Neuropsychological Correlates of Youth Psychopathy

by

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Abstract

This study investigated the neuropsychological correlates of psychopathy among adolescents. Forty-four male offenders between the ages of 15 and 18 were evaluated for level of psychopathy using the Psychopathy Checklist: Youth Version (PCL:YV). The PCL:YV results for the entire sample were then subjected to a Rasch analysis. The sample of youth were also administered a series of neuropsychological measures designed to assess functioning of the prefrontal cortex and hemispheric specialization. A questionnaire designed to assess schizotypy was also administered. All participants were assessed while in custody and had been charged or convicted of a criminal offense. Hypotheses included (1) that the PCL:YV would fit the Rasch model, (2) that youth high on psychopathy would display deficits on executive functioning measures sensitive to processing of the orbital prefrontal cortex (OPFC), but not on measures sensitive to functioning of the dorsolateral prefrontal cortex (DLPFC), (3) that the psychopathic group would display reduced hemispheric lateralization, and (4) that the psychopathic group would display elevations on measures of schizotypy. The results indicated that the PCL:YV does fit the Rasch model, but failed to support either the presence of orbitofrontal dysfunction or reduced laterality among psychopaths. Psychopaths, however, were elevated on the schizotypy measures of Social Anhedonia and Impulsivity-Nonconformity. Results are discussed in terms of the biological and developmental characteristics of psychopathy.

Examiners:

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DEDICATION AND ACKNOWLEDGEMENTS

This dissertation is dedicated my parents and to my sister Michelle.

There are many people who directly contributed to this project and I would like to acknowledge them. Firstly, I would like to thank the young offenders who participated in this study and who answered difficult and personal questions in order to assist me in my research objectives. Secondly, I would like to thank the staff at the custody centres who helped me with the operational aspects of this study. Thirdly, I would like to thank the committee members, Marion Ehrenberg, Catherine Mateer, Max Uhlemann, and Roger Graves, for their input along the way. In particular, I owe a special debt of gratitude to Roger Graves who provided a model from which it was easy to gain inspiration. On numerous occasions he led me to fruitful lines of study and pointed out the "phantom flowers" of research so that they could be avoided. As Zen Master Rinzai said, "I don't care whether you can pour out torrents of eloquence. I don't care whether you display brilliant intellects. All I ask is that you have true and proper understanding…when no clouds block the sun, the beautiful light of heaven shines everywhere. When no disease afflicts the eye, it does not see phantom flowers in the empty air."

On a personal note, I give thanks to my many friends who supported me, laughed with me, and reminded me of the true joys in life. Finally, I want to pay special tribute to a special person. Colleen, thanks for just being you: caring, spirited, loving, and understanding. Lots of KFY!

Introduction

Concepts of Psychopathy

For some time it has been known that a small percentage of offenders are responsible for the majority of offenses. Approximately 5% of offenders commit 50% to 60% of reported crimes (Farrington, Ohlin, & Wilson, 1986). Due to the profound social costs created by these offenders a substantial amount of research has gone into clarifying the personality traits of these individuals. The concept of psychopathy emerged out of this research and it has contributed to the understanding of these frequent offenders. Psychopathy was first described in detail by Cleckley in his book called *The Mask of Sanity* (1941/1976). Cleckley wanted to show that although psychopaths display a facade of normalcy, underneath this veneer is an affective deficit that hinders their capacity for emotional ties to others. In the absence of these emotional ties, the typical human reluctance to use others routinely for one's own ends is removed. A greater likelihood of criminal activity is one result of this deficit. Others have tried to refine Cleckley's conceptualization of the psychopath. Lykken (1957), for example, has argued that it is anxiety and fear specifically that are dysfunctional in the psychopath. This lack of fear and anxiety, he argues, severely limits the utility of punishment cues, which are important in shaping appropriate social behavior. Again, this makes criminal offending more likely.

In spite of the different conceptualizations of psychopathy, certain consistent features have been cited as central to the construct, including a lack of empathy, egocentricity, superficial charm, and dishonesty. Various attempts have been made to unite these traits on a measurable scale. The focus in this study will be psychopathy as

defined by the Psychopathy Checklist - Youth Version (PCL:YV), which is modeled after the Psychopathy Checklist - Revised (PCL-R). The PCL:YV preserves the same 20 items of the PCL-R but has changed the item definitions so that they are suitable for an adolescent population. The PCL, the original version of the PCL-R, was a 22-item scale from which 2 items were removed ("previous diagnosis as a psychopath" and "drug or alcohol abuse not direct cause of antisocial behavior") and some other minor modifications were made to arrive at the PCL-R (see Hare, 2003). There is also a shortened version of the PCL-R called the Psychopathy Checklist - Screening Version (PCL-SV). The PCL-R, and hence each of the related PCL instruments, was developed on the basis of Cleckley's conceptualization of psychopathy (Hare, 2003).

Psychopathy, as defined by the PCL-R, PCL-SV and the PCL:YV, consists of two factors. The first factor is an interpersonal or affective dimension. It includes items related to personality characteristics such as glibness/superficial charm, grandiose sense of self worth, and shallow affect. The second factor consists of items related to an impulsive, antisocial, and unstable lifestyle. Factor 2 rates individuals on characteristics such as poor behavioral controls, parasitic lifestyle, and impulsivity. Recent factor analyses have further subdivided Factor 1 into interpersonal and affective facets and Factor 2 into lifestyle and antisocial facets (Hare, 2003).

The PCL-R is one of the most widespread tools for the measurement of psychopathy; however, other instruments are still used to assess this construct. In general, other personality measures correlate highly with the behavioral component of psychopathy (Factor 2) but poorly with the interpersonal or affective dimension (Factor 1) (Edens, Hart, Johnson, Johnson, & Olver, 2000). Hare reports, for example, that the

Psychopathic Deviate (Pd) scale of the MMPI correlates .11 with Factor 1 and .31 with Factor 2 of the PCL-R (2003). The Antisocial scale of the MCMI-II correlates .24 with Factor 1 and .51 with Factor 2 (Hare, 2003). In other words, these other personality instruments do a better job of assessing the behavioral aspects of psychopathy than the interpersonal and affective aspects.

Psychopathy as a Social Concern

The literature involving the PCL-R indicates that psychopaths begin their criminal activities at an earlier age, that they commit a greater variety of crimes, and that they offend with greater frequency than do non-psychopathic offenders (Hare, McPherson, & Forth, 1988; Hemphill, Hare, & Wong, 1998). They also commit more violent offenses (Kosson, Smith, & Newman, 1990). Salekin, Rogers, and Sewell (1996) conducted a meta-analysis and showed that the PCL-R provided good predictions of general recidivism (Mdn d = .55) and institutional violence and violent recidivism (Mdn d = .79), as measured by Cohen's d (Cohen, 1988). The MacArthur Violence Risk Assessment Study, which has arguably provided the most comprehensive information on violence risk variables to date, found that psychopathy as measured by the Psychopathy Checklist: Screening Version (PCL:SV) was the best indicator of risk for future violence (Steadman et al., 2000). Thus, the literature on psychopaths is quite persuasive in its demonstration of the criminal and violent proclivities of individuals with elevated scores on this construct.

Psychopathy and Conceptual Frameworks of Personality Disorders

Personality has been conceptualized in many different ways. One approach has been to establish a separation between normal and abnormal personality and classify abnormal personality into categorically distinct disorders. This is the approach adopted in the DSM-IV-TR and this approach will be discussed further below. An alternative approach is to conceptualize personality as conforming to certain fundamental dimensions or traits. The so-called trait models of personality have been very influential for their descriptions of personality and their empirical support. The most researched of the trait models is the Five Factor Model (FFM) (see Costa & Widiger, 2001). The FFM evaluates personality according to the following domains: Neuroticism (N), Extraversion (E), Openness to Experience (O), Agreeableness (A), and Conscientiousness (C). Lynam has shown that psychopathic individuals appear to be low in most or all facets of Agreeableness and Conscientiousness (2002). There appears to be little association with Openness to Experience. They have a more complex relationship to the domains of Neuroticism and Extraversion. Within the domain of Neuroticism, the scores of psychopaths appear to be elevated on Impulsiveness and Angry Hostility and low on Anxiety and Self-Consciousness. Within the domain of Extraversion, they appear to be elevated in Excitement Seeking and low in Warmth. The FFM helps to conceptualize psychopathy as a disorder within an overarching framework of personality that describes normal or non-pathological personality styles in addition to clinical or pathological variants.

As mentioned above, the DSM-IV-TR uses a categorical approach and only describes the criteria for personality disorders. The relevance to non-pathological

personality is therefore unclear. Regardless, psychopathy could be included in a categorical personality framework, but at this point it has not been incorporated into the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; American Psychiatric Association, 2000). The diagnosis with the most similar criteria is that of Antisocial Personality Disorder (APD), which is based largely on behavioral descriptors. Hare (1998) has argued that the DSM-IV-TR definition of APD has poor content validity compared to his psychopathy construct and that they should be viewed as distinct disorders. Hare reports that about 90% of psychopathic offenders meet the criteria for APD, while only 25% of offenders given the diagnosis of APD are psychopaths as measured by the PCL-R (1985). In spite of the differences between psychopathy and APD, it is clear that if psychopathy were included in the DSM-IV-TR, it would be included with the Cluster B personality disorders (Histrionic, Narcissistic, Antisocial, and Borderline), which are united by their dramatic and emotional behaviors. Research that relates psychopathy to narcissism (Hart & Hare, 1998), and in females to Histrionic Personality Disorder (Cale & Lilienfeld, 2002), supports the link to the Cluster B personality disorders.

