types of drugs. Windle (1990) found that antisocial behaviour at age 14-15 years predicted using alcohol and marijuana at age 18-19 years, but not smoking or illicit drug use.

Another commonly researched field, bearing an association with ASB, is academic failure and underachievement. Poor academic performance has been found to relate to both onset and prevalence of delinquency (Maguin & Loeber, 1996). Academic underachievement might also be related to the increased likelihood of delinquents presenting with learning disabilities and/or lower IQ/verbal IQ (Hinshaw, 1992). Academic problems and school drop-outs could also relate to later difficulties in finding employment, both of which have been found to lead to offending (Farrington et al., 1986). Unemployment, which usually comes as a consequence of academic underachievement, has been found to relate to higher rates of committing crimes, but again for specific types of crime. In particular, it was found that unemployed young people were more likely to commit crimes involving material gain, such as theft, burglary, robbery, and fraud, rather than assault, taking and driving away vehicles, damaging property, and drug use (Farrington et al., 1986). This finding is consistent with theories suggesting that financial hardship leads to crime (Farrington et al., 1986).

Being in financial need also results from growing up in lower status families. Poverty and income inequality have been found to predict delinquency (Pagani et al., 1999). However, it should be noted that the literature reports associations with specific types of offending. For example, Pagani et al. (1999) found that family poverty only predicted delinquent acts which comprised the 'extreme delinquency' scale in their self-reported delinquency measures. Examples of serious manifestations of delinquent behaviour were: purposely setting a fire in a public place, stealing objects worth of more than $100, engaging in coercion, and vandalising a car. Family

poverty, however, did not predict self-reported acts of theft, substance use, and physical violence. In a meta-analysis of 34 studies Hsieh and Pugh (1993) reported that poverty and income inequality were associated with violent crime. Again this association was true for particular types of violent crime, namely homicide and assault rather than rape and robbery.

Previous studies have typically examined the impact of isolated psychosocial variables on unfavourable outcomes while large scale longitudinal studies in community samples usually assessed a variety of variables (e.g., Farrington, 1995; Fergusson & Horwood, 2003). The current study will investigate a number of psychosocial risk factors as it has been suggested that high-risk individuals are characterised by multiple risk environments (Fergusson & Horwood, 2003). Furthermore, it should be kept in mind, from a methodological point of view, that some variables could have a mediating influence on ASB; for example, poverty might not affect ASB directly, but rather affect parenting practices which become harder in financial hardship (Rutter, 2001). Parental practices then affect the parent-child relationship and contribute to child psychopathology. The relationship between psychosocial adversity and antisocial behaviour could also be genetically mediated. For example with respect to family factors, parents not only transmit their genes to their children, but also influence their upbringing. Rearing practices could be a result of parents' own genes, which implicates a genetic predisposition in a seemingly 'environmental' influence (Rutter, 2001). Evidence for a bidirectional relationship between parental negativity and childhood antisocial behaviour has been found where parent's negative feelings environmentally mediate risk for their child's ASB, and genetically mediated child effects deriving from genetic predisposition to ASB elicit negative parenting practices (Larsson, Viding, Rijsdijk, & Plomin, 2008). Even though genetic risks have not been assessed in the current group of young offenders,

biobehavioural variables, which can reflect predispositions such as low autonomic arousal, have been collected with the aim to examine their potential influence, and these will be examined in following chapters.

3.1.3. Aim of present study

Different psychosocial variables which have been shown to play a role in previous studies on ASB will be investigated in a sample of young offenders. In order to find out whether the same variables have similar effects in a normative British sample, data were also analysed from the BHPS. It was not possible to directly assess the same information collected from the young offender group in a normal comparison group because the information was gained from interviews carried out with young people at the YOT. The BHPS was selected for this purpose, because it assesses a large number of variables, including the ones we were interested in, in a large random sample of households across the UK.

Regarding BHPS data, the goal of the analyses was to look at whether the psychosocial variables under inspection were related to frequency of fighting and vandalism in youths, in a representative sample in the UK. The psychosocial variables were explored by asking explicit questions relating to parenting practices, deviant peers, material deprivation, substance use, and academic problems. Consistent with findings from the OCJS and previous studies on poverty (e.g., Pagani et al., 1999) it was hypothesised that young people who grow up in more adverse environments in terms of parenting practices, who associate with deviant peers, use substances, have problems at school, and live in deprived houses and areas, would engage more in delinquent behaviour, as revealed by rates of fighting and vandalism.

In the second study, an analysis was carried out in order to investigate which psychosocial background variables would relate to frequency and seriousness of

antisocial behaviour in a group recruited from a youth offending service. The specific psychosocial variables were: family relationships, education and/or employment, neighbourhood, substance use, and associating with deviant peers. Additionally, variables which could reveal social-information processing deficits, such as perception of self and others, were also examined. More serious and prolific offenders were expected to be affected by the majority of these factors. Consistent with the literature mentioned above, inadequate parenting, such as harshness, lack of monitoring, inconsistency, and family conflict were expected to affect engagement in delinquent acts, whereas poverty was expected to affect serious antisocial behaviour only (Pagani et al., 1999). Affiliation with deviant peers, academic problems, and substance use were expected to predict frequency and severity of offending. Variables related to social-information processing deficits (i.e., how the young person perceived others) were expected to predict severity of offending, consistent with research suggesting hostile attribution bias in aggressive and psychiatric populations (Bickett, Milich, & Brown, 1996; Milich & Dodge, 1984), as well as frequency, given that reactive/impulsive aggression has been found to relate to more frequent attribution of hostile intent to peers in children (Polman, Orobio de Castro, Koops, van Boxtel, & Merk, 2007).

3.2. Methods and Materials

Data were taken from a general population household sample in the UK and from a youth offender institution in Cardiff, Wales. These studies had similar measures on youths' social background information, and thus an attempt was made to compare how those risk factors were related to antisocial behaviour in both a normative and an at-risk sample. Samples and methods for the two studies are summarised below.

3.2.1. Study 1: British Household Panel Survey

3.2.1.1. Participants

The BHPS is a longitudinal panel survey which samples at the household level. Those who are 16 years and over complete the full adult survey, whereas those under 16 but over 10 years complete the shorter youth survey. Thus, variation in the number of youths participating changes as youths become eligible for the youth survey, when they were previously too young or become old enough to complete the adult survey. This means that wave by wave numbers of available youths varied as youths became eligible for the survey and then moved into the adult survey. One source of attrition was therefore due to youths reaching 16 years of age (see Table 3.1). Another source of attrition may also be due to constructs associated with vandalism and fighting, the two outcome variables of interest here, such that young people who get involved in any of these activities are also less likely to take part in the survey (for example, they may not want to discuss their potentially illegal behaviours with strangers or because of their lifestyle are unavailable for the survey). It is important to examine attrition rates in longitudinal studies, especially relating to ASB, because of the potential low respondent rates and the implications of how missing data are treated. Data missing due to attrition rely on different assumptions; in the case of the BHPS analyses, data could be 'missing at random' (MAR) if young people drop out from the study or start completing the adult version, or the household loses contact with surveyors for reasons like moving house. However, if missing data are related to disorderly behaviour and young people refuse to answer particular questions, then data are 'not missing at random' (NMAR) and this could skew the results. NMAR means that missing data relate to the outcomes variables of interest. To test whether data was not missing at random in the BHPS analyses, logistic

regressions were run with vandalism and fighting as the predictor variables, and the number of people who dropped from the survey as the outcome measure. These analyses showed that vandalism did not predict dropping out ($z = 1.17$, $p = 0.243$), but fighting did ($z = 2.69$, $p = 0.007$). This indicates that individuals involved in fighting in the BHPS were less likely to respond in violence questions. The second study, assessing young offenders, circumvents this problem of attrition of NMAR. Since violent individuals are a difficult group to get to engage in general population surveys, replicating analysis with young offenders is the only sure way to confirm observations. Because of the NMAR assumption, the second study carried out in young offenders is so valuable because data were obtained in an otherwise very difficult to get sample group of participants.

Fifteen data waves have been collected for the BHPS; waves seven to eleven were analysed in the current study, as these contained full information on the psychosocial variables under investigation and youths' fighting and vandalism. Respondents were young people aged 11-15 years, and adults living in households in the UK.

Table 3-1: Number of people (in %) participating by wave (N) and information on attrition for vandalism and fighting

Vandalised	Wave 7	Wave 8	Wave 9	Wave 10	Wave 11
Never	80.57	78.61	78.24	75.64	63.64
Once or twice	17.84	19.23	17.56	20.51	27.27
Several times	1.06	1.20	3.05	1.92	6.49
Often	0.53	0.96	1.15	1.92	2.60
N	566	416	262	156	77
Fight Frequency					
None	70.66	76.92	72.57	65.44	73.53
Once	19.16	15.93	18.57	23.53	17.65
2 to 5 times	7.58	5.77	8.02	8.82	4.41
6 to 9 times	0.00	0.55	0.42	1.47	1.47
10 or more times	2.59	0.82	0.42	0.74	2.94
N	501	364	237	136	68

Respondents in the vandalism frequency question were 1477, while involvement in fighting was answered by 1306 young people. As shown by Table

3.1, the majority of responders answered that they had not been involved in fighting or vandalism, with respondents varying between 15-30% in being involved once or twice in these types of behaviour. The number of people answering questions relating to fighting and vandalism reduced considerably with each data wave.

3.2.1.2. Procedure

Data were taken from the British Household Panel Survey (BHPS) data archive; data is open and freely available for academic research[6]. Data were analysed from the BHPS records, after identifying which variables had been found to be related to delinquency and antisocial behaviour in the literature, and which variables were comparable to the ones from the Youth Offending Team's official records. Variables reported in most of the waves of the BHPS were used in the analyses. Youth surveys were combined with their mother's survey responses to the household survey by each wave. General household characteristics were included, such as levels of deprivation and household income. The specific variables included in the analyses are described in detail in the measures section.

3.2.1.3. Measures

3.2.1.3.1. Dependent variables and model selection

Frequency of fighting was assessed by asking young people how often they had a fight with someone that involved physical violence, such as hitting, punching, or kicking, in the past month. Their responses were classified into: none, 1, 2-5, 6-9, and 10 or more.

[6] Data can be accessed in: http://www.data-archive.ac.uk/findingData/bhpsTitles.asp. Ethical approval was not required for secondary analysis of anonymised data.

Vandalism was assessed by asking whether the young person had deliberately broken or damaged property that didn't belong to him/her, in the past year. Their responses were classified into: never, once or twice, several times, and often.

These outcome variables present difficulties in longitudinal data analyses. They are ordinal and therefore standard longitudinal regression analyses that assume a Gaussian distribution in the dependent variable are inappropriate. While econometric methods that might be used to estimate models using panel dataset with ordinal outcome measures exist, they are beyond the scope of this thesis. An alternative is to reduce the outcome variable to a binary variable and use more generally available logistic models.

Broadly, there are two types of longitudinal analysis. Random effects models (RE) and fixed effects models (FE). FE models will only consider within respondent changes over time such as age, income, education, etc. Between respondent measures are not included such as gender. This is not dissimilar to repeated measures ANOVAs where the participant acts as their own control over time. RE models, on the other hand, contain both within and between measures and therefore consider variables that do not necessarily change over time but vary between subjects such as gender. As variables varied between (e.g., gender) and within respondents (e.g., age, household income) a FE model was inappropriate and a random effects (RE) longitudinal logistic model was selected.

Longitudinal analyses are of considerable importance in social research. They are superior to cross-sectional survey research as they consider change over time and as such offer the potential for a more robust assessment of the causal relationships between predictor and dependent variables. While they do not specifically test for causality, observing that, for example, changes in household income, which are usually outside the control of youths, are associated with levels of disorderly

behaviour, they go some way in supporting the conjecture that inequalities in income might promote problem behaviour – a conclusion that would be weaker in cross-sectional analyses.

To construct binary outcome variables a zero was assigned if the respondent indicated they had never engaged in a particular activity and a one if they had at some point in the past.

3.2.1.3.2. Independent variables

Age and gender were included as independent variables. Age was scored as a continuous variable, and gender was coded with 0 as female and 1 as male.

Parenting related questions included if youths told parents where they were going when they went out, and if their parents stopped them from watching a particular programme on TV because they didn't think it was suitable. For the variable 'youth tells parents where they were going' there were four categories of responses: always, usually, sometimes, and not usually. This variable was reduced to a binary variable with the outcomes 'always' and 'usually' combined. The variable 'do parents stop you watching a programme' was answered with a yes or no response.

'Associating with deviant peers' was measured by asking the young person whether any of their friends ever use illegal drugs, such as smoking cannabis, or taking ecstasy, cocaine, or crack. This question was scored with either none, a few, or most.

'Substance use' could only be assessed by the number of cigarettes young people had smoked in the last 7 days. Unfortunately questions related to alcohol use could not be used as they were only answered in very few waves and including them would restrict the data to only these waves. There were no questions relating to illicit drug use specifically although we assume that mixing with friends who do take illegal

substances provides a reasonable proxy to this measure. The amount of cigarettes smoked was included as a continuous variable.

Education related factors were assessed by questions about whether the young person had been expelled or suspended from school and whether they planned to leave school by the age of 16 or to go on to college. In terms of being suspended or expelled from school responses were given on a yes or no basis. The age by which they wanted to leave school was coded as a binary variable, with 0 meaning that they planned to leave school by 16 and 1 that they planned to go on to college.

Income was calculated using the equivalised (Office for National Statistics, 2004) annual household income before housing costs which was log transformed to adjust the non-normal distribution. To equivalise household income, the McClements Equivalence Scale (MES) was used. The MES is additive with a single adult receiving a score of 0.61 to which is added, for example, 0.39 for a cohabiting partner and 0.42 for a 16-18 year old child. The MES is divided from household income to provide an equivalised income measure. For example, a household consisting of a married couple with three children (aged three, nine and eleven) has an income of £20,000; their equivalised household size is 0.61 + 0.39 + 0.18 + 0.23 + 0.25 = 1.66. This implies they need 66 per cent more income than a couple with no children to have the same standard of living. Their equivalised income would therefore be £20,000/1.66 = £12,048 (Office for National Statistics, 2004).

Poverty can generally be measured 'indirectly' via income (e.g., financial poverty), and 'directly' via assessing living standards (e.g., material poverty). A cut-off point based on mean or median income to define poverty can be somewhat arbitrary, while assessing who can afford items which the society considers essential can be a more direct measure of acceptable living standards and thus poverty (McKay, 2004). However, a problem arises as to whether self-reports of living standards equate

to actual deprivation, as people often claim they are deprived of certain items but have in fact commodities which are deemed 'unnecessary' (McKay, 2004). To circumvent this inconsistency between self-report and actual deprivation, deprivation was scored using a method derived by McKay (2004) who rated which items are deemed necessary by a majority of respondents in his survey (e.g., over 50% of the sample) and which of these commodities people can actually afford. In the BHPS, 'material deprivation' was assessed via parents' responding. 'Material deprivation' was questioned in terms of daily living, durables, housing and area. Daily living items included being able to eat meat, buy new clothes, and buy new furniture. Durables contained information on being able to afford e.g., a dishwasher, microwave, telephone, colour TV, cable TV, and home computer. Housing and area included questions relating to being able to keep their house warm and free of damp and rot, live in a neighbourhood free of crime, pollution, and lacking noise. For our purposes, the latter variable (e.g., housing and area) was the one more directly comparable to the variable neighbourhood assessed via the Asset interview in young offenders. A daily living deprivation (DLD) index was created; variables were recoded so that if a household could not, for example, buy furniture, a score of 1 was assigned, and a score of 0 if they could. These binary outcomes were used to assess material deprivation. A higher DLD score meant greater deprivation. MES income and material deprivation were used as dependent variables to assess both financial and material poverty respectively.

3.2.2. Study 2: Young Offenders

3.2.2.1. Participants

One hundred and fifteen 12-18 year old youngsters (mean age = 16.26, SD = 1.47), consisting of one hundred and four males and eleven females, were recruited from the Youth Offending Team (YOT) offices in Cardiff. Participants had exhibited aberrant behaviour at different levels of seriousness, which was indicated by the varying degrees of contact they were obliged to have with the Youth Offending team's support workers.

3.2.2.2. Procedure

Data used for the purposes of the current paper have been collected from the Cardiff Youth Offending Team's databases. Participants were approached for taking part in a study carried out by the School of Psychology, Cardiff University, however, data analysed in the current chapter only concern information on young offender's backgrounds. Prior to taking part in the research, each young person signed a consent form, which gave the researchers permission to access their data files at the YOT. Data files contained information, completed by young offender's case workers, regarding 12 main categories in terms of young people's backgrounds, namely living arrangements, family and personal relationships, education/training/employment, neighbourhood, lifestyle, substance use, physical health, emotional and mental health, perception of self and others, thinking and behaviour, attitudes to offending, and motivation to change. Information for each of the categories was collected through an extensive interview with each young person, which was carried out by their case worker. At the end of each section, young peoples' case workers gave an estimation of the extent to which each of these background factors was associated with the

likelihood of further offending. The score with which they rated the likelihood of re-offending was estimated on a 0-4 scale, with 0 being not associated and 4 being very strongly associated. Full details of the specific information collected for each of these background factors are provided in the measures section.

3.2.2.3. Measures

3.2.2.3.1. Dependent variables

Frequency of offending was calculated by adding up all of the offences each young person had committed till the date they took part in the research. An offence was only counted if the participant had been sentenced at court and found guilty. The one hundred and fifteen participants had committed a mean number of 9.1 offences.

The severity of all offences committed on a scale of 1-8 was recorded using the youth justice board counting rules sheet (Appendix 3.1). Examples of offences scored as 1 were: being drunk and disorderly, or committing a minor offence, such as urinating in a public place and purchasing alcohol under the age of 18. A score of 8 was given for offences such as murder, rape, and death by dangerous driving. Nobody scored below a 2 and above a score of 7. The highest severity score for the offences each young person had committed till the date they took part in the research was used for the analyses.

Antisocial behaviour was also assessed by asking participants to complete the Youth Self-Report (YSR; Achenbach 1991), details of which are reported in Chapter Six. Briefly stated, the YSR assesses behavioural and emotional functioning in adolescents. Symptoms of aggressive behaviour, externalising problems and conduct disorder problems were used for the purposes of our study.

3.2.2.3.2. Independent variables

Background social variables for each young person were taken from the Asset interview. A score of 0-4 was given for each of the twelve background categories, which was a subjective rating by the case worker of the young person s/he was seeing at the YOT. The rating for each of the background categories was given on the basis of risk factors, which according to the case worker's impression were associated with the likelihood of the young person re-offending in the future. The following categories were completed:

- *Living arrangements:* This section reported with whom the young person had been living in the last six months and whether their living circumstances were unsuitable (e.g., overcrowded, lack basic amenities). Examples of other questions were whether the young person was living in deprived households or living with known offender (s). The whole section is included in Appendix 3.2.

- *Family and Personal Relationships*: Information was given on which family members or carers the young person had been in contact with in the last six months. Case workers also reported if there was evidence of those family members or carers being involved in criminal activity, heavy alcohol or drug misuse. Experience of abuse, witnessing other violence in family context, significant bereavement or loss, and difficulties with care of his/her own children, if applicable, were also part of this section. Finally, information about parenting practices was also reported (Appendix 3.3).

- *Education, training, and employment (ETE):* This section contained information on whether the young person attended school, if they were of compulsory school age, and if not, whether they were in full time employment

or doing something else (e.g., attending a training course). Appendix 3.4 includes the relevant section.

- *Neighbourhood:* This section reported if the neighbourhood where the young person was living was identified as a crime 'hotspot', and whether there were problems with drug dealing and/or usage, lack of age-appropriate facilities (e.g., youth clubs, sports facilities), and racial or ethnic tensions (Appendix 3.5).

- *Lifestyle:* This category was mostly about the young person engaging with deviant peers. More specifically, it was noted if lack of age-appropriate friendships, associating with predominantly pro-criminal peers, and lacking non-criminal friends was characteristic of the young person's lifestyle (Appendix 3.6).

- *Substance Use:* Information was provided about several substance use categories, ranging from tobacco and alcohol, to more serious use of cocaine, crack or heroin. If the young person had used any substances, age at first use, and whether use was recent, was also conveyed, if available. Examples of other information conveyed in this section were in relation to whether the young person had a positive attitude toward using substances, whether substance use was affecting daily functioning, and whether there were any links with offending behaviour, such as offending to obtain money for substances (see Appendix 3.7).

- *Physical Health:* Case workers assessed if any physical health conditions were applicable. Specifically, the existence of health conditions significantly affecting everyday life functioning, physical immaturity/delayed development,

and lack of access to appropriate health services (e.g., dentist) were mentioned as part of this category (Appendix 3.8).

- *Emotional and Mental Health:* This section provided information on whether the young person had been formally diagnosed with any mental illness and if they had been referred to a mental health service. Questions concerned whether the young person was affected by emotional or psychological difficulties (e.g., phobias, eating or sleep disorders), had deliberately tried to hurt himself/herself, or had previously attempted suicide (Appendix 3.9).

- *Perception of self and others:* Questions focused on whether the young person had difficulties with self-identity and/or inappropriate self-esteem (e.g., too high or too low), had a general mistrust of others, saw himself/herself as a victim of discrimination or unfair treatment (e.g., in the home, school, community, prison), displayed discriminatory attitudes towards others (e.g., race, ethnicity, religion, gender, age, class, disability, sexuality), and perceived self as having a criminal identity (Appendix 3.10).

- *Thinking and behaviour:* There were two sub-sections in this category; the first referred to whether the young person's actions were characterised by lack of understanding of consequences, impulsiveness, need for excitement, poor control of temper, inappropriate social and communication skills, and by giving in easily to pressure from others. The second sub-section questioned whether the young person had displayed aggressive (e.g., verbal, physical) or sexually inappropriate behaviour, destroyed property or had attempted to manipulate others (Appendix 3.11).

- *Attitudes to offending:* Case workers described if the young person displayed lack of remorse, lack of understanding about impact of his/her behaviour on

victim(s) and/or family/carers, and if they were denying the seriousness of their behaviour and were reluctant to accept any responsibility for involvement in most recent offence/s (Appendix 3.12).

- *Motivation to change:* The final section referred to young people's positive attitudes, such as having an appropriate understanding of the problematic aspects of their behaviour, showing evidence of wanting to deal with problems in their life, understanding the consequences of further offending, and showing evidence that they want to stop offending (Appendix 3.13).

3.2.3. Data Analyses

Longitudinal logistic models were run for the BHPS analyses in order to inspect the influence of psychosocial variables on the dependent variables fighting and vandalism.

For the Asset data different analyses were used. In order to address the issue of having count data as the dependent variable (e.g., frequency of offending) Poisson regression analyses were deemed appropriate. However, ordinary Poisson regression would have difficulty with the current type of data because it would try to predict zero counts even though there were no zero values in the dataset regarding frequency of offending, given that all participants had committed at least one offence in order to attend the YOT. For this reason, a zero truncated Poisson regression was run. Even though Poisson regression is commonly used for count data, a condition called over-dispersion often occurs because the observed counts show more variation than what the Poisson predicts (Slymen, Ayala, Arredondo, & Elder, 2006). In these cases, the extra variability is managed by using alternative models, in our case the zero-truncated negative binomial – zero truncated refers to a special case of the negative binomial model that accounts for data where no zeros occur. In both Poisson and

negative binomial models the fit attempts to explain data at 0 and this is inappropriate as explained before. The zero truncated models adjust for the fact that some data have no zeros. Both zero truncated Poisson and zero truncated negative binomial regressions were run as both were applicable to the nature of the data in question, and the issue of over-dispersion was addressed in order to choose the most appropriate model for our data. Both results from the Poisson and the zero truncated negative binomial regression are reported in terms of the frequency of offending, and the process by which the most suitable model was selected.

Seriousness of offending was an ordinal variable, thus an ordered probit regression model, which is preferred over linear regression when the nature of the dependent variable is ordinal, was used. An ordered probit model was chosen over an ordered logistic regression model because the former is applicable when data categories are not independent, and the latter when there are independent categories. Self-reported behavioural problems, as assessed by the YSR, in terms of aggression, externalising problems, and conduct disorder scores were also investigated as dependent variables in simple linear regressions.

3.3. Results

3.3.1. Demographic Information

Young offenders' demographic data are presented in Table 3.2. As explained before, it was not possible to directly compare information collected in the YOT group to a normal comparison group, but only to a normative population sample taken from the BHPS. Since the number of people who participated in the BHPS is presented in Table 3.1, only demographic data for the YOT group are presented.

Table 3-2: Demographic characteristics

	YOT	N
Age	16.26 (± 1.47)	115
IQ	92.54 (± 11.8)	80

Data are presented in means (±SD).

3.3.2. British Household Panel Survey (BHPS)

Data taken from the BHPS were analysed by using a longitudinal logistic model where the binary dependant variables were fighting and vandalism. Table 3.3 shows the results of the analyses.

Table 3-3: Longitudinal logistic models on fighting and vandalism

		Vandalism		**Fight**	
		Beta	SE	Beta	SE
Youth	Age	0.01	-0.17	-0.338	6.34**
	Gender	1.467	7.81**	1.174	6.82**
	Parents control TV	-0.118	-0.71	-0.17	-1.16
	Inform parents	-0.606	3.09**	-0.876	4.92**
	Smoking frequency	0.007	-1.17	0.012	-1.94
	Friends take drugs	1.698	9.09**	0.968	5.59**
	Suspended/expelled from school	0.758	2.55*	0.411	-1.44
	Age plan leave school	-0.049	2.09*	-0.057	2.71**
Mother	Deprivation: Daily living	0.013	-0.17	0.032	-0.48
	Deprivation: Durables	-0.003	-0.05	-0.01	-0.18
	Deprivation: Housing and area	0.01	-0.2	0.084	2.00*
	Equivalised income	-0.152	-0.97	-0.12	-0.85
	Constant	-1.368	-0.72	3.098	-1.8
	Observations	3595		3595	
	Number of cross-wave person identifier	1681		1681	

As Table 3.3 shows, younger people were more likely to engage in fighting. Males were more likely than females to both fight and vandalise properties. Out of the two parenting related questions, telling parents where they were going, was significantly associated with both fighting and vandalism frequencies. The question related to associating with deviant peers (e.g., friends take drugs) was also significantly related to both fighting and vandalism, while the substance use variable (e.g., number of cigarettes smoked) was not. Out of the two academic problems

questions, being suspended or expelled from school predicted vandalism, while leaving school early was associated with both fighting and vandalism. Finally, out of the three material deprivation variables, only the one which was more comparable to the data collected from the Asset interview, namely housing and area, was significantly associated with fighting rates. Income was not associated with rates of fighting or vandalism.

3.3.3. Asset interview

A zero truncated Poisson regression model and a zero truncated negative binomial regression were run with frequency of offending as the dependent variable. An ordered probit regression was run with offence severity score as the dependent variable. Linear regressions were run with aggression, externalising problems, and conduct disorder symptoms as the dependent variables. In the first two models age was entered as an exposure variable, and in the ordered probit and linear regressions age was accounted for. The results of the regressions are reported in Tables 3.4 and 3.5 below.

Table 3-4: Zero truncated Poisson and negative binomial regressions on frequency of offending

	Zero truncated Poisson		Zero truncated negative binomial	
	z	P > |z|	z	P > |z|
Living arrangements	0.42	0.676	0.32	0.751
Family/personal relationships	-2.41	0.016	-1.09	0.276
Education/training/employment	5.95	<0.001	2.68	0.007
Neighbourhood	4.97	<0.001	2.70	0.007
Lifestyle	3.17	0.002	1.37	0.172
Substance use	6.18	<0.001	3.31	0.001
Physical health	0.01	0.991	0.35	0.730
Emotional/mental health	0.47	0.640	-0.40	0.692
Perception of self/others	-2.65	0.008	-0.34	0.737
Thinking and behaviour	0.45	0.651	0.59	0.554
Attitudes to offending	-4.28	<0.001	-1.82	0.069
Motivation to change	3.95	<0.001	0.99	0.321

In the zero truncated Poisson regression, family relationships, associating with deviant peers (e.g., lifestyle category), education/training/employment, neighbourhood, and substance use were associated with frequency of offending, as well as perception of self and others, attitudes to offending, and motivation to change. However, when over-dispersion was examined in the zero truncated negative binomial regression, results showed that the Likelihood-ratio test of alpha=0: chibar2(01) = 505.01 Prob>=chibar2 = 0.000, which suggests that there is significant evidence of over-dispersion: (G^2 = 505.01, $p<0.01$), and thus the zero truncated negative binomial model is preferred over the zero truncated Poisson regression in best explaining the data.

Results of the zero truncated negative binomial regression showed significant associations between education/training/employment, neighbourhood and substance use, on the one hand, and frequency of offending, on the other.

Table 3-5: Ordered probit regressions on seriousness of offending and Linear regressions on YSR aggression, externalising, and conduct disorder (CD) problems

Dependent variables	Seriousness		YSR Aggression		YSR-Externalising		CD symptom counts of YSR	
	z	P > |z|	t	P > |t|	t	P > |t|	t	P > |t|
Living arrangements	0.59	0.555	-1.08	0.283	-0.67	0.506	-0.24	0.810
Family/personal relationships	-1.40	0.160	-1.18	0.240	-1.26	0.212	-0.11	0.915
Education/training/employment	1.55	0.121	0.67	0.502	0.31	0.757	0.57	0.569
Neighbourhood	-0.02	0.982	1.21	0.230	1.74	0.085	1.25	0.215
Lifestyle	1.05	0.292	-0.41	0.685	0.39	0.694	0.18	0.860
Substance use	0.19	0.847	-0.38	0.703	0.89	0.373	0.25	0.805
Physical health	-0.56	0.576	1.13	0.263	1.77	0.080	1.30	0.195
Emotional/mental health	-1.09	0.276	0.76	0.449	0.36	0.720	-0.14	0.890
Perception of self/others	1.60	0.110	0.96	0.338	0.79	0.429	0.81	0.418
Thinking and behaviour	0.29	0.774	0.92	0.359	1.69	0.094	0.65	0.515
Attitudes to offending	0.10	0.920	-0.06	0.949	-0.36	0.722	-0.74	0.460
Motivation to change	0.62	0.537	2.57	0.012	2.90	0.005	2.21	0.029
Age	2.43	0.011	0.86	0.394	0.90	0.371	-0.37	0.715

There were no significant associations between seriousness of offending and any of the psychosocial variables. Older participants were more likely to commit serious offences than younger ones.

In terms of self-reported antisocial behavioural problems, YSR aggression, externalising problems and conduct disorder problems were associated with greater likelihood of reoffending due to lack of being motivated to change their antisocial behaviour.

3.4. Discussion

The current study investigated whether a range of psychosocial variables, previously found to be related to antisocial behaviour, were associated with delinquent behaviour in a representative, normative UK sample, and in a sample of young offenders, with the aim of comparing psychosocial risk factors in both types of populations. The inspection of the Asset data in young offenders was also a preliminary step in later examining the conjunction of different factors in the emergence of antisocial behaviour in adolescent young offenders, in a sample recruited from the Cardiff Youth Offending Team, and comprises part of a larger study.

In the normative sample assessed in the BHPS, most of the predictions were confirmed. Poverty, as assessed by living in a deprived house and area, was found to be significantly associated with fighting but not with vandalism. In a study by Pagani et al. (1999), it was found that family poverty was associated with the most serious delinquent acts; one of the items in this list was vandalising a car. Therefore, in this respect, the BHPS results are not consistent with Pagani et al's (1999) study; however, this inconsistency might arise from different perceptions of what constitutes serious delinquent acts. If one considers fighting as more serious than vandalism, then

the present results can be interpreted as consistent with the notion that poverty relates to the more serious acts. As only two types of delinquent acts, fighting and vandalism, were assessed in the BHPS, one should try to replicate these findings with a wider variety of delinquent behaviours. Income was not found to be related to fighting or vandalism, consistent with McKay's (2004) suggestions that deprivation is a more approximate estimate of poverty. Substance use (e.g., number of cigarettes smoking) was also not significantly associated with fighting or vandalism, however, this might be due to the fact that other substances, such as alcohol and drugs, were not assessed. The question relating to substance misuse by peers (associating with deviant peers) could act as good proxy measure to substance abuse, and this was indeed significantly related to fighting and vandalism. The remainder of the analyses of the BHPS data revealed that poor parenting practices, as assessed by whether parents knew where young people were going when they were going out, and academic problems (e.g., leaving school at an early age), were significantly related to both fighting and vandalism in a normative sample of young people up to 16 years of age. Being suspended or expelled from school was significantly associated with vandalism only. The latter pattern of findings is consistent with previous research and findings from other surveys, such as the OCJS, which find that poor parenting, delinquent peers, and academic problems are related to antisocial behaviour. As mentioned already, our failure to replicate findings on the role of substance use in ASB could have been caused by the specific content of the current questions and the failure to ask about the use of other, more serious substances.

We mentioned one limitation of the BHPS survey related to the content of their questions. Another limitation is that some questions were not assessed in all waves of the data collection. However, the advantage of the current study was that questions directly comparable to the Asset interview had been identified, and

questions loading to each of the background social risk factors of interest could be analysed.

In terms of the Asset data, poverty could not be directly assessed through the Asset interview. However, the most relevant categories to the material deprivation variable of the BHPS (housing and area) were living arrangements and neighbourhood. Neighbourhood was significantly related to frequency of offending, but neither living arrangements nor neighbourhood were significantly related to seriousness of offending. Thus, the deprivation hypothesis was only supported partially in terms of prolific offending, consistent with findings from the BHPS sample and previous research (e.g., Hsieh & Pugh, 1993). Education, training, and employment, and substance use were associated with frequency of offending in the Cardiff YOT sample. A great deal of research has found academic underachievement to be related to delinquent behaviour (Maguin & Loeber, 1996). Present results are consistent with these findings, and with the OCJS survey, which found that school problems were related to frequency of offending in young people. The finding that substance use was associated with frequency of offending was also consistent with previous research (Brook et al., 1996) and with the OCJS results in terms of frequency of offending. The reason that there was no relation in our sample between substance use and seriousness of offending could be because the use of particular substances was not investigated. For example, Windle's study (1990) found that antisocial behaviour at age 14-years related to the use of alcohol and cannabis at age 18-19, but not the use of smoking and illicit drugs. Thus, the use of certain drugs might relate more to ASB than others.

Finally, the analyses of the Asset interview data did not reveal any significant associations between frequency and seriousness of offending and associating with deviant peers and/or parenting practices. This is probably the most surprising finding,

as both consistently come out as important psychosocial factors explaining ASB in youngsters (Patterson et al., 1992, Ary et al., 1999). The result is also contrary to the results of both the BHPS analyses and the OCJS. Specifically, the OCJS found that association with deviant peers was related to frequency of offending in both younger and older aged groups and that parenting was related to offending frequency in younger people and to offending seriousness in older ones. However, the OCJS has been carried out in a normative population and the present results concern young offenders. Furthermore, a failure of psychosocial variables to explain severity of offending could mean that other (e.g., more biologically based) variables can better do this. This argument will be examined in the subsequent chapters. The only variable found to explain severity of antisocial behaviour, as indexed by self-reported behavioural problems (i.e., YSR aggression, externalising problems, and conduct disorder scores) was lack of motivation to change antisocial behaviour. Even though other social variables, such as poor family relationships, would be expected to relate to aggressive behaviours, the lack of significant findings in these domains could also mean that biobehavioural variables are in better place to do so.

With respect to the absence of relationships between some of the psychosocial variables and the occurrence of antisocial behaviour in our young offenders, another reason some of these associations were not found might be because we did not examine the effects of specific questions within the separate categories, especially the ones that have been found to be associated with delinquency in previous literature. This issue goes back to the limitations arising from the use of the Asset data set, as this pertains general psychosocial factors associated with frequency or seriousness of offending. Specific items in the Asset interview, such as those related to the use of substances in offending, were not considered in the present chapter due to time constraints. Other variables which have been identified in previous research as critical

in explaining offending, such as growing up in single parent families or in foster care homes, could be taken into consideration in future analyses.

The strength of the current study is that it examined a multitude of psychosocial risk factors with this selection being based on a thorough review of existing evidence (Fergusson & Horwood, 2003). Even though frequency of offending in youngsters was only explained by education/training/employment, living in a bad neighbourhood and substance use, and seriousness of offending was not accounted for by any psychosocial variable, there was no normal control group for comparison. The current study also did not address the issue that the relationship between psychosocial adversity and antisocial behaviour could be genetically mediated, nor did it examine the possible impact of biological predispositions. The fact that differences in cognitive processes, i.e., motivation to change, best explained self-reported levels of antisocial behaviour indicates that individual differences are of vital importance in explaining differences in antisocial behaviour.

For all of these reasons, it is in the scope of the PhD thesis to incorporate additional factors when investigating frequency and seriousness of offending in this at-risk sample of participants. Biobehavioural risk factors will next be considered as biological risk factors have been found to better explain antisocial behaviour in the absence of psychosocial risk (Raine, & Venables, 1981). In addition, biological and social factors together best explain antisocial behaviour (Raine, 2002b). In the light of this evidence, it will be considered how neuropsychological and psychophysiological factors interact with psychosocial risk variables in explaining differences in antisocial behaviour.

Even though the present study examined a selection of psychosocial variables, in order to identify their relationship with antisocial behaviour, the pattern of results is important as most factors were found to relate to fighting and vandalism in a

normative sample, but only specific risk factors were found to be associated with antisocial behaviour in the young offenders. Education/employment problems, neighbourhood and substance use were significantly related to frequency of offending, whereas a cognitive dimension (e.g., motivation to change) was related to self-reported level of ASB. These specific risk factors could be used as starting points for the development of successful interventions by focusing specifically on those aspects that have been identified as the most crucial ones in the occurrence of delinquency.

4. Chapter Four – Psychophysiology and antisocial behaviour

4.1. Introduction

Emotional impairments, specifically those related to emotional learning and processing, have been part of the explanatory factors of antisocial behaviour. Abnormal emotional processing has been found in different groups with antisocial problems, such as children with disruptive behaviour disorder (DBD; van Goozen, Snoek, Matthys, van Rossum, & van Engeland, 2004), and in psychopaths (Blair, Jones, Clark, & Smith, 1997). In fact, an abnormal affective component has been suggested to be one of the dimensions in a three-factor model of psychopathy (Blair, Mitchell, & Blair, 2005), the other two being a narcissism/interpersonal component, and an impulsivity/antisocial behaviour dimension.

The observation that emotional processing difficulties are present in different antisocial groups, compared to normal control groups, have directed researchers to look for objective measures, such as psychophysiological ones, to clarify the link between emotional processing impairments and antisocial behaviour. Psychophysiological measures provide an index of autonomic nervous system (ANS), and central nervous system (CNS) functioning. Increasing evidence indicating that lower autonomic responses to affective stimuli are a marker of antisocial behaviour (Scarpa & Raine, 1997; Patrick, Bradley, & Lang, 1993) has led to different theories. One of the more prominent ones has been the assertion that the observed under-arousal (i.e., low responsivity in psychophysiological systems, such as low skin conductance level and low heart rate) in the autonomic nervous system can be explained as antisocial individuals experiencing muted levels of fear compared to control groups (Raine, 1993a). For this reason it is argued, antisocial individuals are more likely to engage in risky and dangerous behaviours as the emotions, i.e., fear,

associated with the prospective negative consequences of their actions are relatively weak or non-existent. Zuckerman (1979), in his stimulation-seeking theory suggests, on the other hand, that under-arousal in the ANS prompts antisocial people to seek sensations in order to acquire a more optimal ANS level.

In terms of brain functioning, emotional processing has been mainly associated with the amygdala, while neuropsychological functioning has been investigated mainly in terms of the prefrontal cortex, and specifically executive functioning (Seguin, Sylver, & Lilienfeld, 2007). One region of the prefrontal cortex, the orbitofrontal (OFC) lobe area, is also associated with emotional regulation problems. Specifically, patients with lesions in this area behave in a socially inappropriate, impulsive way (Damasio, 1994; Bechara, 2004). An association exists between the amygdala and the orbitofrontal cortex, in that the amygdala is involved in reactive aggression in psychopaths as part of a neural circuit that involves both the orbital frontal lobe and the anterior cingulate cortex (Davidson, Putnam, & Larson, 2000). Furthermore, Blair (2004) suggested that orbitofrontal cortex dysfunction might succeed amygdala dysfunction, as children with psychopathic tendencies seem to exhibit only amygdala deficits, while adult psychopaths appear to show dysfunctions in both areas. More evidence suggesting that the OFC is part of an emotional response circuit has been presented by Angrilli, Bianchin, Radaelli, Bertagnoni, & Pertile (2008). Angrilli et al. (2008) found that lesions in the polar orbitofrontal cortex, a more superficially placed cortex area of the OFC, resulted in reduced startle amplitudes in response to a sudden loud white noise, and lower self-reported unpleasantness. This finding suggests that the OFC is not only involved in secondary aspects of emotions, as previously thought (Adolphs, 1999), but may also regulate primary emotional responses in tandem with the amygdala.

Biopsychological research that investigates emotional processing has often focused on studying the effects of negative emotions, such as fear, because these negative affective states can form the foundation for more chronic emotional effects, such as those associated with disease and psychopathology (Pinel, 2000). Earlier research has stressed the critical role of the amygdala in investigations of aggressive and antisocial behaviour, as this region of the brain is responsible for emotional learning (Everitt, Cardinal, Parkinson, & Robbins, 2003) and is activated during fear conditioning (Buchel, Morris, Dolan, & Friston, 1998). The role of the amygdala in experiencing negative emotions has been demonstrated by both neuropsychological (e.g., Angrilli et al., 1996) and neuroimaging studies (e.g., Birbaumer, et al., 2005). Amygdala damage has been shown to affect the recognition of fear and anger in patients, while amygdala activation has been found to occur when viewing fearful faces and negative pictures, respectively (van Goozen, Fairchild, Snoek, & Harold, 2007).

Lang, Davis, and Öhman (2000) proposed that the activation of unpleasant emotions depends on a motivational neural circuit, which includes the nuclei of the amygdala, and the neural structures to which it projects, with the purpose to promote the survival of the species in dangerous situations. This threat-response system of the brain is proposed to initiate violence responses if highly triggered (Blair, 2001). Thus, at low levels of threat the organism freezes, if a threat is more prominent a flight response is initiated, and in instances where flight is not feasible reactive aggression is initiated. The amygdala is involved in the flight-fight system by providing information on the level of threat in the environment, thus impaired amygdala functioning might facilitate the occurrence of reactive aggression. The orbitofrontal cortex is implicated in this system by projecting to autonomic control centres that mediate the flight-fight response. It has been found that the risk for reactive

aggression is greater when the orbitofrontal cortex is damaged (Blair, 2001). This motivational circuit, forming the organism's defence system, mediates autonomic and somatic responses in both animals and humans, and has been used to explain the occurrence of the startle reflex; the defence system is activated by fear states and an exaggerated startle reflex has been found to occur in response to a sudden stimulus, as a measurable element of a fear state (Lang et al., 2000). The main brain pathways thought to be involved in the defence motivation circuit have been elucidated: Autonomic emotional responses are mediated by amygdala's central nucleus, which projects to the lateral hypothalamic area, while coping behaviours are mediated by projections to the midbrain central grey region, and finally, the startle circuit is modulated by a projection to the nucleus reticularis pontis caudalis (Lang, Bradley, & Cuthbert, 1998).

Disentangling the link between the amygdala and the orbitofrontal cortex is an interesting issue to be addressed in future research. Even though emotional processing difficulties have been found in adolescents with Conduct Disorder (Fairchild, van Goozen, Stollery, & Goodyer, 2008), the influence of protective factors, such as intact executive functioning abilities has not been investigated at the same time. The main focus in this chapter is to carry out an investigation into emotional processing abilities of young offenders; their prefrontal cortex functioning will be investigated in a later chapter.

In the study by Fairchild et al. (2008), emotional processing was investigated in adolescents with early onset and adolescent onset conduct disorder (CD) and a matched group of healthy control participants. Emotional processing was assessed via measuring electrodermal activity during a fear conditioning paradigm, and eye blink startle magnitudes in response to acoustic probes during the viewing of affective

pictures. The same methods were used to assess emotional processing in the participants of our study.

Psychophysiological assessments have been used as objective measures to assess the relationship between bodily responses and psychological states such as emotion, arousal, and cognition (Scarpa & Raine, 1997). In particular, heart rate (HR), skin conductance (SC), and cortical measures (EEG) have been commonly used to assess whether antisocial individuals respond differently than normal controls to aversive stimuli. Reduced resting HR has been the best replicated psychophysiological marker in antisocial samples (Scarpa & Raine, 1997); other psychophysiological findings include reduced skin conductance responses to fear conditioning paradigms (e.g., Fairchild, et al. 2008), and atypical startle modulation in psychopaths (Patrick et al., 1993; Levenston, Patrick, Bradley, & Lang, 2000) and behaviourally disordered children (van Goozen, et al., 2004). The present study focuses on measuring skin conductance responses and startle reflex modulation as autonomic indexes of participants' emotional processing and will be described in greater detail below.

Fear conditioning has been used to study emotional processing in antisocial populations, in order to investigate whether the acquisition of fear is hampered in those populations, consistent with the fearlessness theory (Raine, 1993a). Skin conductance responses have been the measure of interest in this paradigm. Besides examining whether young offenders would have a specific deficit in learning a fear response, we were also interested in investigating whether they would have a general emotional processing deficit. However, skin conductance activity increases in the presence of different types of arousing stimuli, whether pleasant or unpleasant (Patrick, et al., 1993), making difficult to explore the potential impact of different emotions. For this reason, the startle paradigm has been used additionally to skin

conductance measurements, since electromyographic (EMG) recording has been reported to capture different affective states by recording larger responses during fear and smaller responses during pleasant emotional states (Patrick et al., 1993).

Even though atypical affective modulation of the startle reflex has been found in children displaying oppositional defiant disorder (ODD), and adult psychopaths, the only study, to our knowledge, that has examined emotional startle reflex modulation in a sample of conduct disordered adolescents has been carried out by Fairchild et al. (2008), who found that both early-onset and an adolescent-onset conduct-disordered (CD) teenagers showed reduced startle responses when viewing affective pictures when compared to normal healthy controls. In the study by Fairchild et al. (2008) emotional processing deficits, in terms of fear conditioning ability and startle reflex modulation, were found in both types of CD adolescents. Startle magnitudes were much lower in participants with CD across valence categories relative to controls, although both groups appeared to show a normal pattern of affective modulation. These data are consistent with previous findings in children with ODD (van Goozen et al., 2004), and suggest that augmentation of the startle reflex by negative visual primes is broadly intact in those with CD, in contrast with adult psychopaths (Patrick et al., 1993). These results may be interpreted as evidence for reduced tonic innervation of the brainstem startle circuit by the amygdala in CD. Overall, the findings by Fairchild et al. (2008) did not support the developmental taxonomy theory of Moffitt (1993), which proposes that neurobiological deficits are only present in youngsters with early-onset CD, and that adolescence-onset CD is mainly prompted by psychosocial factors. According to Moffitt's (1993) theory, neurobiological deficits are not part of the aetiology of adolescence-onset CD, and thus emotional impairments should have been constricted to the early-onset CD group. A potential explanation provided for the findings in the

Fairchild et al. (2008) study was that emotional dysfunction was existent in both CD groups, but due to other factors, the timing of onset was different.

The current study was carried out in an adolescent group of young offenders for two reasons; first in order to examine emotional processing in an adolescent antisocial group defined from a criminological rather than clinical perspective, and second because more studies need to be carried out in child and adolescent antisocial populations as they are necessary in the identification of the early antecedents of antisocial behaviour (Raine, 1993b) and to inform the development and design of interventions targeting the early developmental stages or at-risk groups.

The goal of this chapter is (1) to replicate the findings of Fairchild et al. (2008) in an adolescent sample of young offenders and matched controls, and (2) find out whether electrodermal responding and the eye-blink startle reflex can explain variance in key outcome measures (severity and rate) within the young offender group.

In more detail, the objectives of the present chapter were to investigate fear conditioning and startle reflex modulation in a young offender group, which had exhibited antisocial behaviour at different levels of frequency and severity of offending. The first goal was to examine whether emotional processing deficits were present in this group as compared to normal controls, and second, to find out whether more serious/prolific young offenders would show more serious emotional processing deficits than less serious/prolific offenders. For these purposes, electrodermal responding was measured during a fear conditioning task and electromyographic measurements were taken after an acoustic probe while participants viewed affective pictures. With respect to the first goal of the study, it was expected that emotional processing deficits would characterise young offenders as a group, compared to a normal control group, as shown by impairments in fear conditioning ability and startle reflex modulation. As for the second goal, within-group comparisons were carried out

on both tasks, in terms of high vs. low offending severity and high vs. low rate of offending groups, in order to explore the relationship between emotional processing and level of antisocial behaviour. This was an open question, as this is the first study to examine physiological arousal in different types of offenders of this age range.

4.2.Methods and Materials

4.2.1. Participants

Participants were 43 young males, and five females, aged 12-18 years old (mean age = 15.99, SD = 1.53), who were recruited from the Youth Offending Team (YOT) in Cardiff. These participants were required by the local courts to attend the YOT for rehabilitation. As will be discussed, levels of seriousness and frequency of offending behaviour varied between YOT participants.

Information on young people's offences records was taken from the Youth Offending Team's databases. Permission on accessing those records was provided via written informed consent by each young person.

Participants were excluded if their IQ was <75, as assessed by the Vocabulary and the Block Design subtests of the Wechsler Abbreviated Scale of Intelligence (Wechsler, 1999).

For the purposes of comparing participants' skin conductance responses to a normal control (NC) sample, data collected in Cambridge (Fairchild et al., 2008), consisting of 54 adolescents, aged 14-18 years of age (mean age = 15.84, SD = .89), were compared to the YOT sample.[7] NC participants were recruited in secondary schools and colleges from relatively deprived areas in Cambridge. They were

[7] Fear conditioning data were also collected in normal controls in Cardiff (n=16) recruited from secondary schools. These data are not reported because of the limited sample size. The Cardiff NC group did not differ from the Cambridge NC group in baseline skin conductance.

screened for presence of serious antisocial behaviour and/or current psychiatric illnesses.

For the purpose of comparing startle reflex responses of a normal control group to the YOT group, participants were recruited from secondary schools in Cardiff. The NC group consisted of 16 young males, aged 12-16 (mean age = 15.03, SD = .90). We were unable to collect more data from secondary schools due to time constraints, and because the group size was relatively small, startle reflex data from 38 male undergraduate students were added to those of the secondary school pupils. Although significantly older, one-way ANOVAs showed that the startle amplitudes did not differ significantly between these groups for any of the emotion categories (i.e., neutral: $F(1, 51) = .917$, $p = .343$; positive: $F(1, 51) = .852$ $p = .361$; fearful: $F(1, 51) = 1.708$, $p = .197$; sad: $F(1, 51) = 2.186$, $p = .146$; disgust: $F(1, 51) = .940$, $p = .337$). Thus, data from these groups were collated for analyses purposes.

4.2.2. Skin conductance recording

Electrodermal activity was recorded using a skin conductance amplifier (PSYLAB Contact Precision Instruments, UK) while participants took part in the fear conditioning task. Skin conductance paste was used to fill the electrodes before attaching them to participants' hands. The electrodes were then placed in the distal phalanges of the index and middle fingers of the non-dominant hand

The fear conditioning experiment replicated the procedure described by Bechara and Damasio (2002). Participants viewed 48 coloured slides (red, blue, orange, and green) presented on a computer screen. Ten of the 48 blue slides were paired with a loud (99 dB) aversive white noise, which was presented binaurally using headphones. The slides served as the visual conditioned stimuli (CS), the aversive loud noise was the unconditioned stimulus (US), and skin conductance responses

(SCR) were measured as the dependent variables during conditioning. The coloured slides were presented for 3 sec, with a 10 sec inter-stimulus interval. White noise was paired with the stimulus 2 sec after slide onset. Skin conductance responses (SCRs) were measured in the 6 sec period following presentation of the conditioned stimulus (CS). A valid SCR was considered to exceed an amplitude of .1 μSiemens (μs) (Fairchild et al., 2008). As blue slides were the only coloured slides paired with white noise, a measure of the conditioning acquisition was calculated by subtracting red slides (CS-) from the unreinforced blue slides (CS+). If participants were conditioned, they would produce increased SCRs in response to the unreinforced conditioned stimuli (CS+), compared to the red slides (CS-).

The fear conditioning protocol was divided into four phases; a habituation phase, two acquisition phases, and an extinction phase. The blue slides were reinforced with the US only during the acquisition phases. The habituation phase consisted of the presentation of two CS- and two CS+, mixed with other colours. The two acquisition phases consisted of four unreinforced blue slides, five reinforced blue slides, and five red slides. The extinction phase consisted of six unreinforced CS + and three CS-. Each phase was scored by subtracting the CS- from the unreinforced CS+, in order to investigate whether SCRs increased as a result of differential conditioning to the CS+.

Following Bechara and Damasio's (2002) protocol, participants were asked at the end of the task some memory questions, in order to check whether they were paying attention while they were attending to the fear conditioning task. Specifically, they were asked to name how many and which colours they had seen (.5 for each correct answer), name the number of slides paired with the aversive sound (.5 for correct answer), and to name the number colour of the slide which had been paired

with the aversive noise (2.0 for correct answer; 1.0 if they said blue and another colour).

4.2.3. Measurement of the startle reflex

Startle-elicited blinks were assessed while participants viewed differently valence pictures, which were taken from the International Affective Pictures System (IAPS). Forty-five slides were shown, of which 9 were positive, 9 were neutral, 9 depicted disgust, 9 were sad inducing, and 9 were fearful slides. Examples of each type of picture are provided in Appendix 4.1. 31 Slides were paired with a loud (99 dB) aversive white noise, with 6 startled slides for each emotional category (the first slide paired with the white noise was a neutral one and its response was not included in the analyses for habituation/familiarisation reasons). The order in which the slides were shown was pseudo-random and identical for all participants. The slides were shown for 10 sec with an inter-trial interval of 10 sec.

Electromyographic (EMG) measurements were taken by placing three silver/silver chloride (Ag/AgCl) electrodes, according to established guidelines (Tassinary & Cacioppo, 2000). Electrode conductance paste was used before placing the electrodes; one electrode was placed on the forehead, and the other two were placed over the orbicularis oculi muscle under the left eye. White noise was presented binaurally through headphones at 2.5, 3.5, and 4.5 sec. slide onset, lasting 0.4 sec. EMG was recorded with a range of 200 μV and a bandpass of 30 to 500 Hz, using an EMG amplifier (PSYLAB Contact Precision Instruments, UK). Blink magnitude scores are reported in μVolts.

4.2.4. Procedure

Participants first completed the fear conditioning paradigm. Participants were asked to wash their hands before starting the procedure and were seated in a semi-soundproof room. As soon as the electrodes were placed, they were asked to sit as comfortably as they could, while leaving their non-dominant hand still on the table. In this way, no movement artefacts would interfere with SCRs in response to the stimuli. Participants were told that different colours would be presented on a computer screen, and they were told to pay attention whilst watching them, and that some of the colours would be paired with a sound, and some would not. The experiment started a few minutes after the instructions were given, in order to allow SCRs to reach baseline before commencing the experiment.

After the termination of this paradigm, participants took part in some other tests (see Chapters 5 and 6) and filled out some questionnaires, in order to avoid any carry-over effects of the loud noise presented during the fear conditioning task[8]. A similar procedure was followed while participants watched the IAPS pictures and startle reflex measurements were taken. The surface on the face where the electrodes were placed was carefully cleaned before the electrodes were stuck, and participants were told that they would watch some pleasant and unpleasant pictures, with a loud noise paired with some of them. They were asked to attend to the pictures. In both experiments, it was made sure that participants felt comfortable enough before leaving them on their own in the dark room, and they were told that the experimenter would be in the next room, and could be called at any time.

[8]All tasks were administered in the same order so that any order effects would be constant for all participants.

4.2.5. Within group classification based on official records and questionnaire measures

These analyses were based on the application of a median split procedure on the YOT participants' total number of offences committed and their highest gravity score (severity score taken from rating scale used in the youth justice system) of their offences. In addition, the Aggressive and Conduct Disorder symptoms subscales of the Youth Self Report (YSR; Achenbach, 1991; see Chapter 2 for details) were used to classify young offenders in terms of severity of clinically defined symptoms of antisocial behaviour. Thus, young offenders were classified in terms of the seriousness of their behaviour in three ways: based on their highest gravity score, their YSR aggressive and YSR conduct disorder scores. Psychopathic tendencies were also measured based on the offenders' Youth Psychopathic Inventory (YPI) scores (Andershed, Kerr, Stattin, & Levander, 2002; see Chapter 2 for details). Participants were divided into high and low psychopathic tendencies groups based on the cut-off score of 2.5 suggested by Skeem and Cauffman (2003); the latter analyses were carried out with the aim of investigating a potential effect of psychopathic traits in our sample.

4.2.6. Data analyses

In the young offender group, data were not recorded for one participant, and one other participant did not finish the whole testing session due to fatigue. One participant had to be excluded because of low IQ (<75), and therefore data of 45 young offenders were included in the fear conditioning and startle reflex modulation analyses. For the fear conditioning paradigm (FCP), data of 50 NC participants were available and included in analyses; technical problems meant that data of 4 participants were unavailable. With regards to startle reflex modulation paradigm

(SRP), data of 2 NC participants were not available due to technical problems; accordingly, data of 52 NC participants were available for analysis.

In order to examine the effects of differences in age and IQ, one-way analyses of variance (ANOVA) were used.

SCRs were root transformed to correct for non-normal distribution of the data. Startle reflex magnitudes were normally distributed for all of the emotional categories. For the fear conditioning paradigm, repeated-measures ANCOVAs were carried out with group (control vs. offender) as between-subjects factor and conditioning phase as within-subjects factor. Slide valence was used as within-subjects factor for the repeated-measures ANCOVA conducted to test for differences in startle reflex amplitude, with group (control vs. offender) as between-subjects factor. Degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity, where the assumption of sphericity was violated. Dependent measures were SCR amplitudes at each phase of the fear conditioning paradigm, and startle reflex magnitudes to different affective pictures. Bonferroni t-tests were used to examine posthoc comparisons among the different levels of the within subjects factor, and one way-ANOVAs were used to test for simple effects of between subjects factors (Kinnear & Gray, 2000). Analyses were carried out using SPSS 12.0 (SPSS Inc., Chicago, Illinois).

Finally, for the purposes of within group comparisons, repeated-measures ANOVAs were conducted with offender group (more serious vs. less serious offenders and more prolific vs. less prolific offenders) and psychopathic groups as between-subjects factors and conditioning phase or slide valence as within-subjects factor. Age was entered as a covariate in the analyses where groups were categorised by frequency of offending, in order to account for exposure to the opportunity to offend in younger aged participants.

4.3. Results

4.3.1. Demographic information

Participants' demographic information is presented in Table 4.1. The Cambridge NC group was used for the fear conditioning comparisons and the Cardiff NC group for the startle comparisons. For the Cardiff NC group data on age and IQ were only available for the participants from secondary schools.

Table 4-1: Demographic characteristics

	YOT (n = 48)	Cambridge NC (n = 54)	Cardiff NC (n = 16)
Age	15.99 (± 1.53)	15.84 (± .89)	15.03 (± .90)
IQ	94.5 (± 11.5)	106.9 (± 11.9)	107.1 (± 9.9)

Data are presented in means (±SD).

In the fear conditioning study the NC and YOT groups did not differ significantly in terms of age. The mean age of the control group in the startle reflex study was only known for the data collected from secondary schools. Pearson's product moment correlations did not reveal any significant association between age and EMG. There were significant differences in terms of estimated IQ between the NC and YOT groups in both the fear conditioning [$F(1, 95) = 26.1$, $p < 0.001$], and startle reflex [$F(1, 59) = 14.91$, $p < 0.001$] studies, with both control groups having a significantly higher estimated IQ [mean IQ of NC in FCP = 106.87 (± 11.92); mean of NC in SRP = 107.13 (± 9.93)] than the YOT group [mean estimated IQ = 94.55 (SD = 11.5)]. In order to account for potential age and IQ effects, age was entered as a covariate in the startle reflex analyses, while IQ was entered as a covariate in all subsequent analyses.

4.3.2. Fear conditioning paradigm

4.3.2.1. Between group comparisons

In the memory experiment, all participants obtained a score of 1.5 or more, so none were excluded from the analyses (Fairchild et al., 2008).

There were no differences between the two groups (YOT and control) during the habituation phase of the fear conditioning paradigm [$F(1, 93) = .326$, $p = .569$], indicating that the two groups had similar baseline SCRs.

There was a significant habituation effect on SCRs to the unconditioned stimuli [$F(4.94, 458.91) = 125.71$, $p < 0.001$], however, there was no main effect of group [mean values (± SD) in μS for HC = .73 (± .47), and for YOT = .67 (± .41); $F(1, 93) = .074$, $p = 0.79$], suggesting that the two groups perceived the US in the same way.

In order to examine group differences in conditioning ability, a group × phase × CS type (CS + vs. CS-) mixed model ANCOVA was used. This showed that there was a main effect of phase [$F(2.63, 244.71) = 112.34$, $p < 0.001$], and a main effect of group [$F(1, 93) = 13.69$, $p < 0.001$]. There was also a significant group × CS type interaction [$F(1, 93) = 14.56$, $p < 0.001$], and a significant phase × CS type interaction [$F(3, 279) = 47.35$, $p < 0.001$]. A significant three-way interaction was also revealed [$F(3, 279) = 6.29$, $p < 0.001$]. One-way ANOVAs, which examined simple effects of the between-subject factor at different levels of the within-subjects factors, showed that the acquisition of a conditioned response to the blue slides were greater at ACQ1 [$F(1, 93) = 26.58$, $p < 0.001$] and ACQ2 [$F(1, 93) = 16.43$, $p < 0.001$) in the NC group relative to the YOT group (Figure 4.1). There was also an effect of both the CS+ [$F(1, 93) = 3.72$, $p = 0.057$] and the CS- [$F(1, 93) = 6.23$, $p = 0.014$] in the extinction phase, with greater SCRs in the control group.

The effect of the CS+ and CS- was further explored by performing separate repeated-measures ANCOVA tests for each CS type. For the CS+ (unreinforced blue slide) a main effect of phase [$F(2.65, 246.77) = 95.41$, $p < 0.001$], a main effect of group [$F(1, 93) = 22.78$, $p < 0.001$], and a significant phase × group interaction [$F(2.65, 246.77) = 4.79$, $p = 0.004$] were found. This indicated that the SCR to the CS+ differed across all phases in the NC group relative to YOT group, as shown by the increase between HAB and ACQ1 phase in NC participants only (Figure 4.1). For the CS- slide there was a significant effect of phase [$F(3, 279) = 60.59$, $p < 0.001$], and a significant phase × group interaction [$F(3, 279) = 2.98$, $p = 0.032$], but no main effect of group [$F(1, 93) = .535$, $p = 0.47$]. Post hoc comparison indicated that the SCR to the CS- differed between HAB and ACQ1 and EXT ($p <. 001$), and ACQ2 differed significantly from ACQ1 ($p <. 001$). These changes occurred in parallel fashion for both the NC and YOT groups.

Estimated IQ was found to be a significant covariate of conditioning ability, with participants with lower IQ's having lower SCRs. After controlling for estimated IQ, the group effect remained, however, significant [$F(1, 92) = 5.13$, $p = 0.026$].

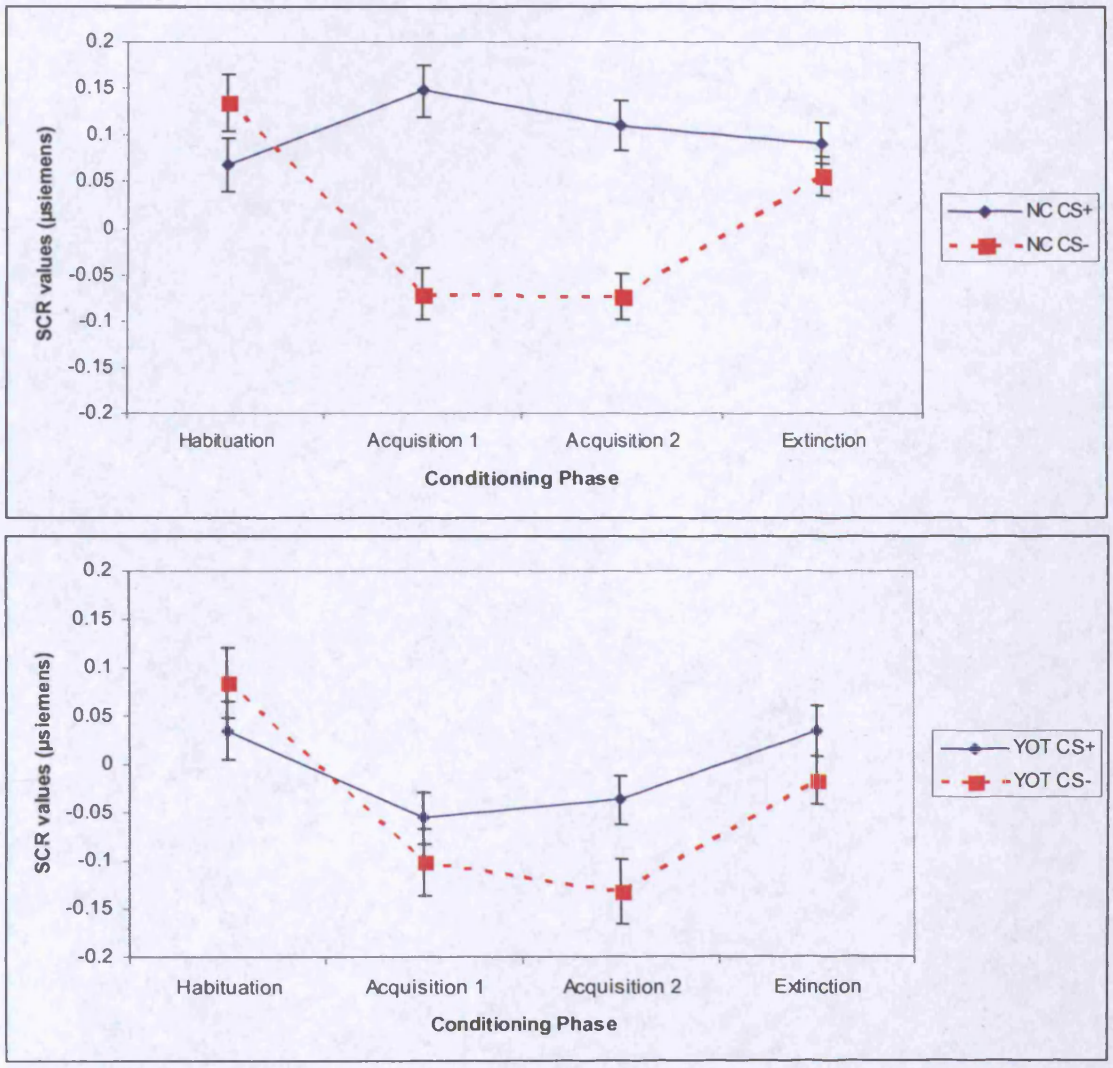


Figure 4.1: Mean (±SE) skin conductance responses to blue slides (CS+) and red slides (CS-) throughout conditioning phases. Differential conditioning to the blue slides is only shown by the NC group, as evidenced by the increase during acquisition phases 1 and 2. NC, healthy control participants; YOT, young offender group; CS, conditioned stimulus; SCR, skin conductance response.

4.3.2.2. Within group comparisons

Although all participants in the 'experimental' group were young offenders, they were recruited from different levels of interventions in the justice system, and were thus expected to vary in their frequency and severity of antisocial behaviour. Out of the 45 offenders who were included in the analyses, 23 were classified as prolific and 22 as non-prolific offenders. With regards to the severity of antisocial behaviour based on the highest gravity score received for offensive behaviour, 20 young offenders were considered to be 'not severe' and 25 to be 'severe'. Twenty six were

found to be 'not aggressive' and 19 to be 'aggressive' based on their YSR scores, whilst 21 were found to have no conduct disorder (CD) symptoms and 24 to score in the borderline/clinical range of the YSR on CD symptoms. Finally, according to their YPI scores, 30 participants were low and 15 were high in psychopathic tendencies.

Within-group comparisons were carried out and no significant differences were found between any of the groups differing in severity of offending and groups differing in frequency of offending. Thus there was no group effect in terms of young offenders with high or low number of offences [$F(1, 42) = 0.015$, $p = 0.902$], with high or low gravity scores [$F(1, 43) = 0.043$, $p = 0.836$], with high or low YSR aggression scores [$F(1, 43) = 0.635$, $p = 0.430$], with high or low YSR conduct disorder scores [$F(1, 43) = 0.987$, $p = 0.326$], or high and low YPI scores [$F(1, 43) = 0.045$, $p = 0.833$].

4.3.3. Startle Reflex Modulation

4.3.3.1. Habituation

The effect of habituation was examined by testing for an effect of time on blink magnitudes in response to the neutral slides, and if so, whether this pattern occurred in both groups to a similar extent. A repeated-measures ANOVA showed a main effect of time [$F(5, 475) = 7.8$, $p < 0.001$], a main effect of group [$F(1, 95) = 18.13$, $p < 0.001$], but no group × time interaction. This implied that the young offender group responded with lower blink magnitudes throughout all neutral slides, whilst habituation occurred to a similar extent in both groups (see Figure 4.2).

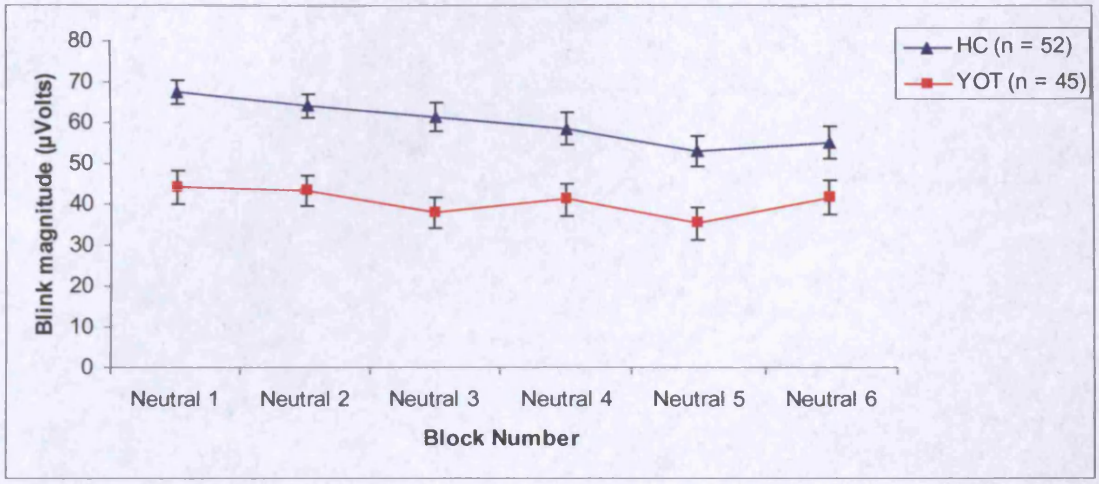


Figure 4.2: Habituation effect on startle reflex magnitudes when viewing neutral slides paired with the aversive noise, separated by group.

4.3.3.2. Effect of Affective Modulation

There was an effect of slide valence on startle response amplitudes [effect of valence: F (3.36, 318.69) = 14.63, p<.001]. The mean values (± SD) for each emotion category were: Positive = 50.6 (SD = 23.97), Neutral = 51.18 (SD = 24.48), Sad = 53.82 (SD = 23.06), Fear = 55.76 (SD = 23.0), Disgust = 56.4 (SD = 22.36). Bonferroni t-tests showed that blink amplitudes were smaller when viewing positive slides, relative to the negatively valenced slides ($p < 0.001$ for disgust and fear, and $p = 0.005$ for sad), with no difference relative to the neutral slides ($p > 0.05$). When viewing disgust and fearful slides, participants showed larger startle amplitudes, relative to positive and neutral slides (with all p's < 0.001), and when viewing sad slides participants showed marginally larger startle amplitudes than neutral slides ($p = 0.059$).

4.3.3.3. Group Differences

There was a main effect of group on startle magnitude [$F (1, 95) = 23.93$, $p < 0.001$]. There was no interaction between slide valence and group, which indicated that the YOT group showed a similar pattern of affective modulation as the control

group, but with consistently lower values across all emotional categories (see Figure 4.3).

Age and IQ were not found to be significant covariates of startle reflex modulation.

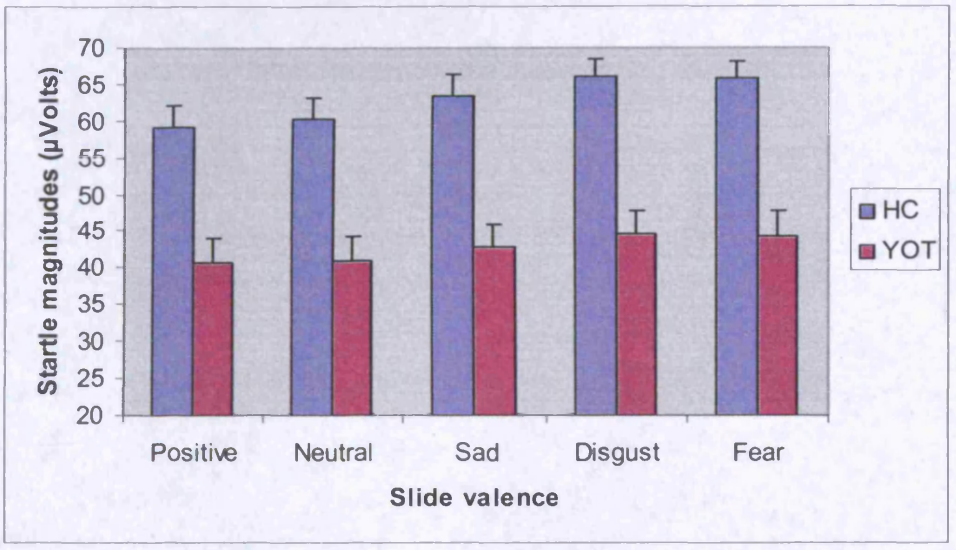


Figure 4.3: Mean startle magnitudes showing the effect of slide valence according to group. Error bars reflect standard errors.

4.3.3.4. Within group comparisons

The effects of frequency and seriousness of offending on startle reflex modulation were examined within the young offender group. There were no within group differences in terms of frequency [F (1, 42) = 1.22, p = 0.28] and severity of offending, based on the highest gravity score participants had received [F (1, 43) = 0.45, p = 0.51]. However, there was a marginally significant group effect of participants scoring in the borderline/clinical range (n = 24) or non clinical range (n = 21) of conduct disorder symptoms in the YSR [F (1, 43) = 3.47, p = 0.069]. Participants in the borderline/clinical range on CD had marginally lower startle blink amplitudes [mean startle amplitude = 37.13 (SD = 4.34)] compared to participants in the normal range of this scale [mean = 48.9 (SD = 4.6)]. There was no difference

between high (n = 19) and low (n = 26) groups in aggressive symptoms on the YSR [F (1, 43) = 2.58, p = 0.12]. Finally, there was a marginal group effect [F (1, 43) = 3.06, p = 0.088] in participants high (n = 30) and low (n = 15) in psychopathic traits. Mean startle magnitudes were somewhat lower in participants high in psychopathic traits [mean = 34.8 (5.46)] compared to participants low in psychopathic traits [mean = 46.5 (3.86)].

4.4. Discussion

The goal of this study was to investigate emotional processing in young offenders, by assessing skin conductance responses in a fear conditioning paradigm and startle reflex magnitudes in response to different emotional categories. Previously an investigation into differential fear conditioning and modulation of the startle reflex in response to an acoustic probe has been carried out in an adolescent CD group (Fairchild et al., 2008), but the current study is the first to examine these parameters in young offenders of similar age.

The findings showed that young offenders did not acquire a fear response during the acquisition phases of the fear conditioning task, due to an inability to learn the association between the unconditioned stimulus (US), which was an aversive white noise, and the conditioned response (CS), namely an elevated skin conductance response. Young offenders showed SCRs to the aversive unconditioned stimulus (US), indicating that reduced SCRs during the acquisition phases were a result of inability to form the US-CS association. Additionally, normal control participants clearly showed differential conditioning to the CS+ and CS-, whilst young offenders responded in a similar fashion to both types of stimuli. These results suggest that young offenders present with a deficit in emotional learning, specifically one of

learning a fear response, which provides support for the fearlessness theory by Raine (1993a).

In terms of startle reflex modulation, young offenders demonstrated lowered eye-blink responses across all five emotion categories. These findings suggest generally lowered autonomic responses, and thus emotional processing difficulties in the young offender group in comparison with the normal control group. Research in adult psychopaths has shown impaired startle modulation only in response to negative primes (Patrick et al., 1993), whilst the young offender group in this study exhibited lower blink magnitudes generally, rather than specifically during the presentation of negative slides. This finding is consistent with evidence in children with DBD (van Goozen et al., 2004) and adolescents with CD (Fairchild et al., 2008), and suggests similar impairments in emotional processing in different groups of antisocial youngsters.

The effect of separate negative emotion categories (i.e., sad, disgust, and fear slides) rather than one single negative category was examined because previous research in psychopaths has identified differential sensitivity to threat versus distress cues (Blair et al., 1997). This was not found to be the case in young offenders, a result consistent with findings in CD participants (Fairchild et al., 2008).

Finally, separate analyses were carried out in order to investigate whether differences in fear conditioning and startle reflex modulation existed between different groups of offenders. Fear conditioning has been found to be better in antisocial boys from low rather than high socioeconomic (SES) status (Raine & Venables, 1981). In the current study, no differences were found in fear conditioning ability between less/more serious or frequent offenders; however the majority of our sample was living in deprived Cardiff neighbourhoods, which could account for the findings, consistent with the study by Raine and Venables (1981). In terms of startle

reflex modulation, DBD children with higher levels of delinquency have been found to show lower startle responses, but only when viewing negative slides (van Goozen et al., 2004), a pattern similar to that in adult psychopaths (Levenston et al., 2000). This pattern was not observed in young offenders. However, generally lower startle magnitudes were observed in offenders scoring in the clinical range of the YSR conduct disorder scale (a marginally significant result). Thus, the hypothesis that more serious and/or more prolific offenders would show decreased fear conditioning ability and lower blink magnitudes was not supported: lower blink magnitudes were found in more serious offenders when seriousness was defined in terms of clinical symptoms, but the difference was marginal. An investigation into whether individuals relatively high in psychopathic traits would show reduced autonomic responses was also carried out to find out whether this could explain some of the variance in our sample. This was not found to be the case, as no differences were found in terms of fear conditioning, and only a marginally significant difference was found, with participants high in psychopathic traits having somewhat lower startle magnitudes.

A potential limitation of the current study was that SES was not assessed in our participants. Even though information on the social environments in which YOT participants resided was available, specific SES information was not collected. Furthermore, the YOT group was known to live in generally deprived neighbourhoods in the Cardiff area. On those grounds, a discrepancy in terms of SES between the YOT and the NC group was not examined.

Limited startle potentiation by negative visual primes was found in normal control participants (specific to disgust), which could have resulted from the large number of negative slides used in the startle study. However, young offenders showed a normal pattern of affective modulation, consistent with findings in adolescents with CD (Fairchild et al., 2008) and children with ODD (van Goozen et al., 2004).

With regards to within-group comparisons in the YOT sample, a larger group could be recruited in a future study, mainly for allowing for more equal group sizes, e.g., regarding psychopathic traits.

The findings from the current study provide support for deficits in emotional learning and emotional processing in a group of adolescent youngsters who have been in contact with the police system. From Chapter Three we already know that psychosocial variables play a role in the occurrence of antisocial behaviour in the normative population, as well as that prolific young offenders had low levels of education, and employment, lived in bad neighbourhoods, and had the propensity for using substances. Cognitive aspects were related to clinically defined dimensions of ASB. Together these findings indicate that young offenders suffer from a multitude of both biological and social risks. What remains to be seen is to further examine the influence of emotional processing difficulties, as revealed by facial recognition ability, of neuropsychological factors, and how biobehavioural and social factors interact in the emergence of ASB. These set of risk factors will be considered in Chapters Five, Six and Seven.