Consistent with the association of psychopathy with cluster B personality disorder types, Lowen (1985) argued that psychopathy could be identified along a dimension of narcissism. He identified psychopathy as somewhat more narcissistic than borderline personality and less narcissistic than paranoid personality. The psychopath, he argued, was characterized by traumatic experiences in childhood that could not be integrated with the developing ego. As a result, the psychopath's impulses to act are executed without the conscious experience that would otherwise serve to temper the behaviors. While

there is insufficient evidence of traumatic experiences such as frank physical abuse, there is limited evidence that parental rejection and inconsistent discipline are associated with the development of psychopathy (Hare, 1970; Marshall & Cooke, 1995).

Although psychopathy is most clearly related to the personality traits that characterize the cluster B dramatic, erratic, and emotional disorders, there is evidence for similarity with other personality styles. For example, a link between psychopathy and schizotypy, a personality disorder that the DSM-IV-TR situates within the "cluster A" odd and eccentric personality disorders, has some research to support it. Schizotypy is a cluster of traits that are similar in many ways to the symptoms of psychotic disorders. These symptoms include ideas of reference, unusual perceptual experiences, and odd beliefs (Vollema & van den Bosch, 1995).

The symptoms of schizotypy can be subdivided into negative and positive dimensions. The former reflects a pattern of social withdrawal and anhedonia, while the latter refer to unusual ideation and perceptual experiences. These two dimensions parallel the positive versus negative symptom complex posited for Schizophrenia (Vollema & van den Bosch, 1995). Ross, Lutz, and Bailley (2002) compared responses on the Wisconsin Scales of Psychosis Proneness, which measures various aspects of schizotypy, with the FFM dimensions and provided evidence that the negative symptoms of schizotypy are characterized by high Neuroticism and low Extraversion, Openness, and Agreeableness. The positive symptoms, they indicate, are characterized by high Neuroticism and Openness and low Agreeableness. According to this analysis, there may be some similarity in the two constructs in that both the positive and negative dimensions of schizotypy appear to relate to higher Neuroticism and lower Agreeableness.

As mentioned previously, within the FFM framework psychopathy appears to be particularly related to low Agreeableness and Conscientiousness (Lynam, 2002). The finding of low Agreeableness in both psychopathy and the positive and negative schizotypy dimensions suggests there may be an association between psychopathy and both aspects of schizotypy. The relationship between schizotypy and psychopathy will be investigated in the present study and although this association would appear to be weaker than between, for example, psychopathy and narcissism, there are reasons, which will be discussed later, to suggest the presence of a link between the two personality styles. In addition, the exploration of the relationship between psychopathy and other personality styles is useful since it helps to situate psychopathy within a larger personality framework.

It is worthwhile considering psychopathy not only within the framework of other personality disorders or dimensions, but also in relation to the multiple influences affecting its emergence. As with all the personality disorders, the etiology of psychopathy is likely to involve a complex and reciprocal relationship between genetics and environmental influences. For this reason a model that illustrates these influences is needed. Siever, Koenigsberg, and Reynolds (2003) provide such a model of personality development, one that can usefully be applied to psychopathy. Figure 1 demonstrates how genetics, the intrauterine environment, and interpersonal interactions all combine to impact and shape the neurobiology of the individual. These influences structure the personality of the individual, including their psychological makeup and behaviors. Underneath each of the headings are some of the factors with suggested or demonstrated relevance to psychopathy.

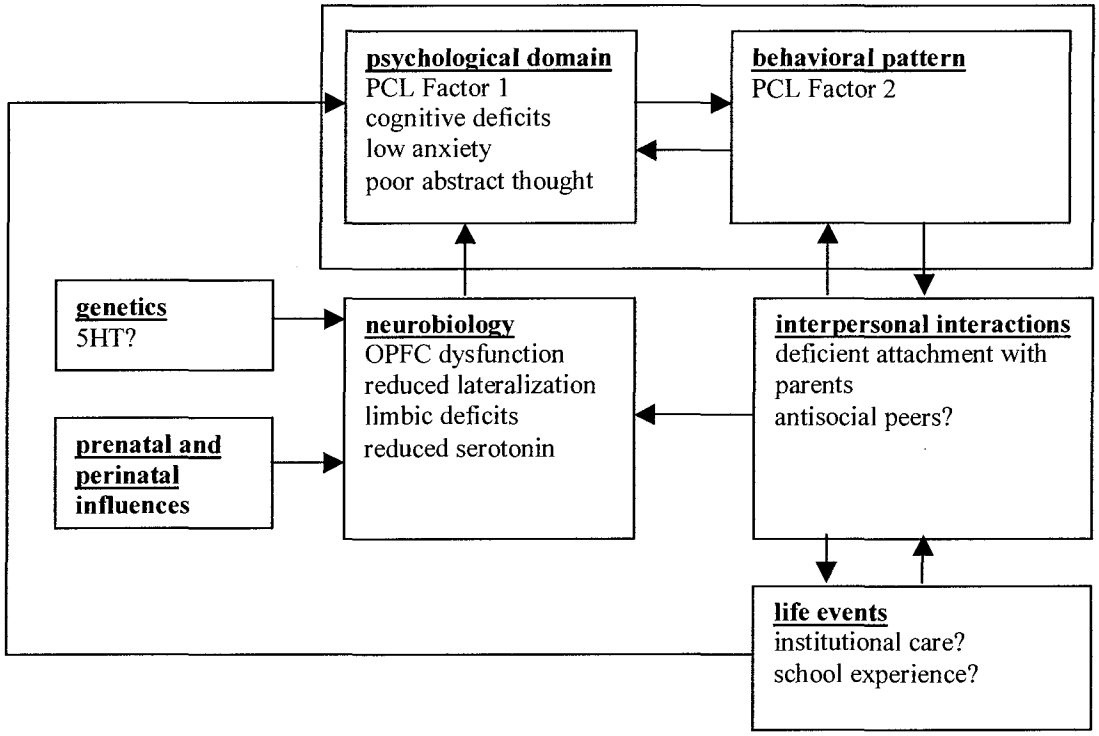

Figure 1. A model of personality development and its influences, with specific reference to psychopathy.

The genetics of psychopathy remains unclear. However, it is probable that multiple genes are involved and that they code for particular traits of psychopathy such as impulsivity. The trait irritable impulsiveness, for example, has been demonstrated to be strongly heritable (Coccaro, Bergeman, & McClearn, 1993). Since the neurotransmitter serotonin (5-HT) has been repeatedly linked to impulsive aggression and to the orbital prefrontal cortex (OPFC) (Siever, Koenigsberg, & Reynolds, 2003), the genes that code for its functioning may play an important role in psychopathy. Environmental factors may modify this genetic contribution as gene expression responds to particular environmental stressors. The role of the environment is broad and includes pre and peri-natal influences in addition to key developmental variables such as attachment to the

primary caregivers and peer group influences. The specific impact of pre and peri-natal factors on psychopathy remains unclear. However, both genetics and intrauterine factors may be expected to exert their influence through the neurobiology of the individual. Moreover, given the delayed maturational period of the prefrontal cortex, these influences likely operate throughout childhood and well into adolescence.

Interpersonal interactions can also be expected to exert an influence on the neurobiology of the individual. Specifically, attachment to the primary caregiver has been postulated to influence the development of the OPFC region of the brain (Schore, 1996). The OPFC is highly interconnected with the limbic system and this network is strongly involved in emotional experience and expression. In the absence of a meaningful and secure bond with the primary caregiver, this region of the brain may be adversely affected, contributing to emotional dysregulation and disinhibited behaviors. Parenting likely contributes to the development of psychopathy as well through modeling and in support of this point psychopaths often have an antisocial parent (Marshall & Cooke, 1995). Peers are also likely to play an important formative role in the development of personality. While peer influences have not been specifically examined in psychopathy, they have been shown to play an important role in conduct disorder (Heinze, Toro, Urberg, & Toro, 2004).

The interaction between the caregivers and the child's personality and temperament is reciprocal and, in the case, of psychopathy it may be that the narcissism and novelty-seeking temperament tends to elicit harsher disciplinary approaches from the caregivers. Such a disciplinary approach would affect attachment to the caregivers and perhaps lead to a greater sense of mistrust from the child. Meloy (1988) argues that it is

the psychopath's lack of trust that interferes with the internalization of parental images and, in turn, superego development. The inadequately developed superego increases the likelihood of breaches of social norms. There is also evidence that the parents of antisocial children have problem-solving difficulties (Fagot, Gauvain, & Kavanagh, 1996) and this executive function deficit might contribute to the child's own cognitive limitations through modeling behavior and/or an underlying genetic influence.

As the child develops, his/her cognitive processing of the environment plays an increasingly important role. As will be discussed in detail in the following sections, some research supports the presence of deficits among psychopaths in the functioning of the prefrontal cortex and in the functional lateralization of the cerebral hemispheres. Deficits in certain regions of the prefrontal cortex are not only likely to lead to disinhibited and thrill-seeking behaviors that will challenge the patience of the caregivers, but also to judgment impairments which limit the child's understanding of parental decisions and punishment. In a similar vein, given that the left hemisphere is dominant for most aspects of language and the right hemisphere appears to be particularly important to the generation of emotional arousal (Lezak, 1995), a change to the relationship between the hemispheres may alter the processing and expression of emotions and perhaps hinder the development of empathy.

In addition to the deficits in impulse control and verbal processing that are key aspects of the present study, some research indicates that psychopaths have difficulty processing abstract words and this may represent one aspect of a larger deficit in abstract verbal thought (Kiehl, Smith, Mendrek, Forster, Hare, & Liddle, 2004). Piaget claimed that abstract thought was a crucial developmental accomplishment during adolescence

and comprised the 'formal operations' level, in which reasoning was conducted in relation to verbal hypotheses (1926). The internalization of abstract social mores is central to the maintenance of normative behaviors and a failure in comprehending the verbal transmission of these social rules may be another contribution to the development of psychopathy. Support for this theoretical explanation is provided by research indicating that childhood aggression is related to verbal processing deficits (Brownlie et al., 2004).

Overall, these cognitive characteristics are expressions of the neurobiology of the individual and they have a reciprocal relationship with behavior. On the one hand, the psychological domain, which includes Factor 1 traits, increases the likelihood of engaging in risky behaviors. On the other hand, those behaviors, which include Factor 2 tendencies, in turn exert their own influences on the psychological domain. For example, one can see how a deficit in executive functioning involving poor judgment could contribute to experimentation with drugs and how such experimentation could further impair the individual's sense of judgment.

Clearly the path to psychopathy and antisocial behavior is determined and perpetuated by multiple influences. The research group at the Oregon Learning Center has conducted numerous studies investigating many of the interactional influences outlined in Figure 1. While they do not specifically address psychopathy, they argue that there are different paths to offending, an early-onset course and a late-onset course (see Patterson & Yoerger, 2002). This is similar to Moffitt's classification of youth into "life-course-persistent" and "adolescent limited" types (1993). It is clear that the majority of psychopaths would fall into the early-onset trajectory. In general, the two trajectories are

similar in many respects as both are contributed to by divorce, poverty, the child's coercive behaviors (e.g., kicking, fighting etc.) negatively reinforcing a harsh response from the parent, and deviant peer contacts. However, Patterson and Yoerger (2002) indicate there are some differences in the severity and impact of these experiences. The parents of the early-onset trajectory youth tend to be more ineffective in their disciplinary practices and are more often antisocial and unemployed. There is also a tendency for youth from this trajectory to have lower socioeconomic status and to be cared for by parents who experience more frequent marital transitions. Finally, it has been shown that youth who follow this trajectory tend to have less social skills and more disrupted peer relations as assessed by parent and teacher ratings (Patterson & Yoerger, 1997). Overall, they argue that the child's interactions, particularly with parents and peers, are key in the development of antisocial behavior and one would expect that the child's cognitive functioning would be an important mediator in those relationships.

Thus, psychopathy is usefully conceptualized in terms of its relationship with other personality disorders and in terms of the multiple influences that contribute to its emergence. While aspects of the aforementioned models of personality and its development may eventually be related to biological correlates, some models of personality are more directly informed by the biological underpinnings of personality. Such models can help to shed light on the specific neurobiological factors that may be dysfunctional in psychopathy.

Psychopathy and Neurobiological Frameworks of Personality Disorders

In addition to the above frameworks of personality based on factor analysis (FFM) or the consensus of a clinical task force (DSM-IV-TR), other frameworks consider personality in terms of its neurobiological basis. Research is quite limited in this area making it difficult to validate the utility of the models. One model will be presented here to help clarify the position of psychopathy in relation to the other personality disorders. Robert Cloninger presents a two-fold model of personality based on temperament and character, the framework of which is displayed in Table 1. Temperament can be divided into four subcategories and character into three subcategories and therefore the model is called the "Seven Factor Model of Personality." Cloninger defines temperament as "the automatic associative responses to basic emotional stimuli that determine habits and skills" (1998, p.64). Character is defined as "the self-aware concepts that influence our voluntary intentions and attitudes" (1998, p.64). Temperament is developed very early in life through associative habit learning and likely involves older, non-neocortical brain structures, while character develops over the lifespan and relies on hippocampal and neocortical brain structures. Character traits are thought to reflect the presence and severity of a personality disorder, while temperament identifies the specific personality disorder.

Research suggests that individuals with Antisocial Personality Disorder have high novelty seeking and low self-directedness and cooperativeness (Svrakic, Draganic, Hill, Przybeck, & Cloninger, 2002). These aspects of Antisocial Personality Disorder are also associated features of psychopathy. The temperament aspect of "novelty seeking" is captured by the "stimulation seeking" item on the PCL:YV. The low results on self-

directedness reflect the lack of long-term goals and the difficulty accepting responsibility that is a common feature in individuals with APD and psychopathy. In the dimension of character, cooperativeness is low. This is not especially surprising since APD and psychopathy are associated with a tendency to betray the allegiance of others.

Research has been conducted on the neurobiological correlates of the temperament subtypes, but similar research has not been done for the character subtypes. Nevertheless, predictive hypotheses concerning APD and psychopathy can be drawn from the research on the temperament subcategories. Novelty seeking, which is strongly related to thrill seeking, argumentativeness, and impulsivity, is associated with the neurotransmitter dopamine and the brain structure nucleus accumbens (Cloninger, 1998). The nucleus accumbens is one part of a network, which includes the OPFC, involved in motivation, emotion, and social behavior and dopamine is one of the key neurotransmitters in this system (Cardinal, Parkinson, Hall, & Everitt, 2002). Behaviorally, novelty seeking is associated with hyperactivity and substance abuse, both of which are common features of psychopathy. It comes as a surprise that persistence was not positively associated with APD since one would expect psychopaths to be elevated on this domain of personality given they have difficulty disengaging from a previously rewarded response (Mitchell, Colledge, Leonard, & Blair, 2002). Persistence has also been anatomically linked with dysfunction in the OPFC and with the neurotransmitter serotonin (Cloninger, 1998). Psychopathy has been associated with serotonin in a complex way. Based on limited research, it appears that the impulsive and antisocial component of psychopathy is associated with a deficiency in serotonin, while

the arrogant and deceitful component displays a positive association with the neurotransmitter (Dolan & Anderson, 2003).

Table 1
The Seven Factor Model of Personality

			Results for Individuals with APD
Personality	Temperament	Harm avoidance	____
		Novelty seeking	High
		Reward dependence	____
		Persistence	____
	Character	Self-directedness	Low
		Cooperativeness	Low
		Self-transcendence	____

Personality Disorders in Adolescents

The diagnosis of personality disorders in children and adolescents is a contentious topic. A diagnosis of Antisocial Personality Disorder (APD) cannot be made until an individual is 18 years of age. Anyone less than 18 who meets all of the criteria, other than the age restriction, for APD would be given a diagnosis of Conduct Disorder (CD). However, Conduct Disorder is not considered a personality disorder and rightly so since it has been estimated that approximately 50% of CD children and adolescents neither retain this diagnosis nor progress to APD in adulthood (Robins, 1978). The DSM-IV-TR (American Psychiatric Association, 2000) makes the following recommendation regarding the diagnosis of personality disorders in adolescents and children:

> "Personality Disorder categories may be applied to children or adolescents in those relatively unusual instances in which the individual's particular maladaptive personality traits appear to be pervasive, persistent, and unlikely to be limited to a particular developmental stage or an episode of an Axis I disorder. It should be recognized that the traits of a Personality Disorder that appear in childhood will often not persist unchanged into adult life. To diagnose a Personality Disorder in an individual under age 18 years, the features must have been present for at least 1 year" (p.687).

Caution must therefore be exercised in the diagnosis of a construct that conveys a sense of permanence and intractability. The risk in diagnosing a personality disorder in children or adolescents is that it could convince parents, or mental health professionals, if not also the child or adolescent, that the relevant behavior problems and personality traits are fixed and irremediable. This has the potential of being especially damaging when the diagnosis is psychopathy, since it has strong negative associations. The applicability of psychopathy to adolescents hinges on the stability of personality and there is evidence that personality, as measured by the FFM structure, is replicated in studies with children and adolescents (De Fruyt, Mervielde, Hoekstra, & Rolland, 2000). Roberts and DelVecchio (2000) also provide evidence that the stability coefficients for the five factors of personality from ages 12-17 are in the moderate to large range. It is also important to note that a failure to investigate the early presence of psychopathy prevents the possibility for the introduction of successful interventions.

Psychopathy in Adolescents

Although some degree of caution is certainly warranted in applying the psychopathy construct to children and adolescents, it is probable that traits and behaviors of psychopathy begin in childhood (Frick, 1998; Lynam, 1996). Since some of the PCL-R items are only applicable to an adult population an assessment tool to aid in identifying psychopathy in adolescents was necessary. A number of attempts have been made to modify the PCL-R to enable its use with an adolescent population. Forth, Hart and Hare (1990) deleted two items from the PCL-R (item 9 - parasitic lifestyle, item 17 - many short-term marital relationships) and validated the resulting 18-item scale on an adolescent forensic population. Recently, a more careful modification of the PCL-R has been developed for use with a youth forensic population. It is known as the Psychopathy Checklist: Youth Version or PCL:YV (Forth, Hare, & Kosson, 2003).

The PCL:YV makes modifications to many of the items on the PCL-R in order to take into account the limited life experiences of adolescents. Based on the studies that have been done on this instrument so far, it appears to have good internal consistency and interrater reliability (Forth & Burke, 1998). Like the PCL-R, the PCL:YV indicates that youth who score high on the psychopathy scale commit a greater number of offenses, start criminal activity at a younger age and commit a greater variety of offenses. The asymmetry that exists between the ratios of APD to psychopathy in the adult population, appears to hold in the youth population as well with approximately 30% of CD offenders meeting the criteria for psychopathy, while all of the youth psychopaths met the criteria for CD (Forth & Burke, 1998).

The crucial factors involved in the development of psychopathy during childhood and adolescence remain unclear. However, a number of important family variables have been shown to correlate with psychopathy. Hare (1970) found that parental substance abuse and the combination of a parent with antisocial traits and inconsistent discipline were related to the development of psychopathy. One study using regression analysis indicated that 70% of PCL-R total scores could be predicted by the combination of three variables: poor discipline, poor school experience, and parental rejection (Marshall & Cooke, 1995). Inconsistent discipline in particular contributed 26% of the variance in Factor 2 scores. However, others have not found any evidence of family dysfunction being related to psychopathy (DeVita, Forth, & Hare, 1990).

The discrepant findings may be due to variability in self-reports and/or to actual heterogeneity in the psychopathic population. Nevertheless, there is some indication that parental alcoholism, inconsistent discipline, having an antisocial or psychopathic parent and a lack of supervision are all associated with the development of psychopathy.