5. Chapter Five - Face recognition

5.1. Introduction

5.1.1. Relationship between emotional processing and behaviour

Being able to correctly identify facial affect in others is important for interpersonal behaviour and social interaction (Herba & Phillips, 2004). The usual communicatory function of emotion is to transmit information about the valence of objects/situations to conspecifics and a failure to respond to the emotional expressions of others could therefore lead to atypical responding in social interactions (Blair, 2003). Knowing more about the consequences of problems in facial processing could contribute to our understanding of the aetiology of disorders that involve social interaction.

In the present study, facial expression recognition was investigated in a sample of young offenders. The justification of such an investigation derives from the observation that individuals with antisocial behaviour have problems with facial affect recognition (Marsh & Blair, 2008). Impairments in facial affect recognition have been found in individuals (a) scoring high in psychopathic traits, (b) with criminal records and (c) high in externalising behaviour (Walker & Leister, 1994; Woodbury-Smith et al., 2005).

5.1.2. Neuroscience of emotional processing

A theory accounting for the relationship between problem behaviour and impairments in facial affect recognition is provided by Blair's (2005) Integrated Emotions Systems (IES) theory. According to the IES, distress cues, such as fear and sadness, serve to inhibit antisocial behaviour. Specifically, it has been proposed that this process occurs by learning to avoid aggressive acts, which can cause fear and

sadness, as both of these emotions elicit empathy in those who see them (Marsh & Blair, 2008). This theory is consistent with data from ethological studies, which find that primates avoid aggressive behaviours in the presence of distress cues (Preuschoft, 2000). From an evolutionary point of view, the message being conveyed by facial displays and the meaning attached to these might have developed in such a way that human and non-human primates respond in the same manner when they see emotions showing distress.

According to the IES, different brain areas are implicated in different forms of antisocial and aggressive behaviour. Specifically, the amygdala is mainly associated with dysfunction in psychopaths, who present with high levels of goal-directed instrumental aggression, while orbitofrontal cortex dysfunction, which is found in patients with acquired sociopathy, is associated with impulsive aggressive behaviour (Dolan & Fullam, 2006). Each of these brain areas is associated with the expression of different emotions; humans with amygdala damage show deficient fear conditioning and reduced fear recognition ability (Pinel, 2000), while orbitofrontal cortex damage results in specific impairments in the recognition of facial expressions of anger and disgust (Blair & Cipolotti, 2000). In addition to specific emotion recognition deficits, both amygdala and prefrontal cortex dysfunctions are related to general deficits in facial affect processing, verified by the finding that both prefrontal cortex lobotomy and amygdalectomy (surgical destruction of the amygdala) are associated with general emotional blunting (Pinel, 2000).

5.1.3. Functions of different emotions

Findings from the literature already mentioned stress the importance of investigating different emotions, as their processing depends on different brain areas and impairments might be present only in response to specific emotions. Furthermore,

different emotions serve different functions (Blair, 2003). Fearful and sad expressions act as aversive, unconditioned stimuli (US), and as such they formulate socialisation processes. Classical conditioning is an associative process, by which a neutral stimulus attains the connotation of a stimulus with an innate salience (e.g., appetitive/positive or aversive/negative). In this way, when a salient unconditioned stimulus (US) is temporarily associated with a conditioned stimulus (CS), a conditioned response (CR) is formed in the presence of the CS. For example, unpleasant experiences, such as fear and sadness (US), are often associated with actions which result in harming others (CS). Normal individuals learn to avoid these actions (CR) (Marsh & Blair, 2008). It is argued that psychopaths fail to process expressions of fear and sadness appropriately, ultimately resulting in their failure to socialise, and in turn leading them to harm others (Blair, 2003). By contrast, happy expressions are innately appetitive stimuli (Morris, Friston, & Dolan, 1997) and as such they act as appetitive unconditioned stimuli, which reinforce the repeat of actions which have been associated with their occurrence (Matthews & Wells, 1999). The emotions of fear, sadness, and happiness, which are related to positive or negative reinforcement, activate the amygdala (Blair, 2003). The amygdala has been known to be implicated in emotional processing, and especially in learning regarding appetitive and aversive behaviour (Everitt, Cardinal, Parkinson, & Robbins, 2003). Expressions of disgust also relate to reinforcement of behaviour and occur in response to food (Rozin, Haidt, &McCauley, 1993). Angry expressions, however, do not act as unconditioned stimuli; they are involved in response reversal, which activates regions of the orbital frontal cortex (OFC), and thus serve an important role in modulating behaviour, dependent on changing contingencies (Blair, 2003). Specifically, it has been argued (Blair & Cipolotti, 2000) that the orbitofrontal cortex is implicated in the ability to know what to expect in the presence of negative reactions, and specifically

anger. In line with this argument, a patient with a lesion in the OFC would not anticipate a negative consequence following an angry reaction, and thus would have difficulty modulating his/her behaviour using this information in order to avoid inappropriate actions. On the contrary, individuals able to recognise angry expressions are expected to be able to modulate their behaviour, and thus suppress aberrant activities in the presence of an angry cue.

5.1.4. Emotional processing deficits in antisocial populations

Consistent with the IES theory, empirical research confirms impairments in the recognition of fearful and sad expressions in psychopaths (Blair, Colledge, Murray, & Mitchell, 2001; Blair, et al., 2004), and deficits for anger and disgust in acquired sociopathy (Blair & Cipolotti, 2000). Acquired sociopathy syndrome is also broadly characterised by emotion regulation difficulties (Seguin, Sylver & Lilienfeld, 2007), impairments in the ability to respond appropriately to social reinforcement (Rolls, Hornak, Wade, & McGrath, 1994), and the ability to make inferences about the mental states of others (Theory of Mind; Stone, Baron-Cohen, & Knight, 1998). In terms of a more varied sample of antisocial individuals, a meta-analysis of 20 studies conducted in antisocial samples, defined by different criteria and characterised as psychopathic, conduct disordered, aggressive, unsocialised, abusive, or criminal, identified a specific impairment in fearful expression recognition (Marsh & Blair, 2008).

Impaired facial recognition has also been found in both early-onset and adolescent-onset conduct disorder (CD; Fairchild, van Goozen, Calder, Stollery, & Goodyer, in press) identifying the magnitude of potential repercussions that such impairments might have when they are present from a young age. In the study by Fairchild et al. (in press) both early-onset and adolescent-onset CD participants

presented with facial affect recognition deficits, even though impairments were more pronounced in early-onset individuals. Early-onset CD participants were characterised by deficits in recognising anger, disgust, and happiness, while adolescent-onset CD participants showed problems in recognising fear. The role of psychopathic traits was also examined in the same study. CD adolescents high in psychopathic traits were found to be impaired in the recognition of fear, sadness, and surprise as compared to CD participants low in psychopathic traits. Children and adults with psychopathic traits have consistently been found to exhibit recognition difficulties for sad and fearful expressions (Blair et al., 2001, 2004; Habel, Egbert, Salloum, Devos, & Schneider, 2002).

5.1.5. Current study

Even though research has identified both general face affect recognition deficits in antisocial individuals, and particular impairments in different antisocial samples in terms of different emotions, existing literature has mainly focused on incarcerated offenders and psychopaths, and to our knowledge a study on facial affect recognition in community-based adolescent young offenders has not been carried out.

The current study aims to identify whether a young offender group, with varying degrees of severity and frequency of offending, would exhibit face recognition difficulties, and whether difficulties would be confined to specific emotions, as compared to a normal control sample. The primary hypothesis was that the young offender group would be less able to recognise negative facial expressions than a normal control group, as revealed by their total accuracy scores in a face recognition task, and that there would be a specific impairment in fear recognition, consistent with findings by the meta-analysis of Marsh and Blair (2008). Furthermore, it was expected that more serious and/or more prolific offenders would have more

serious impairments in recognising different negative emotions than less serious/prolific offenders. This hypothesis was not confined to the expression of fear, given that findings in different groups of seriously antisocial individuals, i.e., those scoring high on psychopathy or those with a psychiatric diagnosis of CD, show a wide range of impairments, such as impaired recognition of fear, sadness, anger, and disgust (Blair, 2003; Blair & Cipolotti, 2000; Fairchild et al., in press).

In order to account for a potential artifact of psychopathic traits present in the sample, accuracy of facial affect recognition was also investigated in participants high and low in psychopathic traits. Participants high in psychopathic traits were expected to show a specific impairment in the recognition of fearful and sad faces, consistent with previous literature (Blair et al., 2001; 2004).

5.2. Methods and materials

5.2.1. Participants

Participants were 32 young offenders, consisting of twenty eight males and 4 females, aged 13-18 years old (mean age = 15.92, SD = 1.34), who were recruited from the Youth Offending Team (YOT) in Cardiff. These participants were all attending the YOT as a prerequisite of different court orders, therefore the level of seriousness and frequency of offending behaviour varied between participants.

Information on young people's offences records was taken from the Youth Offending Team's databases. Permission on accessing those records was provided via written consent by each young person.

A normal control sample (NC) of 20 participants, aged 13-18 years old (mean age = 15.63, SD = 1.5), was used for comparison with the YOT sample[9].

[9] Data on healthy control participants was collected by Dr. Rachael Fullam (University of Manchester and Bolton, Salford and Trafford Mental Health Trust, Manchester, UK) who kindly agreed that these data could be used for comparisons with the young offender sample.

Participants were excluded if their IQ was <75, as assessed by the Vocabulary and the Block Design subtests of the Wechsler Abbreviated Scale of Intelligence (Wechsler, 1999).

YOT participants were categorised according to the rate and severity of offending behaviour with the aim to examine variation between different types of offenders[10]. Furthermore, different behavioural problems used to assess symptoms reflecting DSM-IV criteria were assessed using the Youth Self-Report questionnaire[11] (YSR; Achenbach 1991). Scores on the YSR show whether participants score in the normal or borderline/clinical range of different dimensions of behavioural and emotional problems. In the current study, scores on the aggressive, conduct disorder and externalising scales of the YSR were used to assess severity of clinical related symptoms in young offenders.

Furthermore, psychopathic tendencies were assessed using the Youth Psychopathic traits Inventory[12] (YPI; Andershed, Kerr, Stattin, & Levander., 2002). The YPI is a self-report questionnaire consisting of 50 items scored on a 4-point Likert scale. This gives a total score of 50-200 which is then divided by 50 to give a score of 1-4, the highest of which indicates the presence of psychopathic traits. A score of above 2.5 was used (consistent with Fairchild et al., in press) to classify participants as high in psychopathic traits.

5.2.2. Facial expression recognition

Participants completed a facial expression recognition task, which was a modified version of the Animated Full Facial Comprehension Test (AFFECT) developed by Gagliardi et al. (2003). During the task, participants were asked to click

[10] Details on how the groups were categorised are provided in Chapter 2.3.
[11] Details on the YSR are reported in Chapter 6.2.3.1.
[12] Details on the YPI are reported in Chapter 6.2.3.1.

on the corresponding emotion label, after watching a face changing expression on a computer screen. There were two male and two female faces taken from the Ekman and Friesen (1976) standardised battery. Each face was morphed to produce facial expressions which varied in intensity from 25%, 50%, 75%, to 100%. Participants had to complete a practice trial first, followed by four sets of trials where they had to identify one of six emotions: happiness, surprise, sadness, fear, anger, disgust. In each trial, each emotion came up four times for each intensity level, giving a total of 96 trials for the task.

When looking at individual emotions, one should also take into account that even healthy populations find some expressions, particularly fearful expressions, more difficult to identify (Marsh & Blair, 2008). For this reason, task difficulty was taken into account when examining potential differences in the recognition of different emotions; if impairment in a specific emotion was found, which was not attributable to task difficulty, then a dysfunction was presumed in neural systems associated with the expression or recognition of that particular emotion. For this reason, correct identifications were calculated for each emotion, in order to test for differences between emotions, and also for 100% intensity level, in order to see whether correct identification depended on level of difficulty.

5.2.3. Data analyses

In order to examine possible differences in age and IQ, one-way analysis of variance (ANOVA) were used. Both age and IQ were normally distributed.

Data on the facial recognition task were skewed for scores on recognition of happiness, and for this reason data were square root transformed for both participants' total accuracy scores and each intensity level. In this way, data were transformed to the normal distribution for the total accuracy score and for recognition at 25% and

50% intensity level, but it could not be transformed for recognition of happiness at 75% and 100% intensity level. Due to this ceiling effect, and the fact that data were not normally distributed, it was considered appropriate to carry out Mann Whitney U tests to examine whether there were group differences in recognition of happiness. If no significant differences were found, the groups were considered as equally able to recognise facial expressions of happiness, and accuracy in recognition of happiness could be removed from further analyses.

A group (YOT, normal control) × intensity (25%, 50%, 75%, 100%) x emotion (fear, anger, sad, disgust, surprise) mixed design ANOVA was used to examine between group differences. One-way ANOVA comparisons were carried out to investigate differences between groups for each of the emotions collapsed across intensity. In addition, one-way ANOVA analyses were conducted comparing the two groups at 100% intensity level for each emotion to examine whether potential differences could be attributed to task difficulty rather than actual deficits in recognising certain emotions over others.

Non parametric Mann Whitney tests were used to examine differences within the young offender group in terms of severity and rate of offending, clinical symptoms of aggression, conduct disorder, externalising problems, and psychopathic traits[13]. Parametric equivalent tests were not carried out in the within group comparisons due to the fact that data were skewed for accuracy on happiness recognition.

Data were analysed using SPSS version 12.0 (SPSS Inc., Chicago, IL, USA).

[13] Details on these divisions are provided in Chapter 2.3.

5.3. Results

5.3.1. Demographic Information

The participants' demographic data are presented in Table 5.1. The normal control group did not differ significantly from the young offender group in terms of age [F (1, 50) = .510, p = 0.478]. However, because the difference in IQ scores approached significance, with a mean lower score for the YOT group [F (1, 50) = 3.97, p = 0 .052], IQ was entered as a covariate in subsequent analyses.

Table 5-1: Demographic characteristics

	YOT (n = 32)	NC (n = 20)
Age	15.92 (± 1.34)	15.63 (± 1.5)
IQ	93.6 (± 11.65)	100.4 (± 12.5)

Data are presented in means (±SD).

5.3.2. Between group comparisons

Group differences were investigated by carrying out Mann-Whitney U tests for total accuracy and at each intensity level of recognition of happiness. No significant differences were found between the two groups of participants (see Table 5.2) on any of the variables, and therefore data on accuracy at recognising facial expressions of happy emotions were excluded from subsequent analyses.

Table 5-2: Facial recognition accuracy (in mean number of correct trials) for happy for control and YOT groups

	Controls (n = 20)		YOT (n = 32)			
	Mean	S.D.	Mean	S.D.	U	p
Happy total correct	14.70	1.22	14.22	1.86	283.50	0.48
Happy correct at 25%	3.25	0.79	3.06	1.19	313.50	0.90
Happy correct at 50%	3.60	.503	3.53	.621	310.00	0.83
Happy correct at 75%	3.95	.224	3.81	.397	276.00	0.16
Happy correct at 100%	3.90	.308	3.81	.592	311.00	0.76

YOT= Young Offenders; S.D., Standard deviation; U, Mann-Whitney U; p, probability.

A group (YOT, Control) × intensity (25%, 50%, 75%, 100%) x emotion (fear, anger, sad, disgust, surprise) mixed design ANOVA (assumption of sphericity was not

violated) revealed a significant main effect of group [F(1,49)= 9.18, p = 0.004], a significant main effect of emotion [F(4, 196)= 18.51, p < 0.001], a significant main effect of intensity [F(3, 147)= 115.61, p < 0.001], a significant emotion x intensity interaction [F (12, 588)=11.31, p <0.001], and a three way emotion x intensity x group interaction [F (12, 588)=2.52, p = 0.003].

One-way ANOVAs analyses carried out to investigate differences for each emotion, showed that the YOT group had significantly worse recognition accuracy for fear, anger, and surprise. There was a marginal difference between the two groups in recognition of disgust and no significant difference in terms of sadness recognition. YOT participants also scored significantly lower in total accuracy recognition than NC participants (see Table 5.3).

Next it was investigated whether difficulty of recognising particular emotions could have affected participants' responses. For this purpose, accuracy for each emotion was examined at 100% emotion intensity level. One-way ANOVA analyses showed that the groups only differed in the recognition of disgust at 100% intensity level (see Table 5.4).

Table 5-3: Facial affect recognition accuracy (mean number of correct trials across all intensity levels) for control and YOT groups

	Controls (n = 20)		YOT (n = 32)			
	Mean	S.D.	Mean	S.D.	F(1, 50)	p
Total correct	52.7	10.6	43.44	10.5	9.18	0.004
Anger total correct	10.00	2.06	8.38	2.78	4.89	0.032
Sad total correct	10.85	3.35	9.44	3.06	2.44	0.124
Fear total correct	9.10	3.11	6.88	3.33	5.78	0.020
Disgust total correct	9.60	3.78	7.72	3.33	3.54	0.066
Surprise total correct	13.15	2.06	11.03	3.01	7.64	0.008

YOT= Young Offenders; S.D., Standard deviation; p, probability.

Table 5-4: Facial affect recognition accuracy (mean number of correct trials) at 100% intensity level for control and YOT groups

	Controls (n = 20)		YOT (n = 32)			
	Mean	S.D.	Mean	S.D.	F(1, 50)	p
Anger number correct 100% intensity	3.20	.77	3.19	.86	.003	0.96.
Sad number correct 100% intensity	2.75	1.12	3.0	.88	.805	0.38
Fear number correct 100% intensity	2.90	1.02	2.44	1.22	2.0	0.16
Disgust number correct 100% intensity	2.80	1.11	1.84	1.22	8.11	0.006
Surprise number correct 100% intensity	3.25	.79	2.94	1.01	1.38	0.25

YOT= Young Offenders; S.D., Standard deviation; p, probability.

When IQ was entered as a covariate in the analyses a significant main effect of group [F (1, 48) = 5.08, p = 0.029] remained. Posthoc analyses only showed a marginal difference in the recognition of surprise [F (1, 48) = 3.89, p = 0.054], but no longer showed any significant differences for any of the other emotions.

5.3.3. Within group comparisons

Within-group comparisons were carried out to test whether significant differences would be found between YOT groups classified based on their frequency and severity of offending, and their clinical symptom scores for aggression, conduct disorder, externalising problems, and psychopathic traits.

Groups membership was defined by a median split on rate (i.e., frequent offending indexed by total number of offences divided by age) and severity of offending. This resulted in equal numbers of 16 not prolific and 16 prolific offenders, as well as 16 not severe and 16 severe offenders. Based on YSR scores, participants were assigned to a 'low' group on aggressive, conduct disorder, externalising problems when they scored in the normal range of these YSR subscales, and in a 'high' group when they scored in the clinical/borderline range of the same subscales. In terms of aggressive symptoms, 17 participants scored in the normal range, while 15 participants scored in the borderline/clinical range. In terms of conduct disorder

symptoms, 14 were assigned to the 'low' group and 18 to the 'high' group, while for externalising problem, 10 were classified in the 'low' and 22 in the 'high' group.

Groups were also defined using the YPI cut-off point, suggested by Skeem and Cauffman (2003), which gave 22 participants a score that classified them as 'low' in psychopathic traits, and 10 were classified as 'high' in psychopathic traits.

Mann-Whitney U tests were carried out to investigate potential group differences. The only significant difference (see Table 5.9) found in these group divisions was in that participants in the 'high' externalising problems group were better at recognising facial expressions of disgust than participants in the 'low' group (U=54.00, Z=-2.29, p=0.022). A Mann Whitney U test was additionally run to examine if this difference was attributable to difficulty in recognising disgust at 100% intensity level. A marginally significant difference was found with participants in the clinical range on the externalising problem scale recognising disgust better at 100% (U=66.00, Z=-1.85, p=0.065), indicating that even when disgust was presented in full intensity participants in the 'low' externalising group still had greater difficulty recognising it. The same pattern existed in relation to conduct disorder symptoms, but only a marginally significant difference was found (U=78.00, Z=-1.83, p=0.067). Participants scoring in the clinical range of the YSR conduct disorder scale were better at recognising facial expressions of disgust, however this was not the case at 100% intensity of the emotion (U=96.50, Z=-1.16, p=0.248).

Even though no other significant differences were found in any of the other group divisions of the YOT group, means and standard deviations are provided in the tables below (Tables 5.5-5.10). These show that in many instances the more serious antisocial group (i.e., 'high') was better at recognising some specific emotions, particularly disgust.

Table 5-5: Facial recognition accuracy (mean number of correct trials and SD) for 'high' and 'low' groups in rate of offending

	'High" (n = 16)		'Low' (n = 16)			
	Mean	S.D.	Mean	S.D.	U	p
Fear total correct	6.44	3.37	7.31	3.34	87.50	0.13
Anger total correct	8.00	2.78	8.75	2.82	123.50	0.86
Happy total correct	13.56	2.22	14.87	1.15	105.00	0.37
Sad total correct	8.94	3.15	9.94	2.98	125.50	0.92
Disgust total correct	7.88	3.10	7.56	3.65	118.50	0.72
Surprise total correct	10.75	3.24	11.31	2.85	118.50	0.72

S.D., Standard deviation; U, Mann-Whitney U, p, probability.

Table 5-6: Facial recognition accuracy (mean number of correct trials and SD) for 'high' and 'low' groups in severity of offending

	'High" (n = 16)		'Low' (n = 16)			
	Mean	S.D.	Mean	S.D.	U	p
Fear total correct	7.75	3.19	6.0	3.33	87.50	0.13
Anger total correct	8.44	2.88	8.31	2.77	127.00	0.97
Happy total correct	13.81	2.46	14.63	.89	122.00	0.82
Sad total correct	9.25	2.89	9.63	3.3	116.00	0.65
Disgust total correct	8.19	2.51	7.25	4.03	102.00	0.32
Surprise total correct	11.12	2.8	10.94	3.3	126.00	0.94

S.D., Standard deviation; U, Mann-Whitney U, p, probability.

Table 5-7: Facial recognition accuracy (mean number of correct trials and SD) for 'high' and 'low' groups in aggressive symptoms

	'High" (n = 15)		'Low' (n = 17)			
	Mean	S.D.	Mean	S.D.	U	p
Fear total correct	6.8	3.18	6.94	3.56	117.00	0.69
Anger total correct	8.4	2.82	8.35	2.83	126.00	0.95
Happy total correct	14.5	1.2	14.0	1.77	96.00	0.22
Sad total correct	9.73	2.94	9.18	3.23	110.00	0.51
Disgust total correct	8.67	2.9	6.88	3.55	86.00	0.12
Surprise total correct	11.27	2.46	10.82	3.49	125.00	0.92

S.D., Standard deviation; U, Mann-Whitney U, p, probability.

Table 5-8: Facial recognition accuracy (mean number of correct trials and SD) for 'high' and 'low' groups in conduct disorder symptoms

	'High" (n = 18)		'Low' (n = 14)			
	Mean	S.D.	Mean	S.D.	U	p
Fear total correct	6.89	3.68	6.86	2.96	122.50	0.89
Anger total correct	8.33	2.72	8.43	2.95	120.00	0.82
Happy total correct	14.6	1.85	13.79	1.85	85.00	0.11
Sad total correct	9.44	2.3	9.43	3.25	121.50	0.86
Disgust total correct	8.67	2.97	6.5	3.48	78.00	0.067
Surprise total correct	11.39	2.89	10.57	3.2	111.00	0.57

S.D., Standard deviation; U, Mann-Whitney U, p, probability.

Table 5-9: Facial recognition accuracy (mean number of correct trials and SD) for 'high' and 'low' groups in externalising problems

	'High" (n = 22)		'Low' (n = 10)			
	Mean	S.D.	Mean	S.D.	U	p
Fear total correct	7.18	3.51	6.2	2.94	94.50	0.53
Anger total correct	8.59	2.75	7.9	2.92	98.50	0.64
Happy total correct	14.18	2.1	14.3	1.25	99.00	0.65
Sad total correct	9.68	3.15	8.9	2.92	92.00	0.46
Disgust total correct	8.64	3.1	5.70	3.1	55.00	0.024
Surprise total correct	11.4	2.92	10.3	3.23	87.50	0.36

S.D., Standard deviation; U, Mann-Whitney U, p, probability.

Table 5-10: Facial recognition accuracy (mean number of correct trials and SD) for 'high' and 'low' groups in psychopathic traits

	'High" (n = 10)		'Low' (n = 22)			
	Mean	S.D.	Mean	S.D.	U	p
Fear total correct	5.6	2.17	7.45	3.64	73.00	0.13
Anger total correct	7.8	2.49	8.64	2.92	85.00	0.31
Happy total correct	13.6	2.27	14.5	1.63	85.50	0.31
Sad total correct	9.7	2.16	9.32	3.43	99.00	0.65
Disgust total correct	7.1	2.28	8.0	3.73	93.50	0.50
Surprise total correct	11.9	2.77	11.1	3.18	102.00	0.74

S.D., Standard deviation; U, Mann-Whitney U, p, probability.

In order to examine whether estimated IQ was related to emotion expression recognition, and could account for the differences in the recognition of disgust, non parametric Spearman rank correlations were run. Estimated IQ was not correlated with any of the antisocial behaviour variables (e.g., rate, severity, aggression, conduct disorder, externalising problems), nor with the accuracy of recognising disgust (see Appendix 5.1.).

5.3.4. Attribution errors

Data on the young offender group was further explored by examining the types of mistakes participants commonly made in the emotion face recognition task. Table 5.11 shows the types of emotions more frequently misidentified.

Table 5-11: Attribution errors in face recognition task for young offender group.

		Emotion selected						
		Fear	**Anger**	**Happy**	**Sad**	**Disgust**	**Surprise**	**Total**
Emotion shown	**Fear**	**227**	18	28	26	39	174	512
	Anger	30	**274**	14	52	91	51	512
	Happy	5	3	**457**	17	11	19	512
	Sad	47	18	23	**306**	74	44	512
	Disgust	12	196	12	20	**250**	22	512
	Surprise	63	9	35	18	29	**358**	512
	Total	384	518	569	439	494	668	

The total number of correct responses added up to 512 for each of the target emotions, thus correct recognition of emotions is shown in bold. It can be seen from the table that fear was frequently confused with surprise, and anger was frequently misidentified for disgust and vice versa.

5.4. Discussion

The current study was the first to examine facial affect recognition in young offenders. The findings showed that young offenders made less correct responses in recognising emotions (i.e., anger, sad, fear, disgust, and surprise) compared to controls, as reflected by their total accuracy score on the facial expression recognition task. When each of the emotions was examined separately, they also exhibited impairments across all intensity levels in fear, anger, and surprise recognition. These facial recognition impairments were similar to the ones shown by early-onset and adolescent-onset CD groups in the study by Fairchild et al. (in press). An investigation of between group differences at 100% emotion intensity level was carried out to investigate whether potential differences were attributable to task difficulty. Both the YOT and NC group were equally able in recognising fear, anger, and surprise at 100%. This meant that the problems of the YOT group seemed to be rather subtle and only apparent when the emotions were presented at less than full intensity level. Furthermore, the effect of these deficits disappeared when IQ was

entered as a covariate in the analyses. Nonetheless, the YOT group was more impaired in terms of total accuracy of recognition (excluding happiness). These findings partially support our primary hypothesis regarding general negative emotion recognition in facial displays; however the hypothesis was not supported in that we predicted a specific impairment in fear recognition, consistent with the meta-analysis in antisocial populations by Marsh and Blair (2008). Even though young offenders presented with face recognition difficulties in terms of negative emotions, they were equally able as normal controls in identifying happiness. Given previous studies and theory on facial emotion recognition in antisocial groups these findings confirm that young offenders did not present with difficulties in recognising positive emotions.

Data from the young offender group were examined to determine how seriousness and frequency of offending, clinical symptoms of aggression, conduct disorder symptoms, externalising problems, and psychopathic traits were related to differences in facial emotion processing. However, the only significant difference was in relation to externalising problems and the findings were contrary to our expectations. Specifically, the group scoring in the borderline/clinical range of externalising problems recognised facial disgust better than the group scoring in the normal range. A trend towards better disgust recognition also existed in the other 'high' antisocial groups, except for psychopathic traits. This difference is unlikely to have occurred due to differences within the YOT group in estimated IQ, as IQ was not correlated with any of the antisocial behaviour scales, nor with level of accuracy in recognising disgust. This finding is contrary to previous studies, where impairments in recognition of disgust have been found in antisocial groups, such as early-onset conduct disordered groups (Fairchild et al., in press) and adults with high levels of impulsive aggression (Best, Williams & Coccaro, 2002), however a significant

difference within the young offender group in our study was found with respect to externalising problems.

Frequently made attribution errors by the young offenders were for easily confusable emotions, such as misattributing fear for surprise, anger for disgust, and vice versa. This set of data is also consistent with findings on conduct disorder youths (Fairchild et al., in press).

In addition, our findings were not attributable to individual differences in psychopathic traits, even though there was a trend for participants low in psychopathic traits to better recognise expressions of fear. However, our sample was relatively small and detecting group differences is more difficult in these circumstances.

This limitation also stands for the between group comparisons, when IQ was entered as a covariate in the mixed model ANOVA, especially since the difference in IQ scores between the two group only approached significance. Significant differences might have been affected as the number of participants who completed the face recognition task was limited.

The findings of the current study suggest a deficit in amygdala and prefrontal cortex functioning in young offenders, as both of these brain areas are involved in negative facial affect processing (Pinel, 2000). Furthermore, young offenders did not exhibit a problem in recognising happiness at all intensity levels. The fact that happy expressions reinforce the repeat of actions (Matthews & Wells, 1999) could serve as a valuable tool to inform intervention research. Indeed, psychopaths have been found to respond to positive reinforcement (Newman, Kosson, & Patterson, 1992; Scerbo, et al., 1990). In the study by Scerbo et al. (1990) adolescent psychopaths showed increased responsivity to reward in conditions of both reward and punishment contingencies. In the same way, if antisocial groups are able to recognise happy

expressions and respond to positive reinforcement, then finding ways to develop this ability is necessary. Consistent with this assertion, Raine and Dunkin (1990) suggested that reward of prosocial behaviour might result in better outcomes than the punishment of antisocial behaviour. The focus of future research should be to confirm that different types of antisocial groups present with hyperresponsivity to reward, whilst at the same time showing that punishment might have no or little effect, and incorporate these findings in intervention programs the goal of which is to change adverse behaviour.

6. Chapter Six - Neuropsychological functioning

6.1. Introduction

Individuals displaying violent or antisocial behaviour often additionally show disinhibited, impulsive, and risk-taking behaviours, and are not concerned with the consequences of their actions. These patterns of behaviours are similar to the behaviours displayed by patients with ventromedial prefrontal cortex deficits, suggesting that frontal lobe dysfunction may underlie antisocial behaviour (Seguin, 2004).

Violence research is usually carried out within two disciplines, legal/judicial and clinical (Seguin, Sylver, & Lilienfeld, 2007). Whereas the legal/judicial field involves research on delinquent and criminal behaviour, research from a clinical perspective focuses on clinical conditions, such as conduct disorder (CD; 312.xx), antisocial personality disorder (ASPD; 301.7), as defined by the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; American Psychiatric Association, 2000), and psychopathy (as defined by Hare and colleagues, 1999). The current study aims to provide a better understanding of the neuropsychological processes involved in antisocial behaviour committed by young offenders.

The reason for incorporating neuropsychological measures of prefrontal or executive function in research on antisocial behaviour is because neurological functioning is often associated with the expression of conduct problems and criminal behaviour (Raine, 2002a). Neuropsychological and neurological deficits are associated with executive function (EF) deficits, which involve processes such as spatial span, working memory, perseveration, risk taking, sensation seeking, impulsivity, planning, and problem solving. Executive functions are thought to be necessary for the execution of socially appropriate behaviour, as they allow for careful

planning, and goal-directed and controlled behavioural output. EF also regulates emotional processes and contributes towards the nature of certain personality dimensions (Morgan & Lilienfeld, 2000).

EF has been described as "the ability to maintain an appropriate problem-solving set for attainment of a future goal. This set can involve one or more of the following: a) an intention to inhibit a response or to defer it to a later, more appropriate time, b) a strategic plan of action consequences, and c) a mental representation of the task, including the relevant stimulus information encoded into memory and the desired future goal-state" (Welsh & Pennington; 1988, pp.201-202).

In one prominent theory of antisocial behaviour, proposed by Moffitt (1993), neuropsychological functions, together with those processes involved with EF, are implicated in the aetiology of antisocial behaviour. According to Moffitt, two qualitatively distinct categories of individuals exhibit antisocial behaviour; *life-course-persistent* and *adolescence-limited* delinquents. A different set of predictors exists for each of these distinct groups. Life-course-persistent antisocial youths are more likely to exhibit neuropsychological functioning deficits compared to adolescence-limited delinquents (Moffitt & Caspi, 2001). These deficits appear to interact with life-course persistent youths' developmental context, in turn affecting the course of their antisocial behaviour. Accordingly, individual differences in cognitive ability, personality, and family circumstances provide the strongest predictors of persistent antisocial behaviour. In contrast, it is contact with delinquent peers, an increased sense of autonomy, a cultural and historical context which forbids certain privileges, and age that predict adolescence-limited antisocial behaviour (Moffitt, 1993).

An extensive literature suggests that a prefrontal cortex dysfunction, which usually but not always results in executive dysfunction (ED; Pennington & Ozonoff,

1996), is implicated in the expression of antisocial behaviour (Blair, Mitchell, & Blair, 2005). For example, working memory function, one of the components of EF, has been found to be limited in boys with a history of physical aggression, regardless of IQ and ADHD (Seguin, Boulerice, Harden, Tremblay, & Pihl, 1999) compared to a group of non-aggressive boys. It is important to examine working memory when investigating ED because it affects all stages of EF: working memory involves keeping information in memory and controlling for the effect of other processes, while at the same time triggering information processing when an individual performs an action (Seguin et al., 2007). The observation that behaviour problems (e.g., typically present in Oppositional Defiant Disorder, Conduct Disorder, and Attention Deficit Hyperactivity Disorder) are usually related to deficits in EF further implicates the prefrontal cortex (Pennington & Ozonoff, 1996) in the emergence of antisocial behaviour. In particular, ED is consistently observed in Attention Deficit Hyperactivity Disorder (ADHD), while evidence is not as consistent for Conduct Disorder (CD) (Pennington & Ozonoff, 1996). Due to the comorbidity of ADHD with CD and Oppositional Defiant Disorder (ODD), ED is further associated with aggressive and antisocial behaviour. Pennington and Ozonoff (1996) reviewed the existing literature and concluded that ED is not manifest in patients presenting with CD alone, but only when CD is comorbid with ADHD. This finding implicates that ADHD in ADHD/CD comorbidity is responsible for the ED, leading to a greater risk for antisocial behaviour and a poorer prognosis in comorbid cases. Even though the meta-analysis by Pennington and Ozonoff (1996) is informative about the role of EF in different developmental psychopathologies, the studies reviewed with respect to CD used some neuropsychological tests which have not been well-validated or had unclear links with EF (Morgan & Lilienfeld, 2000). In addition, a number of studies used the Wisconsin Card Sorting Test (WCST; Heaton, 2005), one of the most

commonly used EF tests, but this test relies heavily on the dorsolateral prefrontal cortex, an area of the brain not usually associated with antisocial behaviour (Blair et al., 2005). Contrary to Pennington and Ozonoff's (1996) meta-analysis, support for EF impairments (i.e. impulsivity) in antisocial groups was found in a meta-analysis by Morgan and Lilienfeld (2000), with greater effect sizes in studies using criminal and delinquent groups than clinical groups (i.e. ASPD, CD, psychopathy). Even though effect sizes for the results of the meta-analysis were in the medium to the large range, potential confounds, such as ADHD comorbidity, were not taken into account. Furthermore, even though a better range of EF tests was used, these did not distinguish between the different brain regions (e.g., dorsolateral, orbitomedial) relevant in antisocial behaviour (Blair et al., 2005).

Investigations into the neuropsychology of antisocial behaviour, especially ones focussing on EF, have thus yielded mixed results. The reasons for these inconsistencies include a failure (a) to control for ADHD or hyperactivity in the antisocial groups studied, (b) to take the history of problem behaviour into account, and (c) to control for IQ or verbal ability (Seguin et al., 2007). The inconclusive evidence with respect to the role of executive dysfunction in individuals presenting with antisocial behaviour was the primary motivation to conduct the current study. Finding out more about the presence as well as the extent of these impairments is important as the current lack of clarity may hinder the development of more optimal interventions.

6.1.1. Brain areas involved in EF processes

Research has successfully distinguished between the different processes involved in EF, and established that these overlap with the domains of attention, reasoning, and problem-solving (Pennington & Ozonoff, 1996). EF is thought to be

implicated in processes such as set shifting, inhibition, planning, and working memory. These functions are all linked to the frontal lobe, which is divided into the motor, premotor, and prefrontal cortex. The prefrontal cortex is the part of the brain controlling executive function and is further subdivided into dorsolateral, inferior (or ventral or orbital), and medial prefrontal cortex (Seguin, et al., 2007). For the types of behaviour under investigation, the orbital and medial areas of the prefrontal cortex are of particular interest. It is, however, important to note that the definition and boundaries of the orbitofrontal cortex (OFC) vary across studies (Angrilli, Bianchin, Radaelli, Bertagnoni, & Pertile, 2008); some restrict the OFC to the ventromedial PFC only (Anderson & Tranel, 2002), whereas others divide the OFC into ventromedial, and polar PFC (Angrilli et al., 2008).

In addition to the role played by the OFC in higher order cognitive functions such as EF, it also appears to be involved in emotional responding together with the amygdala (Angrilli et al., 2008). It has been suggested that a deficit in emotional processing can lead to impaired decision-making (Bechara, Damasio, & Damasio, 2000), as reflected in problem behaviours such as risk-taking and impulsive behaviour. A deficit in ventromedial (orbitofrontal and medial frontal cortex) prefrontal cortex functioning has been associated with decision-making impairments (Bechara, Damasio, Damasio, & Anderson, 1994). Damasio's "somatic marker" hypothesis proposes that somatic processes give signals to the emotional circuitry of the brain, particularly the ventromedial prefrontal cortex (VMPFC), thereby facilitating decision-making in case of uncertainty and difficulty (Damasio, 1996). The "somatic marker" hypothesis has mainly been tested via performance on the Iowa Gambling Task (IGT), however performance on this task might also relate to neuropsychological processes other than somatic marking, such as poor working

memory and sensitivity to reward and punishment (Dunn, Dalgleish, & Lawrence, 2006).

Decision-making processes typically involve the evaluation of a response in terms of potential outcomes (e.g., cost-benefit assessment of whether a positive outcome is more likely than a negative one), which is part of the rational process in carrying out a particular action (Dunn et al., 2006). Decision-making can also be guided by marker signals which index the likelihood of how rewarding or punishing an action can be in instances where a rational evaluation of cost and benefits cannot occur. This forms the basis of Damasio's "somatic marker" hypothesis, according to which individuals with decision-making impairments would be unable to use their emotional experiences in selecting an optimal action when a logical analysis of possible advantages and disadvantages is not feasible. Altered reward and punishment processing and/or sensitivity could also be present in antisocial individuals given their propensity to abuse substances (Disney, Elkins, McGue, & Iacono, 1999; Lewis, Cloninger, & Pais, 1983). Substance misuse has been found to be related to altered frontal lobe functioning, specifically the orbitofrontal cortex (London, Ernst, Grant, Bonson, & Weinstein, 2000). For example, drug users have been found to opt for short-term gains, which ultimately result in long-term negative outcomes, in the Iowa Gambling Task (Grant, Contoreggi, & London, 2000). Two explanations were given for this outcome: first, the performance of drug users could be interpreted as a bias in choosing small immediate rewards over larger delayed rewards, also called discounting, impulsivity or lack of self-control (Grant et al., 2000, p.1184); or alternatively, they tend to choose positive reinforcers over negative ones. The Gambling Task taps into ventromedial prefrontal cortex functioning and the finding that drug users showed impaired performance in this task suggests a deficit in this neuronal substrate of the brain. Patients with ventromedial prefrontal cortex

impairments have been found to be characterised by insensitivity to future consequences, whether positive or negative, rather than hypersensitivity to reward and/or insensitivity to punishment (Bechara, Tranel, & Damasio, 2000). If antisocial individuals would have comparable problems in frontal lobe functioning, then a similar behavioural pattern can be expected to occur. The present study will directly assess risk taking behaviour in young offenders. Because impaired performance on the Iowa Gambling Task might at the same time reflect impairments in other processes, a modified version of the Risky Choice Task (Rogers et al., 2003) was used as an alternative, more direct measure of decision making and sensitivity to reward and punishment.