The Psychopathy Checklist and its Psychometric Properties

Extensive research has been conducted on the psychometric properties of the PCL-R and its reliability and validity have been clearly demonstrated (Hare, 2003). Given the relatively minor changes to the PCL:YV and the stability of personality, major psychometric problems would not be expected. Indeed, the technical manual of the PCL:YV confirms the good reliability and validity of this instrument (Forth, Hare, & Kosson, 2003). The psychometric properties of both instruments will be presented in the following section for comparison purposes.

Internal Consistency

Cronbach's alpha for the PCL-R was .85 (Hare, 2003). Results for the PCL:YV were identical with an alpha value of .85 for an institutionalized sample (Forth, Hare, & Kosson, 2003).

Inter-Rater Reliability

The PCL-R has been shown to have very good reliability. Hare (2003) reported very good interrater reliability with intraclass correlation coefficients (ICC) across four inmate samples that ranged from .78 to .89. Alterman, Cacciola, and Rutherford (1993) reported very good test-retest reliability in a group of 10 prisoners across a 1 month interval (r=.84). Forth, Hare, and Kosson (2003) reported an ICC of .93 for one-rater on the PCL:YV and .96 for two raters.

Factor Structure

The PCL-R has been shown to have a very stable factor structure. As shown in Table 2, it is composed of two factors and four facets (Hare, 2003).

Table 2
Factor Structure and Items for the PCL:YV

Total PCL:YV Score	Factor 1 Interpersonal and Affective	Interpersonal	Items: 1,2,4,5
		Affective	Items: 6,7,8,16
	Factor 2 Behavioral and Antisocial	Behavioral	Items: 3,9,13,14,15
		Antisocial	Items: 10,12,18,19,20

Factor 1 contains items relevant to personality traits and in particular the selfish, callous, and remorseless use of others. Factor 2 relates to behavioral or lifestyle qualities and in particular an unstable, antisocial and deviant lifestyle. Factor 2 scores have better correlations with criminal behavior (>.3) than Factor 1 scores (<.2) (Hare, 2003). The facets then further subdivide these two factors into interpersonal and affective dimensions for Factor 1 and behavioral and antisocial dimensions for Factor 2.

Diagnostic Issues: Sensitivity and Specificity

Psychopathy is often defined as a PCL-R total of 30 or more. Hare (2003) reports that this cut score produces a sensitivity of .72 and a specificity of .93. However, other researchers have used a cut score of 25 arguing that 30 and above is excessively stringent and that this lower threshold is especially appropriate in research studies (Harris, Rice, & Cormier, 1991). A taxometric analysis of the PCL-R suggests that this lower cut score produces a relatively "pure" sample (Harris, Rice, & Quinsey, 1994). The threshold for the determination of psychopathy is likely influenced by the means of arriving at the scores (file review vs. interview and file review) and various other individual factors (e.g., gender, race etc.). The PCL:YV has avoided providing a cut score because of concerns about whether psychopathy is best conceptualized as a category or taxon and because of limited research on the stability of psychopathy from adolescence into adulthood.

Predictive Validity

Although not explicitly designed to predict criminal behavior, the PCL-R has been demonstrated to be a robust predictor of recidivism and violent recidivism (see

Hare, 2003). Recent research has also indicated that the PCL:YV predicts both nonviolent and violent offenses (Gretton, Hare, & Catchpole, 2004).

Stability

The PCL-R appears quite stable through early adulthood, but there may be a reduction in the level of psychopathy in older adulthood. In particular, after the age of approximately 40 there does appear to be a decline in PCL-R total scores and this is especially related to an effect on Factor 2 (Harpur & Hare, 1994). Scores on the PCL:YV, as mentioned above, appear to be a stable measure of violent recidivism among youth.

Item Response Theory Analyses

Although an Item Response Theory (IRT) analysis has not been done for the PCL:YV, Cooke and Michie (1997) used IRT to analyze the PCL-R normative data. Their analysis indicated that all of the items meaningfully related to the underlying trait. Overall, the items from Factor 1 were found to be more central to the latent trait than the items from Factor 2. The Factor 1 items carried more information about the psychopathy construct and were more likely to be discriminant at higher levels of the latent trait. An IRT analysis of the PCL:SV indicated that it has statistical properties similar to the PCL-R and that it can be considered a short or parallel form of the PCL-R (Cooke, Michie, Hart, & Hare, 1999). Rasch Scaling analysis, which is the one-parameter logistic model of IRT, has never been conducted on any of the PCL scales. A Rasch analysis would clarify whether the PCL:YV fits the Rasch model and the extent to which its items successfully assess the construct across its entire range. One would anticipate, given that the PCL-R has been supported by IRT, and given the similarities between the PCL-R and

the PCL:YV, that the latter would fit the Rasch model. Since the two and three parameter IRT models require large samples (Nunnally & Bernstein, 1994), the one-parameter model provides the only IRT analysis option for the present study.

The Prefrontal Cortex

Subdivisions

Cummings has argued that 5 circuits can be distinguished in the human prefrontal cortex (1993). Two of these are particularly pertinent for this study: the dorsolateral circuit and the orbitofrontal circuit. These circuits follow distinct pathways from their respective region of the prefrontal cortex to a region of the striatum to portions of the thalamus and then back to the original location in the prefrontal cortex. Damage to either of these circuits tends to produce characteristic cognitive impairments and emotional or personality changes.

The dorsolateral region is typically considered to include Brodmann's areas 8,9,10 and 46 (Fuster, 1997). It has connections with the mediodorsal nucleus of the thalamus. Cognitive deficits associated with damage to the dorsolateral prefrontal cortex (DLPFC) consist of those relating to executive functions such as temporal ordering, cognitive flexibility, planning and learning from experience (Lezak, 1995). It is considered particularly specialized for the on-line retention of information for the purpose of a planned action or the monitoring of an expected action. Although individuals with damage to this region often perform within normal limits on tests of intelligence, they may show profound impairments on conventional tests of executive functioning such as the Wisconsin Card Sorting Test and the Tower of London (Milner,

1963; Dagher, Owen, Boecker, & Brooks, 1999). These individuals are often concrete in their thinking and show a tendency to perseverate. They are clinically referred to as "pseudodepressed" since their lack of spontaneity, psychomotor retardation and environmental disregard make them appear depressed to others (Duffy & Campbell, 1994). However, they do not display the resistance to requests for their involvement in activities, nor the pattern of cognitive distortions that is often observed in the truly depressed individual.

In contrast, individuals with damage to the orbitofrontal region of the brain may present with a range of symptoms including disinhibition, obstinacy, aggressive outbursts, jocularity and a lack of sensitivity to the sentiments of others. This constellation of symptoms occurring subsequent to damage to the OPFC has been termed "pseudopsychopathy" because of its impulsive and seemingly callous aspects. The cognitive presentation of this syndrome is chararacterized primarily by errors due to impulsive responding. Errors of commission are more common, for example, than errors of omission on neuropsychological measures. It has been argued that within the orbitofrontal region it is the medial portion, sometimes called the ventral-medial frontal region (VMF), that is particularly important for this "pseudopsychopathic" presentation (Damasio, 1994).

Anatomically, the orbital region has been defined according to Brodmann's areas as including the caudal portion of area 13, area 14 medially, as well as regions of the inferior convexity including area 12 caudally and area 11 anteriorly (Rolls, 1999). The OPFC has extensive connections with the limbic system and in particular the amygdala. The amygdala is known to be important for fear responses. The orbital region is

generally involved in the elaboration and synthesis of the emotional and appetitive drive states associated with the limbic system. It is therefore not surprising that damage to this region leads to emotional changes.

The OPFC has been implicated in the processing of a number of different senses including taste, touch, and smell. In each case the role of the OPFC appears to convey the reward value of the particular stimulus to other regions of the brain and because of its role in the attribution of value to sensory stimuli it is sometimes referred to as secondary cortex (Rolls, 1999). Specific cells in the taste cortex of this region, for example, will continue to respond to the taste of food only until the animal is fed to satiety at which time they stop (Rolls, Sienkiewicz, & Yaxley, 1989). Neurons in the primary taste cortex, in contrast will continue to respond after satiety has been reached. Cells in the olfactory portion of the OPFC also show diminished responding after a monkey is fed to satiety (Critchley & Rolls, 1996). It appears, therefore, that damage to the OPFC can affect the reward value of stimuli without affecting the sensory detection of those same stimuli. However, in the case of olfaction it must be kept in mind that the olfactory nerve runs along the OPFC. Hence, damage to this region of the brain may not only affect the pleasurableness of smell but also odour detection. As will be mentioned later, there is an indication that psychopaths have impaired odour detection (Lapierre, Braun, & Hodgins, 1995).

Development and Associated Cognitive Processes

The prefrontal cortex (PFC) is, in many respects, one of the last regions of the brain to develop. Myelination of this region continues into adolescence (Stuss, 1992). Other important changes, such as dendritic growth and dopamine levels, occur during

childhood but stabilize before adolescence (Fuster, 1997). EEG patterns suggest that CNS changes occur in periods, the first occurring between birth and 2 years, the next between 7 to 9 years, and the a final change during adolescence (Thatcher, 1991). This stepwise progression of PFC development also receives some support from neuropsychological data on executive function.

The development of executive functions also suggests a protracted course relative to cognitive abilities subserved by other regions of the brain. Levin et al. (1991) administered a battery of executive function measures to children and adolescents. They then factor analyzed the battery and concluded that there were three identifiable factors. Factor 1 was contributed to by semantic association and concept formation and Factor 3 related to problem solving. Both of these factors showed stage-like changes that were evident into adolescence (13 - 15 years). Factor 2, related to impulse control and mental flexibility, appeared to reach adult levels by age 12. Others have also argued that some higher-level executive functions, such as verbal fluency and planning, do not mature until adolescence (Welsh, Pennington, Groisser, 1991). It is clear that the PFC is still in a stage of development during adolescence and hence comparisons between adolescents on executive function measures need to be very sensitive to age.