Three lines of research inform the relationship between ED and antisocial behaviour: data from patients with acquired frontal lobe lesions; neuropsychological findings in people with antisocial behaviour problems, and neuro-imaging studies in individuals with antisocial behaviour (Blair et al., 2005). However, in the majority of studies, no distinction between different regions of the prefrontal cortex has been made. One of the few studies which have investigated specific brain regions, Dolan, Deakin, Roberts, and Anderson (2002), found reduced volume in the medial frontal lobe in impulsive-aggressive personality-disordered male patients. Goyer et al. (1994) studied patients with a personality disorder and found that that there was a correlation between lower normalised cerebral blood flow (CBF) in the orbitofrontal cortex and the patients' history of aggressive impulse difficulties. Raine et al. (1998) conducted a positron emission tomography (PET) study and found that affective murderers (with affective aggression being defined as "a response to physical or verbal aggression initiated by others, with violence that is both uncontrolled and emotionally charged", Raine et al.; 1998, pp.320) had significantly reduced lateral and medial prefrontal glucose metabolism compared to normal controls. Apart from the few cited studies,

the majority of the literature has not investigated the role of specific frontal sub-regions in aggressive and antisocial behaviour and has not distinguished between different forms of executive function. It is therefore important to further investigate the different executive functioning processes associated with different frontal areas and their relation with the occurrence of antisocial behaviour.

6.1.2. Inhibition and measures used in the present study

Different measures have been used in this study to examine the relationship between orbitofrontal and medial prefrontal cortex deficits and the expression of antisocial behaviour. One primary goal was to assess the role of inhibition in young offenders, given that inhibition is clearly a problem in those getting into trouble because of their antisocial behaviour (e.g., inhibiting ones' responses involves considering future consequences and is linked to the ventromedial prefrontal cortex), and because inhibition is one of the most commonly measured aspects of executive function. Inhibition is a complex construct; disinhibition has been described as the tendency (a) to act without thinking, (b) to be impulsive, and (c) to have problems planning ahead (Barratt & Patton, 1983).

There are different types of inhibition; Nigg (2000) distinguished between two types of inhibitory control; executive and motivational. The distinction between these two inhibitory processes was examined in a study by van Goozen et al. (2004), in which 7 neuropsychological measures that tapped into different aspects of executive functioning were administered to different groups of 7- to 12-year old children; children with Oppositional Defiant Disorder (ODD), children with ODD comorbid with ADHD (ODD/ADHD), and a normal control sample. The ODD/ADHD group was found to perform worse than the normal control group on a set shifting task, while both the ODD/ADHD and the ODD groups were worse on a response

perseveration task (i.e., an adapted version of the card playing task [CPT]). The latter result in combination with the finding that the ODD groups had no problems with an executive inhibition task (i.e., the Continuous Performance Test [CPT]-AX) led the researchers to conclude that ODD children have a particular disadvantage under motivational inhibitory conditions. The present study will further examine the distinction between executive and motivational inhibition by using one of the most frequently used measures of general executive control, the Wisconsin Card Sorting Task (WCST; Heaton, 2005), and by using two measures of motivational inhibitory control; the card playing task (CPT; Newman, Patterson & Kosson, 1987), which assesses the participant's ability to stop executing a once rewarded response (i.e., response extinction), and a decision-making task (CxR), adapted from the Iowa Gambling Task (Bechara, Damasio, Damasio & Anderson, 1994), during which risk taking behaviour and sensitivity to reward and punishment are measured by the amount of money individuals are prepared to gamble when odds are not in their favour. Risk taking behaviour and sensitivity to reward and punishment were of particular interest, because it was in the scope of this study to test whether young offenders show impaired performance in tasks assessing motivational inhibitory control. Moreover, functional MRI research shows increased activity in the medial orbitofrontal cortex, not only after participants receive a reward, but also after they have been able to avoid an aversive outcome (Kim, Shimojo, & O'Doherty, 2006), suggesting that if aggressive individuals suffer from an orbitofrontal cortex impairment, they will exhibit impaired performance in tasks measuring sensitivity to reward and punishment.

Tests from the Cambridge Neuropsychological Test Automated Battery (CANTAB CeNeS Ltd, Cambridge, UK), tapping specifically into the orbitofrontal and medial prefrontal areas, were used to investigate different aspects of EF. The

CANTAB is a battery of computerised tests administered with the aid of a touch-sensitive screen. It has been extensively used to test various aspects of executive functioning in children (Lehto, Juujärvi, Kooistra, & Pulkkinen, 2003) and adults (Robbins et al., 1998), and its usefulness with different populations, ranging from normal healthy volunteers (Murphy, Smith, Cowen, Robbins, & Sahakian, 2002) to those with ADHD (Mehta, Goodyer, & Sahakian, 2004) and substance misuse problems (Townshend & Duka, 2001) makes this battery of tests suitable for the purposes of this study.

6.1.3. Psychopathy

Participants' psychopathic tendencies were also considered in this study. The construct of psychopathy has received a lot of attention in recent years, also in research on antisocial and violent behaviour because psychopathic offenders commit a higher number and more violent crimes than the non-psychopathic offenders (Hare, 1981). Psychopathy is a personality dimension consisting of manifold and complex individual characteristics which tap into the emotional, interpersonal, and behavioural domains, and is most commonly assessed through questionnaires (Blair et al., 2005). Psychopathy has been linked to deficits in amygdala function, and pure psychopaths do not seem to experience a dorsolateral prefrontal cortex dysfunction as indexed by their WCST performance (Blair et al., 2005; LaPierre, Braun, & Hodgins, 1995). However, impaired performance on neuropsychological measures of the ventromedial prefrontal lobe area (LaPierre et al., 1995, Mitchell, Colledge, Leonard, & Blair, 2002) has been observed. Because of this pattern of impairments in psychopaths, a behavioural pattern that is also relevant in those who commit antisocial acts, psychopathic tendencies will be assessed in our young offenders.

6.1.4. IQ

Finally, participants' IQ was taken into account when investigating executive functioning. Antisocial behaviour has been found to be related to both intellectual and neuropsychological functioning, with antisocial groups scoring lower on intelligence tests than non-antisocial groups by about 8 points on average (Moffitt, 1990). Previous research has suggested that the frontal lobes are mostly associated with "fluid" intelligence, which is usually assessed through performance IQ tests, typically consisting of nonverbal tests of attention to detail, sequential reasoning, manual design construction, visual puzzle solving, symbolic encoding and decoding, and maze completion (Moffitt, 1990, p.134). Duncan, Burgess and Emslie (1995) found that patients with a frontal lobe lesion had significantly lower scores on a fluid intelligence test compared to posterior lesion patients and healthy controls. However, other studies show that delinquents have specific problems on verbal IQ tests (Wolff, Waber, Bauermeister, Cohen, & Ferber, 1982). Since delinquent behaviour is linked to lower intelligence, less schooling and social disadvantage (Blair et al., 2005; Moffitt, 1990) we examined the role of IQ in executive function in individuals presenting with antisocial behaviour.

6.1.5. Scope of current study

To summarise, behavioural measures assessing risk taking, sensitivity to reward and punishment, and general executive functioning were used in this study, as well as IQ and detailed assessments of working memory, planning and set-shifting ability. Frequency and severity of offending behaviour, as well as self-report measures of psychopathy and behavioural problems, such as levels of aggression, externalising, and conduct behaviour problems, were used to distinguish between

different groups of participants and to examine the effects of variations in behaviour and/or personality on neuropsychological functioning and IQ.

It was hypothesised that young offenders would show a specific impairment in the modified version of the Risky Choice Task (Rogers et al., 2003) and the Cambridge Gambling Task from the CANTAB (CGT; Rahman, Sahakian, Cardinal, Rogers, & Robbins, 2001), which are tapping into ventromedial prefrontal cortex functioning, and provide measures of motivational inhibitory control. A deficit in motivational inhibitory control rather than in executive inhibition was expected, consistent with research in antisocial children (van Goozen et al., 2004). For this reason, deficits were also expected on the Card Playing Task (Newman, Patterson & Kosson, 1987). However, because no control data were available, the current data were only used descriptively to find out whether task performance was related to frequency and severity of offending. The CxR and the CGT were both expected to measure risk taking behaviour, but each has an advantage over the other; sensitivity to reward and punishment can be examined in the CxR, while CGT dissociates impulsivity from risk taking (for details see Methods section). It was also hypothesised that young offenders would show higher responsivity to reward as opposed to punishment, consistent with evidence showing that lesions of the orbitofrontal cortex result in sensitivity to positive reinforcement (LaPierre et al., 1995; Rolls, 2000). Young offenders were also expected to show lower estimated IQ scores compared to controls.

The relationship between elevated levels of self-reported antisocial behaviour, more severe and/or frequent offending behaviour as revealed by official records, and EF deficits was also investigated. More severe and prolific offenders were expected to show more pronounced EF deficits, consistent with the findings of the meta-analysis by Morgan and Lilienfeld (2000) where criminality and delinquency were mostly

associated with EF impairments. It was also expected that antisocial youths with elevated levels of psychopathic traits would perform worse on tasks tapping into ventromedial cortex functioning, consistent with previous literature (LaPierre et al., 1995; Mitchell et al., 2002).

6.2. Methods and Materials

6.2.1. Participants

One hundred and fifteen 12-18 year old youngsters (mean age = 16.26, SD = 1.47), consisting of 104 males and 11 females, were recruited from the Youth Offending Team (YOT) in Cardiff. Participants (referred to throughout this paper as "the YOT" group) had exhibited aberrant behaviour at different levels of seriousness and were expected to differ in the extent of their emotional and behavioural difficulties. In order to examine the extent of emotional and behavioural difficulties, as well as psychopathic tendencies of the YOT group, the Youth Self-Report (YSR; Achenbach, 1991) and the Youth Psychopathic Inventory (YPI; Andershed, Kerr, Stattin, & Levander, 2002) questionnaires were completed. Data on frequency and severity of offending were used from official records, the procedure of which has been described in Chapter 2.3.

Data on the Wisconsin Card Sorting Test were compared to available norm data taken from the Wisconsin Card Sorting Test-64 Card Version Professional Manual (Kongs, Thomson, Iverson, & Heaton, 2000).

Data for one of the decision making/risk taking tasks (i.e., the CxR) were compared to those of a normal control (NC) group from Cambridge (hereafter Cambridge-NC; Fairchild et al., in press), consisting of 85 male adolescents, aged 14-18 years old (mean age = 15.77, SD = 0.82). These controls from Cambridge had been

recruited from secondary schools and colleges in relatively deprived areas in Cambridge.

Forty eight of the YOT participants (mean age = 15.99, SD = 1.53) also completed a second study in which more extensive neuropsychological assessments were carried out. During this study young offenders completed 4 tests from the CANTAB and their data were compared to existing age-matched norm data for three of the CANTAB tests (CeNeS Ltd, Cambridge, UK), namely the Spatial Working Memory test, the Stockings of Cambridge, and the Intra-Extra Dimensional set shift test. The YOT group's data on the Cambridge Gambling Task were compared to those collected in 40 14-16 year old male participants (mean age = 15.31, SD = .26) recruited from secondary schools in the Cardiff area. Data on estimated IQ of the YOT group were also compared to this Cardiff control group (hereafter Cardiff-NC). When the questionnaire data of the Cardiff-NC group were explored, they were found to score relatively high on the behavioural problem scales of the YSR. Specifically, one-way ANOVAs showed that this group did not differ from the YOT group in terms of aggressive behaviour, $F(1, 60) = .205$, $p=0.652$, externalising problems, $F(1, 60) = .007$, $p=0.936$, and conduct disorder symptoms, $F(1, 60) = .778$, $p=0.381$. Even though we will refer to this group as the Cardiff-NC group, the fact that these boys reported to have behavioural problems will be addressed again in the discussion.

6.2.2. Procedure

Data have been collected at the Cardiff Youth Offending Team (YOT). Recruitment of young people attending the YOT was carried out in collaboration with their case workers. Referrals were made for people considered suitable for taking part in the research, and these people were either firstly approached by their case worker or by the researcher. Information letters and consent forms were given out to both

young people and their parents or guardians, if they were under 18 years of age. Signed consent forms were returned to the researcher before the study proceeded, and upon receipt of the consent form the researcher arranged for a suitable time for the study to take place. Upon arrival, participants received a full explanation of the procedure, outlining the aim of the study and the tasks they were required to undertake. Participants were made aware of their right to withdraw at any time and encouraged to ask any questions they had regarding the research.

Participants completed the following materials: the Raven's Standard Progressive Matrices (Raven, Raven and Court, 2004)/Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999), the Youth Psychopathic Inventory (YPI; Andershed, et al., 2002), the Wisconsin Card Sorting Test (WCST; Heaton, 2005), the Barratt Impulsivity Scale, (BIS; Patton, Stanford, & Barratt, 1995), the Card Playing task (CPT; Newman et al., 1987), the Youth Self-Report (YSR; Achenbach 1991), and an adjusted version (Fairchild et al., in press) of the Risky Choice Task (CxR; Rogers et al., 2003). Participants (n=35) were initially only assessed for their Performance IQ by completing the Raven's Progressive Matrices; however, at a later stage the WASI was administered to also assess VIQ. An overall estimated IQ score was calculated for participants who completed the WASI.

After completion of these tasks, participants were informed about the 2nd part of the study, which took place at Cardiff University's School of Psychology and involved the completion of seven tasks from the Cambridge Neuropsychological Testing Automated Battery (CANTAB). These consisted of the Spatial Working Memory (SWM), Cambridge Gambling Task (CGT), Spatial Span (SSP), Affective Go/No-go (AGN), Pattern Recognition Memory (PRM), Intra-Extra Dimensional Set Shift (IED), and Stockings of Cambridge (SOC).

All participants were fully debriefed after the 1st and 2nd part of the study by handing out a debriefing form outlining the hypotheses of the research. During the entire procedure, participants were encouraged to ask any questions or address any concerns they had regarding the research. Each participant received a 5-pound gift voucher for each hour of participation.

6.2.3. Measures

6.2.3.1. Psychometric measures

- **Raven's Standard Progressive Matrices (Raven, Raven and Court, 2004):** The Raven was used to determine the IQ of participants. The Raven is a culture free test, eliminating the use of literacy skills to assess IQ. The test comprises of five 12-item sets, which give a total score of 0-60. Participants have to choose one figure out of six or eight possible options to complete a pattern for each item. Based on their total score participants are assigned to a percentile of people of the same age group. According to this percentile score they are then classified to a grade. Grades range from 1-5; people who are classified in Grade 1 are categorised as 'Intellectually superior" and those who are classified in Grade 5 are categorised as 'Intellectually impaired'.
- **Youth Psychopathic Inventory (YPI; Andershed et al., 2002):** The YPI is a self-report 50-item questionnaire used to measure psychopathic tendencies in youths by asking them to indicate the degree to which each statement reflects how they most often think and feel. A total score is calculated which ranges from 50-200. According to Skeem and Cauffman (2003), this score is divided by 50, giving a value from 1 to 4. A higher score corresponds to more

psychopathic traits, with 2.5 as a threshold for belonging to a high psychopathic trait group.

- **Youth Self-Report (YSR; Achenbach 1991)**: The YSR is an index of emotional and behavioural functioning of adolescents. It contains 2 sub-areas: (1) 20 competence items that measure the subject's participation in hobbies, games, sports, jobs, friendship and activities, and (2) 112 items that measure 8 subscale symptoms: withdrawn, somatic complaints, anxiety and depression, social problems, thought problems, attention problems, aggressive behaviour, and delinquent behaviours. Overall behavioural and emotional functioning is measured by the total problem scale. The YSR is widely used in community based and clinical research on problem behaviour in youths. Each of the items on the behavioural and emotional subscales of the YSR is rated on a scale of 0-2, with 0 corresponding to whether a behaviour or feeling is "not true" and 2 corresponding to whether it is "very true or often true". The aggressive, externalising problems, and conduct disorder scales were used for the present study. Each of these subscales was scored with individuals belonging either in the normal range or in the borderline/clinical range of each of these symptoms, as determined by the YSR manual (Achenbach, 1991).
- **The Sensation Seeking Scale (Zuckerman, 1994)** – A 40-item self-report questionnaire used to measure individual differences in stimulation and arousal needs. The participant has to choose one of two statements that mostly describe their likes or dislikes. A total sensation seeking score is calculated.
- **Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999):** The WASI provides a brief and reliable estimate of a person's intellectual functioning. The two sub-scale version was used; participants completed the vocabulary and block design components of the WASI, which tap into

crystallized and fluid abilities. The score that a participant obtained in each of the sub-tests corresponded to a t-score, which was reported in the WASI manual. A total t-score from the individual t-scores of the sub-tests was then calculated. The total t-score can be used to be converted to an IQ estimate, which is concordant with respondent age. The Wechsler scales have been revised over time and are the most widely used individual intelligence scales. The WASI was completed by the YOT and Cardiff-NC groups.

6.2.3.2. Cognitive/Behavioural measures

- **Wisconsin card sorting test (WCST; Heaton, 2005):** The WCST was used as a measure of global executive inhibitory control. Participants completed the computerised Wisconsin Card Sorting Test-64 Card Version (WCST-64), which is an abbreviated form of the standard 128-card version (WCST; Heaton, 1981). The WCST-64 maintains the task requirements of the WCST; the reason the shorter version was selected for the latter group was for ensuring sustained attention of the participants and also due to time limits in administering all of the tasks.

Participants were given the following instructions:

> "This test is a little unusual because I am not allowed to tell you very much about how to do it. You will be asked to match each of the cards that appear at the bottom of the screen to one of the four key cards that appear at the top of the screen.
>
> I cannot tell you how to match the cards, but the computer screen will tell you each time whether you are right (correct) or wrong (incorrect). The

computer will also say the same word it shows on the screen, 'right (correct)' or 'wrong (incorrect).

If you are wrong, simply try to match the next card correctly, and then continue matching the cards correctly until the test is over. There is no time limit on this test. If you ready, you may begin."

The cards should be matched by colour, shape, or number, and the participant is unaware of the fact that after 10 consecutive correct trials the sorting rule changes. The test is completed when all 64 cards have been used, or when 6 categories have been completed. Each of the 3 possible categories (colour, shape and number) can thus be completed twice successfully.

Several measures are obtained to evaluate participants' performance: total number of errors made (ranging from 0-64), perseverative errors (errors made when continuing to sort cards according to the rule that was correct for the prior stage of the task; ranging 0-62), non-perseverative errors (range 0-64), number of categories completed (range 0-6), the number of trials to complete the first category (ranging 10-65), and failure to maintain set (when more than 5, but less than 10 correct consecutive trials were made).

- **Card Playing Task (CPT; Newman et al., 1987):** The CPT is a computer based card playing game used to assess perseveration in the face of changing contingencies, extinction, and sensitivity to reward and punishment. Participants are told that the aim of the game is to win as many points as they can, and that they can stop playing the game whenever they decide they are

happy with the amount they have won. The game starts with zero points and stops when participants have played all cards (n=110).

The deck of cards are shown on the computer screen facing down, so that the participant cannot see what is going to come up next; they are told that they cannot skip any cards, and that they must see them in the order the computer will present them. At the beginning of each trial a question comes up on top of the computer screen asking the participant whether they want to play or not. If they decide they want to play, they have to click on the deck, which is made up of cards like in a normal pack of cards; spades, clubs, diamonds, and hearts. If a black card (spade or club) appears on the screen, the participant wins ten points. If a red card (diamond or heart) appears on the screen, the participant loses ten points. The computer calculates the amount of points the participant has each time, and makes a sound when a card is presented to them.

What the participants do not know is that the probability of winning decreases by 10% with every ten cards played. Therefore, if they carry on playing too long they are going to lose all of their points.

The total number of cards each participant plays is a measure of response perseveration. The number of premature responses, measured as the number of trials the participant clicked on the deck of cards before the card had actually appeared, serves as an index of impulsivity. The time elapsed between winning points and the next click on the deck of cards to continue the game is used as a measure of reward sensitivity, while the elapse in time between losing points and the next click on the deck of cards to continue is used as a measure of sensitivity to punishment. Data on the CPT were only available for

the YOT group. Due to lack of CPT data on a control group, data were only analysed in terms of how it related to other neuropsychological measures and offending behaviour.

- **Decision-making Task (CxR):** A modified version of the Risky Choice Task was used (Rogers et al., 2003): This computer-based task was used to assess behavioural inhibition under motivational conditions, and specifically risk taking behaviour. It was adapted from Bechara, Damasio, Damasio, and Anderson's (1994) Gambling task. The CxR was first used by Rogers et al. (2003) to examine decision-making in healthy controls following tryptophan depletion. Participants in the tryptophan-depletion condition presented with difficulty in discriminating between expected rewards of differing amounts.

  The aim of the current version of the CxR is to win as many points as possible. Participants are told that they will see two wheels of fortune on the computer screen, one on the left and one on the right, and have to choose the wheel that will give them the best chance of winning as many points as possible. Each wheel consists of eight segments, which have differing amounts they can win or lose each time. The participants have to choose between "control" and "experimental" wheels. The control wheels have a 50-50% chance of either winning or losing 10 points. Only the experimental wheel varies in the probability of winning or losing points (75% or 25%), as well as the magnitude of a gain (20 or 80 points) and the magnitude of a loss (20 or 80 points). An example of what participants are shown is provided in Appendix 6.1.

Participants play four games of 20 rounds each. At the beginning of each game they are given 100 points and at the end of each game their total from the 20 rounds is calculated. The computer calculates the amount of points on each trial by adding or subtracting the number of points the participant wins or loses, accompanied by a sound for either winning or losing. A visual representation of how the game is played is presented in Appendix 6.2 (adapted by Fairchild et al., in press).

The dependent measure is the number of times the experimental wheel is chosen over the control wheel. Making more high risk choices gives a higher score, which indicates behavioural disinhibition. This was calculated for four different conditions: gamble percentage just after a big loss, after a small loss, after a big win, and after a small win. These four conditions served as an indicator of sensitivity to reward and punishment.

- The following computerised tests from the CANTAB were used. All tasks were presented on a monitor with a touch-sensitive screen, and responses were recorded either via the touch-sensitive screen or a button box.
    - **Spatial Working Memory (SWM)**: This is a self-ordered test assessing the participant's ability to retain spatial information in working memory, whilst also incorporating a strategic search element to index "central executive" function (Owen, Downes, Sahakian, Polkey, & Robbins, 1990). Participants are presented with a number of coloured boxes and asked to find equal numbers of tokens hidden under the boxes, up until they fill a column on the right-hand side of the computer screen. The number of boxes gradually increases from four presentations of 3 boxes to four presentations of each of 4, 6, and

8 boxes. Participants are told that once a token is found, the computer will never hide a token under the same box, allowing for different types of errors recorded for this task. A "within error" is made when a participant re-opens a box, which was previously found to be empty in the same search sequence. A "between error" occurs upon returning to a box, which has already been found to contain a token. Another variable in the SWM task concerns the type of strategy that participants use for completing the task. An estimate of a successful strategy (according to Owen et al., 1990, p.1025) is calculated by adding the number of times participants start a new search by opening a different box. A high score corresponds to a poor use of the strategy, while a low score reflects effective use, consistent with Owen et al., (1990) who found that an ordered, systematic search approach was associated with better performance in normal subjects. The variables between errors and strategy score from the SWM task were compared to the norms, provided by the CANTAB (CeNeS Ltd, Cambridge, UK).

- **Cambridge Gambling Task (CGT):** The CGT is a test assessing decision-making and risk-taking behaviour. In this task, participants are presented with a row of ten boxes (red and blue), and are asked to find a yellow token that the computer has hidden under a red or a blue box by choosing the corresponding button on the screen. Participants are given 100 points at the beginning of each trial, and they are asked to make a bet on their choice being correct. The number of points won or lost gets added or subtracted from the total number of points earned in each trial. There are two conditions: an "ascending" and a

"descending" one. In the former, the amount of bets participants can place starts with low points and increases the longer one can wait. In the "descending" condition, the offered bets start with the higher amount of points and become smaller. There are four blocks of nine trials (for each possible ratio from 1:9, to 9:1) in each condition. The CGT was chosen as it differs from other gambling task in that risk taking behaviour is dissociated from impulsivity in the "ascending" condition, due to the fact that participants are required to wait in order to bet a large amount of points (Manes et al., 2002). Furthermore, the CGT is thought to tap into the orbitofrontal prefrontal cortex (see CANTAB website). There are six outcome measures in the CGT: quality of decision making, deliberation time, risk taking, risk adjustment, delay aversion, and overall proportion bet. The variables we chose to use were: overall proportion bet, an index of how risky an individual is; risk taking, a measure of the mean proportion of points that an individual chose to risk on gamble trials where they had more chance of winning than losing, and delay aversion, the tendency to bet larger amounts when the possible bet amounts are presented in descending order, as an indication of being unable to wait. Data collected on the YOT group on the CGT was compared to data from the control group from Cardiff.

- **Intra-Extra Dimensional Set Shift (IED):** The IED is a test of attentional set shifting and reversal learning. Participants are presented with two types of stimuli, colour-filled shapes and white lines, with the combination of both types of stimuli comprising compound stimuli. Participants are told they will be presented with two patterns on each

trial, one of which is correct and the other one is incorrect. They should choose the pattern they think is correct by learning a rule and following it. They are also told that once the computer thinks that they know the rule, it will change the rule, but this will not happen very often. Participants' ability to learn to attend to compound stimuli and to shift their attention from one type of stimuli to another is examined. Participants progress by learning a set criterion (6 consecutive correct responses) and the test comes to an end if a criterion is failed after 50 trials. The task consists of 9 blocks and has two key stages, the intra-dimensional shift (IED; block 6), and the extra-dimensional shift (EDS; block 8). The intra-dimensional shift stage requires participants to carry on attending to the previously relevant dimension, while the extra-dimensional shift stage requires participants to switch their attention to the previously irrelevant dimension and to learn which stimuli is correct in this dimension. These two key stages correspond to the rules of the Wisconsin Card Sorting Test. However, the IED breaks down confounded stages of the WCST (Seguin et al., 2007) and dissociates response reversal from attentional set-shifting (Mitchell et al., 2002). Attentional set-shifting corresponds to the EDS component of the task and is a component also measured by the WCST. Contingencies change in blocks 2, 5, 7, and 9, thus reversal learning can also be examined in the IED. The main outcome measures of the IED can be divided into errors and number of trials and stages completed. Specific variables are: Pre-ED errors, EDS errors, total errors, total errors (adjusted for when participants fail to complete a stage), completed stage errors, errors by each block, stages completed,

total trials completed on all attempted stages, total trials on all attempted stages (adjusted for when failing to complete a stage), and completed stage trials, which refers to number of trials on all successfully completed stages. For our study, the variables used were: number of errors made in each of the two key stages (IED and EDS), total number of errors made throughout the task, and number of stages passed. Performance of the YOT group on the IED was compared to the norms.

- **Stockings of Cambridge (SOC):** The SOC is based on the Tower of London task (Shallice, 1982) and used to measure spatial planning ability. Two sets of coloured balls are presented, positioned in vertically placed "stockings" hanging in three pockets. The positions of balls in both sets vary for each trial, and the problems increase in difficulty with subjects having to complete two, three, four, or five-move problems. The aim of the task is to replicate the top arrangement of balls in the bottom display of balls by moving one ball at a time. The main outcome variables for the SOC are: problems solved in minimum moves, mean moves for 2, 3, 4, and 5-move problems, initial thinking time for 2, 3, 4, and 5-move problems, and subsequent thinking time for 2, 3, 4, and 5-move problems. For our study purposes, only the first variable was used, the number of trials which participants manage to complete in minimum problem solutions. These data were compared to the norms.

6.2.4. Data analyses

A one-way ANOVA was carried out to test whether the estimated IQ of the YOT group differed from the control group. To examine whether lower IQ was related to neuropsychological functioning, Spearman rank correlations were carried out. Non-parametric correlations were run because not all variables were normally distributed. Performance on the WCST (to examine global executive functioning), and data collected on the CANTAB tasks (to examine neuropsychological functioning tapping into more specific frontal lobe areas) in young offenders were compared to existing norms by carrying out one sample t-tests. Data were checked for normality and were normally distributed. With respect to the CxR task, normal control data were available from Cambridge[14] and a mixed design ANOVA was carried out with group (control vs. offender) as a between-subjects factor, and outcome (large loss, small loss, large gain, small gain) as a within-subjects factor. One-way ANOVAs were used as post-hoc comparisons between the two groups. Where the assumption of sphericity was violated degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity. Effect sizes are reported as partial eta squared (η_p^2; small≥01, medium≥06, large≥14; Cohen, 1988).

The relationships between frequency and severity of offending and neuropsychological functioning were examined by running Spearman rank order correlations; Mann-Whitney tests compared 'high' and 'low' groups, which were created based on their levels of clinically defined symptoms of aggression, conduct disorder, externalising problems, and psychopathic tendencies, in terms of IQ, sensation seeking, and neuropsychological functioning. The reason that Mann-Whitney tests were only run with these constructs, and not also with frequency and severity of offending, is because they provide with more clear-cut criteria of creating

[14] See paper by Fairchild et al., (in press).

'high' and 'low' groups. Frequency of offending was assessed via the total number of offences committed by each YOT participant as revealed by official records, and severity of offending was assessed both by official records and self-report measures of clinical symptoms of aggression, conduct disorder, externalising problems, and psychopathic traits.

Analyses were carried out using SPSS 12.0 (SPSS Inc., Chicago, Illinois).

6.3. Results

6.3.1. Demographic information

Table 6.1 shows the number of participants who completed the different neuropsychological measures and Table 6.2 presents participants' demographic information.

Table 6-1: Number of participants for each neuropsychological measure

Measure	YOT n	Cardiff NC n	Cambridge NC n	Norms
IQ	80	40		
WCST	114			
SWM	48			64
SOC	48			63
IED	48			64
CGT	48	40		
CPT	112			
CxR	112		85	

Table 6-2: Demographic characteristics

	YOT (n_{age} = 115; n_{IQ} = 80)		Cardiff NC (n = 40)		Cambridge NC(n = 85)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Age	16.3	1.5	15.3	.26	15.8	.82
Estimated IQ	92.5	11.8	98.7	13.3	105.9	12.2

6.3.2. Between group comparisons: IQ data

A one-way ANOVA was run to compare the estimated IQ of the YOT group to the estimated IQ of control participants. Eighty YOT participants and 40 control participants completed the WASI and are included in the analysis. The results are presented in Table 6.3.

Table 6-3: Estimated IQ scores on WASI for YOT and control group.

	YOT		Cardiff NC			
	Mean	S.D.	Mean	S.D.	F(1,119)	p
Estimated IQ	92.54	11.80	98.68	13.26	6.64	0.011

Consistent with expectations, the YOT group had a significantly lower estimated IQ score.

Spearman rank correlations were run to examine whether IQ scores in the YOT group were related to performance on the neuropsychological tests. Correlations between IQ and the WCST, the CPT, and the CxR are reported in Appendix 6.3. Correlations between IQ and the same tasks but with the addition of the CANTAB tasks are reported in Appendix 6.4, as the CANTAB tasks were only performed by a sub-sample of the YOT group. In the larger YOT sample (n=72), IQ was found to be significantly positively correlated to the number of categories completed on the WCST (ρ =.322, p =0.006, two tailed), and inversely correlated to number of errors (ρ =-.422, p<0.001, two tailed) and non-perseverative errors (ρ =-.410, p<0.001, two tailed). IQ was not significantly associated with any of the CPT or CxR variables, nor was it correlated with seriousness or frequency of offending.

In the correlations carried out in the smaller number of YOT participants (n=48), it was found that IQ was negatively correlated with SWM between errors (ρ =-.366, p =0.011, two tailed) and strategy score (ρ =-.418, p =0.003, two tailed), and with IED total errors (ρ =-.312, p =0.033, two tailed).

6.3.3. YOT data comparisons to the norms

The results of one sample t-tests comparing the YOT mean group scores for each of the WCST variables to available norms are shown in Table 6.4.

Table 6-4: Wisconsin Card Sorting Test (WCST) scores for YOT and norms.

Measures	YOT (n=114)		Norms			
Wisconsin Card Sorting Test	Mean	S.D.	Mean	S.D.	t (113)	p
Total errors	21.72	8.89	21.07	8.73	185.00	0.44
Perseverative errors	9.61	4.40	8.55	4.14	203.00	0.011
Non perseverative errors	12.11	6.79	12.52	6.80	248.50	0.52
Categories completed	2.86	1.07	2.79	1.35	216.50	0.49

The results show that the YOT group only performed significantly worse in the number of perseverative errors made. Importantly, the number of perseverative errors made by YOT participants was not significantly correlated with IQ (see Appendix 6.1), suggesting that the difference is not attributable to the influence of IQ.

The CANTAB data turned out to be normally distributed and one sample t-tests were therefore deemed appropriate for comparing data collected in young offenders to existing norms. The IED data for one YOT participant were removed because he made too many errors in the preED stage. Tables 6.5 and 6.6 present means and standard deviations for both the YOT group and norm data, and the results of the statistical comparisons.

Table 6-5: CANTAB scores on SWM and SOC for YOT group and norms

	YOT		Norms			
	Mean	S.D.	Mean	S.D.	t (47)	p
SWM strategy score	34.50	4.00	29.12	5.19	9.33	<0.001
SWM between errors	30.37	14.80	11.95	11.27	8.61	<0.001
SOC minimum move solutions	8.21	1.97	9.52	1.97	-4.62	<0.001

SWM, Spatial Working Memory; SOC; Stockings of Cambridge; YOT, young offender group.

Table 6-6: CANTAB scores on IED for YOT group and norms

	YOT		Norms			
	Mean	S.D.	Mean	S.D.	t (46)	p
IED pre-ES errors	8.06	2.99	7.34	5.97	1.66	0.10
IED EDS errors	8.60	9.29	5.81	7.22	2.06	0.046
IED total errors	21.94	11.55	14.61	8.72	4.35	<0.001
IED no. of stages passed	8.55	0.802	8.79	0.74	-2.02	0.049

IED, Intra-Extra Dimensional Set Shift; YOT, young offender group.

The YOT group clearly performed worse than the norm group on nearly all of the variables. Because no norm data are available for the CGT, comparison data from

the Cardiff-NC together with the results of one-way ANOVAs are presented in Table 6.7.

Table 6-7: CANTAB scores on CGT for YOT group and control group

	YOT		Cardiff-NC			
	Mean	S.D.	Mean	S.D.	F(1,86)	P
CGT Overall proportion bet	.56	.14	.47	.16	7.87	0.006
CGT risk taking	.61	.14	.50	.18	10.42	0.002

CGT, Cambridge Gambling Task; YOT, young offender group.

As shown in Table 6.7, the YOT group gambled more and showed more risk taking behaviour than the control group.

With respect to the CPT, no norm data were available and the data can therefore only be used descriptively. The mean number of cards played on the CPT was 57.88 (SD = 27.89; n=112), and the mean number of premature responses was 17.24 (SD = 20.28; n = 109). The version of the CPT used in this study was similar to the Door Opening Task used by van Goozen et el. (2004) in that the number of cards played was 110 rather than 100, as used in the original task (Newman et al., 1987). The normal control children in the study by van Goozen et al. (2004) played a mean number of cards of 49.6 (SD = 28.6) and their mean number of premature responses was 1.6 (SD = 2.9). These results suggest that the young offenders did not show perseveration of responding as indexed by the total number of cards played, especially if one considers that the optimal point to stop the task is half-way through the task, thus after 55 cards have been played. However, the young offenders did show a tendency to respond prematurely, suggesting they might have a problem with impulsivity.

6.3.4. Between group comparisons: CxR data

First, a one-way ANOVA was run to examine whether the YOT (n=112) and Cambridge-NC (n=85) groups differed in terms of the overall proportion gambled across trials. The YOT group gambled significantly more than the Cambridge-NC

group, F (1, 195) = 31.96, p <0.001], with a mean overall proportion bet of 60.02 (SD = 10.54) for the YOT group and a mean overall proportion bet of 51.76 (SD = 9.78) for the Cambridge-NC group.

Pearson correlations revealed that the young offenders' estimated IQ was not significantly correlated with risk taking behaviour (r = 0.034, n=77, p=0.766, two tailed) and IQ was therefore not used as a covariate in further analyses.

Next, the CxR data were analysed to examine the effect of different outcomes on subsequent risk taking behaviour. For this purpose a mixed model ANOVA was used with group (control vs. young offenders) as between-subjects factor, and outcome (big loss, big win, small loss, and small win) as within-subjects factor. The assumption of sphericity was violated, so degrees of freedom were adjusted using the Greenhouse-Geisser procedure. There was a main effect of outcome, F (2.73, 533.01) = 5.48, p=0.002, partial eta squared =0.027, a main effect of group, F (1,195) = 17.15, p<0.001, partial eta squared =0.081, and a significant group × outcome interaction, F (2.73, 533.01) = 3.0, p=0.034, partial eta squared =0.015. Post hoc one-way ANOVA tests carried out to examine these effects further revealed that the YOT group gambled significantly more than the controls after most outcomes, but not after a large loss (see Figure 6.1): after a large loss, F (1,195) = 2.51, p=0.12, partial eta squared =0.013, after a large win, F (1,195) = 3.96, p=0.048, partial eta squared =0.020, after a small loss, F (1,195) = 4.64, p=0.033, partial eta squared =0.023, and after a small win, F (1,195) = 35.68, p<0.001, partial eta squared =0.155. The large effect size after a small win indicates that the significant interaction was particularly driven by the young offenders' stronger tendency to gamble after receipt of a small reward.

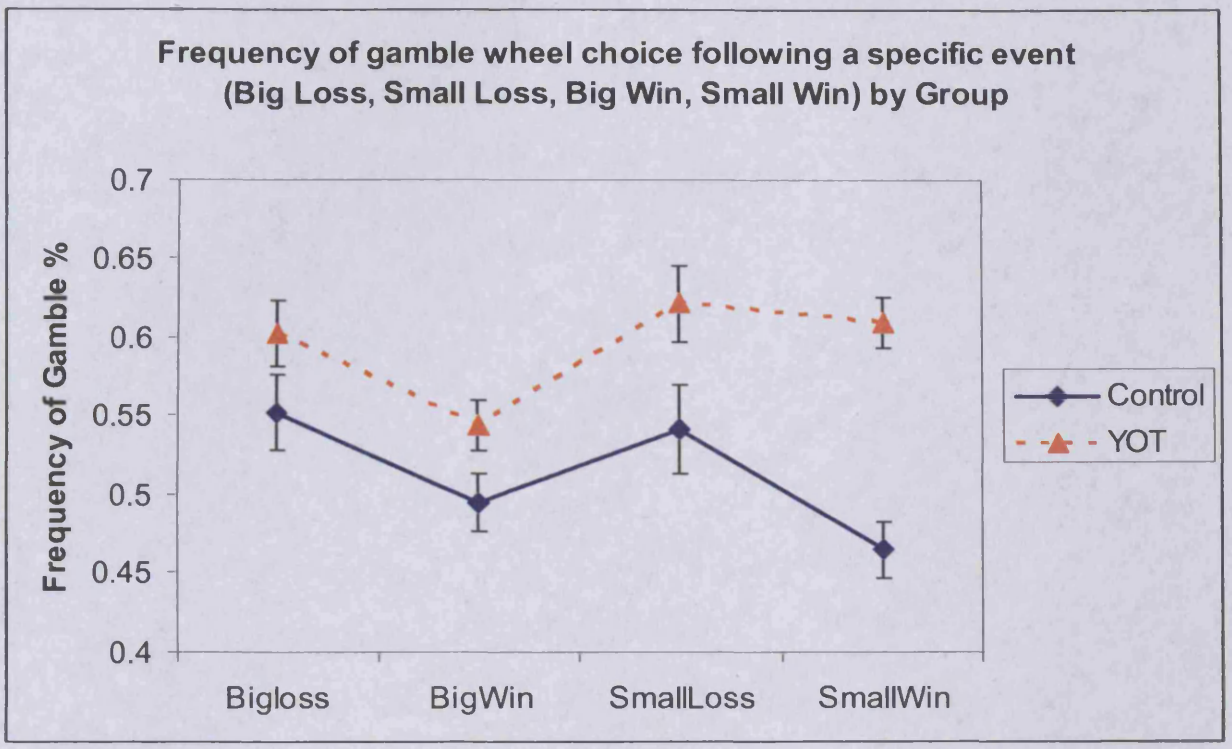


Figure 6.1: Frequency of gamble wheel choice following a specific event (Big Loss, Small Loss, Big Win, and Small Win) by Group

6.3.5. Relations between neuropsychological measures

Spearman correlations were run to examine to what extent the different neuropsychological tasks showed overlap. Out of the variables of interest, the CxR and CGT were not found to be correlated. However, the number of cards played on the CPT was significantly correlated with the number of between errors made on the SWM (ρ =0.362, n = 47, p=0.012, two tailed). The number of trials to complete a category in the WCST was correlated with the number of between errors made in the SWM (ρ =0.290, n = 48, p=0.046, two tailed), and negatively correlated with the number of stages completed in the IED (ρ =-0.338, n = 47, p=0.020, two tailed). Lastly, failure to maintain set in the WCST was correlated with the number of pre-ED errors (ρ =0.354, n = 47, p=0.015, two tailed). All correlations are reported in Appendix 6.5.

6.3.6. Relationship between frequency/severity of offending and neuropsychological functioning

Correlations were run to examine relationships within the young offender group between severity and frequency of offending, on the one hand, and the neuropsychological measures, on the other. Mann-Whitney test were also performed to examine whether variations in clinical symptoms of aggression, conduct disorder, externalising problems, and psychopathic traits, were related to IQ, sensation seeking personality and neuropsychological measures. Data on the CxR, CPT, and WCST were collected in the larger sample of young offenders, while the sub-sample of 48 participants completed the set of 4 CANTAB tests. Due to the fact the some of the variables were skewed non-parametric Spearman's rank correlations were calculated and Mann-Whitney tests were run. The reason for carrying out Mann-Whitney tests instead of correlations with some of the measures is because the clinical symptoms and psychopathic traits could be based on more established criteria in order to distinguish between high and low groups of participants. Three participants were removed from the analyses that involved the number of premature responses on the CPT (>3 SDs above sample mean).

Frequency and severity of offending were inversely associated with number of cards played in the CPT (ρ =-0.215, n = 112, p=0.023, two tailed, and ρ =-0.207, n = 111, p=0.029, two-tailed, respectively). A similar association was found between YPI (psychopathic tendencies) and number of premature responses in the CPT (ρ =-0.223, n = 108, p=0.021, two tailed). Finally, frequency of offending was positively correlated to total errors in the WCST (ρ =0.193, n = 111, p=0.042, two tailed) and inversely related to categories completed (ρ =-0.219, n = 111, p=0.021, two tailed). A table of all of the correlations is included in Appendix 6.3.

In the correlations carried out in the smaller number of participants, sensation seeking was positively correlated with SOC minimum move solutions (ρ =0.308, n = 46, p=0.037, two tailed), and frequency of offending, externalising and conduct disorder problems were inversely related to CGT overall proportion bet (ρ =-0.299, n = 46, p=0.043, two tailed; ρ =-0.301, n = 48, p=0.037, two tailed; ρ = -0.286, n = 48, p=0.049, two tailed, respectively). Appendix 6.4 contains all of the correlations. Within group comparisons are reported next.

Table 6-8: Scores on neuropsychological tests for 'high' and 'low' groups in aggressive symptoms

	'High"		'Low'			
	Mean	S.D.	Mean	S.D.	U	p
Age	16.36	1.40	16.29	1.41	1403.50	0.85
IQ score	94.22	11.06	91.71	12.65	614.00	0.47
Total Sensation Seeking Score	21.55	4.84	18.77	5.00	842.50	0.001
WCST: Total errors	20.71	9.59	22.14	8.53	1228.50	0.25
WCST: perseverative errors	8.71	4.18	9.96	4.37	1161.50	0.12
WCST: non-perseverative errors	12.00	6.92	12.19	6.93	1373.00	0.80
WCST: categories completed	3.00	1.00	2.80	1.13	1242.00	0.27
CPT: Total number of cards played	56.78	29.05	58.06	27.66	1373.00	0.87
CPR: premature responses	15.76	17.47	18.29	21.90	1276.00	0.90
CxR: overall % gambling	0.61	0.12	0.60	0.10	1336.50	0.69
SWM between errors	28.42	16.04	31.66	14.11	237.00	0.42
SWM strategy score	34.21	4.13	34.69	3.97	232.50	0.36
CGT overall proportion bet	0.54	0.13	0.57	0.15	235.00	0.39
CGT risk taking	0.60	0.14	0.62	0.14	261.50	0.77
IED pre-ED errors	7.95	3.39	8.69	3.99	247.00	0.55
IED EDS errors	8.84	9.54	9.03	9.69	268.00	0.87
IED total errors	23.84	13.66	21.66	11.17	255.50	0.67
IED stages completed	8.58	0.78	8.48	0.87	266.50	0.81
SOC minimum move solutions	8.84	1.92	7.79	1.92	182.50	0.047

As can be seen from Table 6.8, 'high' and 'low' aggressive groups only differed in sensation seeking scores and planning ability, with more aggressive individuals showing a more sensation seeking personality and better planning on the SOC task.

Table 6-9: Scores on neuropsychological tests for 'high' and 'low' groups in conduct disorder symptoms

	'High"		'Low'			
	Mean	S.D.	Mean	S.D.	U	p
Age	16.25	1.28	16.39	1.53	1378.50	0.34
IQ score	92.65	11.72	92.75	12.57	677.00	0.65
Total Sensation Seeking Score	21.35	4.52	18.20	5.21	850.50	<0.001
WCST: Total errors	20.60	8.75	22.70	9.06	1300.00	0.21
WCST: perseverative errors	8.95	4.28	10.08	4.34	1245.00	0.11
WCST: non-perseverative errors	11.65	6.17	12.62	7.62	1435.50	0.65
WCST: categories completed	2.93	1.02	2.81	1.16	1400.00	0.49
CPT: Total number of cards played	55.28	27.53	60.00	28.63	1384.50	0.45
CPR: premature responses	18.83	23.85	16.02	16.51	1398.50	0.84
CxR: overall % gambling	0.60	0.11	0.61	0.10	1389.00	0.46
SWM between errors	29.29	14.87	31.46	15.02	264.50	0.63
SWM strategy score	34.42	3.79	34.58	4.27	255.50	0.50
CGT overall proportion bet	0.52	0.14	0.60	0.13	189.00	0.041
CGT risk taking	0.58	0.15	0.65	0.12	217.50	0.15
IED pre-ED errors	8.17	3.60	8.62	3.95	267.50	0.67
IED EDS errors	7.75	8.81	10.17	10.24	239.50	0.31
IED total errors	22.33	13.16	22.71	11.27	272.00	0.74
IED stages completed	8.67	0.70	8.38	0.92	246.50	0.27
SOC minimum move solutions	8.54	1.96	7.88	1.96	222.50	0.17

Groups 'high' in conduct disorder symptoms reported to be more sensation seeking and gambled less in the CGT.

Table 6-10: Scores on neuropsychological tests for 'high' and 'low' groups in externalising problems

	'High"		'Low'			
	Mean	S.D.	Mean	S.D.	U	p
Age	16.23	1.47	16.46	1.29	1345.50	0.53
IQ score	93.95	11.98	90.48	12.04	641.00	0.74
Total Sensation Seeking Score	20.76	4.63	18.24	5.49	920.50	0.002
WCST: Total errors	21.43	9.07	21.90	8.77	1353.00	0.70
WCST: perseverative errors	9.29	4.29	9.83	4.42	1295.50	0.46
WCST: non-perseverative errors	12.14	6.82	12.07	7.09	1413.00	0.99
WCST: categories completed	2.87	1.04	2.88	1.17	1394.50	0.90
CPT: Total number of cards played	57.81	28.60	57.24	27.48	1404.00	0.88
CPR: premature responses	19.83	22.69	13.67	15.86	1135.50	0.14
CxR: overall % gambling	0.60	0.11	0.61	0.10	1334.00	0.56
SWM between errors	31.17	15.65	29.06	13.68	256.00	0.77
SWM strategy score	34.87	3.71	33.89	4.47	250.50	0.68
CGT overall proportion bet	0.53	0.13	0.59	0.14	207.00	0.18
CGT risk taking	0.60	0.14	0.63	0.14	237.50	0.49
IED pre-ED errors	8.70	4.36	7.89	2.42	260.00	0.83
IED EDS errors	8.23	9.24	10.17	10.15	221.50	0.30
IED total errors	22.73	13.50	22.17	9.75	256.00	0.77
IED stages completed	8.60	0.77	8.39	0.92	240.50	0.42
SOC minimum move solutions	8.27	1.93	8.11	2.08	250.00	0.67

The only difference found to occur in groups 'high' and 'low' in externalising problems was in terms of sensation seeking scores again, with the 'high' group reporting higher scores.

Table 6-11: Scores on neuropsychological tests for 'high' and 'low' groups in psychopathic traits

	'High"		'Low'			
	Mean	S.D.	Mean	S.D.	U	p
Age	16.38	1.47	16.22	1.48	1268.00	0.57
IQ score	90.67	9.34	93.08	12.98	560.50	0.37
Total Sensation Seeking Score	22.06	4.08	18.95	5.20	798.00	0.002
WCST: Total errors	21.53	8.74	21.91	9.02	1325.00	0.91
WCST: perseverative errors	9.29	4.25	9.78	4.50	1263.00	0.62
WCST: non-perseverative errors	12.24	5.91	12.13	7.18	1244.50	0.54
WCST: categories completed	2.79	0.98	2.87	1.11	1280.50	0.68
CPT: Total number of cards played	52.33	24.34	60.42	29.19	1132.50	0.32
CPR: premature responses	13.39	12.71	18.94	22.58	1067.00	0.39
CxR: overall % gambling	0.61	0.11	0.60	0.11	1206.00	0.51
SWM between errors	29.44	17.87	30.84	13.34	229.00	0.56
SWM strategy score	34.81	3.45	34.34	4.29	238.50	0.70
CGT overall proportion bet	0.55	0.11	0.56	0.15	242.00	0.76
CGT risk taking	0.62	0.12	0.61	0.15	251.50	0.92
IED pre-ED errors	8.50	3.86	8.34	3.75	247.50	0.85
IED EDS errors	7.81	8.23	9.53	10.20	221.00	0.44
IED total errors	24.19	14.63	21.69	10.82	237.50	0.69
IED stages completed	8.62	0.72	8.47	0.88	241.00	0.67
SOC minimum move solutions	7.94	1.69	8.34	2.10	231.00	0.58

The same difference occurred in groups 'high' and 'low' in psychopathic traits; again individuals with ore psychopathic tendencies were more prone to sensations, according to self-reports. No other differences were found in this group in any of the neuropsychological measures.

6.4. Discussion

The purpose of the present study was to explore neuropsychological functioning in an adolescent group of young offenders. Several measures were used, incorporating both an assessment of global executive functioning, and assessments believed to tap into more specific prefrontal cortex regions related to antisocial behaviour (i.e., orbitofrontal cortex). The aims of the current study were (a) to compare data collected in young offenders with those collected in normal controls to find out whether neuropsychological deficits (global and/or more specific) are only

present in individuals who engage in antisocial behaviour and (b) to assess in the young offender group the relationship between frequency and severity of antisocial behaviour as well as psychopathic tendencies, and neuropsychological performance.

Compared with normal controls the young offender group had a lower estimated IQ score, which was consistent with our hypothesis and previous literature (Moffitt, 1990). The young offender group also showed more general executive deficits, as revealed by their performance on the WCST. Young offenders committed more perseverative errors, an indication of being unable to shift behaviour in the face of changing contingencies. Previous studies also found that antisocial groups have an impaired performance on the WCST (Blair et al., 2005).

The YOT group also exhibited a range of specific executive deficits as shown by their performance on the CANTAB tests and the decision making task (CxR). In particular, young offenders made more errors on the spatial working memory task and were less able to use a systematic search strategy, which is associated with better performance on this task. Their planning ability was worse (i.e., SOC test) and they had trouble shifting their behaviour by making more errors in the Intra-Extra Dimensional Set Shift task, specifically the extra-dimensional stage of the test. This finding indicates that young offenders found it difficult to shift their attention to another dimension. The fact that YOT group also completed fewer stages compared to norms on the IED, suggests they generally had a problem with completing this task. Finally, the YOT group gambled more (CxR) and showed elevated risk taking behaviour on the CGT.

The Cardiff control group, who reported similar levels of aggressive and externalising behavioural problems as the YOT group (i.e., on the YSR), performed better on the CGT and had a higher mean IQ level. Thus although they reported to engage in some forms of antisocial behaviour, their reduced risk taking behaviour

(CGT) and higher IQ might have been the reason that this group had managed to stay out of contact with the youth offending service.

The YOT group generally demonstrated a greater propensity to gamble, but especially so after the receipt of a small win, as shown by the effect sizes of the differences, whilst the opposite was true for control participants: they showed reduced gambling behaviour - more than any other previous outcome - after small wins. IQ did not affect these results, as it was not found to be correlated with performance on the CxR (see Appendix 6.3). This result is consistent with findings in conduct disorder adolescents (see Fairchild et al., in press). If the difference between antisocial and normal control groups in gambling behaviour is due to the fact that antisocial individuals are less satisfied with small rewards, then their sensitivity to reward rather than to punishment requires manipulation when considering interventions.

The fact that the CxR and CGT variables were not found to be correlated suggests that these tests tap into different aspects of risk taking. A component that seems to be different in the two tasks is that the CGT more clearly dissociates risk taking from impulsivity because it involves and "ascending" and a "descending" condition; in the "ascending" condition participants have to wait before they can bet a large amount of points and thus need to show non-impulsive behaviour if they want to take more risk. However, the CxR provides a better index of sensitivity to reward and punishment by examining the effect of different outcomes (i.e., big loss, big win, small loss, and small win) on subsequent risk taking behaviour. Even so, given that the young offenders gambled more on both tests, it is evident that they are more prone to risk taking behaviour. The findings on the CANTAB and the decision making (CxR) task are consistent with our hypothesis and previous research suggesting working memory impairments (Seguin et al., 1999) and deficits associated with orbitofrontal cortex functioning in antisocial groups (Blair, 2004; Seguin, 2004).

In the analyses pertaining to the YOT group and contrary to our expectations, an inverse relationship was revealed between more serious and more frequent offenders, as well as more psychopathic offenders, and response perseveration (i.e., the number of cards played on the CPT). Evidence of impaired extinction on this task has been found in many studies (van Goozen et al., 2004), but we did not observe a problem in young offenders. Unfortunately we did not have any control data, but when we compared the mean number of cards played by young offenders it was not particularly high and quite similar to published performance data in normal children. Thus although our correlational findings are unexpected, we have to remind ourselves that these concern within-YOT comparisons and that young offenders actually did not show evidence of perseveration in this test.

To our knowledge, no other study has examined the effect of variations in offending behaviour on neuropsychological functioning. More prolific offenders were found to make more learning errors and to complete fewer categories on the WCST; they did not make more perseverative errors and therefore did not seem to have a problem with changing their behaviour. Even though IQ was positively associated with the number of categories completed and inversely related to number of errors, more prolific offenders did not have a lower IQ.

Findings within the YOT group on the CANTAB tasks also proved to be contrary to expectation; offenders with more conduct disorder problems gambled less on the CGT and more aggressive participants showed better planning ability. The CGT assesses decision making and risk taking and is thought to tap into the orbitofrontal prefrontal cortex. Research has identified relations between the orbitofrontal cortex and patients' history of aggression (Goyer et al., 1994), as well as the involvement of orbitofrontal cortex in antisocial behaviour (Blair, 2004; Seguin, 2004). IQ score was negatively correlated with some of the CANTAB measures,

namely SWM between errors, strategy score, and total errors in the IED, so it could not have played a role in the findings. These findings might be contrary to what was expected, but they could both be explained with the type of aggressive behaviour involved. Participants with high levels of instrumental rather than impulsive behaviour are more likely to plan their offending, so they might also be less willing to take risks at the same time. It should also be kept in mind that specific problems in the CANTAB tests were found in the young offender group as a whole. Differences within the young offender group might be explained when other factors (e.g. social disadvantage) are also taken into account.

Overall, the results of the within-group analyses do not support any of our predictions. Prolific offenders performed slightly worse on the WCST, making more errors and completing fewer categories, but they did not make more perseverative errors. There was also no support for the hypothesis that more serious offenders or more psychopathic offenders would exhibit more serious neuropsychological impairments. A larger sample size to carry out these analyses would be useful in future.

Previous studies examining neuropsychological functioning in antisocial groups have used a limited range of executive functioning tasks, which were tapping into frontal brain regions, but not the ones found to be more directly related to ASB (i.e., orbitomedial rather than dorsolateral prefrontal cortex). The present study addressed this issue by employing different types of executive functioning tests. Deficits observed on the WCST suggest the existence of global executive functioning problems in young offenders. However, worse performance on more specific executive functioning tests, such as those assessing working memory and planning (i.e., SWM and SOC tests) were also found, as well as impaired performance on two decision-making tasks, which have been shown to be related to functioning of the

ventromedial prefrontal cortex (i.e., Bechara et al., 2000; Rahman et al., 2001). Thus, the results of the current study support the notion of some specific (e.g., working memory, planning and decision making) executive deficits in young offenders, and these deficits are similar to the ones reported in CD and physically aggressive youngsters (Fairchild et al., in press; Seguin et al., 1999). These findings highlight the importance of examining neuropsychological factors in antisocial behaviour and support the important role of the prefrontal cortex in this. Moreover, our results show that young offenders differed most from their controls in risk taking behaviour after receipt of a small win. This finding replicates risk taking in early-onset conduct disordered youngsters on the same task (Fairchild et al., in press), but is a novel finding in young offenders. Outcomes like this, of differential sensitivity to reward as compared to punishment, could have important implications for interventions in antisocial groups.

7. Chapter Seven – Explaining ASB

7.1.Introduction

The relationship between social and biobehavioural risk factors and offending behaviour is examined in this chapter by looking at whether variations in these variables could explain differences in the frequency, severity and persistence of offending behaviour. Additionally, we were interested in finding out whether social adversity would have a moderating effect on the association between early biobehavioural deficits and ASB. These questions will be addressed and the layout is as follows. First, we examine the role of social and biobehavioural risk factors in different types of offending behaviour. Second, we assess whether social and biobehavioural variables interact in explaining ASB.

With regard to how social and biobehavioural risk factors relate to different types of offending behaviour, previous research has shown that a range of risk factors has been associated with the emergence of antisocial behaviour; biological and social variables have been used in various studies to disentangle the most important predictors of antisocial behaviour. According to Raine (2002b), different types of variables inform the interaction between biological and sociological factors implicated in violent and antisocial behaviour. Relevant social/ecological variables, reported in the review by Raine (2002b), include poor parenting practices, unstable family environments, and social class. Other social factors which play a role in the emergence of ASB are poor academic achievement, living in neighbourhoods with high levels of poverty and crime, and socialising in delinquent peer groups (Loeber & Farrington, 1998; Shader, 2001). Risk factors can also be of a biological nature. These originate from genetic risk which can contribute towards certain psychological and behavioural characteristics, which can place an individual at risk of psychopathology.

Biobehavioural risk factors associated with ASB include birth complications, psychophysiological (e.g., atypical autonomic arousal), and neuropsychological deficits. Neuropsychological deficits associated with executive function deficits have been shown to be associated with ASB through impairments in spatial span, working memory problems, perseveration, risk taking, sensation seeking, impulsivity, and poor planning and problem solving ability.

Previous research has identified both social and biobehavioural influences in ASB but taken a narrow view of delinquency focusing on violence or aggression, and recidivism. When investigating delinquency, studies mostly used participants' criminal records as the dependent variable and did not distinguish between variations in offending behaviour in terms of its frequency and/or severity. For example, in one study psychophysiological under-arousal at age 15 years was found to predict criminality at age 24 years (Raine, Venables, & Williams, 1990b). Criminality was revealed by registration for criminal offences recorded in official criminal records, and ranged from theft and burglary to wounding. Delinquency and crime were analysed as general constructs without breaking these down into the nature of the offences. A similar methodology has been used in studies reporting that executive dysfunctions are found in delinquent and antisocial populations, which were defined by their criminal records without taking account of the severity and/or frequency of their offence records (Morgan & Lilienfeld, 2000).

In the instances where more specific antisocial behaviour constructs have been investigated, violence has been a typical outcome measure, as an index of a more serious form of ASB (i.e., Raine, Brennan, & Mednick, 1994). It has been proposed that the risk for violent behaviour increases in the presence of multiple early risk factors, which arise from the interaction between individual, contextual (i.e., family, school, peers), situational, and neighbourhood factors (Loeber & Farrington, 1998, p.

13). Individual factors include risk taking behaviour, aggression, favourable attitudes towards ASB, early onset of violent behaviour, restlessness and hyperactivity, and involvement in other forms of ASB. Aggressive behaviour has been another commonly researched topic of ASB. Aggression has been found to relate to both social (i.e., history of abuse) and biological influences, such as poor neuropsychological functioning and deficits in working memory (Seguin, Sylver, & Lilienfeld, 2007). Another example of a predisposition to aggressive behaviour is a fearless and/or a stimulation-seeking temperament, which when present at age 3 years has been found to relate to aggression at age 11 years (Raine, Reynolds, Venables, Mednick, & Farrington, 1998). Recidivism has also been of interest, especially in attempts to devise risk assessment instruments. Low levels of social control have been found to predict more convictions for violent offences at age 18 years (Henry, Caspi, Moffitt, & Silva, 1996), and more involvement in criminal activity (Caspi, Moffitt, Newman & Silva, 1996). Psychopathy has been another risk factor for criminal and sexual recidivism (Salekin, Rogers, & Sewell, 1996). Generally, evidence suggests that the recidivistic, chronic offender is more likely to be characterised by heritable biological factors (Buikhuisen & Mednick, 1988), such that they make abstinence from ASB difficult.

The influence/role of frequency and severity of offending behaviour (with 'severity' defined from a criminal/legal point of view) in adolescent young offenders has not been investigated before. One important risk factor is age of onset, with early engagement in ASB relating to chronic offending, seriousness of crimes committed, and recidivism (Stouthamer-Loeber & Loeber, 1988). To our knowledge, an investigation into the effect of both social and biobehavioural variables on prolific, severe, and persistent offending in adolescents has not been carried out. Thus, the

present chapter aims to look at a broad range of ASB factors in relation to how these are influenced by different social and biological variables in adolescent offenders.

Social adversity moderates the biobehavioural - ASB relationship. In the 'social push hypothesis' (Raine, 2002b, p. 314), described in Chapter One, a biological predisposition to offend is more prominent in individuals socialised in relatively benign environments (e.g., individuals from higher social classes and/or not exposed to adverse home environments). According to the 'social push hypothesis', adverse social circumstances mask the influence of biological predisposing factors. Consistent with this line of research, this chapter will investigate whether biobehavioural risk factors will better predict offending behaviour in individuals from areas relatively low in social risk.

To sum up, in this chapter we will investigate the contribution of different social and biobehavioural variables, as well as their combined effects, in explaining the frequency, severity, and persistence of ASB in young offenders. It has become clear from the preceding chapters that social and biobehavioural variables are involved in ASB committed by young offenders, but these effects were examined separately so far. This chapter will only consider those risk factors that were found to be significant predictors. The analyses will examine (a) whether either social and/or biobehavioural variables predict frequency of offending behaviour, testing the hypothesis that prolific offending will not necessarily relate to severity of antisocial behaviours, and thus might be better explained by social influences, (b) whether either social and/or biobehavioural variables will predict severity of offending behaviour, testing the hypothesis that biobehavioural variables will better explain severe antisocial behaviour, (c) whether either social and/or biobehavioural variables will predict persistence or desistence from offending behaviour, testing the hypothesis that

biobehavioural variables will better predict recidivism, and (d) whether social and biobehavioural variables interact in explaining these different outcomes.

7.2.Methods and Materials

7.2.1. Participants

One hundred and fifteen 12-18 year old young people (mean age = 16.26, SD = 1.47), of which 104 were males and 11 were females, were recruited from the Youth Offending Team (YOT) in Cardiff.

7.2.2. Procedure

The research procedure has been described in detail in Chapter 2.2. Briefly, during the first study session, participants completed an IQ assessment (Raven's Standard Progressive Matrices (Raven, Raven and Court, 2004) – later replaced by the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999), several questionnaires, and three computer-based tasks. The questionnaire measures assessed personality dimensions, previously found to be related to ASB, and behavioural/emotional problems. Personality traits assessed were sensation-seeking temperament and psychopathic traits, by completing the Sensation-Seeking scale (SSS; Zuckerman, 1994), and the Youth Psychopathic Inventory (YPI; Andershed, Kerr, Stattin, & Levander, 2002) respectively. Data concerning behavioural problems were collected using the Youth Self-Report (YSR; Achenbach 1991). The computer-based tests measured different types of executive functioning; the Wisconsin Card Sorting Test (WCST; Heaton, 2005) assessed executive inhibitory control, and two decision-making tests (the CxR, adapted from the Iowa Gambling Task [Bechara, Damasio, Damasio & Anderson, 1994] and the Card Playing Task [CPT; Newman, Patterson & Kosson, 1987]) were used to measure motivational inhibitory control.

The distinction between these tests has been described in more detail in Chapter Six. Approximately half of the participants, who took part in this first study, also completed a more extensive second study taking place at the School of Psychology at Cardiff University, during which more detailed assessments of executive functioning and emotional responding were made. Data collected on these more detailed assessments could not be used in the current chapter, as this would restrict the analyses to a subset of participants and therefore negate the opportunity to deploy more exacting analytic strategies. Data were also used from the YOT database that describes young offenders' psychosocial risks. Thus three categories of risk factors were used: neurocognitive, psychosocial, and personality-related risk factors. Those variables that had been found to be significantly associated with offending were used in the present analyses: estimated IQ scores, the WCST, and the CxR as neurocognitive factors; neighbourhood, education, and substance use as psychosocial risk factors; and finally, psychopathic personality and sensation seeking traits as personality-related factors.

7.2.3. Measures

7.2.3.1. Dependent variables

There were three dependent variables: prolific offending, serious offending, and persistent offending. The first dependent variable was created by dividing offenders into those who are prolific and non-prolific. This categorisation is important in terms of policy relating to appropriately identifying individuals engaging in the majority of crime. Policy makers aim to reduce excessive crime in certain areas and identify suitable interventions targeting individuals who are more prolific. As revealed by the range of total offences shown in the histogram in Figure 7.1 below,

young offenders in our sample ranged from low level to prolific. The mean number of total offences was 9.12 (SD = 10.1). Further examination suggests that the bulk of young offenders commit only a few (1 – 10) offences and the distributions' long tail suggests a further group is prone to profligacy. With no strict definition of a prolific offender, k-means cluster analysis was used as an exploratory technique to determine the threshold between prolific and non-prolific offending groups. Cluster analysis is a method used to classify or partition a dataset into subsets, so that they constitute meaningful units. In the case of prolific offending, k-means cluster analysis was run on rate of offending (total number of offences divided by age) which resulted in two groups of n = 31 prolific offenders and n = 84 non-prolific offenders. Prolific offenders were classified as those individuals who had a rate of offending score of 0.80 or above (mean rate of offending = 1.36 [SD = 0.46] for prolific offenders and mean rate of offending = 0.24 [SD = 0.18] for non-prolific offenders) which was the threshold resulting from cluster analysis, as compared to 0.28 as the threshold dividing the two groups, suggested by a median split. Cluster analysis was the preferred method to classify offenders as its emphasis is on the similarity of offenders by group rather than by an arbitrary classification scheme such as a median split that relies on the distribution of offences in the available sample.

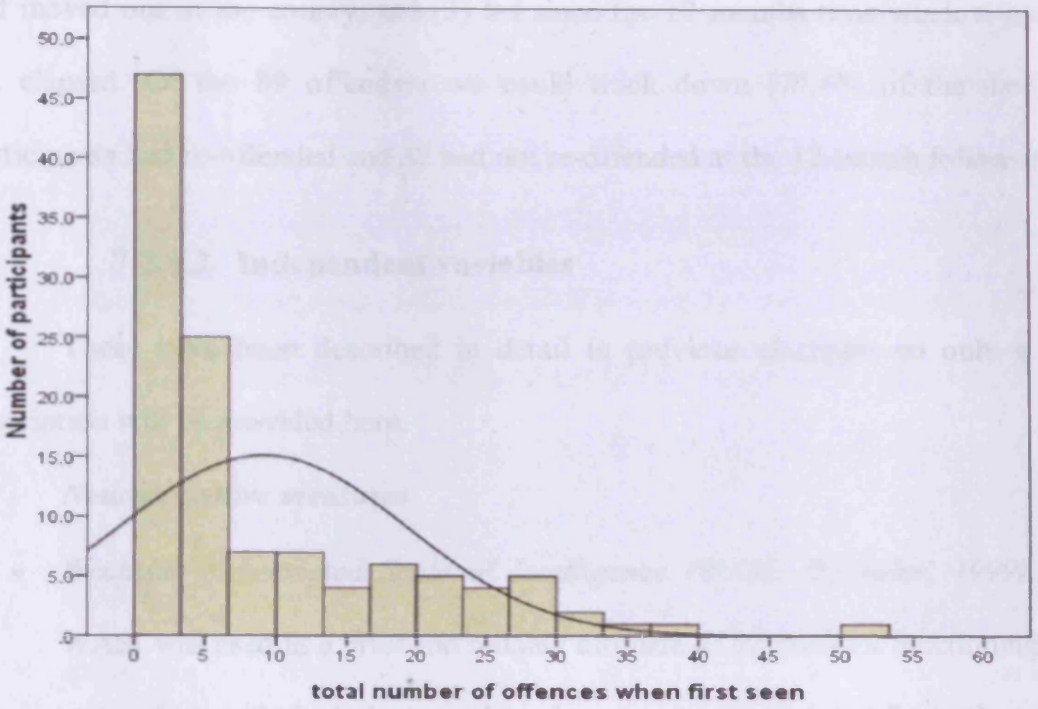


Figure 7.1: Histogram of number of offences committed by young offenders at time of first contact.

Severity of offending was recorded on the basis of the highest gravity score received out of the total number of offences committed. Details on this scoring system are provided in Chapter 2.3. Participants were classified as severe offenders if they had committed an offence with a gravity score of 5 and above (on a scale of 1-8), and as non-severe offenders if their highest gravity offence had a rating of 4 and below. A breakdown of the types of offences by severity score is provided in Appendix 3.1. This classification resulted in 65 severe and 50 non-severe offenders.

Finally, participants were classified as persistent or non-persistent offenders. This classification occurred on the basis of whether the young offender had re-offended within one year after our first testing. Information on reoffending was collected via both telephone interviews with the young people and information collected from official records of offence history accessed via the YOT. Information on reoffending was not available for 26 participants (22.6%) for three reasons: (1) inability to track them down via phone interviews, (2) they were over 18 years old or

had moved out of the county, and (3) for some the 12 months time window had not yet elapsed. Of the 89 offenders we could track down (77.4% of the data), 52 participants had re-offended and 37 had not re-offended at the 12-month follow-up.

7.2.3.2. Independent variables

These have been described in detail in previous chapters, so only a brief description will be provided here.

Neurocognitive measures

- *Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999):* The WASI was used as a brief and reliable estimate of intellectual functioning. The vocabulary and block design sub-scales were used, allowing for both a verbal and spatial/performance component to be incorporated in the assessment.
- *Wisconsin Card Sorting Test (WCST; Heaton, 2005):* is a measure of global executive inhibitory control. Even though several outcome variables emerge from the WCST, the only variable used in the present analyses is the number of perseverative errors participants made. This was the only outcome variable found to be significantly different from the norms.
- *Decision-making Task (CxR):* This modified version of the Risky Choice Task was used (Rogers et al., 2003); it provides a measure of risk taking behaviour under motivational conditions. Risk taking is measured by calculating the number of times participants choose high risk wheels of fortune over control ones, which always give a 50-50% probability of winning or losing points.

Psychosocial variables

All data had been collected from participants' Asset interviews at the YOT, the process and information of which were described in Chapter Three. Only

significant variables found in the analyses pertaining to frequency and severity of offending have been included in the present analyses. The original data were scored on a scale of 0-4, with a score of 4 indicating a higher risk. Due to unequal and insufficient numbers in the different categories of risk (i.e., for education only one participant received a score of 4 and nine a score of 3), the full ordinal measure could not be used. The risk measures were therefore converted to binary variables, with a score of 0 corresponding to a total score of 0 given by case workers (i.e. no risk), and 1 corresponding to all other scoring values (1-4).

- *Education, training, and employment (ETE):* ETE was scored according to participants' involvement in school (if they were of compulsory school age), or whether they were in employment or on a vocational training course. A higher score on this measure indicated an absence of ETE and therefore a greater risk of criminality.
- *Neighbourhood:* Information in this section related to whether young people were living in bad neighbourhoods, known for concentrated crime. Other neighbourhood indicators were related to signs of drug dealing/usage in the area, lack of appropriate facilities and adequate transport, and evidence of other foreseeable problems including racial or ethnic tensions.
- *Substance use:* This section contained information on whether the young person was using different substances, ranging from tobacco and alcohol to crack and heroin. There was detailed information on age of first use and whether substance use was related to offending behaviour. Practitioners were asked to indicate whether they thought that the young person's substance use placed them at risk for the likelihood of further offending.

Personality variables:

- *Youth Psychopathic Inventory (YPI; Andershed, Kerr, Stattin, & Levander. 2002):* The YPI was used to measure participants' psychopathic tendencies. The total score was used, which ranges from 50-200, with a higher score indicating more psychopathic traits.
- *The Sensation Seeking Scale (Zuckerman, 1994):* The SSS was used to assess the need for stimulation and arousal. A higher total score indicated a greater need for seeking sensations.

7.2.4. Data analyses

In order to examine the role of social and/or biobehavioural variables in explaining ASB, regressions were carried out with social and biobehavioural variables as independent variables, and prolific, severe, and persistent offending as dependent variables. Logistic regression is the appropriate analytic strategy for binary outcome variables and was adopted here.

In order to compare whether the different ASB types were related, tetrachoric correlations (i.e., correlations designed for binary variables) were used to compare reoffending, prolific and severe offending.

Biobehavioural and social interaction effects were next explored. In case of prolific offending and reoffending, where both social and biobehavioural variables were found to be significant predictors, their interactions were examined in subsequent regression models. To test whether the 'social push hypothesis' was true for our sample of young offenders, and to examine whether a biological explanation of ASB was applicable to adolescents who were not socially disadvantaged, analyses were carried out according to the recommendations of Baron and Kenny (1986) in terms of examining moderation. Dependent on the social variables that were

significant in the analyses, high and low socially disadvantaged groups (i.e., in terms of neighbourhood, substance use, education) were created. Logistic regressions were run separately for each of the high and low socially disadvantaged groups, with the biobehavioural variable as the independent variable and each of the ASB subtypes (i.e., prolific and persistence) as the outcome variable. The significance of the difference between the regression coefficients for the high and low socially disadvantaged groups was then tested by running Wald tests. Additional moderated regression analyses, with each independent variable and the product term of the interaction as predictors and each of the ASB types as outcome variables, were also run to test for interactions. Analyses were carried out using SPSS 12.0 (SPSS Inc., Chicago, Illinois) and Stata v10.

7.3. Results

7.3.1. Demographic information

Since the aim of the present chapter was to examine within group variation in explaining different offending types, demographic information for the young offender group only is presented in table 7.1.

Table 7-1: Demographic characteristics

	YOT	N
Age	16.26 (± 1.47)	115
IQ	92.54 (± 11.8)	80

Data are presented in means (±SD).

7.3.2. Regressions on frequency of offending

Significant variables from previous chapters were entered as independent variables in the logistic regression, and the binary outcome prolific offending was entered as the outcome variable. Estimated IQ was originally entered as an independent variable (IV) but dropped subsequently because it reduced the number of

observations considerably (to n=63) and was not found to be significant. Results of the logistic regression, without IQ as an IV, are reported in Table 7.2 (n = 107).

Table 7-2: Logistic regression on prolific offending behaviour

	Prolific offending	
	z	P > |z|
CxR overall bet	1.33	0.185
Perseverative errors	0.53	0.599
Total YPI score	-1.56	0.120
Total SSS score	3.73	<0.001
Education	1.73	0.084
Neighbourhood	3.35	0.001
Substance use	3.16	0.002

Results showed that young offenders who reported to be more prone to seeking sensations were more likely to be prolific offenders. In addition, young offenders who were seen to be more likely to reoffend because they lived in bad neighbourhoods or used substances, actually committed more offences than young offenders who were thought to be less socially disadvantaged.

7.3.3. Regressions on severity of offending

A logistic regression was run with severity of offending as the dependent variable. Because social variables were not found to predict severity of offending in Chapter Three, we hypothesised that a biobehavioural explanation would be more pertinent than a social one in committing more severe offences. For this reason, only biobehavioural risk variables (i.e., perseverative errors in the WCST, CxR overall bet, total SSS and total YPI scores) were entered in the regression initially. IQ score was initially included in the analyses, but removed later for the same reasons outlined above. Perseverative errors and total SSS were not significant in the regression and removed because analyses become weaker when more predictors are used. Results of the logistic regression (n=111) with the significant biobehavioural variables, and the social variables entered as controls, are reported in Table 7.3.

Table 7-3: Logistic regression on seriousness of offending behaviour

	Severe offending	
	Z	P > |z|
Age	2.99	0.003
CxR overall bet	-2.14	0.032
Total YPI score	2.46	0.014
Education	0.31	0.754
Neighbourhood	0.22	0.829
Substance use	-0.46	0.647

Table 7.3 shows that severity of offending was only predicted by biobehavioural variables. In particular, variables from the CxR and YPI questionnaire were significant. More psychopathic offenders and relatively older offenders committed more severe crimes. However, contrary to our expectation more serious offending was also related to less risk taking behaviour in the CxR.

7.3.4. Regressions on persistence of offending

Our final hypothesis was related to what predicts whether participants persist in or refrain from offending one year after first contact. For this purpose, the same biobehavioural and social variables were used as independent variables in a logistic regression, with reoffending as the binary outcome measure. IQ was again used in the initial analysis but then removed, because it was not a significant predictor and resulted in a reduction in the number of observations from 82 to 42. The results are reported in Table 7.4.

Table 7-4: Logistic regression on persistence of offending

	Persistence	
	z	P > |z|
Age	0.17	0.866
CxR overall bet	-0.23	0.821
Perseverative errors in WCST	0.39	0.694
Total YPI score	0.14	0.889
Total SSS score	3.21	0.001
Education	2.48	0.013
Neighbourhood	-0.24	0.812
Substance use	-0.57	0.566

Results of the logistic regression showed that the likelihood of re-offending in a one-year interval was related to having a sensation seeking personality and risk related to not attending school or being employed.

7.3.5. Correlations to compare different ASB outcomes

Tetrachoric correlations with data from 89 offenders indicated that reoffending was related to prolific offending (ρ =.616, n=89, p<0.001), but not to severe offending (ρ =-.119, n=89, p=0.52). Prolific offending was positively associated with severity of offending (ρ =.495, n=114, p=0.001).

7.3.6. Investigation into the moderating influence of social variables

Results from the logistic regressions on the different ASB outcome measures showed that severity of offending was solely predicted by biobehavioural variables, while prolific and persistent offending were predicted by both social and biobehavioural variables. Thus for these two outcomes, Social × Biobehavioural interactions were further explored. Regressions on prolific offending were carried out on 111 participants, and on 85 participants for whom re-offending data were available. To test our hypothesis that social factors moderate the effect of biobehavioural variables on prolific offending, four logistic regressions were conducted because prolific offending was found to be predicted by two psychosocial variables. In two logistic regressions, sensation seeking scores of young people growing up in adverse neighbourhoods were entered as the independent variable in the first instance, and sensation seeking scores of young people not growing up in bad neighbourhoods in the second, with prolific offending as the outcome variable. The other two logistic regressions were run in exactly the same way by splitting sensation

seeking scores of young people at risk for re-offending due to substance misuse or not, with prolific offending as the outcome variable. Next, persistent offending was considered. A logistic regression was conducted with sensation seeking scores of young people at risk because of low educational attainment, with re-offending as the outcome variable, and a second logistic regression with sensation seeking scores of young people not at risk because of educational circumstances, with the same outcome measure.