While there has been little research thus far into the cognitive and neuroanatomical correlates of psychopathy in adolescence, a considerable literature has been conducted in this field with the adult population. This research has attempted to elucidate the neural processes underlying this personality style. Executive function deficits and reduced hemispheric asymmetry are two of the neurological findings that stand out in this research.

Research from the Neural Sciences

Evidence for Frontal Lobe Dysfunction

There is increasing evidence that damage to frontal regions of the brain can be associated with antisocial, criminal and violent behavior (Eslinger & Damasio, 1985; LaPierre et al., 1995). This association has been investigated in two somewhat distinct populations: (1) a population of individuals with acquired injuries to the brain due to various causes such as tumors and traumatic brain injuries and (2) criminal offenders, including psychopaths.

One theory has proposed that those individuals with acquired damage to the ventral-medial region of the prefrontal cortex (VMF) share many features with antisocial and psychopathic individuals (Damasio, 1994). Individuals with damage to the VMF region, unlike controls and those with damage to other regions of the frontal lobes, do not display a change in skin conductance in response to emotionally significant stimuli (Tranel & Damasio, 1994), although more recent findings challenge this finding (Zahn, Grafman, & Tranel, 1999). Psychopaths also display reduced autonomic activity in response to fear and anxiety provoking situations (Hare, 1978).

Another characteristic of those with VMF damage is poor and illogical decision-making (Satish, Streufert, & Eslinger, 1999). It has been speculated that this problem arises because individuals with damage to these areas have difficulty eliciting the feelings based on previous experience that guide reasoning in the present. In other words, there is a deficit, presumably due to VMF damage, which prevents the incorporation of somatic information into decision-making. Damasio has called this theory the "somatic marker hypothesis" (1994). He argues that individuals who sustain damage to this region of the

brain become disinhibited, obnoxious, and display many antisocial traits. For these reasons, Damasio labels this syndrome "acquired sociopathy".

While a variety of authors have suggested that psychopathy specifically might be associated with frontal lobe dysfunction (Lapierre et al., 1995; Roussy & Toupin, 2000), to this point there has been very limited direct evidence of this presented (e.g., autopsy or functional or structural imaging data). Instead, the majority of the evidence in the research literature is indirect and is based on similarities between personality and cognitive patterns of psychopaths and patients with frontal damage. Clincally, psychopathy appears to bear only a limited resemblance to 'acquired sociopathy', the latter lacking the predatory, manipulative and scheming qualities that are often in evidence in the psychopath. One recent article did not find support for the somatic marker hypothesis in psychopaths (Schmitt, Brinkley, & Newman 1999). In this study, a gambling task was used in which participants are presented with four decks of cards. Cards from the first two decks yield large rewards and large and unpredictable punishments while the latter two decks yield smaller rewards and smaller and more predictable punishments. Controls in this task will quickly become risk averse and recognize that the cost-to-benefit ratio is better in more conservative gambling, while the VMF patients continue to gamble with the first two decks. Psychopaths, however, did not perform differently than controls on this same task in the Schmitt et al. study. The authors speculate that one reason for this nonsignificant finding may have been that they used an older version of the gambling task and therefore did not include instructions stating the comparative value of each of the decks. Perhaps this led to some confusion about the meaning of the task and as a result the nonsignificant findings. Regardless of

the reason for the failure to detect impairment on the VMF associated gambling task, it is clear that psychopaths have neurocognitive deficiencies that are not identical to those seen with acquired damage to the brain.

One might expect there to be anatomical differences between psychopaths and "acquired sociopaths" solely on the basis that since psychopathy appears to be a stable personality trait that begins in adolescence or earlier, it may reflect a developmental dysgenesis that is distinct from the gross anatomical changes that occur with acquired insults to the brain. In further support of this difference is the simple fact that the individual with adult-onset prefrontal damage rarely displays violent or criminal behavior, although antisocial traits do appear to be greater if the damage occurs early in life (Anderson, Bechara, Damasio, Tranel, & Damasio, 1999). Furthermore, as will be discussed, it appears that psychopaths have neural deficiencies in regions beyond the PFC.

One of the primary indirect links between psychopathy and frontal lobe function concerns executive functioning. It has been observed that frontal lobe damage often leads to impairments in executive functioning (Lezak, 1995). Thus several studies have looked for evidence of executive function impairment in the psychopath population. Many additional studies have also investigated this possibility in the larger criminal population. The evidence for executive function impairments in the general criminal population has not been consistent (Hawkins & Trobst, 2000). Similarly, neuropsychological research investigating executive functioning in psychopaths has also provided conflicting results. While some researchers have found psychopaths to be deficient on executive function measures (Gorenstein, 1982), others have not (Hare,

1984). A recent meta-analysis of the relationship between antisocial behavior, which included psychopathy, APD and Conduct Disorder (CD), and executive functioning impairments found an effect size of .62 (Cohen's d) (Morgan & Lilienfeld, 2000). An effect size of this magnitude is considered to be in the medium to large range (Cohen, 1988). However, when this effect size is converted to percent non-overlap the result appears less impressive. Percent non-overlap is the percentage of combined area of both populations that is non-overlapping. The effect size for executive function impairments in psychopaths (d=.62) equals about 62% non-overlap (Cohen's U_2). Thus, the top 38% of psychopaths have executive function measures as high as the lower 38% of non-psychopaths. One may argue that, for clinical purposes, a 62% expected correct diagnostic classification is an insignificant improvement over chance (50%) level. A major problem with this meta-analysis is that it coalesced studies that measured both psychopathy and executive functions in a variety of ways. This is a highly questionable procedure given that the correlation between the PCL and other instruments used to measure psychopathy is often low (Hare, 1985). A review of the published neuropsychological studies of psychopaths, as measured by the PCL/PCL-R, is included in Table 3. Four of these studies were conducted on adult forensic populations and one study was conducted on a youth forensic sample. The effect sizes reported in the table were calculated based on the statistics provided in these published studies.

Table 3 Sample Characteristics and Effect Sizes of Previous Studies using the PCL/PCL-R

Reference	Groups and PCL-(R) distinctions	Mean Age	Sample Size	Measures	Estimated Population Effect Sizes (d) of EF measures
Hare (1984)	High (≥33)	30.2	n1=14	WCST, Necker Cube, SMMT	WCST(PE) = .26
	Medium (21-32)	30.3	n2=16		Necker = .05
NB: used the 22-item PCL	Low (<21)	34.7	n3=16		SMMT = .08
Hart, Forth, and Hare	Study 1:			TMT, COWAT, VRT, AVLT, VOT,	Study 1:
(1990)	High (≥30)	30.8	n1=22	Vocabulary & Block Design (WAIS-R),	COWAT = .07
	Medium (20-29)		n2=41	WRAT-2 Reading	TMT(B) = .63
	Low (<20)		n3=27		
	Study 2:				Study 2:
	High (≥30)	29.8	n1=32		COWAT = .26
	Medium (20-29)		n2=95		TMT(B) = .04
	Low (<20)		n3=40		
Smith, Arnett, and	High (≥30)	25.8	n1=37	Block Design, Digit Span, COWAT,	Low Anxiety:
Newman (1992)	Low (≤20)	25.9	n2=32	Finger Tapping Test, Paired Associate	*COWAT = .19
				Learning, Short Category Test (Booklet	Stroop Time = .59
				Format), Stroop Color-Word Test, TMT	*Stroop Errors = .14
					TMT(B) = .88
					High Anxiety:
					*COWAT = .59
					*Stroop Time = .16
					*Stroop Errors = .06
					*TMT(B) = .51
LaPierre, Braun, and	High (≥30)	33.47	n1=30	Go/No-Go Discrimination Task, PMT,	MST = .87
Hodgins (1995)	Low (≤20)	32.47	n2=30	MST, WCST, Mental Rotation Task	PMT (Q) = 1.49
					Go/No-Go (CE) = 2.03
					WCST(PE) = .48
Roussy and Toupin (2000)	High (≥30)	16.7	n1=25	Go/No-Go Discrimination Task, PMT,	MST = .01
	Low (<20)	16.6	n2=29	MST, WCST, COWAT	PMT (Q) = .51
					Go/No-Go (CE) = .64
NB: used the PCL-R with a					WCST (PE) = .03
youth sample					COWAT = .2

AVLT - Auditory Verbal Learning Test, CE - Commission Errors, COWAT - Controlled Oral Word Association Test, MST - Modular Smell Test, PMT (Q) - Porteus Maze Test (Qualitative Score), SMMT - Sequential Matching Memory Task, TMT(B) - Trail Making Test - Part B, VOT - Visual Organization Test, VRT - Visual Retention Test, WAIS - Wechsler Adult Intelligence Scale, WRAT - Wide Range of Achievement Test, WCST (PE) - Wisconsin Card Sorting Test (Perseverative Errors); * indicates an effect size in an unpredicted direction such that psychopaths performed better than nonpsychopaths. All effect sizes are calculated between high and low groups.

As seen in Table 3, few studies have examined neuropsychological differences in psychopaths as measured by the PCL. In 1984, Hare used the Wisconsin Card Sorting Test, the Necker Cube and a sequential matching memory task believed to measure sustained attention with high, medium and low groups of psychopaths. All measures were interpreted as related to frontal lobe function. Hare found no differences between the groups even after conducting separate analyses with alcohol and drug use acting as covariates in one set and education, age and IQ as covariates in a second set. On the basis of these results Hare concluded that there was "little support for the position that psychopaths have specific cognitive deficits in the processes associated with frontal lobe functioning" (p.139).