Subsequently, Wald tests were run to examine whether the regression coefficients examining the biobehavioural - ASB relationships were different for the high - low socially disadvantaged groups. In this way, an investigation was carried out as to whether the nature of the relationship was the same or stronger (i.e. higher coefficient) in a deprived versus a not deprived social situation. The Wald test examined the null hypothesis that there is no significant difference in the relationship between sensation seeking scores and prolific offending/reoffending between deprived and not-deprived social circumstances.

Even though the effect of sensation seeking as a risk factor remained significant or marginally significant in all of the regressions, the Wald tests of the difference between the coefficients were not significant, as illustrated in Table 7.5.

Table 7-5: Regressions between high and low socially disadvantaged groups on prolific and persistent offending

	Coef.	z	P > |z|	p (diff)
Prolific offending				
Total SSS with Neighbourhood risk	0.31	2.15	0.032	0.84
Total SSS with no Neighbourhood risk	0.35	3.13	0.002	
Total SSS with Substance use risk	0.31	3.31	0.001	0.75
Total SSS with no Substance use risk	0.26	2.14	0.032	
Reoffending				
Total SSS with Education risk	0.30	3.04	0.002	0.18
Total SSS with no Education risk	0.13	1.55	0.12	

These results suggest that social variables did not moderate any of the biobehavioural - ASB relationships in the present study, and hence we cannot reject the null hypothesis.

It has been suggested (Newsom, Prigerson, Schultz, Reynolds III, 2003, Whisman & McClelland, 2005) that a better approach to explicitly test for interaction effects is by using moderated regression analyses. To test our hypothesis that social factors moderate the effect of biobehavioural variables on ASB, two linear regressions were conducted because prolific offending was predicted by two social variables. In the 1st linear regression sensation seeking and neighbourhood circumstances were entered as predictors, and the cross-product of these variables was entered as a third predictor with rate of offending as outcome variable. The 2nd linear regression was conducted with sensation seeking and substance use as predictors, the cross-product of these was the third predictor, and rate of offending was the criterion. Finally, a logistic regression was conducted with sensation seeking and education status as predictors, the cross-product of these two as third predictor, and reoffending as criterion.

Table 7-6: Interaction Effects of Social × Biobehavioural factors on rate and persistence of offending

	b	SE	β	p
Rate of offending				
Total SSS	.098	.034	.266	.005
Neighbourhood	.510	.236	.198	.033
Total SSS× Neighbourhood Interaction	.038	.050	.070	.454
Total SSS	.087	.035	.237	.015
Substance use	.283	.189	.151	.136
Total SSS× Substance use Interaction	.023	.039	.057	.566
Reoffending				
Total SSS	.230	.065		.000
Education	.870	.314		.006
Total SSS× Education Interaction	.074	.069		.283

As illustrated in Table 7.6, even though most of the first-order effects remained, none of the interactions was significant, thus the results of these analyses

do not support our hypothesis. However, failing to find an interaction between social and biobehavioural variables should be considered in light of the caveat that there are serious issues of statistical power in detecting moderator effects (Whisman & McClelland, 2005).

7.4. Discussion

The aims of the current chapter were to examine (1) the influence of social and biobehavioural risk factors in prolific, severe, and persistent offending, (2) the role of different risk factors in these offending types, and (3) whether social variables moderate the biobehavioural – ASB relationship.

Results from regression analyses showed that two psychosocial variables, living in a bad neighbourhood and substance use, and one biobehavioural variable, the personality trait of disinhibition expressed in sensation seeking, explained prolific offending. These findings only partly confirmed our expectation that prolific offending would be better explained by social variables because it was based on the premise that prolific offending and severity of offending would not be related. Given that a positive correlation emerged between both offending types, the finding that a biobehavioural variable was another significant predictor is of no surprise. It is also reasonable that a sensation seeking temperament would predict more prolific offending as it has been theorised that under-aroused individuals engage in risk and need stimulation in order to attain a more optimal level of arousal (see Chapter Four).

A similar pattern emerged with persistent offending. Even though it was expected that persistent offending would be related to biobehavioural variables because of evidence in the literature suggesting that the chronic offender is more likely to be characterised by heritable biological factors (Buikhuisen & Mednick, 1988), it was predicted by sensation seeking and education (a social variable).

However, since prolific and persistent offending were highly correlated, finding that similar types of predictors related to these two types of offending behaviour makes sense. The notion that an interaction of multiple risk factors (i.e., individual, situational, contextual) explains ASB types, such as violence (Loeber & Farrington, 1998) and aggression, might be why other types of offending behaviour, such as prolific and persistent patterns of offending were predicted by a combination of social and biobehavioural variables. If prolific and persistent offending in our sample were also violent and aggressive in nature, then these findings agree with prior literature. However, until we find out what types of offences prolific and persistent offenders had committed, this explanation constitutes an assumption.

In contrast, severe offending was solely explained by biobehavioural variables, consistent with expectations. Older, less risk-taking young offenders, and those characterised by psychopathic traits committed more severe offences. The Psychopathy Checklist purports to reliably measure personality traits that predict the risk of violence (Dolan & Doyle, 2000). The present results support these findings, with psychopathic traits explaining more severe forms of ASB. The finding that psychopathic tendencies predict severity of offending suggests that more elaborate neurobiological assessments related to deficits which characterise psychopathic individuals, for example measuring participants' psychophysiological responses to emotional stimuli, could have provided more detail on how different ASB types develop. Psychopathic tendencies in the present study were measured by means of a questionnaire, thus additional conclusions would have been reached if data on actual emotional reactivity/sensitivity were available[15]. An unexpected finding in our analyses concerned the negative relationship between risk taking behaviour and

[15]Data on psychophysiological assessments were collected; however they could not be used in the present analyses due to a small sample size.

severity of offending, and contradicts other studies which have shown that gambling behaviour and risk taking are positively related to ASB (i.e., Fairchild et al., in press), specifically more violent forms of ASB (Loeber & Farrington, 1998). However, this finding could be explained by considering the profile which seems to emerge for predicting severe offending. Results suggest that severe offences were committed by individuals characterised by a psychopathic personality, who are more likely to engage in instrumental, well-planned aggressive behaviour and so maybe less likely to take risks. Overall, the present analyses suggest that a combination of contextual and individual variables promotes prolific and persistent offending, while biobehavioural factors predict severity of offending.

In relation to the final aim of the study, the assessment of Social × Biobehavioural interaction effects on different ASB types, the results did not support our hypothesis and were contrary to previous findings. Previous research has provided clear evidence of biosocial interactions explaining ASB by showing that biological influences are more prominent in those instances where social disadvantage is minimal (Raine, 2002b). The present study did not use proper biological measures in these analyses[16]. For example, skin conductance activity has been found to be lower in individuals from higher but not from lower social classes (Raine & Venables, 1981). In Chapter 4 we reported skin conductance and electromyographic (EMG) data in young offenders and showed that responses to both of these measures were generally lower compared to matched controls. These assessments could not be used in the present analyses, unfortunately, due to restricted sample size[17]. Furthermore, the sample size in the analyses pertaining to reoffending did not allow for adequate

[16] Even though these assessments have been completed in this research, they could not be used in the present analyses because it reduced the number of observations considerably.
[17] Even though the sample size was adequate for between and within group comparisons, it would not suffice for the regression analyses used in the current chapter.

fits of the statistical models employed, and the results relating to hypothesis 3 (i.e., which examined which variables predicted persistence or desistence from offending behaviour), and 4 (i.e., which examined whether social and biobehavioural interact in explaining ASB outcomes), should therefore be interpreted with caution. Despite these limitations, the present study has provided valuable data in a sufficiently large group of participants with some offending types, providing some novel findings by showing evidence that different biobehavioural and social variables play a role in different types of adolescent ASB.

8. Chapter Eight – General Discussion

This PhD research set out to examine the role of several biobehavioural and social risk factors for antisocial behaviour (ASB) in an adolescent group of young offenders. Young offenders completed a battery of assessments including measures of IQ, detailed neuropsychological assessments, questionnaire measures assessing personality characteristics relating to sensation seeking, psychopathic traits, and behavioural problems, autonomic nervous system (ANS) fear conditioning, startle reflex, and facial affect recognition. In addition, pre-existing information on social background was used from official records in order to examine the influence of social risk factors. The hypotheses addressed were:

a) Antisocial teenagers are characterised by a sensation-seeking personality, neuropsychological impairments as evidenced by executive functioning tasks tapping into the ventromedial prefrontal cortex, low IQ, poor electrodermal fear conditioning, and reduced startle amplitudes, compared to age and sex matched controls.

b) Biobehavioural risk factors interact with social risk factors in explaining ASB, with the expectation that social factors would moderate the biobehavioural – ASB relationship.

Data were initially collected at the Cardiff Youth Offending Team (YOT), where neuropsychological function was assessed in a large group of participants. Measures included an IQ assessment, one general executive functioning measure (Wisconsin Card Sorting Test) and two measures of motivational inhibitory control, one measuring risk taking (CxR) and the other measuring perseveration and impulsivity (Card Playing Task). Questionnaire measures assessing impulsivity, sensation seeking, psychopathic traits and behavioural problems were also completed at this stage, while data on social variables were also available from the YOT records.

Psychophysiological measurements could not be collected at that point as the equipment could not be transferred to the YOT. The findings from the first study, however, made it clear that more thorough tests, including psychophysiological measures and more detailed neuropsychological assessments, should provide valuable information on the psychological underpinnings of ASB. A more extensive study therefore took place in laboratories in the School of Psychology, Cardiff University. Due to the time required to complete this additional study, a sub-sample of the original YOT group took part in this second stage.

With regard to the first hypothesis, impairments in IQ and abilities related to prefrontal cortex function were investigated motivated by previous research suggesting a prefrontal cortex dysfunction in individuals with ASB (Moffitt, 1990; Morgan & Lilienfeld, 2000). However, so far the evidence linking prefrontal cortex function and ASB has been inconclusive; in particular, previous studies have not accurately delineated the role of specific regions in the prefrontal cortex (e.g., ventromedial cortex) and often failed to control for Attention Deficit Hyperactivity Disorder (ADHD), IQ and verbal ability (Seguin, Sylver, & Lilienfeld, 2007). For these reasons, a broad range of neuropsychological assessment tools was employed: tasks were selected that explored different aspects of executive function, including executive and motivational inhibitory control, and that were intended to tap into more specific regions in the prefrontal cortex, such as the orbitofrontal and medial prefrontal areas. Where possible, we controlled for IQ, and a measure of ADHD (i.e., based on YSR scores) showed that young offenders as a group scored in the normal range. Compared with controls, young offenders had significantly lower estimated IQ scores, performed worse on several of the measures of executive function, including set-shifting, working memory, planning ability, and risk taking behaviour. These

results were consistent with literature indicating specific executive deficits involving impairments in working memory (Seguin, Boulerice, Harden, Tremblay, & Pihl, 1999) and decision making (Fairchild et al., in press).

Decision making, as indexed by risk taking behaviour, was measured by recording performance on two gambling tasks. Each task measures different unrelated aspects of decision making: The Cambridge Gambling Task measures risk taking dissociated from impulsivity (i.e., the risk taking score is calculated across two conditions, one of which involves having to wait before one can gamble a lot), while the CxR measures risk taking behaviour but distinguishes between sensitivity to reward and punishment. Even though performance on the two tasks was not correlated, young offenders took more risks on both tasks, providing evidence for ventromedial prefrontal cortex dysfunction in adolescent antisocial groups who are driven by tendencies to take more risks when making decisions. These findings are consistent with a study on early-onset and adolescent-onset conduct disordered adolescents (Fairchild et al., in press), and fit with the fearlessness theory (Raine, 1993a), in which individuals with reduced reactivity to fear are more likely to engage in risky and dangerous behaviours as they are less likely to involve the possible negative consequences of a choice when making their decision. Importantly, the largest difference in gambling behaviour between offenders and controls was found after a small win: although young offenders generally gambled significantly more than controls, no matter whether the previous outcome was a win or loss, the group difference in risk taking behaviour was largest after a small win. These findings suggest that young offenders have problems inhibiting their behaviour under motivational conditions and exhibit risk taking behaviour dissociated from impulsivity.

Further research assessed whether estimated IQ and neuropsychological functioning, specifically working memory, perseveration, risk taking, sensation seeking, impulsivity, planning, and problem solving, varied *within* the young offender group. In this way we aimed to find out whether neuropsychological deficits characterise different *types* of offenders. All of the 'high' ASB groups in relation to clinical severity definitions (i.e., aggressive, CD, externalising problems, psychopathic tendencies) yielded higher scores on the sensation seeking scale than the 'low' ASB groups, but there were few differences on the neuropsychological tests. Participants in the borderline/clinical range of aggressive symptoms showed better planning ability than the non-aggressive group, and non-CD participants gambled more on the Cambridge Gambling Task than the borderline/clinical CD group. Both results were clearly in the opposite direction from what was expected. Better planning ability in the 'highly' aggressive group might be explained by the type of aggressive behaviour concerned; for example, instrumental rather than impulsive aggression may require offenders to plan their crime (Bushman & Anderson, 2002). The finding that young offenders high on CD symptoms showed less risk taking behaviour is contrary to results in the study by Fairchild et al. (in press), who found that both early-onset and adolescent-onset CD participants gambled more than controls on another gambling task (i.e., CxR). However, the study by Fairchild et al. (in press) examined between group differences (i.e., CD participants vs. control groups) while we looked at within group differences, which might explain the difference in results. When our young offenders completed this same task, *greater* risk aversion predicted *more* serious offending (i.e., as indexed by the seriousness of their offences). These unexpected findings might suggest that more serious offences are planned as opposed to impulsive or reactive offending. Offenders who prefer to plan their offending may also be those who do not want to expose themselves to undue risks and could be

characterised relatively (at least in the context of young offenders) as more risk averse. Of note, psychopathic traits, which are traditionally associated with more violence and instrumental aggression (Seguin et al., 2007), were also associated with more serious offending.

The findings outlined so far suggest that young offenders appear to be reward sensitive in gambling choices: they are less satisfied by small wins (the largest difference between young offenders and controls was in risk taking after receiving a small win), but show greater risk aversion after large wins. Since young offenders are less likely to take risks following a large reward but are more likely to take risks following a small reward, one inference is that a large reward would reduce the likelihood of them engaging in further risky behaviour, for example reoffending, whereas a small reward would motivate more risky behaviour. The implication of these results for possible future interventions is that interventions should take account of individual differences in decision making. If young offenders suppress their offending behaviour more easily following a large reward, behavioural change in young offenders might be more effectively achieved by using large, rather than small, rewards. Desistence can only be achieved by the prospect of large positive incentives coming from engaging in prosocial behaviour. However, implementing a reward schedule for offenders that does not involve punishment may face considerable opposition given the criminal justice system's current reliance on it. Further support suggesting that interventions involving positive reinforcement could trigger more desirable behavioural outcomes comes from findings which showed young offenders have difficulties processing and experiencing negative emotions but experience no problem in processing positive emotion, as will be discussed later.

The relationship between psychopathic traits and serious ASB was robust across the research presented in this thesis. Given that young offenders were a heterogeneous group and that a substantial sub-sample could have psychopathic traits, and given the association between psychopathy and emotional functioning, examining emotional functioning in young offenders was a logical extension of the research. Reviews on the psychophysiology of ASB (Scarpa & Raine, 1997; Scarpa & Raine, 2000) suggest that antisocial individuals are characterised by low ANS reactivity, which indexes low responsivity to fear. ANS fear conditioning and responses to emotional stimuli were assessed through measuring skin conductance responses and the modulation of the eye-blink startle reflex while participants passively viewed affective valenced images. Young offenders recorded lower electrodermal responses while completing the fear conditioning task, and lower eye-blink responses across all of the emotional images. These results provide evidence for a deficit in emotional learning, and of low reactivity to fear which is consistent with the fearlessness theory (Raine, 1993a). The startle results were inconsistent with findings on adult psychopaths. Studies in psychopaths suggest that reduced startle amplitudes emerge specifically in response to negative pictures. However, the young offenders in our study produced generally lower eye-blink responses throughout all types of stimuli, a pattern similar to findings in conduct disorder adolescents (Fairchild, van Goozen, Stollery, & Goodyer, 2008) and disruptive children (van Goozen, Snoek, Matthys, van Rossum, & van Engeland, 2004). The extension of these findings to an antisocial group defined from a legal/judicial viewpoint is of importance as it indicates that a pattern of low physiological arousal is present in antisocial groups characterised from different perspectives. In addition to the fearlessness perspective, low physiological arousal has also been theorised to predispose to risk-taking or stimulation-seeking

behaviour (van Goozen, Fairchild, Snoek, & Harold, 2007). Evidence in support of this view will be discussed in more detail below.

This study was the first to compare differences in young offenders' offending patterns (i.e., by their severity and frequency of offending) in terms of psychophysiological responding. Severe offending was defined from a criminological (i.e., in terms of the severity of the offences) and a clinical perspective (i.e., in terms of conduct disorder symptoms, aggressive behaviour, and the presence of psychopathic traits). No differences in fear conditioning ability were observed between the different ASB groups. A marginally significant group effect occurred only in terms of the startle reflex between groups high and low in conduct disorder symptoms and psychopathic traits, in the expected direction. Mean startle blink amplitudes were somewhat lower in both participants in the borderline/clinical range on CD, and those high in psychopathic traits, compared to the group scoring in the normal range on CD and low in psychopathic traits. These within group results only approached significance suggesting that if more participants had been available the finding would have been raised to significance[18]. This pattern of findings - a general decrease in blink amplitude and not one specifically related to negative primes, as has been found in psychopaths - is consistent with earlier research suggesting generally lower startle blink amplitudes in conduct disordered groups (Fairchild et al., 2008) and behaviourally disordered children (van Goozen et al., 2004). Even though a specific problem in terms of negative emotions was expected in the group scoring high in psychopathic tendencies, a difference might not have emerged because previous studies used a single negative category and did not distinguish between

[18] This explanation is supported by the effect sizes, reported as partial eta squared, for the two results: 0.08, and 0.07 for the CD and psychopathic factors respectively, indicating that CD and Psychopathic group accounted for 8% and 7% of the overall variance respectively. The observed power reported in the ANOVA results was also low: 0.45 for CD and 0.40 for psychopathic factors, suggesting that there was a 55% and a 60% chance of failing to detect an effect for the CD and psychopathic factors respectively.

different types of negative emotions. Due to the large number of negative slides used in our study, participants might have responded more strongly to some negative slides (i.e., disgust) and therefore the difference between positive and negative slides might not have been large enough to be detected.

A different type of emotional processing, facial affect recognition, was also investigated in the young offenders to examine whether they had problems in recognising facial affect in others. Even though there is clear evidence suggesting that facial affect recognition is impaired in antisocial individuals (Marsh & Blair, 2008), an investigation has not been carried out in adolescent young offenders. Results presented here showed that young offenders recognised fewer emotional expressions in a facial expression recognition task compared to controls, with the exception of positive emotions, and that specific problems appeared with the recognition of angry, fearful, and surprised faces, providing evidence for a general negative deficit in facial recognition, consistent with literature (Fairchild, van Goozen, Calder, Stollery, & Goodyer, in press). Even though surprise does not belong to the category of negative emotions, the present findings are in line with findings in other antisocial groups, such as personality disordered offenders (Dollan & Fullam, 2006) and conduct disordered adolescents (Fairchild et al., in press). However, the deficits with respect to these three emotions were no longer present when a comparison between the YOT and control groups was carried out with presentation of the emotions at 100% intensity level. The effect also disappeared when IQ was controlled for. These results suggest a subtle problem with these emotions in adolescent young offenders which might be related to a lower IQ. Young offenders did not have any difficulty with recognising sadness, a deficit that is commonly found in psychopaths (Blair, 2003). According to Blair (2003), both sad and fearful expressions act as aversive unconditioned stimuli discouraging actions that caused them. However, this finding might be more

characteristic of the psychopathic individual, who lacks empathy. Young offenders are a more heterogeneous group with slightly different characteristics and, according to the current findings, resemble more closely adolescents with CD (Fairchild et al., in press). The implication of this explanation is that more individually tailored interventions that involve teaching offenders to identify certain expressions in more ambiguous situations, and improving their understanding of the possible reasons why someone would display facial affect are required. Specifically, it has been suggested that as a result of poor conditioning, antisocial individuals fail to learn to make easily associations between negative emotions and harmful actions (Marsh & Blair, 2008). In young offenders with these problems pointing out these associations more clearly might help to overcome some of these difficulties.

Differences in facial affect recognition were assessed within the YOT group, with comparisons made between high and low groups in rate and severity of offending, as well as clinical symptom severity, and psychopathic traits. Only a difference in disgust recognition was found, with the group scoring in the borderline/clinical range on externalising problems performing better than the group scoring in the normal range. The group scoring high on conduct disorder symptoms was marginally better in recognising disgust than the group scoring low on CD symptoms. Better recognition of disgust in the more serious ASB groups was unexpected as studies suggest impairments in recognition of disgust in early-onset conduct disordered groups (Fairchild et al., in press) and adults with high levels of impulsive aggression (Best, Williams & Coccaro, 2002). However, support for worse recognition of disgust comes from studies with differently defined antisocial groups.

The findings from the three tasks (i.e., fear conditioning, startle reflex in response to emotional pictures, and facial affect recognition) suggest that adolescent offenders have difficulty with the learning, processing, and recognition of emotions.

Specifically, they experience problems in learning a fear response, they experience lower autonomic arousal when viewing affective pictures, and they have problems with recognising more ambiguous negative facial expressions. These results suggest possible deficits in amygdala and prefrontal cortex function, as both areas play an important role in emotion regulation and negative affect processing (Pinel, 2000).

The next hypothesis considered the role of social risk factors in ASB and whether they would moderate the biobehavioural–ASB relationship. This hypothesis was developed from literature suggesting an important role for biosocial interactions in ASB aetiology and for a possible moderating role of social variables (Raine, 2002b). Before examining potential interaction effects, the role of social variables was investigated. Even though social risk factors have been widely investigated in antisocial groups, the combination of variables used in this research has not been examined before in a young offender sample. In addition, these variables were explored in relation to different ASB outcomes, namely offending frequency and severity. Data were also analysed from a large survey, the British Household Panel Survey (BHPS), to provide some insight as to how social variables relate to fighting and vandalism in the general population. Results from the BHPS analysis revealed that youngsters' relationship with their parents, socialising with delinquent peers, and academic problems were associated with both fighting and vandalism, while poverty only related to the frequency respondents fought. When the same variables and others were assessed in our sample of young offenders, we found that problems in education and employment, living in neighbourhoods with high concentrations of crime, and substance use predicted prolific offending, while none of the social variables predicted the severity of offending. An association was found between a lack of motivation to change, and aggressive, externalising, and conduct disordered

symptoms, suggesting that personality-related factors might better explain why young people engage in more serious delinquent acts. The fact that different types of predictors were found to explain ASB in young offenders and the normal population suggests that the variables that predict ASB behaviour could be used when designing new risk assessments and that more attention should be paid to targeting these factors when developing interventions. For example, if problems related to education, neighbourhood and substance misuse place prolific offenders in a more disadvantaged position, then assessments with prolific offenders could focus more on identifying whether problems exist in these areas and appropriate referrals can be made to improve their circumstances.

The role of both biobehavioural and social variables were investigated to incorporate as many predictors of ASB as possible. The hypothesis that biobehavioural variables would interact with social variables and that social variables would act as moderators in the relationship between biobehavioural variables and ASB (Raine, 2002b) was tested. When data were analysed, a combination of social and biobehavioural variables explained prolific and persistent offending, while only biobehavioural variables explained severe offending. In the instance of prolific and persistent offending, where both sets of variables played a role, interactions were also explored. However, contrary to expectations, the two sets of variables did not interact in explaining any of the ASB outcomes. A possible explanation for not finding an interaction between social and biobehavioural variables in explaining ASB might be that the variables used in our analyses were slightly different from the ones used in previous studies. For example, the social environment was found to have a moderating role in low psychophysiological responding (Raine & Venables, 1981). Even though we used psychophysiological assessments in our young offenders, they

were only done in a sub-sample and this was too small for these types of analyses. Attaining sufficient participant numbers for these measures should be the goal of future research, the feasibility of which is possible if there are less time constraints in the data collection.

In sum, the first hypothesis of this research, that antisocial teenagers would be characterised by sensation-seeking temperaments, neuropsychological impairments as evidenced by executive functioning tasks, low IQ, poor electrodermal fear conditioning, and reduced startle amplitude, compared to a normal control group, could not be rejected. Although we were not able to compare young offenders and controls on sensation-seeking measures, differences in sensation seeking were observed within the YOT group, with more serious offenders - in terms of aggressive behaviour, conduct disorder symptoms, externalising problems, and psychopathic tendencies – having stronger sensation seeking personalities. Overall, these findings lend support to the assertion that antisocial individuals are predisposed to risk-taking or stimulation-seeking behaviour because they present with comparably lower levels of physiological arousal and fearlessness (van Goozen, Fairchild, Snoek, & Harold, 2007). The second hypothesis, that biobehavioural risk factors would interact with social risk factors in explaining ASB, could not be supported, but some reasons as to why this happened have been presented.

Even though this PhD research has many strengths, no study can be carried out without limitations. The main limitation of the present study involves the number of available participants in some of the lab-based testing (i.e., psychophysiological, neuropsychological). Even though a large number of participants had been recruited, one has to keep in mind that this is a difficult group to test (for example, participants often failed to turn up and/or did not want to complete all the tests that had been

scheduled for a session), we used a large number of tests, and some of the tests took up quite a lot of testing time. Despite that, most assessments were done in sufficiently large groups and the data provide us with novel insights into which factors are associated with ASB in young offenders.

A further limitation concerns the use of cut-off based analyses throughout the thesis. One problem in using this statistical technique is the reduction of power (Irwin & McCLelland, 2003; MacCallum, Zhang, Preacher, & Rucker, 2002), whilst others involve the reduction of individual variability by placing individuals into groups and losing meaningful information (Altman & Royston, 2006, MacCallum et al., 2002). Using alternative statistical methods, such as regressions, is recommended. However, we feel that the use of some cut-off based analyses was legitimate in this research, because the groupings have been used by practitioners and policy makers (e.g., the distinction between prolific and non-prolific offenders) while others were based on well-established criteria (i.e., subgroups based on borderline/clinical range YSR scores).

The research also has numerous strengths, such as the fact that a variety of assessments were carried out allowing some findings to be reported for the first time in a sample of young offenders. Not only is the combination of variables used in this research unique, but the independent contribution of the factors reported in each of the chapters provides us with knowledge about the role of early antecedents in antisocial behaviour, thereby meeting the urgent need for more studies with child and adolescent at-risk populations (Raine, 1993b). Another novel aspect of the present research was the focus on an antisocial group defined from a criminological perspective, providing insight into the extent to which different factors are involved in ASB defined from this relevant perspective.

From a methodological point of view, future studies could benefit greatly from such assessments, especially if some of the measures that could not be used in all analyses are collected in a larger sample. Research is already moving towards conducting more neuro-imaging studies, which can provide more exact information about the brain areas involved in different aspects of ASB, whether these areas are implicated in the emergence of ASB from a young age, and whether involvement of these areas can explain persistence and/or desistence of ASB. Furthermore, as already highlighted, more research on biological and social interactions can reveal how some of these processes take place.

The present study also has important implications for policy and practitioners working with young offenders. Some of our findings can inform interventions for young offenders by taking account of offenders' numerous individual differences that should be taken into account when setting up individual programmes to tackle the young person's behavioural problems. Currently, the criminal justice system relies heavily on the use of deterrence ("naming and shaming") and restorative justice. Specifically, the UK government's view is 'to punish and rehabilitate more offenders' and 'to give victims and witnesses more support' (http://www.cjsonline.gov.uk/the_cjs/how_it_works/). However, the present findings suggest, first, that young offenders present with neuropsychological deficits that are related to poor working memory and planning, and the inability to appreciate the consequences of their actions. Furthermore, because of their relative fearlessness, young offenders are less likely to be deterred by the prospect of receiving punishment. Second, young offenders who commit serious delinquent acts lack in empathy and have problems in experiencing negative emotions generally. In these instances, restorative justice will not be as effective as one might hope. Such realisations can prove helpful in ensuring that resources are deployed appropriately. This is of vital

importance, because until now intervention programs have been designed without an adequate understanding of the individual risk factors involved in antisocial behaviour and as a consequence available resources have been spent inefficiently (Moffitt, 2005). Furthermore, studies like the current one can be used to design risk assessments. The use of actuarial risk assessments is central in forensic settings and should be developed for use in the youth offending services. Being able to identify the individual factors that help predict the likelihood of reoffending in young vulnerable youths is one of the main goals of all prevention efforts.

References

Achenbach, T. M. (1991). *Manual for the Youth Self-Report.* Burlington, VT: University of Vermont, Department of Psychiatry.

Achenbach, T. M., & Edelbrock, C.S. (1983). *Manual for the Child Behavior Checklist and Revised Child Behavior Profile.* Burlington: University of Vermont.

Adalbjarnardottir, S., & Rafnsson, F.D. (2002). Adolescent antisocial behavior and substance use: longitudinal analyses. *Addictive Behaviors, 27*(2), 227-240.

Adolphs, R. (1999). Social cognition and the human brain. *Trends in Cognitive Sciences, 3*(12), 469–479.

Adolphs, R., Tranel, D., Damasio, H., & Damasio, A. (1994). Impaired recognition of emotion in facial expressions following bilateral damage to the human amygdala. *Nature, 372*(6507), 669 - 672.

Altman, D.G., & Royston, P. (2006). The cost of dichotomising continuous variables. *BMJ, 332*,1080.

Andershed, H., Kerr, M., Stattin, H., & Levander, S. (2002). Psychopathic traits in non-referred youths: A new assessment tool. In E. Blaauw, & L. Sheridan (Ed.), *Psychopaths: Current International Perspectives* (pp. 131-158). The Hague: Elsevier.

Anderson, S. W., & Tranel, D. (2002). Neuropsychological consequences of dysfunction in human dorsolateral prefrontal cortex. In J.Grafman (Ed.), *Handbook of Neuropsychology* (pp. 145-156). Ireland: Elsevier Science B.V.

Angrilli, A., Bianchin, M., Radaelli, S., Bertagnoni, G., & Pertile, M. (2008). Reduced startle reflex and aversive noise perception in patients with orbitofrontal cortex lesions *Neuropsychologia, 46*, 1179-1184.

Angrilli, A., Mauri, A., Palomba, D., Flor,H., Birbaumer, N., Sartori, G., di Paola, F. (1996). Startle reflex and emotion modulation impairment after a right amygdala lesion. *Brain, 119*(6), 1991-2000.

Ary, D. V., Duncan, T.E., Biglan, A., Metzler, C.W., Noell, J.W., & Smolkowski, K. (1999). Development of adolescent problem behaviour. *Journal of Abnormal Child Psychology, 27*(2), 141-150.

Ary, D. V., Duncan, T.E., Duncan, S.C., & Hops, H. (1999). Adolescent problem behaviour: the influence of parents and peers. *Behaviour Research and Therapy, 37*(3), 217-230.

Barnes, G. M., Welte, J.W., Hoffman, J.H., & Dintcheff, B.A. (2005). Shared predictors of youthful gambling, substance use, and delinquency. *Psychology of Addictive Behaviors, 19*(2), 165-174.

Baron, R. M., & Kenny, D.A. (1986). The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173-1182.

Barratt, E. S., & Patton, J.H. (1983). Impulsivity: Cognitive, behavioural and psychophysiological correlates. In M.Zuckerman (Ed.), *Biological Bases of Sensation Seeking, Impulsivity and Anxiety*. New York: Harcourt Brace Jovanovic.

Bechara, A. (2004). The role of emotion in decision-making: Evidence from neurological patients with orbitofrontal damage. *Brain and Cognition, 55*, 30-40.

Bechara, A., & Damasio, H. (2002). Decision-making and addiction (part I): impaired activation of somatic states in substance dependent individuals when pondering decisions with negative future consequences. *Neuropsychologia, 40*(10), 1675-1689

Bechara, A., Damasio, A.R., Damasio, H., & Anderson, S.W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition, 50*(1-3), 7-15.

Bechara, A., Damasio, H., & Damasio, A.R. (2000). Emotion, decision making and the orbitofrontal cortex. *Cerebral Cortex, 10*(3), 295-307.

Bechara, A., Damasio, H., Damasio, A.R. (2003). Role of the amygdala in decision-making *Annals of the New York Academy of Sciences, 985*, 356-369.

Bechara, A., Tranel, D., & Damasio, H. (2000). Characterization of the decision-making deficit of patients with ventromedial prefrontal cortex lesions *Brain, 123*(11), 2189-2202.

Best, M., Williams, J.M., & Coccaro, E.F. (2002). Evidence for a dysfunctional prefrontal circuit in patients with an impulsive aggressive disorder. *Proceedings of the National Academy of Sciences of the United States of America, 99*(12), 8448-8453.

Bickett, L. R., Milich, R., & Brown, R.T. (1996). Attributional styles of aggressive boys and their mothers. *Journal of Abnormal Child Psychology, 24*(4), 457-472.

Birbaumer, N., Veit, R., Lotze, M., Erb, M., Hermann, C., Grodd, W., & Flor, H. (2005). Deficient fear conditioning in psychopathy: A functional magnetic resonance study. . *Archives of General Psychiatry, 62*, 799-805.

Blair, R. J. R. (2001). Advances in Neuropsychiatry: Neurocognitive models of aggression, the antisocial personality disorders, and psychopathy *Journal of Neurology, Neurosurgery, and Psychiatry 71*, 727-731.

Blair, R. J. R. (2003). Facial expressions, their communicatory functions and neuro-cognitive substrates. *Philosophical Transactions of the Royal Society: B Series, 358*, 561-572.

Blair, R. J. R. (2004). The roles of orbital frontal cortex in the modulation of antisocial behavior. *Brain and Cognition, 55*, 198-208.

Blair, R. J. R. (2005). Applying a cognitive neuroscience perspective to the disorder of psychopathy. *Development and Psychopathology, 17*, 865-891.

Blair, R. J. R., & Cipolotti, L. (2000). Impaired social response reversal: A case of 'acquired sociopathy' *Brain, 123*(6), 1122-1141.

Blair, R. J. R., Colledge, E., Murray, L., & Mitchell, D.G.V. (2001). A selective impairment in the processing of sad and fearful expressions in children with psychopathic tendencies. *Journal of Abnormal Child Psychology, 29*(6), 491-498.

Blair, R. J., Jones, L., Clark, F., & Smith, M. (1997). The psychopathic individual: A lack of responsiveness to distress cues? *Psychophysiology, 34*, 192-198.

Blair, J., Mitchell, D., & Blair, K. (2005). *The Psychopath: Emotion and the Brain*: Blackwell Publishing.

Blair, R. J. R., Mitchell, D.G.V., Peschardt, K.S., Colledge, E., Leonard, R.A., Shine, J.S., Murray, L.K., & Perrett, D.I. (2004). Reduced sensitivity to others' fearful expressions in psychopathic individuals. *Personality and Individual Differences, 37*(6), 1111-1122.

Brook, J. S., Whiteman, M., Finch, S.J., & Cohen, P. (1996). Youth adult drug use and delinquency: childhood antecedents and adolescent mediators. *Journal of the American Academy of Child and Adolescent Psychiatry, 35*(12), 1584-1592.

Brown, B. B., Mounts, N., Lamborn, S.D., & Steinberg, L. (1993). Parenting Practices and Peer Group Affiliation in Adolescence *Child Development, 64*(2), 467-482.

Buchel, C., Morris, J., Dolan, R.J., & Friston, K.J. (1998). Brain systems mediating aversive conditioning:an event-related fMRI study. *Neuron, 20*, 947-957.

Buikhuisen, W., & Mednick, S. A. (1988). Explaining Crime. In W. Buikhuisen, & S.A. Mednick (Ed.), *The need for an integrative approach in criminology* (pp. 3-7): Leiden,Holland: J. Brill Publishers.

Bushman, B. J., & Anderson, C.A. (2001). Is it time to pull the plug on the hostile versus instrumental aggression dichotomy? *Psychological Review, 108*(1), 273-279.

Caspi, A., Henry, B., McGee, R.O., Moffitt, T.E., & Silva, P.A. (1995). Temperamental origins of child and adolescent behavior problems: from age three to age fifteen. *Child Development, 66*(1), 55-68.

Caspi, A., Moffitt., T.E., Morgan, J., Rutter, M., Taylor, A., Arseneault, L., Tully, L., Jacobs, C., Kim-Cohen, J., & Polo-Tomas, M. (2004). Maternal expressed emotion predicts children's antisocial behaviour problems: using monozygotic-twin differences to identify environmental effects on behavioural development. *Developmental Psychology, 40 (2)*, 149-161.

Caspi, A., Moffitt, T.E., Newman, D.L., & Silva, P.A. (1996). Behavioral observations at age 3 years predict adult psychiatric disorders. Longitudinal evidence from a birth cohort. *Archives of General Psychiatry, 53*(11), 1033-1039.

Caspi, A., & Silva, P.A. (1995). Temperamental qualities at age three predict personality traits in young adulthood: longitudinal evidence from a birth cohort. *Child Development, 66*(2), 486-498.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

Damasio, A. R. (1994). *Descartes' error: Emotion, rationality and the human brain.* New York: Putnam.

Damasio, A. R. (1996). The somatic marker hypothesis and the possible functions of the prefrontal cortex. *Philosophical Transactions of the Royal Society of London (series B), 351*(1346), 1413-1420.

Davidson, R. J., Putnam, K.M., Larson, C.L. (2000). Dysfunction in the neural circuitry of emotion regulation: A possible prelude to violence. *Science, 289*(5479), 591 - 594.

Disney, E. R., Elkins, I.J., McGue, M., & Iacono, W.G. (1999). Effects of ADHD, conduct disorder, and gender on substance use and abuse in adolescence. *American Journal of Psychiatry, 156*, 1515-1521.

Dolan, M. C., Deakin, J.F., Roberts, N., & Anderson, I.M. (2002). Quantitative frontal and temporal structural MRI studies in personality-disordered offenders and control subjects. *Psychiatry Research, 116*(3), 133-149.

Dolan, M., & Doyle, M. (2000). Violence risk prediction: Clinical and actuarial measures and the role of the Psychopathy Checklist. *British Journal of Psychiatry, 177*, 303-311.

Dolan, M., & Fullam, R. (2006). Face affect recognition deficits in personality-disordered offenders: association with psychopathy. *Psychological Medicine, 36*(11), 1563-1569.

Duncan, J., Burgess, P., & Emslie, H. (1995). Fluid intelligence after frontal lobe lesions. *Neuropsychologia, 33*(3), 261-268.

Dunn, B. D., Dalgleish, T., & Lawrence, A.D. (2006). The somatic marker hypothesis: A critical evaluation. *Neuroscience and Biobehavioral Reviews, 30*(2), 239-271.

Ekman, P., & Friesen, W.V. (1976). *Pictures of Facial Affect.* Consulting Psychologists Press: Palo Alto, CA.

Elliott, R., Rubinsztein, J.S., Sahakian, B.J., & Dolan R.J. (2000). Selective attention to emotional stimuli in a verbal go/no-go task: an fMRI study. *NeuroReport, 11*(8), 1739-1744.

Everitt, B. J., Cardinal, R.N., Parkinson, J.A., & Robbins, T.W. (2003). Appetitive behavior: Impact of amygdala-dependent mechanisms of emotional learning. *Annals of the New York Academy of Sciences, 985*, 233-250.

Fairchild, G., van Goozen, S., Calder, A., Stollery, S., & Goodyer, I. (in press). Deficits in facial expression recognition in male adolescents with early-onset or adolescence-onset Conduct Disorder. *The Journal of Child Psychology and Psychiatry.*

Fairchild, G., van Goozen, S., Stollery, S., Aitken, M., Savage, J., Moore, S., & Goodyer, I. (in press). Decision-making and executive function in male adolescents with early-onset or adolescence-onset Conduct Disorder and control participants. *Biological Psychiatry.*

Fairchild, G., van Goozen, S.H., Stollery, S.J., & Goodyer, I.M. (2008). Fear conditioning and affective modulation of the startle reflex in male adolesents with early-onset or adolescence-onset conduct disorder and healthy control subjects. *Biological Psychiatry, 63*(3), 279 - 285.

Farrington, D. P. (1995). The Development of Offending and Antisocial Behaviour from Childhood: Key Findings from the Cambridge Study in Delinquent Development. *Journal of Child Psychology and Psychiatry, 360*(6), 929-964.

Farrington, D. P. (1998). Predictors, causes, and correlates of male youth violence. *Crime and Justice, 24*, 421-475.

Farrington, D. P. (2000). Psychosocial predictors of adult antisocial personality and adult convictions. *Behavioral Sciences & the Law, 18*(5), 605 - 622.

Farrington, D. P., Gallagher, B., Morley, L., Ledger, R.J.ST., & West, D.J. (1986). Unemployment, school leaving, and crime. *The British Journal of Criminology, 26*(4), 335-356.

Farrington, D. P., Jolliffe, D., Loeber, R., Stouthamer-Loeber, M., & Kalb, L.M. (2001). The concentration of offenders in families, and family criminality in the prediction of boys' delinquency. *Journal of Adolescence, 24*(5), 579-596.

Fergusson, D. M., & Horwood, L.J. (2003). Resilience to childhood adversity: Results of a 21 year study. In S. S. Luthar (Ed.), *Resilience and Vulnerability: Adaptation in the context of childhood adversities.* (pp. 130-155): Cambridge University Press.

Fergusson, D. M., Horwood, L.J., & Lynskey, M.T. (1992). Family change, parental discord and early offending. *Journal of Child Psychology and Psychiatry, 33*(6), 1059 - 1075.

Gagliardi, C., Frigerio, E., Burt, D.M., Cazzaniga, I., Perrett, D.I., & Borgatti, R. (2003). Facial expression recognition in Williams syndrome *Neuropsychologia, 41*(6), 733-738.

Geen, R. G. (2001). *Human Aggression* (2nd ed.): Open University Press.

Goyer, P. F., Andreason, P.J., Semple, W.E., Clayton, A.H., King, A.C., Compton-Toth, B.A., Schulz, S.C., & Cohen, R.M. (1994). Positron-emission tomography and personality disorders. *Neuropsychopharmacology, 10*(1), 21-28.

Grant, S., Contoreggi, C., & London, E.D. (2000). Drug abusers show impaired performance in a laboratory test of decision making. *Neuropsychologia, 38*(8), 1180-1187.

Habel, U., Egbert, K., Salloum, J.B., Devos, H. & Schneider, F. (2002). Emotional processing in psychopathic personality. *Aggressive Behavior, 28*(5), 394 - 400.

Hampton, A. N., & O'Doherty, J.P. (2007). Decoding the neural substrates of reward-related decision making with functional MRI. *Proceedings of the National Academy of Sciences of the United States of America, 104*(4), 1377-1382.

Happaney, K., Zelazo, P.D., & Stuss, D.T. (2004). Development of orbitofrontal function: current themes and future directions. *Brain and Cognition, 55*(1), 1-10.

Hare, R. D. (1978). Electrodermal and cardiovascular correlates of psychopathy. In R. D. Hare, & D. Schalling (Ed.), *Psychopathic behavior: Approaches to research* (pp. 107-144). New York, Wiley.

Hare, R. D. (1981). Psychopathy and violence. In J. R. Hayes, T.K. Roberts, & K.S. Solway (Ed.), *Violence and the violent individual* (pp. 53-74). Jamaica, NY: Spectrum.

Hare, R. D. (1999). Psychopathy as a risk factor for violence. *Psychiatric Quarterly, 70*(3), 181-197.

Heaton, R. K. (2005). *Wisconsin Card Sorting Test Manual.* Odessa, FL: Psychological Assessement Resources.

Hemming, J. H. (1981). Electrodermal indices in a selected prison sample and students. *Personality and Individual Differences, 2*, 37-46.

Henry, B., Caspi, A., Moffitt, T.E., & Silva, P. A. (1996). Temperamental and familial predictors of violent and nonviolent criminal convictions: Age 3 to age 18. *Developmental psychology, 32*(4), 614-623.

Herba, C., & Phillips, M. (2004). Annotation: Development of facial expression recognition from childhood to adolescence: behavioural and neurological perspectives. *Journal of Child Psychology and Psychiatry, 45*(7), 1185-1198.

Hinshaw, S. P. (1992). Externalizing behavior problems and academic underachievement in childhood and adolescence: Causal relationships and underlying mechanisms. *Psychological Bulletin, 111*(1), 127-155.

Holmes, S. E., Slaughter, J.R., & Kashani, J. (2001). Risk factors in childhood that lead to the development of conduct disorder and antisocial personality disorder. *Child Psychiatry and Human Development, 31*(3), 183-193.

Home Office (2003-2006). *Offending, Crime and Justice Survey (OCJS).* Retrieved August 3, 2007 from http://www.homeoffice.gov.uk/rds/offending_survey.html.

Hsieh, C. C., & Pugh, M.D. (1993). Poverty, Income Inequality, and Violent Crime: A Meta-Analysis of Recent Aggregate Data Studies. *Criminal Justice Review, 18*(2), 182-202.

Irwin, J.R., & McClelland, G.H. (2003). Negative consequences of dichotomizing continuous predictor variables. *Journal of Marketing Research, XL*, 366-371.

Jones, A.P., Laurens, K.R., Herba, C.M., Barker, G.J., & Viding, E. (2009). Amygdala hypoactivity to fearful faces in boys with conduct problems and callous-unemotional traits. *American Journal of Psychiatry, 166*(1), 95-102.

Juby, H., & Farrington, D.P. (2001). Disentangling the link between disrupted families and delinquency. *British Journal of Criminology, 41*(1), 22-40.

Kim, H., Shimojo, S., & O'Doherty, J.P. (2006). Is avoiding an aversive outcome rewarding? Neural substrates of avoidance learning in the human brain. *PLoS Biology, 4*(8), 1453-1461.

Kinnear, P. R., & Gray, C.D. (2000). *SPSS for Windows Made Simple: Release 10*: Psychology Press Ltd.

Kongs, S. K., Thomson, L.L., Iverson, G.L., & Heaton, R.K. (2000). *WCST-64: Wisconsin Card Sorting Test–64 Card Version Professional Manual.* Odessa, FL: Psychological Assessment Resources.

Lacourse, E., Nagin, D.S., Vitaro, F., Cote, S., Arseneault, L., & Tremblay, R.E. (2006). Prediction of early-onset deviant peer group affiliation: A 12-year longitudinal study. *Archives of General Psychiatry, 63*(5), 562-568.

Lahey, B. B., Waldman, I.D., & McBurnett, K. (1999). Annotation: The development of antisocial behavior: An integrative causal model. *The Journal of Child Psychology and Psychiatry and Allied Disciplines, 40*(5), 669-682.

Lang, P. J., Bradley, M.M., & Cuthbert, B.N. (1997). *International Affective Picture System (IAPS): Technical Manual and Affective Ratings*. Gainesville, FL: National Institute of Mental Health Center for the Study of Emotion and Attention, University of Florida.

Lang, P. J., Bradley, M.M., & Cuthbert, B.N. (1998). Emotion, motivation, and anxiety: brain mechanisms and psychophysiology. *Biological Psychiatry, 44*(12), 1248-1263.

Lang, P. J., Davis, M., & Öhman, A. (2000). Fear and anxiety: animal models and human cognitive psychophysiology *Journal of Affective Disorders, 61*(3), 137-159.

LaPierre, D., Braun, C. M. J., & Hodgins, S. (1995). Ventral frontal deficits in psychopathy: neurpsychological test findings. *Neuropsychologia, 33*, 139-151.

Larsson, H., Viding, E., Rijsdijk, F.V., & Plomin, R. (2008). Relationships between parental negativity and childhood antisocial behavior over time: a bidirectional effects model in a longitudinal genetically informative design. *Journal of Abnormal Child Psychology, 36*(5), 633-645.

Lehto, J. E., Juujärvi, P., Kooistra, L., & Pulkkinen, L. (2003). Dimensions of executive functioning: Evidence from children. *British Journal of Developmental Psychology, 21*(1), 59-80.

Levenston, G. K., Patrick., C.J., Bradley, M.M., & Lang, P.J. (2000). The psychopath as observer: Emotion and attention in picture processing. *Journal of Abnormal Psychology, 109*(3), 373-385.

Lewis, C. E., Cloninger, C.R., & Pais, J. (1983). Alcoholism, antisocial personality and drug use in a criminal population. *Alcohol and Alcoholism, 18*(1), 53-60.

Loeber, R., & Farrington, D.P. (1998). Never too early, never loo Late: Risk factors and successful interventions for serious and violent juvenile offenders. *Studies on Crime and Crime Prevention, 7*(1), 7-30.

Loeber, R., & Farrington, D.P. (2000). Young children who commit crime: Epidemiology, developmental origins, risk factors, early interventions, and policy implications. *Development and Psychopathology, 12*(4), 737-762.

London, E. D., Ernst, M., Grant, S., Bonson, K., & Weinstein, A. (2000). Orbitofrontal cortex and human drug abuse: Functional imaging. *Cerebral Cortex, 10*(3), 334-342.

Losel, F., & Bliesener, T. (1994). Some high-risk adolescents do not develop conduct problems: A study of protective factors. *International Journal of Behavioral Development, 17*(4), 753-777.

MacCallum, R.C., Zhang, S., Preacher, K.J., & Rucker, D.D. (2002). On the practice of dichotomization of quantitative variables. *Psychological Methods, 7*(1), 19-40.

Maguin, E., & Loeber, R. (1996). Academic performance and delinquency. In M. Tonry, & Morris, N. (Ed.), *Crime and justice: A review of research* (Vol. 20, pp. 145-264): Chicago: The University of Chicago Press.

Manes, F., Sahakian, B., Clark, L., Rogers, R., Antoun, N., Aitken, M., Robbins, T. (2002). Decision-making processes following damage to the prefrontal cortex. *Brain, 125*(3), 624-639.

Marsh, A. A., & Blair, R.J.R. (2008). Deficits in facial affect recognition among antisocial populations: A meta-analysis. *Neuroscience & Biobehavioral Reviews, 32*(3), 454-465.

Marsh, A.A., Finger, E.C., Mitchell, D.G.V., Reid, M.E., Sims, C., Kosson, D.S., Towbin, K.E., Leibenluft, E., Pine, D.S., Blair, R.J.R. (2008). *American Journal of Psychiatry, 165*, 712-720.

Matthews, G., & Wells, A. (1999). The cognitive science of attention and emotion. In T. Dalgleish, & M.J. Power (Ed.), *Handbook of cognition and emotion* (pp. 171-192): New York: Wiley.

McKay, S. (2004). Poverty or preference: what do 'consensual deprivation indicators' really measure? *Fiscal Studies, 25*(2), 201-223.

Mehta, M. A., Goodyer, I.M., & Sahakian, B.J. (2004). Methylphenidate improves working memory and set-shifting in AD/HD: relationships to baseline memory capacity. *Journal of Child Psychology and Psychiatry, 45*(2), 293 - 305.

Milich, R., & Dodge, K.A. (1984). Social information processing in child psychiatric populations. *Journal of Abnormal Child Psychology, 12*(3), 471-489.

Milner, B. (1971). Interhemispheric differences in the localization of psychological processes in man. *British Medical Bulletin, 27*(3), 272-277.

Misslin, R. (2003). The defense system of fear: behavior and neurocircuitry. *Neurophysiologie Clinique/Clinical Neurophysiology, 33*(2), 55-66.

Mitchell, D. G. V., Colledge, E., Leonard, A., & Blair, R.J.R. (2002). Risky decisions and response reversal: is there evidence of orbitofrontal cortex dysfunction in psychopathic individuals? *Neuropsychologia, 40*(12), 2013-2022.

Moffitt, T. E. (1988). Neuropsychology and self-reported early delinquency in an unselected birth cohort: A preliminary report from New Zealand. In T. E. Moffitt, & S.A. Mednick (Ed.), *Biological contributions to crime causation* (pp. 93-117): Dordrecht: Martinus Nijhoff Publishers.

Moffitt, T. E. (1990). The neuropsychology of juvenile delinquency: A critical review. *Crime and justice, 12*, 99-169.

Moffitt, T. E. (1993). Adolescence-limited and life-course-persistent antisocial behavior: A developmental taxonomy. *Psychological Review, 100*(4), 674-701.

Moffitt, T. E. (2005). The new look of behavioral genetics in developmental psychopathology: Gene-environment interplay in antisocial behaviors. *Psychological Bulletin, 131*(4), 533-554.

Moffitt, T. E., & Caspi, A. (2001). Childhood predictors differentiate life-course persistent and adolescence-limited antisocial pathways among males and females. *Development and Psychopathology 13*, 355-375.

Moffitt, T. E., Caspi, A., Rutter, M., & Silva, P.A. (2001). *Sex differences in antisocial behaviour: Conduct disorder, delinquency, and violence in the Dunedin Longitudinal Study.* Cambridge: Cambridge University Press.

Moffitt, T. E., Lynam, D.R., & Silva, P.A. (1994). Neuropsychological tests predicting persistent male delinquency. *Criminology, 32*(2), 277-300.

Moffitt, T. E., & Silva, P.H. (1988). Neuropsychological deficit and self-reported delinquency in an unselected birth cohort. *Journal of the American Academy of Child & Adolescent Psychiatry, 27*(2), 233-240.

Morgan, A. B., & Lilienfeld, S.O. (2000). A meta-analytic review of the relation between antisocial behavior and neuropsychological measures of executive function. *Clinical Psychology Review, 20*(1), 113-136.

Morris, J. S., Friston, K.J., & Dolan, R.J. (1997). Neural responses to salient visual stimuli. *Proceedings of the Royal Society B: Biological Sciences, 264* (1382), 769-775.

Murphy, F. C., Smith, K.A., Cowen, P.J., Robbins, T.W., & Sahakian, B.J. (2002). The effects of tryptophan depletion on cognitive and affective processing in healthy volunteers. *Psychopharmacology, 163*(1), 42-53.

Newman, J. P., Kosson, D.S., & Patterson, C.M. (1992). Delay of gratification in psychopathic and nonpsychopathic offenders. *Journal of Abnormal Psychology, 101*(4), 630-636.

Newman, J. P., Patterson, C.M, & Kosson, D.S. (1987). Response perseveration in psychopaths. *Journal of Abnormal Psychology, 96*(2), 145-148.

Newsom, J.T., Prigerson, H.G., Schultz, R., & Reynolds III, C.F. (2003). Investigating moderator hypotheses in aging research: Statistical, methodological, and conceptual difficulties with comparing separate regressions. *International Journal of Aging and Human Development, 57*(2), 119-150

Nigg, J. T. (2000). On inhibition/disinhibition in developmental psychopathology: Views from cognitive and personality psychology and a working inhibition taxonomy. *Psychological Bulletin, 126*(2), 220-246.

Office for National Statistics (2004). *Harmonised concepts and questions for data sources: Income*: London: Office for National Statistics.

Owen, A. M., Downes, J.J., Sahakian, B.J., Polkey, C.E., & Robbins, T.W. (1990). Planning and spatial working memory following frontal lobe lesions in man. *Neuropsychologia, 28*(10), 1021-1034.

Oxford English Dictionary. Http://dictionary.oed.com.

Pagani, L., Boulerice, B., Vitaro, F., & Tremblay, R.E. (1999). Effects of poverty on academic failure and delinquency in boys: A change and process model approach. *The Journal of Child Psychology and Psychiatry and Allied Disciplines, 40*(8), 1209-1219.

Patrick, C. J., Bradley, M. M., & Lang, P.J. (1993). Emotion in the criminal psychopath: Startle reflex modulation. *Journal of Abnormal Psychology, 102*(1), 82-92.

Patrick, C. J., & Verona, E. (2007). The psychophysiology of aggression: Autonomic, electrocortical, and neuro-imaging findings. In D. Flannery, A. Vazsonyi, & I. Waldman (Ed.), *The Cambridge handbook of violent behavior and aggression* (pp. 111-150): New York: Cambridge University Press.

Patterson, G. R., & Dishion, T.J. (1985). Contributions of families and peers to delinquency. *Criminology, 23*(1), 63-79.

Patterson, G. R., Reid, J.B., & Dishion, T. (1992). *Antisocial boys: A social interactional approach* (Vol. 4): Eugene, OR: Castalia Publishing Company.

Patton, J. H., Stanford, M. S., Barratt, E. S. (1995). Factor structure of the Barratt Impulsiveness scale. *Journal of Clinical Psychology, 51*, 768-774.

Pennington, B. F., & Ozonoff, S. (1996). Executive functions and developmental psychopathology. *Journal of Child Psychology and Psychiatry, 37*(1), 51-87.

Pinel, J. P. J. (2000). *Biopsychology* 4th Edition, Allyn & Bacon.

Polman, H., Orobio de Castro, B., Koops, W., van Boxtel, H.W., & Merk, W.W. (2007). A meta-analysis of the distinction between reactive and proactive aggression in children and adolescents. *Journal of Abnormal Child Psychology, 5*(4), 522-535.

Preuschoft, S. (2000). Primate faces and facial expressions. *Social Research, 67*(1), 245-271.

Pulkkinen, L., & Pitkänen, T. (1993). Continuities in aggressive behavior from childhood to adulthood. *Aggresive Behavior, 19*, 249-263.

Rahman, S., Sahakian, B.J., Cardinal, R.N., Rogers, R.D., & Robbins, T.W. (2001). Decision making and neuropsychiatry. *Trends in Cognitive Sciences, 5*(6), 271-277.

Raine, A. (1993a). *The psychopathology of crime: Criminal behavior as a clinical disorder.* San Diego: Academic Press.

Raine, A. (1993b). Violence and biology - Theory and findings. In L. Klose (Ed.), *Proceedings of the Fourth Symposium on Violence and Aggression* (pp. 1-28): University of Saskatchewan: Saskatoon.

Raine, A. (1997). Crime, conditioning, and arousal. In H. Nyborg (Ed.), *The scientific study of human nature: Tribute to Hans J. Eysenck* (pp. 122-141): Oxford: Elsevier.

Raine, A. (2002a). Annotation: The role of prefrontal deficits, low autonomic arousal, and early health factors in the development of antisocial and aggressive behavior. *Journal of Child Psychology and Psychiatry 43*(4), 417-434.

Raine, A. (2002b). Biosocial studies of antisocial and violent behavior in children and adults: A review. *Journal of Abnormal Child Psychology 30*(4), 311-326.

Raine, A., Brennan, P., & Mednick, S.A. (1994). Birth complications combined with early maternal rejection at age 1 year predispose to violent crime at age 18 years. *Archives of General Psychiatry, 51*, 984-988.

Raine, A., Brennan, P., Mednick, B., & Mednick, S.A. (1996). High rates of violence, crime, academic problems, and behavioral problems in males with both early neuromotor deficits and unstable family environments. *Archives of General Psychiatry, 53*(6), 544-549.

Raine, A., & Dunkin, J.J. (1990). The genetic and psychophysiological basis of antisocial behavior: Implications for counseling and therapy. *Journal of Counseling and Development, 68*(6), 637-644.

Raine, A., Meloy, J.R., Bihrle, S., Stoddard, J., Lacasse, L., & Buchsbaum, M.S. (1998). Reduced prefrontal and increased subcortical brain functioning assessed using positron emission tomography in predatory and affective murderers. *Behavioral Sciences and the Law, 16*, 319-332.

Raine, A., Moffitt, T.E., Caspi, A., Loeber, R., Stouthamer-Loeber, M., & Lynam, D. (2005). Neurocognitive impairments in boys on the life-course persistent antisocial path. *Journal of Abnormal Psychology, 114*(1), 38-49.

Raine, A., Reynolds, C., Venables, P.H., Mednick, S.A., & Farrington, D.P. (1998). Fearlessness, stimulation-seeking, and large body size at age 3 years as early predispositions to childhood aggression at age 11 years. *Archives of General Psychiatry, 55*(8), 745-751.

Raine, A., & Venables, P.H. (1981). Classical conditioning and socialization - A biosocial interaction. *Personality and Individual Differences, 2*, 273-283.

Raine, A., Venables, P.H., & Williams, M. (1990a). Autonomic orienting responses in 15-year-old male subjects and criminal behavior at age 24. *The American Journal of Psychiatry, 147*(7), 933-937.

Raine, A., Venables, P.H., & Williams, M. (1990b). Relationships between CNS and ANS measures of arousal at age 15 and criminality at age 24 years. *Archives of General Psychiatry, 47*, 1003-1007.

Raine, A., Yaralian, P.S., Reynolds, C., Venables, P.H., & Mednick, S.A. (2002). Spatial but not verbal cognitive deficits at age 3 years in persistently antisocial individuals. *Development and Psychopathology, 14*, 25-44.

Raven, J., Raven, J. C., & Court, J. H. (2004). *The Standard Progressive Matrices (SPM)* (2004 updated ed.). Harcourt Assessment, OPP, Oxford, UK.

Rhee, S. H., & Waldman, I.D. (2002). Genetic and environmental influences on antisocial behavior: a meta-analysis of twin and adoption studies. *Psychological Bulletin, 128*(3), 490-529.

Robbins, T. W., James, M., Owen, A.M., Sahakian, B.J., Lawrence, A.D., McInnes, L., & Rabbitt, P.M.A. (1998). A study of performance on tests from the CANTAB battery sensitive to frontal lobe dysfunction in a large sample of normal volunteers: Implications for theories of executive functioning and cognitive aging. *Journal of the International Neuropsychological Society, 4*, 474-490.

Rogers, R. D., Tunbridge, E. M., Bhagwagar, Z., Drevets, W. C., Sahakian, B. J., & Carter, C. S. (2003). Trytophan depletion alters the decision-making of healthy volunteers through altered processing of reward cues. *Neuropsychopharmacology, 28*(1), 153-162.

Rolls, E. T. (2000). The orbitofrontal coretx and reward. *Cerebral Cortex, 10*(3), 284-294.

Rolls, E. T., Hornak, J., Wade, D. & McGrath, J. (1994). Emotion-related learning in patients with social and emotional changes associated with frontal lobe damage. *Journal of Neurology, Neurosurgery, and Psychiatry, 57*, 1518-1524.

Rozin, P., Haidt, J., & McCauley, C.R. (1993). Disgust. In M. Lewis, & J.M. Haviland (Ed.), *Handbook of emotions* (pp. 575-594). New York: The Guildford Press.

Rutter, M. (2001). Psychosocial adversity: Risk, resilience and recovery. In J. M. Richman, & M.W. Fraser (Ed.), *The Context of Youth Violence: Resilience, Risk, and Protection* (pp. 13-41): Westport, CT: Praeger Publishers.

Rutter, M., Silberg, J., O'Connor, T., & Simonoff, E. (1999). Genetics and Child Psychiatry: II Empirical Research Findings. *The Journal of Child Psychology and Psychiatry and Allied Disciplines, 40*(1), 19-55.

Salekin, R. T., Rogers, R., & Sewell, K.W. (1996). A review and meta-analysis of the Psychopathy Checklist and Psychopathy Checklist-Revised: Predictive validity of dangerousness. *Clinical Psychology: Science and Practice, 3*(3), 203 - 215.

Scarpa, A., & Raine, A. (1997). Psychophysiology of anger and violent behavior. *Anger, aggression, and violence, 20*(2), 375-394.

Scarpa, A., & Raine, A. (2000). Violence associated with anger and impulsivity. In J. Borod (Ed.), *The neuropsychology of emotion* (pp. 320-339): New York: Oxford University Press.

Scerbo, A., Raine, A., O'Brien, M., Chan, C.J., Rhee, C., & Smiley, N. (1990). Reward dominance and passive avoidance learning in adolescent psychopaths. *Journal of Abnormal Child Psychology, 18*(4), 451-463.

Seguin, J. R. (2004). Neurocognitive elements of antisocial behavior: Relevance of an orbitofrontal cortex account. *Brain and cognition, 55*(1), 185-197.

Seguin, J. R., Boulerice, B., Harden, P.W., Tremblay, R.E., & Pihl, R.O. (1999). Executive functions and physical aggression after controlling for attention deficit hyperactivity disorder, general memory, and IQ. *Journal of Child Psychology and Psychiatry, 40*(8), 1197 - 1208.

Seguin, J. R., Sylver, P., & Lilienfeld, S.O. (2007). The neuropsychology of violence. In I. D. Waldman, D.J. Flannery, & A.T. Vazsonyi (Ed.), *The Cambridge Handbook of violent behavior*: Cambridge University Press, NY.

Shader, M. (2001). *Risk factors for delinquency: An overview.* Washington, D.C., U.S.: Department of Justice, Office of Juvenile Justice and Delinquency Prevention.

Shallice, T. (1982). Specific impairments of planning. *Philosophical Transactions of the Royal Society of London (series B), 298*(1089), 199-209.

Simons, R. L., Wu, C., Conger, R.D., & Lorenz, F.O. (1994). Two routes to delinquency: Differences between early and late starters in the impact of parenting and deviant peers. *Criminology, 32*(2), 247-276.

Skeem, J. L., & Cauffman, E. (2003). Views of the downward extension: comparing the Youth Version of the Psychopathy Checklist with the Youth Psychopathic traits Inventory. *Behavioral Sciences & the Law, 21*(6), 737 - 770.

Slymen, D. J., Ayala, G.X., Arredondo, E.M., & Elder, J.P. (2006). A demonstration of modeling count data with an application to physical activity. *Epidemiologic Perspectives & Innovations 3*(3).

Sterzer, P., Stadler, C., Krebs, A., Kleinschmidt, A., & Poustka, F. (2005). Abnormal neural responses to emotional visual stimuli in adolescents with conduct disorder. *Biological Psychiatry, 57*(1), 7 - 15.

Sterzer, P., Stadler, C., Poustka, F., & Kleinschmidt, A. (2007). A structural neural deficit in adolescents with conduct disorder and its association with lack of empathy. *Neuroimage, 37*(1), 335-342.

Stone, V. E., Baron-Cohen, S., & Knight, R.T. (1998). Frontal lobe contributions to Theory of Mind. *Journal of Cognitive Neuroscience, 10*(5), 640-656.

Stouthamer-Loeber, M., & Loeber, R. (1988). The use of prediction data in understanding delinquency [Special issue: Juvenile delinquency]. *Behavioral Sciences & the Law, 6*(3), 333-354.

Tassinary, L. G., & Cacioppo, J.T. (2000). The skeletomotor system: Surface electromyography. In J. T. Cacioppo, L.G. Tassinary, G.G. Berntson (Ed.), *Handbook of Psychophysiology* (2nd ed., pp. 163-199). Cambridge, England: Cambridge University Press.

Townshend, J. M., & Duka, T. (2001). Attentional bias associated with alcohol cues: differences between heavy and occasional social drinkers. *Psychopharmacology, 157*(1), 67-74.

Tremblay, R. E., Nagin, D.S., Seguin, J.R., Zoccolillo. M., Zelazo, P.D., Boivin, M., Perusse, D., & Japel, C. (2004). Physical Aggression During Early Childhood: Trajectories and Predictors. *Pediatrics, 114*(1), e43-e50.

Tremblay, R. E., Pihl, R.O., Vitaro, F., & Dobkin, P.L. (1994). Predicting early onset of male antisocial behavior from preschool behavior. *Archives of General Psychiatry, 51*(9), 732-739.

University of Essex. Institute for Social and Economic Research, British Household Panel Survey; Waves 1-14, 1991-2005 [computer file]. 2nd Edition ed. Colchester, Essex: UK Data Archive [distributor], June 2006. SN: 5151.

van Goozen, S. H. M., Cohen-Kettenis, P.T., Snoek, H., Matthys, W., Swaab-Barneveld, H., & van Engeland, H. (2004). Executive functioning in children: a comparison of hospitalised ODD and ODD/ADHD children and normal controls. *Journal of Child Psychology and Psychiatry, 45*(2), 284-292.

van Goozen, S. H. M., Fairchild, G., Snoek, H., & Harold, G.T. (2007). The evidence for a neurobiological model of childhood antisocial behavior. *Psychological Bulletin, 133*(1), 149-182.

van Goozen, S. H. M., Snoek, H., Matthys, W., van Rossum, I., & van Engeland, H. (2004). Evidence of fearlessness in behaviourally disordered children: a study on startle reflex modulation. *Journal of Child Psychology and Psychiatry, 45*(4), 884-892.

Verona, E., Curtin, J.J., Patrick, C.J., Bradley, M.M., & Lang, P.J. (2004). Psychopathy and physiological response to emotionally evocative sounds. *Journal of Abnormal Psychology, 113*, 99-108.

Viding, E. (2004). Annotation: Understanding the development of psychopathy. *Journal of Child Psychology and Psychiatry, 45*(8), 1329 - 1337.

Volavka, J. (1995). *Neurobiology of violence.* Washington, DC, American Psychiatric Press.

Walker, D. W., & Leister, C. (1994). Recognition of facial affect cues by adolescents with emotional and behavioral disorders. *Behavioral Disorders, 19*(4), 269-276.

Wechsler, D. (1999). *Wechsler Abbreviated Scale of Intelligence (WASI).* USA: The Psychological Corporation.

Wells, L. E., & Rankin, J.H. (1991). Families and Delinquency: A Meta-Analysis of the Impact of Broken Homes *Social Problems, 38*(1), 71-93.

Welsh, M. C., & Pennington, B.F. (1988). Assessing frontal lobe functioniong in children: views from developmental psychology. *Developmental Neuropsychology, 4*(3), 199-230.

Whisman, M.A., & McClelland, G.H. (2005). Designing, testing and interpreting interactions and moderator effects in family research. *Journal of Family Psychology, 19*(1), 111-120.

Windle, M. (1990). A longitudinal study of antisocial behaviors in early adolescence as predictors of late adolescent substance use: gender and ethnic group differences. *Journal of Abnormal Psychology, 99*(1), 86-91.

Wolff, P. H., Waber, D., Bauermeister, M., Cohen, C., & Ferber, R. (1982). The neuropsychological status of adolescent delinquent boys. *Journal of Child Psychology and Psychiatry, 23*, 267-179.

Woodbury-Smith, M. R., Clare, I.C.H., Holland, A.J., Kearns, A., Staufenberg, E., & Watson, P. (2005). A case-control study of offenders with high functioning autistic

spectrum disorders. *The Journal of Forensic Psychiatry & Psychology, 16*(4), 747 - 763.

Yaralian, P., & Raine, A. (2001). Biological approaches to crime: Psychophysiology and brain dysfunction. In R. Paternoster, & R. Bachman (Ed.), *Explaining criminals and crime: Essays in contemporary criminological theory* (pp. 57-72). Los Angeles: Roxbury.

Zuckerman, M. (1979). *Psychobiology of personality.* Cambridge: Cambridge University Press.

Zuckerman, M. (1994). *Behavioral expressions and biosocial bases of sensation seeking*. Cambridge University Press.

Appendices

Appendix 3.1: Offences severity scores

Section 8: Annexes

CODE	CATEGORY	SCORE	'SERIOUS OFFENCE' (ISSP)
01	VIOLENCE AGAINST THE PERSON		
0101	**Abduction/Kidnapping**	7	
	Abduction of female by force		Serious
	Child abduction		
	False imprisonment		Serious
	Hijacking		Serious
	Kidnapping		Serious
0102	**Assault police officer (common assault)***	3	
	Assault with intent to resist arrest or assaulting a person assisting a police constable		
0103	**Common assault***	3	
	Assault & battery		
	Assault by beating		
0104	**Grievous Bodily Harm (wound or inflict)***	6	
0105	**Manslaughter***	8	Serious
	Child destruction, infanticide or manslaughter due to diminished responsibility		
0106	**Murder***	8	Serious
	Attempted murder		
0107	**Indictable firearms offences**	6	
	Possessing a real or imitation firearm at the time of committing or being arrested for an offence specified in Schedule 1 of the Firearms Act 1968		
	Possession of real or imitation firearms/explosives with intent to commit an indictable offence – including resisting arrest		Serious
	Possession of real or imitation firearms/explosives with intent to cause violence		
0108	**Other wounding***	4	
	Administering poison with intent to injure or annoy		
	Assault occasioning actual bodily harm (ABH)		
0109	**Possession of an offensive weapon**	3	
	Having an article with a blade or point in a public place		
0110	**Threatening, abusive or insulting words or behaviour**	3	
0111	**Threat or conspiracy to Murder**	5	Serious
	Soliciting to commit murder		
0112	**Wounding or other act endangering life***	7	
	Attempting to choke, suffocate with intent to commit an indictable offence (garrotting)		Serious
	Burning or maiming by explosion		
	Creating danger by causing anything to be on the road, or interfering with a vehicle or traffic equipment		
	Causing explosions or casting corrosive fluids with intent to do grievous bodily harm		Serious
	Endangering life or causing harm by administering poison		
	Endangering railway passengers (by placing anything on railway, taking up rails, changing points and signals or by throwing anything at railway carriages)		Serious
	Causing danger to road users (throwing stones etc.)		
	Possession of firearms with intent to endanger life or injure property		Serious
	Using chloroform to commit or assist in committing an indictable offence		Serious
	Using firearms or imitation firearms with intent to resist arrest		Serious
0113	**Wounding with intent to cause grievous bodily harm (section 18)***	7	Serious

CODE	CATEGORY	SCORE	'SERIOUS OFFENCE' (ISSP)
0114	**Other/unspecified violence against the person**	4	
02	**SEXUAL OFFENCES**		
0201	**Buggery***	7	Serious
0202	**Gross indecency with a child***	5	
0203	**Incest***	7	
	Incest with a female under 13		Serious
	Inciting a girl under 16 to have incestuous sexual intercourse		
0204	**Indecent Assault***	5	
0205	**Indecent behaviour/exposure**	4	
0206	**Rape***	8	Serious
	Assault with intent to commit rape or buggery		
	Attempted rape		
	Conspiracy to rape		
0207	**Unlawful sexual intercourse with female under 13***	4	Serious
0208	**Unlawful sexual intercourse with female under 16***	3	
0209	**Other/unspecified sexual offences***	5	
03	**DEATH OR INJURY BY DANGEROUS DRIVING**		
0301	**Death by dangerous driving***	8	Serious
	Causing death by aggravated vehicle taking		
	Causing death by dangerous driving when under the influence of drink or drugs		
0302	**Injury by dangerous driving***	5	
	Causing injury by aggravated vehicle taking		
	Causing injury by dangerous driving when under the influence of drink or drugs		
04	**MOTORING OFFENCES**		
0401	**Dangerous Driving**	5	
0402	**Driving under the influence of drinks/drugs**	3	
0403	**Driving whilst disqualified**	5	
0404	**Interfering with a motor vehicle**	3	
0405	**Refusing to give breath test**	4	
0406	**Road traffic/Additional Offences**	2	
	Driving without due care and attention		
	Driving on a footpath or land common land		
	Driving defective motor vehicle		
	Exceeding speed limit		
	Failure to wear a seatbelt		
	Failure to comply with a road traffic sign		
	Failure to give particulars after an accident		

CODE	CATEGORY	SCORE	'SERIOUS OFFENCE' (ISSP)
	Failure to produce documents		
	Failure to report an accident		
	Failure to stop when requested by a constable		
	Failure to stop after an accident		
	Forge vehicle records/licence		
	No insurance		
	No L plates		
	No licence		
	No MOT		
	Not wearing protective headgear		
	Not well maintained indicators/stop/hazard and light reflectors		
	Pedal cycle offences		
0407	**Other/unspecified Motoring offences**	3	
05	**ROBBERY**		
0501	**Robbery***	6	**Serious**
	Assault with intent to rob		
	Conspiracy to rob		
06	**DOMESTIC BURGLARY**		
0601	**Aggravated burglary of a dwelling***	7	**Serious**
	Burglary with violence or threat of violence		
0602	**Burglary in a dwelling**	6	**Serious**
	Conspiracy to commit burglary of a dwelling		
0603	**Other/unspecified domestic burglary**	6	
07	**NON-DOMESTIC BURGLARY**		
0701	**Aggravated burglary of a non-dwelling***	7	**Serious**
	Burglary with violence or threat of violence		
0702	**Burglary in a non-dwelling**	4	
	Burglary with intent		
	Conspiracy to commit burglary of a non-dwelling		
0703	**Found on enclosed premises**	3	
0704	**Other/unspecified non-domestic burglary**	4	
08	**VEHICLE THEFT/UNAUTHORISED TAKING**		
0801	**Aggravated vehicle taking***	5	
	Injury to person, damage to property or car		
0802	**Being carried***	3	
	Being carried (aggravated)	4	
0803	**Vehicle taking**	4	
	Theft of motor vehicle		
	Unauthorised vehicle taking (TWOC/TADA)		
0804	**Other/unspecified vehicle theft/taking**	4	

CODE	CATEGORY	SCORE	'SERIOUS OFFENCE' (ISSP)
09	THEFT AND HANDLING STOLEN GOODS		
0901	Handling stolen goods	3	Serious
	Receiving stolen goods		
	Undertaking or assisting in the retention, removal, disposal or realisation of stolen goods, or arranging to do so		
0902	Theft	3	
	Extracting electricity		
	Making off without payment		
	Going equipped for stealing		
	Intent to steal		
0903	Other/unspecified theft & handling	3	
10	FRAUD AND FORGERY		
1001	Forgery	3	
	Forgery, or use, of false prescription		
1002	Fraud	3	
	Acting as a peddler without certificate		
	Counterfeiting		
	Conspiracy to defraud		
	Fraudulent use of documents		
	Obtaining pecuniary advantage by deception		
	Obtaining property by deception		
1003	Public/private service vehicle and rail fare evasion	1	
1004	Other/unspecified fraud and forgery	2	
11	ARSON		
1101	Arson endangering life	6	Serious
	Arson reckless as to whether life is in danger		
1102	Arson not endangering life	6	Serious
1103	Other/unspecified arson	5	
12	CRIMINAL DAMAGE		
1201	Criminal damage endangering life	6	Serious
1202	Other Criminal Damage Over £2000	3	
	Equipped with intent to commit criminal damage		
	Threat to commit criminal damage		
1203	Other Criminal Damage Under £2000	2	
	Equipped with intent to commit criminal damage		
	Threat to commit criminal damage		
1204	Other/unspecified criminal damage	3	
13	DRUGS		
1301	Permitting use of premises for use of Class B or Class C drug	3	Serious

CODE	CATEGORY	SCORE	'SERIOUS OFFENCE' (ISSP)
1302	**Possession – Class A drug**	3	
1303	**Possession – Class B drug**	2	
1304	**Possession – Class C drugs**	2	
1305	**Supply – Class A drug**	6	Serious
	Possessing a class A drug with intent to supply		
	Offering to supply a class A drug		
1306	**Supply – Class B drug**	4	Serious
	Possessing a class B drug with intent to supply		
	Offering to supply a class B drug		
1307	**Supply – Class C drug**	4	
	Cultivation of cannabis		Serious
	Possessing a class C drug with intent to supply		
	Offering to supply a class C drug		
1308	**Unlawful importation or exportation of a controlled drug**	5	Serious
1309	**Other/unspecified drug offence**	2	
14	**PUBLIC ORDER**		
1401	**Affray**	4	
1402	**Bomb Hoax**	5	
	Supplying false information about the presence of bombs		
	Dispatching articles to create a bomb hoax		
1403	**Breach of the Peace**	2	
	Behaviour likely to cause breach of the peace		
1404	**Drunk and Disorderly**	1	
1405	**Other Public Order Act offences**	2	
	Section 4 Public Order Act 1986 (fear or provocation of violence)		
	Section 4a Public Order Act 1986 (intentional harassment, alarm or distress)		
	Section 5 Public Order Act 1986 (harassment, alarm or distress)		
	Placing people in fear of violence		
1406	**Rioting**	6	
1407	**Violent disorder**	5	
1408	**Other/unspecified public order offence**	2	
15	**OTHER**		
1501	**Other specified offences**		
	Absconding from lawful custody	5	
	Air weapons offences	3	
	Blackmail	5	Serious
	Cruelty to animals or unlawful killing of animals	3	
	Firearms Act Offences (e.g. no firearm licence)	2	
	Interfering with witness/perverting justice	5	
	Obstruct police or fire service	3	
	Public nuisance (common law offence)	2	
	Resisting arrest	2	
	Sending indecent/offensive articles	4	
	Trespassing on a railway	2	

CODE	CATEGORY	SCORE	'SERIOUS OFFENCE' (ISSP)
1502	**Other minor offences**	1	
	Abusive language		
	Begging		
	Consuming alcohol under the age of 18 in a public place		
	Concealment of birth		
	Cycling in pedestrian area		
	Failure to make children attend school		
	Infuriating an animal (Section1 (1) (a) Protection of Animals Act 1911)		
	Inciting a child away from Local Authority care		
	Littering		
	Nuisance on educational premises		
	Urinating in a public place		
	Vagrancy		
	Making hoax/abusive or malicious telephone calls		
	Non-payment of financial penalty		
	Purchasing alcohol under the age of 18		
	Wasting police time		
1503	**Other/unspecified offence**	3	
16	**RACIALLY AGGRAVATED**		
1601	**Criminal damage – racially aggravated**	3	**Serious**
1602	**Other wounding – racially aggravated***	3	
	Actual bodily harm		
	Common assault		
	Intentional harassment alarm or distress		
	Putting people in fear of violence		
	Threatening, abusive or insulting words or behaviour		
1603	**Wounding or other act endangering life – racially aggravated***	6	**Serious**
	Wounding with intent to do grievous bodily harm		
1604	**Other/unspecified racially aggravated offence**	3	
17	**BREACH OF CONDITIONAL DISCHARGE – this only applies where the breach has resulted in an additional substantive outcome. Where a young person has been re-sentenced, please refer back to the original offence for the seriousness.**		
1701	**Breach of conditions of discharge**	1	
18	**BREACH OF BAIL – this only applies where the breach has resulted in an additional substantive outcome. Where a young person has been re-sentenced, please refer back to the original offence for the seriousness.**		
1801	**Breach of conditions of bail**	2	
19	**BREACH OF STATUTORY ORDER – this only applies where the breach has resulted in an additional substantive outcome. Where a young person has been re-sentenced, please refer back to the original offence for the seriousness.**		
1901	**Breach of Order or license conditions**	4	

Appendix 3.2: Living arrangements Asset questions

1. Living arrangements

*Who has the young person been mostly living with over the last six months?