Hart, Forth, and Hare (1990) have criticized the "brain-damage models of psychopathy," primarily for lacking methodological rigor (p.374). Many previous studies, they claim, were flawed because of inflated Type I error rates, the failure to take into account the effects of age, education, and substance abuse on test performance and the failure to use psychopathy measures with demonstrated reliability and validity. They then examined two different samples (Ns = 90 and 167), each divided into three levels of psychopathy. A multivariate analysis of variance was nonsignificant in both samples, as were all of the analyses of variance.

Smith, Arnett and Newman (1992) divided their subjects into high and low anxiety group and then within each of these groups they further subdivided the sample into high and low psychopathy subgroups. Their low anxious psychopathy group performed poorly on the Trail Making Test (part B) and on Block Design from the WAIS-R. The high anxious psychopathy group performed poorly on the Controlled Oral

Word Association Test and on the Trail Making Test (part B). There was therefore little evidence of the utility of dividing groups based on anxiety. They did not find evidence of a global impairment on executive function measures, which included the Controlled Oral Word Association Test and the Stroop Color/Word Test.

A study similar to the present investigation was that of Lapierre et al. (1995). They aimed to show that psychopaths were more impaired on tasks related to OPFC functioning as opposed to DLPFC functioning. Consistent with expectation, they found significant differences between their high and low psychopathy groups on measures purportedly related to OPFC functioning (Modular Smell Test, Porteus Maze Test, and a Go/No-Go task) but no differences on their putative DLPFC measure (Wisconsin Card Sorting Test). As seen in Table 3, the most discriminating measure was commission errors on a go/no-go task in which the images appeared on a computer screen and the participant had to press the spacebar as fast as possible to white squares and to withhold responses to white crosses. After a strong response habit was formed the conditions were switched so that the participant had to press when crosses appeared and withhold a response when the squares appeared. Commission errors are thought to be sensitive to an impulsive response style (Halperin, Sharma, Greenblatt, & Schwartz, 1991). The Porteus Maze Test (PMT) was also successful at discriminating between groups. The relevant score for the PMT was the Qualitative Score, which consists of pencil lifts and wall traversals and also presumably measures impulsivity.

Roussy and Toupin (2000) used measures almost identical to those in the Lapierre et al. (1995) study. Their most significant result was also on the Go/No-Go discrimination task; however, it was a considerably smaller effect size than observed in

the adult population. In general, the effect sizes with youth were smaller than those identified in the adult population.

Studies examining the neuropsychological profile of psychopathy have used measures that may be sensitive to distinct regions of the prefrontal cortex. If psychopaths are impaired in only one of the prefrontal cortex circuits, this may explain the conflicting neuropsychological findings. As pointed out above, it has been argued on the basis of individuals with acquired brain injuries that the VMF/OPFC region of the brain is particularly important in the mediation of appropriate social behavior and impulse control. Frequently, however, the tests used to assess executive functioning in psychopaths have been tests that are more sensitive to DLPFC functioning. The Wisconsin Card Sorting Test (WCST), for example, has often been used as an executive function measure in the study of psychopathy and it has been argued that the WCST is particularly sensitive to DLPFC function (Milner, 1963). It is more likely that psychopaths are impaired in the OPFC (or ventromedial frontal) region of the prefrontal cortex and this finding has been supported in the adult population (Lapierre et al., 1995), and more recently in the youth population as well (Roussy & Toupin, 2000).

In addition to the neuropsychological studies that have investigated the correlates of psychopathy, there have also been a select number of studies that have used functional and structural brain imaging to assess for neural abnormalities among offenders. One study used magnetic resonance imaging on individuals with Antisocial Personality Disorder and reported the presence of an 11% reduction in prefrontal gray matter volume (Raine, Lencz, Bihrle, LaCasse, & Colletti, 2000). However, the specific regions of the frontal cortex that were compromised were not investigated. Nevertheless, the observed

abnormalities consisted of subtle differences in the thickness of the gray matter and therefore represented a deficit distinct from acquired insults to the OPFC region of the brain.

Intrator et al. (1997) used SPECT scans in their study of semantic and affective processing among psychopaths and found that psychopaths displayed greater activity in the PFC for emotional stimuli than for neutral stimuli. Extending on this finding, Kiehl et al. (2001) used a memory task involving emotional (e.g., hate) and neutral words (e.g., chair) and found that criminal psychopaths displayed an underactivation of limbic structures and an overactivation of bilateral regions of the PFC. These authors argued that this finding may indicate that psychopaths have reduced input from limbic structures, which requires them to employ alternative cognitive strategies while processing emotional information. This latter study also noted that psychopaths did not differ from either criminal nonpsychopaths or noncriminal control participants in their processing of neutral stimuli, either in terms of task performance or in terms of brain activity.

Overall, the above findings are suggestive that there is some brain dysfunction in psychopaths and that this dysfunction includes, but is not limited to, the OPFC region. Beyond the OPFC region of the brain, one of the additional areas of cerebral functioning in which psychopaths may be deficient relates to degree of cerebral hemispheric dominance or hemispheric lateralization. The possibility that psychopaths are also compromised in this domain will be discussed in the next section.

Evidence for Reduced Hemispheric Lateralization

It has been observed, since Cleckley's seminal description of the psychopathy construct, that the language of psychopaths lacks depth and affective meaning. Cleckley proposed that psychopaths have a "semantic aphasia" which impedes their ability to integrate semantic information with emotion (1941/1976). Since that time, a number of studies have been published investigating the language of psychopaths. One of the most important findings arising from this research is that psychopaths appear to have a reduced left-hemisphere dominance for the processing of verbal material. In the large majority of people, language is lateralized to the left hemisphere of the brain. It is believed that this representation of language in the left hemisphere is reflected in dichotic and visual field tasks that indicate superior task performance when the information is presented to the visual field or to the ear contralateral to the left hemisphere. This is significant because both the right visual field and the right ear have more direct projections to the language regions of the left hemisphere than the left visual field or the left ear. In addition to the evidence provided by visual field and dichotic studies, the research indicating the presence of discrepant verbal and performance/nonverbal scores on intelligence testing with psychopaths provides some further support for an unusual pattern of hemispheric dominance.

Visual Field Studies

Hare and Jutai (1988) found that psychopaths committed significantly more errors than nonpsychopaths and controls in the right visual field on an abstract categorization task. This effect was not observed with a simple recognition or a simple categorization task, nor were any differences observed between groups on reaction time.

Dichotic Research

Psychopaths display reduced ear asymmetries on dichotic listening tasks, a result that has been found in both adolescents (Raine, O'Brien, Smiley, Scerbo, & Chan, 1990) and in adults (Hare & McPherson, 1984). It has been speculated that this reduced lateral dominance for language may be related to the psychopath's poor regulation of behavior and apparent lack of a conscience (Hare, 1998). In the Hare and McPherson (1984) study, instructions to selectively attend to one ear did not change the differences between the two groups. However, recent evidence indicates that shifts of attention influence response selection aspects of the task rather than the temporally earlier stimulus identification processes (Hiscock, Inch, & Kinsbourne, 1999). The influence of attentional shifts may therefore only be recognizable if a localization component is added to the detection component of the dichotic task.

Differences between Verbal IQ and Performance IQ

The presence of lower Verbal IQ (VIQ) versus Performance or nonverbal IQ (PIQ) has been interpreted as evidence for abnormally weaker left hemisphere function (Lezak, 1995), although the accuracy of VIQ - PIQ discrepancies in localizing pathology is limited (Hawkins & Tulsky, 2003). Nevertheless, psychological testing with adolescents indicates significantly better PIQ than VIQ performance, as measured by the WISC-R, among psychopaths (Gretton, 1997).

Schizotypy

Reduced hemispheric asymmetry has also been found in individuals who score high on measures of schizotypy (Weinstein & Graves, 2002). The construct of schizotypy includes elements of perceptual aberration, social anhedonia, nonconformity

and magical ideation. Meehl (1962) has argued that both schizophrenia and schizotypy are phenotypes that occur along a spectrum of thought disorders. Some support for this position has been provided by evidence that both individuals with schizophrenia and a portion of the normal population without a formal psychiatric disorder score high on measures of schizotypy (George & Neufield, 1987). Psychopaths have traditionally been seen as distinct from thought-disordered individuals. Cleckley commented that in the psychopath there are often "indications of good sense and sound reasoning," and that the psychopath is "ordinarily free from signs or symptoms traditionally regarded as evidence of a psychosis...outer perceptual reality is accurately recognized, social values and generally accredited personal standards are accepted verbally" (1941/1976, p.358).

Although psychopathy exists and can be reliably measured among psychotic individuals (Tengstrom, Grann, Langstrom, & Kullgren, 2000), psychopaths are typically not psychotic. However, notwithstanding the comments of Cleckley, there is reason to believe that the psychopathy construct shares some similarities with the schizophrenia spectrum. Firstly, on a clinical basis many of the psychopathic attributes overlap with schizotypy characteristics. For example, the narcissistic and unempathic qualities of the psychopath share similarities with the lack of interpersonal warmth of social anhedonia. In addition, the tendency to rule-breaking and criminal offending in the psychopath shares similarities with the nonconformity aspect of schizotypy. Secondly, psychopaths have been shown to be elevated on a thought disorder measure (Williamson, 1991). This latter finding was based on an 18-item scale that includes items such as poverty of speech, incoherence, tangentiality, neologisms and self-reference (Andreasen, 1979). The fact that both psychopaths and individuals high on measures of schizotypy have been

shown to have reduced hemispheric lateralization suggests a possible common neural basis for the putative association.