Mother	☐	Grandparent/s	☐	Friend/s	☐
Father	☐	Other family	☐	Residents of home or institution	☐
Step-parent	☐	By self	☐		
Foster carer/s	☐	Partner	☐	Other/s	☐
Sibling/s	☐	Own child(ren)	☐		

If his/her *current* living arrangements are different, please specify below.

Please indicate whether any of the following apply to the young person.	Yes	No	Don't know
*No fixed abode	☐	☐	☐
*Unsuitable, does not meet his/her needs (e.g. overcrowded, lacks basic amenities)	☐	☐	☐
Deprived household (e.g. dependent on benefits, entitlement to free school meals)	☐	☐	☐
*Living with known offender/s	☐	☐	☐
Absconding or staying away (e.g. ever reported as missing person)	☐	☐	☐
*Disorganised/chaotic (e.g. different people coming and going)	☐	☐	☐
*Other problems (e.g. uncertainty over length of stay)	☐	☐	☐

Evidence (Please explain reasons for any 'Don't know' responses.)

*Rate the extent to which the young person's living arrangements are associated with the likelihood of further offending.

0	1	2	3	4

(0 = not associated, 4 = very strongly associated)

Appendix 3.3: Family and personal relationships Asset questions

3 CORE PROFILE

2. Family and personal relationships

Which family members or carers has the young person been in contact with over the last six months?

Birth mother	☐	Grandparent/s	☐	Other significant adults (e.g. neighbour, family friend)	☐
Birth father	☐	Sibling/s	☐		
Adoptive parent/s	☐	Partner	☐		
Step-parent	☐	Own child(ren)	☐	Other/s	☐
Foster carer/s	☐	Other family	☐		

Please indicate whether any of the following apply to the young person.

		Yes	No	Don't know
*Evidence of family members or carers with whom the young person has been in contact over the last six months being involved in criminal activity		☐	☐	☐
*Evidence of family members or carers with whom the young person has been in contact over the last six months being involved in heavy alcohol misuse		☐	☐	☐
*Evidence of family members or carers with whom the young person has been in contact over the last six months being involved in drug or solvent misuse		☐	☐	☐
*Significant adults fail to communicate with or show care/interest in the young person		☐	☐	☐
Inconsistent supervision and boundary setting		☐	☐	☐
*Experience of abuse (i.e. physical, sexual, emotional, neglect)		☐	☐	☐
*Witnessing other violence in family context		☐	☐	☐
*Significant bereavement or loss		☐	☐	☐
*Difficulties with care of his/her own children	N/A	☐	☐	☐
Other problems (e.g. parent with physical/mental health problem, loss of contact, acrimonious divorce of parents, other stress/tension)		☐	☐	☐

Evidence (Please explain reasons for any 'Don't know' responses.)

*Rate the extent to which the young person's family and personal relationships are associated with the likelihood of further offending. | 0 | 1 | 2 | 3 | 4 |

(0 = not associated, 4 = very strongly associated)

Appendix 3.4: Education, training and employment Asset questions

3. Education, training and employment

Engagement in education, training or employment (ETE)

*Is the young person of compulsory school age? Yes ☐ No ☐

Which of the following best describe his/her current ETE situation?
(Tick as many as apply.)

Mainstream school	☐	Work experience	☐	College/further education	☐
Special school	☐	Full time work	☐	Other training course	☐
Pupil referral unit	☐	Part time work	☐	Unable to work (e.g. incapacity)	☐
Other specialist unit	☐	Casual/temporary work	☐	Looking after family	☐
Community home with education	☐	Unemployed	☐	Nothing currently arranged	☐
		New Deal	☐	Other	☐
Home tuition	☐	Pre-employment/lifeskills training	☐		

*How many hours of ETE are arranged each week? _____ hours

*How many hours of ETE is she/he currently engaged in/receiving per week? ___ hours

*Is there evidence of non-attendance? (Please tick relevant reasons and give details below.) Yes ☐ No ☐

Permanent exclusion ☐ Fixed-term exclusion ☐ Family issues ☐ Illness ☐

Other non-attendance (specify) _____

Evidence (Please explain reasons for any 'Don't know' responses.)

Educational attainment		Yes	No	Don't know
Does s/he have any educational qualifications?		☐	☐	☐
Does s/he have vocational/practical qualifications?		☐	☐	☐
*Have special needs (SEN) been identified?		☐	☐	☐
If 'yes', does s/he have a statement of SEN?	N/A	☐	☐	☐
Does s/he have difficulties with literacy?		☐	☐	☐
Does s/he have difficulties with numeracy?		☐	☐	☐
Does s/he have difficulties caused by a severe lack of English (or Welsh, if applicable) language skills?		☐	☐	☐

Evidence (Please explain reasons for any 'Don't know' responses.)

Other factors relating to engagement in ETE	Yes	No	Don't know
Negative attitudes towards ETE	☐	☐	☐
Lack of attachment to current ETE provision (e.g. wants to leave, cannot see benefits of learning)	☐	☐	☐
*Bullied	☐	☐	☐
*Bullies others	☐	☐	☐
Poor relationships with most teachers/tutors/employers/colleagues	☐	☐	☐
Negative parental/carer attitudes towards education/training or employment	☐	☐	☐
Other problems (e.g. frequent changes of school/educational placement, school is unchallenging/boring, disability, lack of stable address meaning difficulties securing work, no money to buy books/tools/equipment).	☐	☐	☐

Evidence (Please explain reasons for any 'Don't know' responses.)

*Rate the extent to which the young person's education, training and employment is associated with the likelihood of further offending.

0	1	2	3	4

(0 = not associated, 4 = very strongly associated)

Appendix 3.5: Neighbourhood Asset questions

4. Neighbourhood

*Please give a brief description of the neighbourhood in which the young person spends most of their time.

*Is the neighbourhood identified as a crime 'hotspot' (Crime and Disorder Act 1998)?	Yes	No	Don't know
	☐	☐	☐

Please indicate whether any of the following are a problem in the neighbourhood.

	Yes	No	Don't know
*Obvious signs of drug dealing and/or usage	☐	☐	☐
Isolated location/lack of accessible transport	☐	☐	☐
*Lack of age-appropriate facilities (e.g. youth clubs, sports facilities)	☐	☐	☐
Racial or ethnic tensions	☐	☐	☐
Other problems (e.g. lack of amenities such as shops or post office, opportunities to sell stolen goods, red-light district, tension between police and local community)	☐	☐	☐

Evidence (Please explain reasons for any 'Don't know' responses.)

*Rate the extent to which the young person's neighbourhood is associated with the likelihood of further offending.

0	1	2	3	4

(0 = not associated, 4 = very strongly associated)

Appendix 3.6: Lifestyle Asset questions

5. Lifestyle

Please indicate whether the following are characteristic of the young person's lifestyle.	Yes	No	Don't know
*Lack of age-appropriate friendships	☐	☐	☐
*Associating with predominantly pro-criminal peers	☐	☐	☐
*Lack of non-criminal friends	☐	☐	☐
Has nothing much to do in spare time	☐	☐	☐
*Participation in reckless activity	☐	☐	☐
*Inadequate legitimate personal income	☐	☐	☐
Other problems (e.g. gambling, staying out late at night, loneliness)	☐	☐	☐

Evidence (Please explain reasons for any 'Don't know' responses.)

*Rate the extent to which the young person's lifestyle is associated with the likelihood of further offending.

0	1	2	3	4

(0 = not associated, 4 = very strongly associated)

Appendix 3.7: Substance use Asset questions

6. Substance use

Please answer the questions below to give details of substance use (based on the information currently available).

	*Ever used	*Recent use	Age at first use	Not known to have used
Tobacco	☐	☐	☐	☐
Alcohol (Please specify types of alcohol in evidence box.)	☐	☐	☐	☐
Solvents (glue, gas and volatile substances e.g. petrol, lighter fuel)	☐	☐	☐	☐
Cannabis	☐	☐	☐	☐
Ecstasy	☐	☐	☐	☐
Amphetamines	☐	☐	☐	☐
LSD	☐	☐	☐	☐
Poppers	☐	☐	☐	☐
Cocaine	☐	☐	☐	☐
Crack	☐	☐	☐	☐
Heroin	☐	☐	☐	☐
Methadone (obtained legally or illegally – specify in evidence box)	☐	☐	☐	☐
Tranquilisers	☐	☐	☐	☐
Steroids	☐	☐	☐	☐
Other (Please specify in evidence box.)	☐	☐	☐	☐

Please indicate whether any of the following apply to the young person.	Yes	No	Don't know
*Practices which put him/her at particular risk (e.g. injecting, sharing equipment, poly-drug use)	☐	☐	☐
*Sees substance use as positive and/or essential to life	☐	☐	☐
*Noticeably detrimental effect on education, relationships, daily functioning	☐	☐	☐
Offending to obtain money for substances	☐	☐	☐
Other links to offending (e.g. offending while under influence, possessing/supplying illegal drugs, obtaining substances by deception)	☐	☐	☐

Evidence (Please explain reasons for any 'Don't know' responses.)

*Rate the extent to which the young person's substance use is associated with the likelihood of further offending.

0	1	2	3	4

(0 = not associated, 4 = very strongly associated)

Appendix 3.8: Physical health Asset questions

7. Physical health

Please indicate whether any of the following apply to the young person.	Yes	No	Don't know
*Health condition which significantly affects everyday life functioning	☐	☐	☐
*Physical immaturity/delayed development	☐	☐	☐
*Problems caused by not being registered with GP	☐	☐	☐
*Lack of access to other appropriate health care services (e.g. dentist)	☐	☐	☐
*Health put at risk through his/her own behaviour (e.g. hard drug use, unsafe sex, prostitution)	☐	☐	☐
Other problems (prescribed medication, binge drinking, obesity, poor diet, smoking, hyperactivity, early or late physical maturation)	☐	☐	☐

Evidence (Please explain reasons for any 'Don't know' responses.)

*Rate the extent to which the young person's physical health is associated with the likelihood of further offending.

0	1	2	3	4

(0 = not associated, 4 = very strongly associated)

Appendix 3.9: Emotional and mental health Asset questions

8. Emotional and mental health

Is the young person's daily functioning significantly affected by emotions or thoughts resulting from the following?	Yes	No	Don't know
*Coming to terms with significant past event/s (e.g. feelings of anger, sadness, grief, bitterness)	☐	☐	☐
*Current circumstances (e.g. feelings of frustration, stress, sadness, worry/anxiety)	☐	☐	☐
*Concerns about the future (e.g. feelings of worry/anxiety, fear, uncertainty)	☐	☐	☐

Evidence (Please explain reasons for any 'Don't know' responses.)

	Yes	No	Don't know
*Has there been any formal diagnosis of mental illness?	☐	☐	☐
*Any other contact with, or referrals to, mental health services?	☐	☐	☐

Evidence (Please explain reasons for any 'Don't know' responses.)

*Are there indications that any of the following apply to the young person?	Yes	No	Don't know
*S/he is affected by other emotional or psychological difficulties (e.g. phobias, eating or sleep disorders, suicidal feelings not yet acted out, obsessive compulsive disorder, hypochondria).	☐	☐	☐
*S/he has deliberately harmed her/himself.	☐	☐	☐
*S/he has previously attempted suicide.	☐	☐	☐

Details (Specify type of illness, medication, whether she/he co-operates with treatment etc. Please explain reasons for any 'Don't know' responses.)

*Rate the extent to which the young person's emotional and mental health is associated with the likelihood of further offending.

0	1	2	3	4

(0 = not associated, 4 = very strongly associated)

Appendix 3.10: Perception of self and others Asset questions

9. Perception of self and others

Please indicate whether any of the following apply to the young person.	Yes	No	Don't know
*S/he has difficulties with self-identity.	☐	☐	☐
*S/he has inappropriate self-esteem (e.g. too high or too low).	☐	☐	☐
*S/he has a general mistrust of others.	☐	☐	☐
Sees him/herself as a victim of discrimination or unfair treatment (e.g. in the home, school, community, prison).	☐	☐	☐
*S/he displays discriminatory attitudes towards others (e.g. race, ethnicity, religion, gender, age, class, disability, sexuality).	☐	☐	☐
*S/he perceives him/herself as having a criminal identity.	☐	☐	☐

Evidence (Please explain reasons for any 'Don't know' responses.)

*Rate the extent to which the young person's perception of self and others is associated with the likelihood of further offending.

0	1	2	3	4

(0 = not associated, 4 = very strongly associated)

Appendix 3.11: Thinking and behaviour Asset questions

10. Thinking and behaviour

*Are the young person's actions characterised by any of the following?	Yes	No	Don't know
*Lack of understanding of consequences (e.g. immediate and longer term outcomes, direct and indirect consequences, proximal and distal consequences)	☐	☐	☐
*Impulsiveness	☐	☐	☐
*Need for excitement (easily bored)	☐	☐	☐
*Giving in easily to pressure from others (lack of assertiveness)	☐	☐	☐
Poor control of temper	☐	☐	☐
*Inappropriate social and communication skills	☐	☐	☐

*Does the young person display any of the following types of behaviour?	Yes	No	Don't know
*Destruction of property	☐	☐	☐
*Aggression towards others (e.g. verbal, physical)	☐	☐	☐
*Sexually inappropriate behaviour	☐	☐	☐
*Attempts to manipulate/control others	☐	☐	☐

Evidence (Please explain reasons for any 'Don't know' responses.)

*Rate the extent to which the young person's thinking and behaviour is associated with the likelihood of further offending.

0	1	2	3	4

(0 = not associated, 4 = very strongly associated)

Appendix 3.12: Attitudes to offending Asset questions

11. Attitudes to offending

*Please indicate whether the young person displays any of the following attitudes.	Yes	No	Don't know
*Denial of the seriousness of his/her behaviour	☐	☐	☐
*Reluctance to accept any responsibility for involvement in most recent offence/s	☐	☐	☐
*Lack of understanding of the effect of his/her behaviour on victims (if victimless, on society)	☐	☐	☐
*Lack of remorse	☐	☐	☐
*Lack of understanding about the effects of his/her behaviour on family/carers	☐	☐	☐
*A belief that certain types of offences are acceptable	☐	☐	☐
*A belief that certain people/groups are acceptable 'targets' of offending behaviour	☐	☐	☐
*S/he thinks that further offending is inevitable	☐	☐	☐

Evidence (Please explain reasons for any 'Don't know' responses.)

*Rate the extent to which the young person's attitudes to offending is associated with the likelihood of further offending. | 0 | 1 | 2 | 3 | 4 |

(0 = not associated, 4 = very strongly associated)

Appendix 3.13: Motivation to change Asset questions

12. Motivation to change

Please indicate whether the young person displays any of the following attitudes.	Yes	No	Don't know
*Has an appropriate understanding of the problematic aspects of his/her own behaviour	☐	☐	☐
Shows real evidence of wanting to deal with problems in his/her life	☐	☐	☐
*Understands the consequences for him/herself of further offending	☐	☐	☐
*Has identified clear reasons or incentives for him/her to avoid further offending	☐	☐	☐
*Shows real evidence of wanting to stop offending	☐	☐	☐
Will receive positive support from family, friends or others during any intervention	☐	☐	☐
Is willing to co-operate with others (family, Yot, other agencies) to achieve change	☐	☐	☐

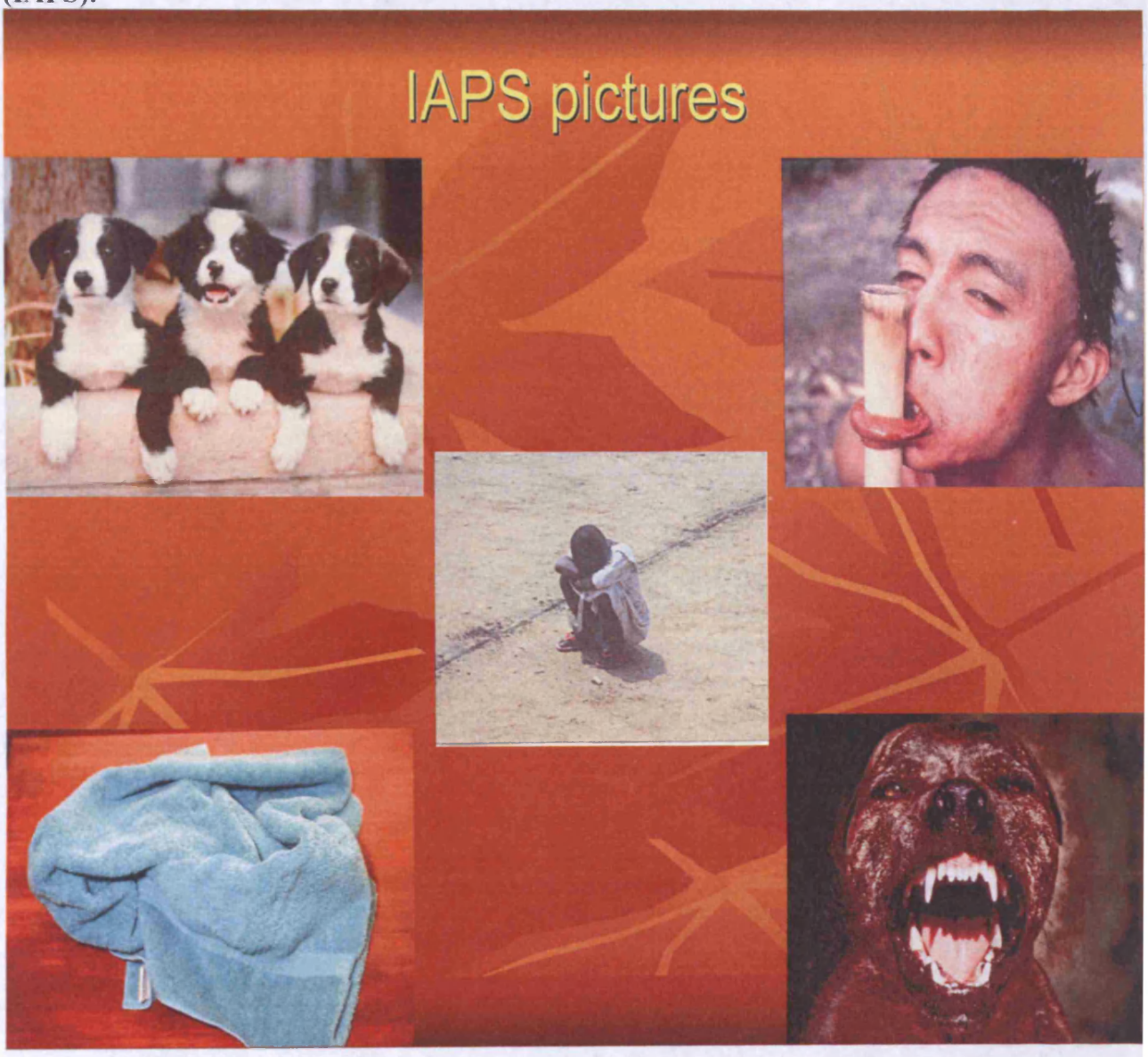
Evidence (Please explain reasons for any 'Don't know' responses.)

*Rate the extent to which the young person's motivation to change is associated with the likelihood of further offending.

0	1	2	3	4

(0 = not associated, 4 = very strongly associated)

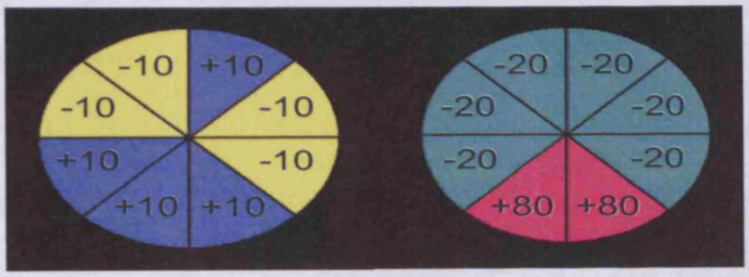
Appendix 4.1: Examples of pictures taken from the International Affective Pictures System (IAPS).



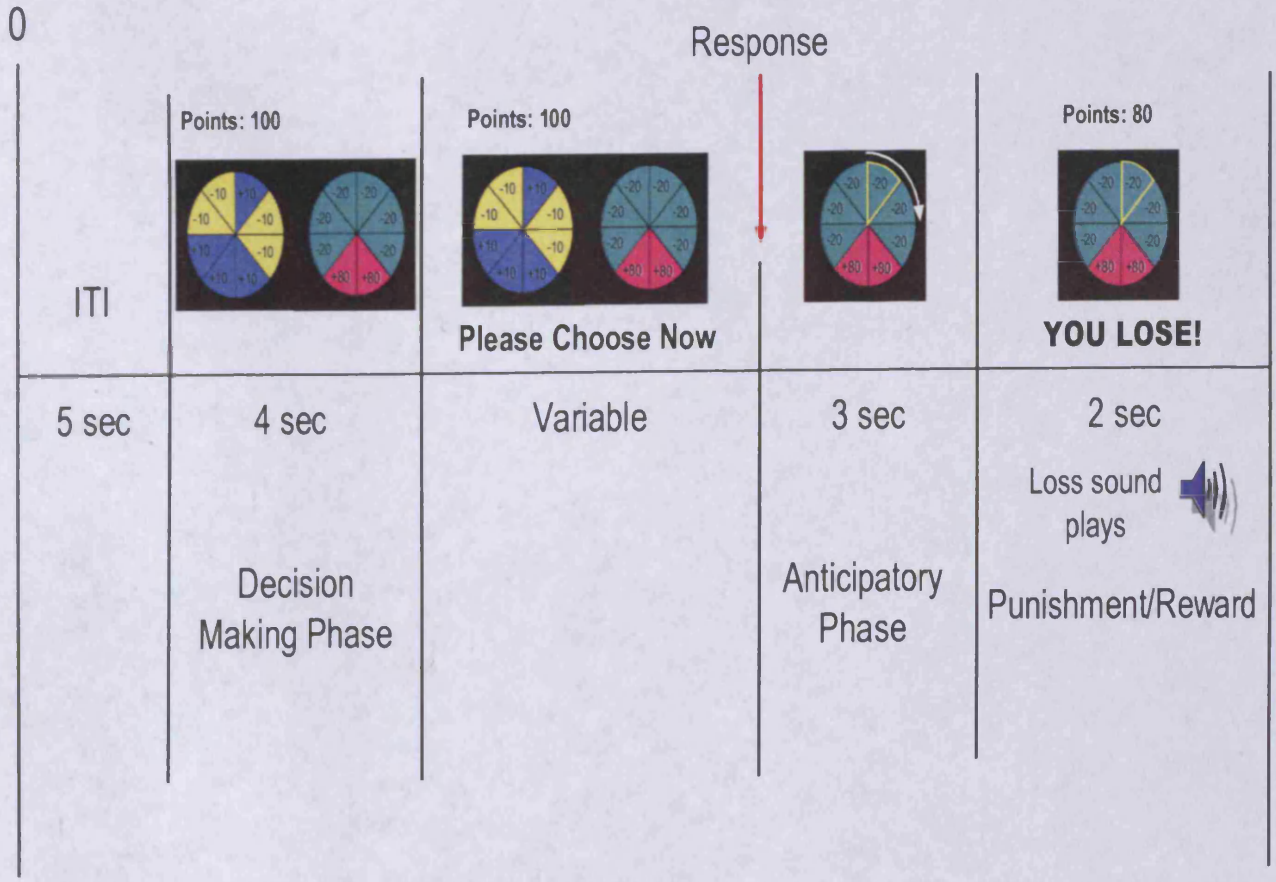
Appendix 5.1.: Correlations between IQ, antisocial behaviour, and face recognition

		wasi_iq	Rate	Most severe offence score at first contact	Aggressive behaviour t-score in YSR	Externalizing problems t-score in YSR	Conduct problems t-score in YSR
Rate	Correlation Coefficient	-.193	1.000	.338	.154	.267	.247
	Sig. (2-tailed)	.289	.	.059	.399	.140	.173
	N	32	32	32	32	32	32
Most severe offence score at first contact	Correlation Coefficient	.002	.338	1.000	.149	.213	.143
	Sig. (2-tailed)	.993	.059	.	.417	.241	.435
	N	32	32	32	32	32	32
Aggressive behaviour t-score in YSR	Correlation Coefficient	.219	.154	.149	1.000	.953(**)	.869(**)
	Sig. (2-tailed)	.229	.399	.417	.	.000	.000
	N	32	32	32	32	32	32
Externalizing problems t-score in YSR	Correlation Coefficient	.166	.267	.213	.953(**)	1.000	.926(**)
	Sig. (2-tailed)	.364	.140	.241	.000	.	.000
	N	32	32	32	32	32	32
Conduct problems t-score in YSR	Correlation Coefficient	.074	.247	.143	.869(**)	.926(**)	1.000
	Sig. (2-tailed)	.686	.173	.435	.000	.000	.
	N	32	32	32	32	32	32
Fear	Correlation Coefficient	.544(**)	-.169	.260	.043	-.005	-.025
	Sig. (2-tailed)	.001	.354	.151	.815	.976	.891
	N	32	32	32	32	32	32
Anger	Correlation Coefficient	.373(*)	-.117	-.012	-.019	.024	.030
	Sig. (2-tailed)	.036	.523	.946	.918	.897	.869
	N	32	32	32	32	32	32
happy	Correlation Coefficient	.384(*)	-.224	-.164	.205	.218	.215
	Sig. (2-tailed)	.030	.218	.368	.260	.230	.237
	N	32	32	32	32	32	32
Sad	Correlation Coefficient	.453(**)	-.106	-.169	.247	.223	.159
	Sig. (2-tailed)	.009	.563	.355	.173	.221	.384
	N	32	32	32	32	32	32
Disgust	Correlation Coefficient	.308	.157	.181	.373(*)	.389(*)	.409(*)
	Sig. (2-tailed)	.087	.390	.320	.035	.028	.020
	N	32	32	32	32	32	32
Surprise	Correlation Coefficient	.335	-.052	-.030	.079	.120	.102
	Sig. (2-tailed)	.061	.778	.872	.667	.514	.578

Appendix 6.1: Example of a trial from the CxR task; the 'control' wheel is shown on the left, and the 'experimental' on the right.



Appendix 6.2: CxR task process



Appendix 6.3: Correlations between severity and frequency of antisocial behaviour and neuropsychological tasks in larger group of young offenders

		Total number of offences	Most severe offence	Aggressive behaviour t-score in YSR	Externalizing problems t-score in YSR	Conduct problems t-score in YSR	YPI score	IQ score	Total SSS score
Total SSS score	Rho	.244(**)	.197(*)	.369(**)	.450(**)	.391(**)	.389(**)	.010	1.000
	P value	.010	.039	.000	.000	.000	.000	.933	.
	N	111	110	109	109	109	110	69	111
Cards played in CPT	Rho	-.215*	-.207*	-.011	-.014	-.048	-.163	-.136	.018
	P value	.023	.029	.912	.885	.615	.087	.261	.849
	N	112	111	110	110	110	111	70	109
Premature responses in CPT	Rho	.064	.044	.090	.077	.006	-.223(*)	.135	.048
	P value	.513	.650	.355	.428	.947	.021	.270	.629
	N	107	107	107	107	107	108	69	106
total errors	Rho	.193(*)	.106	-.051	-.027	-.075	.009	-.422(**)	-.051
	P value	.042	.269	.595	.780	.435	.923	.000	.598
	N	111	111	110	110	110	113	72	110
perseverative errors	Rho	.071	-.027	-.169	-.132	-.155	-.020	-.222	-.086
	P value	.458	.780	.078	.170	.107	.833	.061	.370
	N	111	111	110	110	110	113	72	110
nonperseverative errors	Rho	.177	.128	.056	.061	.022	.075	-.410(**)	-.007
	P value	.063	.180	.563	.527	.816	.428	.000	.939
	N	111	111	110	110	110	113	72	110
categories completed	Rho	-.219(*)	-.140	.011	.006	.046	-.035	.322(**)	-.003
	P value	.021	.142	.910	.951	.633	.716	.006	.974
	N	111	111	110	110	110	113	72	110
trials to first category	Rho	.135	.059	.004	.032	.098	.107	-.127	.094
	P value	.157	.539	.965	.740	.306	.257	.286	.331
	N	111	111	110	110	110	113	72	110
failure to maintain set	Rho	-.046	.065	.049	.056	.105	.058	-.099	.160
	P value	.632	.498	.610	.562	.274	.543	.408	.095
	N	111	111	110	110	110	113	72	110
Overall % gamble in CxR	Rho	.049	-.140	-.011	.002	-.076	.029	-.005	.082
	P value	.612	.146	.912	.986	.431	.762	.967	.395
	N	109	109	110	110	110	111	70	109

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Appendix 6.4: Correlations between frequency and severity of antisocial behaviour and CANTAB tasks

		Most severe offence	Total YPI score	Aggressive behaviour t-score in YSR	Externalizing problems t-score in YSR	Conduct problems t-score in YSR	Total number of offences	IQ score	Total SSS score
SWM Between Errors	Rho	.021	-.127	-.132	-.081	-.133	.212	-.366(*)	.110
	P value	.892	.389	.373	.586	.367	.158	.011	.465
	N	46	48	48	48	48	46	48	46
SWM Strategy Score	Rho	-.090	.080	-.127	-.102	-.107	.146	-.418(**)	-.005
	P value	.552	.590	.389	.492	.470	.334	.003	.972
	N	46	48	48	48	48	46	48	46
CGT Delay Aversion	Rho	.096	.199	.180	.250	.271	.147	-.067	-.103
	P value	.524	.175	.222	.087	.062	.329	.650	.497
	N	46	48	48	48	48	46	48	46
CGT Overall proportion bet	Rho	-.153	-.107	-.244	-.301(*)	-.286(*)	-.299(*)	-.005	-.159
	P value	.311	.468	.095	.037	.049	.043	.976	.293
	N	46	48	48	48	48	46	48	46
CGT risk taking	Rho	-.158	-.036	-.146	-.200	-.201	-.250	-.079	-.120
	P value	.295	.810	.320	.174	.170	.094	.592	.426
	N	46	48	48	48	48	46	48	46
ED preED Errors	Rho	.041	-.086	-.002	.052	.116	.133	-.132	-.117
	P value	.787	.564	.988	.730	.439	.384	.375	.445
	N	45	47	47	47	47	45	47	45
ED EDS Errors	Rho	.069	.059	-.149	-.071	-.055	.011	.018	.083
	P value	.653	.696	.317	.637	.716	.940	.906	.587
	N	45	47	47	47	47	45	47	45
ED Total Errors	Rho	.044	.153	-.163	-.047	.019	.017	-.312(*)	.058
	P value	.773	.304	.273	.753	.898	.913	.033	.707
	N	45	47	47	47	47	45	47	45
ED stages completed	Rho	.018	-.113	.255	.105	.025	-.096	.132	-.051
	P value	.909	.449	.084	.482	.865	.531	.375	.740
	N	45	47	47	47	47	45	47	45
SOC problems solved in minimum moves	Rho	-.063	-.101	.265	.274	.241	-.117	.228	.308(*)
	P value	.679	.496	.069	.060	.099	.438	.120	.037
	N	46	48	48	48	48	46	48	46

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Appendix 6.5: Correlations between neuropsychological tasks

		SWM Between Errors	SWM Strategy score	Cards played in CPT	Premature responses in CPT	Total errors in WCST	Perseverative errors in WCST	Non perseverative errors in WCST	Categories completed in WCST	Trials to first category (WCST)	Failure to maintain test (WCST)	Overall % gamble in CxR
SWM Between Errors	Rho	1.000	.589(**)	.362(*)	.024	.282	.253	.249	-.270	.290(*)	.078	.018
	P val	.	.000	.012	.872	.052	.083	.088	.064	.046	.598	.904
	N	48	48	47	47	48	48	48	48	48	48	48
SWM Strategy score	Rho	.589(**)	1.000	.245	.119	.096	.171	.076	-.256	.232	.085	.021
	P val	.000	.	.097	.425	.516	.246	.609	.079	.113	.565	.888
	N	48	48	47	47	48	48	48	48	48	48	48
CGT Delay Aversion	Rho	.198	.199	.146	.197	.059	-.040	.136	-.048	.093	.089	-.215
	P val	.178	.174	.326	.183	.690	.787	.358	.747	.530	.549	.142
	N	48	48	47	47	48	48	48	48	48	48	48
CGT Overall proportion bet	Rho	.057	-.003	-.140	-.167	.069	.169	-.016	-.037	.067	-.033	.152
	P val	.702	.986	.348	.261	.640	.251	.916	.804	.650	.825	.304
	N	48	48	47	47	48	48	48	48	48	48	48
CGT risk taking	Rho	.123	.050	-.180	-.173	.046	.090	-.007	.006	.060	-.002	.195
	P val	.404	.736	.225	.246	.756	.545	.964	.965	.686	.988	.183
	N	48	48	47	47	48	48	48	48	48	48	48
IED_preED Errors	Rho	.099	.011	-.040	.154	-.007	-.131	.064	-.029	.040	.354(*)	.013
	P val	.508	.940	.794	.306	.962	.380	.671	.849	.789	.015	.930
	N	47	47	46	46	47	47	47	47	47	47	47
IED EDS Errors	Rho	.140	.188	.101	-.159	.064	-.016	.109	-.181	.224	.205	.190
	P val	.348	.206	.504	.291	.667	.913	.466	.224	.131	.168	.200
	N	47	47	46	46	47	47	47	47	47	47	47
IED Total Errors	Rho	.254	.295(*)	.143	-.181	.168	.006	.228	-.161	.232	.163	.149
	P val	.085	.044	.343	.230	.259	.971	.123	.280	.117	.273	.316
	N	47	47	46	46	47	47	47	47	47	47	47
IED stages completed	Rho	-.246	-.254	-.286	.194	-.176	-.129	-.169	.131	-.338(*)	.083	-.051
	P val	.095	.085	.054	.197	.237	.389	.256	.380	.020	.580	.734
	N	47	47	46	46	47	47	47	47	47	47	47
SOC solved in minimum moves	Rho	-.238	-.401(**)	.153	.120	-.142	-.228	-.082	.233	-.168	-.118	-.110
	P val	.104	.005	.305	.422	.334	.120	.578	.111	.254	.423	.458
	N	48	48	47	47	48	48	48	48	48	48	48
Cards played in CPT	Rho	.362(*)	.245	1.000	.296(*)	-.032	-.046	.009	.043	.012	-.025	-.110
	P val	.012	.097	.	.043	.833	.761	.951	.774	.935	.865	.462
	N	47	47	47	47	47	47	47	47	47	47	47

		SWM Between Errors	SWM Strategy score	Cards played in CPT	Premature responses in CPT	Total errors in WCST	Perseverative errors in WCST	Non perseverative errors in WCST	Categories completed in WCST	Trials to first category (WCST)	Failure to maintain test (WCST)	Overall % gamble in CxR
Premature responses in CPT	Rho	.024	.119	.296(*)	1.000	-.100	-.181	-.019	.105	-.039	-.096	-.060
	P val	.872	.425	.043	.	.504	.222	.900	.484	.794	.521	.690
	N	47	47	47	47	47	47	47	47	47	47	47
Total errors in WCST	**Rho**	**.282**	**.096**	**-.032**	**-.100**	**1.000**	**.731(**)**	**.896(**)**	**-.765(**)**	**.468(**)**	**-.110**	**.032**
	P val	**.052**	**.516**	**.833**	**.504**	**.**	**.000**	**.000**	**.000**	**.001**	**.455**	**.830**
	N	**48**	**48**	**47**	**47**	**48**	**48**	**48**	**48**	**48**	**48**	**48**
Perseverative errors in WCST	Rho	.253	.171	-.046	-.181	.731(**)	1.000	.390(**)	-.626(**)	.119	-.082	.119
	P val	.083	.246	.761	.222	.000	.	.006	.000	.421	.581	.419
	N	48	48	47	47	48	48	48	48	48	48	48
Non persev. errors in WCST	**Rho**	**.249**	**.076**	**.009**	**-.019**	**.896(**)**	**.390(**)**	**1.000**	**-.690(**)**	**.595(**)**	**-.103**	**-.030**
	P val	**.088**	**.609**	**.951**	**.900**	**.000**	**.006**	**.**	**.000**	**.000**	**.485**	**.839**
	N	**48**	**48**	**47**	**47**	**48**	**48**	**48**	**48**	**48**	**48**	**48**
Categories completed in WCST	Rho	-.270	-.256	.043	.105	-.765(**)	-.626(**)	-.690(**)	1.000	-.403(**)	-.237	-.147
	P val	.064	.079	.774	.484	.000	.000	.000	.	.005	.105	.320
	N	48	48	47	47	48	48	48	48	48	48	48
Trials to first category WCST	**Rho**	**.290(*)**	**.232**	**.012**	**-.039**	**.468(**)**	**.119**	**.595(**)**	**-.403(**)**	**1.000**	**.048**	**-.093**
	P val	**.046**	**.113**	**.935**	**.794**	**.001**	**.421**	**.000**	**.005**	**.**	**.748**	**.530**
	N	**48**	**48**	**47**	**47**	**48**	**48**	**48**	**48**	**48**	**48**	**48**
Failure to maintain test WCST	Rho	.078	.085	-.025	-.096	-.110	-.082	-.103	-.237	.048	1.000	.209
	P val	.598	.565	.865	.521	.455	.581	.485	.105	.748	.	.155
	N	48	48	47	47	48	48	48	48	48	48	48
Overall % gamble in CxR	**Rho**	**.018**	**.021**	**-.110**	**-.060**	**.032**	**.119**	**-.030**	**-.147**	**-.093**	**.209**	**1.000**
	P val	**.904**	**.888**	**.462**	**.690**	**.830**	**.419**	**.839**	**.320**	**.530**	**.155**	**.**
	N	**48**	**48**	**47**	**47**	**48**	**48**	**48**	**48**	**48**	**48**	**48**

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Key: SWM = Spatial Working Memory
CGT = Cambridge Gambling Task
IED = Intra-Extra Dimensional Set Shift
SOC = Stockings of Cambridge
CPT = Card Playing Task
WCST = Wisconsin Card Sorting Test
CxR = Decision-making Task