To this author's knowledge only one study has so far been published on schizotypy and psychopathy (Raine, 1987). This study examined the association that psychopathy and schizotypy had to skin conductance orienting response (SCOR) in a group of 41 male inmates in a maximum security institution. Schizotypy was measured with 9 different scales, which were then factor analyzed to form two dimensions. One dimension, Schizophrenism, was comprised of scales assessing schizophrenism, disordered thinking, withdrawn-disturbed relationships, and perceptual aberration. The second dimension, Anhedonia-Psychoticism, was comprised of scales assessing social anhedonia, physical anhedonia, psychoticism, and hallucinatory predisposition. The number of psychopaths in the sample, and whether participants were divided into high and low groups, is never stated. Intercorrelations between psychopathy, as measured by the 22-item PCL, and the electrodermal variables were not significant. However, those subjects who were high on the measures of schizotypy, especially the Anhedonia-Psychoticism dimension, displayed significantly reduced SCOR. On cognitive testing, Anhedonia-Psychoticism was related to reduced performance on the Attention-Distraction factor, which is comprised of the Digit Span and Arithmetic subtests, on the WAIS, to reduced VIQ, and to superior PIQ relative to VIQ. No relationships between psychopathy and WAIS performance were significant. Aspects of the association between schizotypy and psychopathy were either not investigated or not reported. For the purposes of this study, it is important to note that the Attention-Distraction factor is typically associated with auditory working memory, a cognitive domain that appears to

be subserved by the DLPFC region (Parks et al., 1988). The finding of reduced VIQ and a PIQ - VIQ discrepancy suggests some left hemisphere dysfunction among schizotypic individuals. Superior PIQ relative to VIQ, as mentioned above, has also been found in adolescent psychopaths (Gretton, 1997). Perhaps in the Raine (1987) study there was insufficient variance in the inmate sample to detect significant differences related to psychopathy.

Random number generation, another measure of executive functioning, has been related to both reduced lateralization and schizotypy (Brugger, 1997). Individuals from various clinical populations, including both schizophrenia and dementia of the Alzheimer type, have been reported to display more difficulty in the production of random numbers than normal controls (Brugger, 1997). A commonly used measure of random number generation is the Mental Dice Task, which requires participants to state the number that results each time after they throw a die in their imagination (Brugger, Milicevic, Regard, & Cook, 1993). This task was included in this study as another hemispheric latereralization measure that has been specifically related to schizotypy and to executive functioning. Problems with random number generation can occur due to abnormalities in executive functioning, lateralization, or schizotypy. Psychopaths may have difficulty on the Mental Dice Task because psychopathy has been related to all of these concepts.

Summary

While the research into the biological underpinnings of psychopathy is considerable, most of this research has been conducted on adults. Initial evaluations of the psychopathy construct in the youth population are promising but need to be extended. It remains unclear how well the literature on psychopathic features in the adult population

are meaningful to the adolescent population. Although many psychological tests have been shown to be associated with psychopathy, no one has yet assembled a battery of such tests. A battery of neuropsychological measures thought to be sensitive to psychopathy may ultimately help to identify a subpopulation of psychopaths with somewhat unique characteristics. This study aimed to compare psychopathy scores, as measured by the PCL:YV, with other measures of cognition and personality and to complete a Rasch IRT analysis of the PCL:YV. Measures included in the study were selected for the purpose of identifying general cognitive functioning (Wechsler Abbreviated Scales of Intelligence), OPFC functioning (Alberta Smell Test, Stroop Color Word Test, Porteus Maze Test, Go/No-Go Test), DLPFC functioning (Tower of London, Self-Ordered Pointing Test), hemispheric lateralization (Dichotic Listening Task, Mental Dice Task), and schizotypy (Impulsive-Nonconformity Scale, Revised Social Anhedonia Scale).

Goals and Hypotheses

This study had four main goals. Goals 2 through 4 relate to the cognitive measures that are thought to be sensitive to the functioning of particular regions of the brain. Table 4 relates these measures to the different functions they each assess.

1. The first goal was to assess the PCL:YV with a Rasch analysis. At the commencement of this study the PCL:YV had not been released and it was therefore unclear to what extent its psychometric properties would be similar to the PCL-R. Due to the similarity of the items between the two instruments it was predicted that a two-factor solution with a personality and a behavioral dimension would best fit the data. In addition, it was expected that the PCL:YV would fit the Rasch model.

2. The second goal was to examine the hypothesis that psychopaths have a specific deficit in the functioning of the orbitofrontal region of the brain. Specifically, it was predicted that the higher the elevation on the PCL:YV the greater the likelihood of impairment on measures sensitive to orbitofrontal functioning; this difference was not expected to hold for the measures sensitive to dorsolateral functioning.

Table 4
List of Cognitive Measures and the Putative Functions they Assess

Cognitive/Personality Function	Specific Function	Measure
Global Intellectual Ability	General intelligence	WASI
Executive Functioning (sensitive to orbitofrontal region)	Olfaction	Alberta Smell Test
	Selective attention, cognitive flexibility, and impulse control	Victoria Stroop Test (interference score)
	Impulse control	Porteus Mazes Test (qualitative score)
	Impulse control, sustained attention	Go/No-Go test (commission errors)
	Impulse control in the service of planning	Tower of London (initiation time)
Executive Functioning (sensitive to dorsolateral region)	Planning, monitoring responses	Self-Ordered Pointing Test
	Planning, sustained attention	Tower of London (number of moves)
Hemispheric Specialization	Divided attention and selective attention	Dichotic Listening
	Attention, monitoring responses	Mental Dice Task
Schizotypy	Nonconformity and social anhedonia	Scales of Psychosis Proneness

3. The third objective was to identify the relationship between hemispheric specialization and psychopathy. It was predicted that those youths with elevated scores on the PCL:YV would display an overall reduction in left hemisphere dominance as measured by a dichotic listening task. In addition, it was predicted that the group elevated on psychopathy would show a pattern of stereotyped responses on the MDT, based on the evidence that psychopaths may be dysfunctional in certain aspects of right hemisphere processing (Kiehl et al., 2004).

4. The fourth objective was to examine the relationship between psychopathy and schizotypy. A positive association was predicted, such that those youth higher on psychopathy would also show elevations on both the Revised Social Anhedonia Scale and the Impulsive-Nonconformity Scale.

Methods

Participants

Participants were 44 male youths ages 15 to 18 interviewed while in custody. Thirty-seven participants were in custody at the Victoria Youth Detention Centre and seven were in custody at the Ottawa-Carleton Detention Centre. All male youth were invited to participate by the director of the detention centre. Those who wished to participate provided their names and the phone number of their parent or guardian. Written consent was obtained from the youth and consent from the parent or guardian was obtained on the telephone. There were approximately 40 youth in each of the facilities; however, the turnover was quite rapid with many inmates being admitted and released on a weekly basis. Over the course of the participant recruitment, it is estimated that about 10-15% of the youth available to participate were assessed and included in the study. While there was no direct evidence of a sampling bias, the ratio of psychopaths to nonpsychopaths in the study may have been slightly higher than in the actual inmate population due to a tendency for the directors to recruit those with greater evidence of antisocial behavior. All youth were assessed individually in a quiet room and were paid $10 for participation. Prior to involvement in this study, participants were screened and excluded if there was a history of a psychotic disorder or they were assessed to have subnormal IQ, defined as an estimated FSIQ < 80.

The sample size obtained was deemed to be sufficient on the basis of an *a priori* power analysis. To arrive at an appropriate effect size for this analysis, the study in the adult psychopathy population that most closely approximated the present study (Lapierre

et al, 1995) was examined[1]. In this study, the researchers examined executive functioning in adult psychopaths and showed an estimated population effect size for the selected OPFC measures that was very large (Cohen's d = 1.4). Assuming the same effect size for the present study with statistical power set at .95 and alpha at .05, a total sample size of only 24 individuals was needed. The sample size for this study (N=44) should therefore have been adequate to detect significant differences between groups.

The first stage of the evaluation was to administer the WASI to ensure that IQ met the cutoff of 80. Only one individual was excluded for low IQ. Each youth then participated in a semi-structured interview lasting approximately one hour. The battery of neuropsychological measures was then administered and this lasted approximately two hours. Following the interview and assessment, a file review, including an examination of the criminal record of the youth, was completed. Records of offenses, required for scoring the Psychopathy Checklist, were obtained through Provincial Case Files, which list the criminal offenses committed in British Columbia. The PCL:YV was then scored on the basis of the information from the interview and the file review. The time to complete the file review and score the PCL:YV was about one hour.

Measures

General Measures

Psychopathy Checklist: Youth Version (PCL:YV) (Forth, Hare, & Kosson, 2000)

The PCL:YV is a 20-item rating scale scored on the basis of either a file review alone or a file review in combination with an interview. Item descriptions are provided in

[1] At the inception of this study, the Roussy and Toupin (2000) study had not been published.

Appendix B. The psychometric properties of the PCL:YV have been discussed above. Analyses examined the PCL:YV as a continuous measure and, when indicated, as a categorical variable. Groups were divided according to a cutoff recommended for research purposes such that the low scorers had a PCL:YV total score of <25 and the high scorers had a total score ≥25 (Harris, Rice, & Quinsey, 1994).

Wechsler Abbreviated Scales of Intelligence (WASI) (Wechsler, 1999)

The two-subtest version of this test was given, which includes Vocabulary and Matrix Reasoning. It provides an estimate of Full Scale IQ and can be administered to individuals from 6 to 89 years of age. While the subtests do not provide estimates of VIQ and PIQ, they were examined as representative measures of these subscales.

There have been inconsistent findings regarding PIQ and VIQ differences between psychopaths and nonpsychopaths, with some studies indicating no differences (Raine, 1987) and others finding significant PIQ minus VIQ discrepancies (Gretton, 1997). Although a complete WISC-III or WAIS-III would clearly provide more information, in the interest of brevity the shortest instrument that could provide a reliable estimate of overall cognitive ability was selected.

The executive function measures were selected on the basis of previous research suggesting that they are more sensitive to either the orbitofrontal or the dorsolateral prefrontal regions.

Measures Sensitive to Functioning of the Orbitofrontal Cortex

Alberta Smell Test (Green & Iverson, 1998)

In the Alberta Smell Test the participant smells a scented marker while closing off one nasal passage by pressing on the side of their nose. Their eyes remain closed while they smell the marker so that the color of it does not cue them to its fragrance. Participants are then required to identify the correct smell from a group of eight choices, which are listed on a sheet that is placed in front of them. The presentation of the marker is alternated between nostrils, with ten trials for each nostril. The total score is the number correct for both nostrils. Although the test allows for investigation of lateralization, it will not be used for this purpose in this study since recent evidence suggests that the olfactory pathway sends projections to both the contralateral and the ipsilateral hemisphere (Savic & Gulyas, 2000).

Individuals with damage to the orbitofrontal region of the brain have been shown to be impaired on various smell tasks (Jones-Gotman & Zatorre, 1988; Potter & Butters, 1980). Adult psychopaths have also been shown to be impaired on a smell identification task (Lapierre et al., 1995).

Stroop Color Word Test (Victoria Version) (Regard, 1981)

This version of the Stroop involves three different cards. The first card presents a series of colored dots. The second presents a series of colored words. The third card is the interference trial in which the individual must state the color of the word, while resisting the urge to say the word that is a color (e.g., blue).

The Stroop task is believed to assess cognitive flexibility and inhibitory capacity. The capacity to inhibit a prepotent response appears to be mediated by orbitofrontal

regions of the brain. Physiological studies have implicated the orbitofrontal area of the brain in normal subjects as the region that subserves this task (Bench, Frith, Grasby, & Friston, 1993).

Porteus Maze Test (PMT) (Porteus, 1965)

The PMT is a task that requires the individual to draw a line from a starting point through a maze to a point of completion. The PMT requires the participant to plan the correct route out of the maze ahead of time, lest they enter a dead end. When a dead end is entered, the participant is required to start again at the beginning with a new copy of the same maze. An impulsive response style may be demonstrated by going into blind alleys and by committing rule violations. A time score and a qualitative score based on rule violations, including the number of wall traversals and pencil lifts, are calculated. In this study, the rule violations will be used as an index of impulsivity.

Previous studies have identified deficits in offenders on this task. Porteus has presented evidence that juvenile delinquents show impairments (1945). More recently, Lapierre et al. have shown that adult psychopaths are impaired on the rule violations aspect of this task (1995).

Go/No-Go task (Lapierre et al., 1995)

The Go/No-Go task assesses inhibitory control and ability to remember and shift between different rules. This task will be modeled after the one used in Lapierre et al. (1995). A block of 50 trials is initially given to establish a response habit to particular stimuli (white squares). A 150 trial block is then given in which the subject has to inhibit their response to the previously correct stimuli (white squares) and instead respond to

new stimuli (white crosses). The target location of the stimuli on the computer screen will be randomized. Reaction times, omissions, and commission errors will be recorded.

Various Go/No-Go tasks have been used in psychological research studies. This particular task was selected because adult psychopaths showed impairments on it in a previous study (Lapierre et al., 1995). Research has indicated that Go/No-Go tasks are sensitive to the orbitofrontal region of the brain. Orbitomedially lesioned animals show greater deficits than animals with lesions to the dorsolateral prefrontal cortex (Fuster 1997). Commission errors, in particular, appear to be sensitive to orbitofrontal deficits as indicated in studies involving monkeys (Kubota & Komatsu, 1985) and humans (Leimkuhler & Mesulam, 1985).

Measures Sensitive to Functioning of the Dorsolateral Prefrontal Cortex

Tower of London (TOL) (Culbertson & Zillmer, 1998)

The TOL uses two stands, each with a set of three colored balls (red, green or blue) with one ball for each of three vertical dowels. Participants are instructed to rearrange the balls so that they match the order in which they appear on the examiner's stand. Only one ball can be moved at a time and the aim is to arrive at the solution in as few moves as possible and as quickly as possible. Number of moves, time to initiate a move, and time to completion will be recorded.

Completion of the TOL is thought to rely largely on the dorsolateral region of the frontal lobes. Although, a recent PET activation study indicated that the TOL activates many different regions of the brain (Dagher et al., 1999). The areas that were especially activated were the lateral premotor cortex (area 6), rostral anterior cingulate cortex (area

32 and 24), dorsolateral prefrontal cortex (areas 9 and 46) bilaterally, and right dorsal caudate nucleus. Other research has indicated that the TOL is mediated predominantly within the PFC by the dorsolateral prefrontal regions of the brain (Baker et al., 1996). The movement initiation time data, which provides a measure of impulsivity, will also be examined for its relationship to the other measures reputed to be sensitive to OPFC functioning.

Self-Ordered Pointing Test (SOPT) (Petrides & Milner, 1982)

The SOPT was initially used to evaluate adults with frontal lobe lesions (Petrides & Milner, 1982). The test presents the participant with a single page of drawings of common objects. Subsequent pages contain the same objects, each time with a different spatial arrangement. The participant is asked to point to one object on each page and to try and point to a different object each time. The number of pages is equal to the number of objects on the page, so if the participant completes the task perfectly they would never have to choose an object twice and all objects would have been selected. Participants are asked not to point to the same spatial position on consecutive pages. For this study, stimuli were shown in two blocks, one with ten objects and a second with twelve objects and each block was administered three times. The participant was asked to begin by pointing to a different object than on previous trials. The number of errors (i.e., the number of times the individuals mistakenly selected a previously chosen object) was recorded and summed to form a total score for the six trials.

The SOPT requires the participant to plan, sequence, and monitor their responses. The administration of similar tasks in non-human primates has indicated that lesions to the mid-dorsolateral frontal cortex lead to impaired performance (Petrides, Alivisatos,

Evans, & Meyer, 1995). Research with Positron Emission Tomography has also shown that activation in the mid-dorsolateral prefrontal cortex occurs during self-ordered task performance (Petrides, 1993).

Measures associated with Hemispheric Lateralization

Dichotic Listening Task (DLT) (Hiscock, Inch, & Kinsbourne, 1999)

This dichotic listening task consists of a series of six consonant-vowel (CV) nonsense syllables. Each of the six English stop consonants were combined with the vowel /a/ resulting in: /ba/, /pa/, /ga/, /ta/, /da/, and /ka/. There were a total of 15 possible unique pairs (e.g., ba/ka) and 30 possible unique dichotic pairs (e.g., ba/ka, ka/ba). Each of the thirty dichotic pairs was presented three times, each time with a different visual pre-cue. The visual pre-cues matched the auditory syllable in either the right or the left ear or neither. A total of 60 trials were given, presented in two blocks of 30. The dichotic pairings and frequency of each type of cue were equally dispersed among the three blocks, which were then randomly ordered within each block for presentation. This dichotic task follows the procedure devised by Hiscock, Inch, and Kinsbourne (1999), although different stimulus samples and equipment were used. Weinstein and Graves (2002) also used this task.

Participants were told that the visual pre-cue may or may not be the same as one of the two auditory stimuli which follow the pre-cue and were asked to decide if this was the case and, if so, to which ear the matching stimulus had been presented. Participants were asked to respond verbally by saying "left" if they believed the matching stimulus had been presented to the left ear, or say "right" for the right ear, and "none" if they

believed that neither of the auditory stimuli were the same as the visual pre-cue. There are many indices of performance on this task including, the number of correctly identified targets (hits), false positives, false negatives, and mislocalizations (e.g., a right ear signal incorrectly identified as being heard in the left ear). This data is analyzed using signal detection theory.

Dichotic listening tasks are often used to identify language lateralization. This follows from the fact that the contralateral auditory pathways are stronger than the ipsilateral pathways. As a result a right ear advantage is typically identified since the pathway to the language areas of the left hemisphere is more direct via this route than it is when the information is presented to the left ear. There is a high level of agreement between dichotic results and sodium amytal testing, which is typically considered the gold standard for the identification of language lateralization (Strauss, Gaddes, & Wada, 1987). As mentioned above, reduced ear asymmetries have been reported in adult (Hare & McPherson, 1984) and adolescent (Raine et al., 1990) psychopaths. The latter study used a self-report measure of psychopathy, which may be of questionable validity given that pathological lying is a sign of psychopathy. Furthermore, neither of the above studies used the advantages of signal detection theory that have been introduced to dichotic tasks (Hiscock & Mackay, 1987). Signal detection analysis allows one to mathematically distinguish between hemispheric sensitivity to a signal and the subject's response style. If the subject's response style is less conservative for the right ear then this may produce a right ear advantage (REA) and falsely create the impression of greater left hemisphere sensitivity to the stimuli.

Mental Dice Task (MDT) (Brugger et al., 1993)

This task requires participants to imagine throwing a die repeatedly and to subsequently state the number from 1 to 6 that they think was produced by the roll. They are reminded that the numbers they report should be random, as if it were a real die. They are further told that they should provide their responses upon hearing a sound (beat) from a metronome, which emits a beat every second. Sixty-six responses are obtained and notes are made on the number of rule violations (digits provided other than 1 through 6) and the number of beats on the metronome in which a number was not provided.

Previous research has indicated that the responses of individuals with dementia of the Alzheimer's type are more stereotyped than the responses of normals on the MDT (Brugger, Monsch, Salmon, & Butters, 1996). It was speculated in this study that this might relate to damage to the frontal lobes of the brain and impairment in executive functions. The MDT is significantly correlated with design fluency, but not with letter fluency (Brugger, Monsch, & Johnson, 1996). Due to the significant association between the MDT and design fluency, it has been proposed that the avoidance of repetition required on the MDT relies on intact functioning of the right hemisphere (Brugger et al., 1996). There is some research to support a right hemisphere deficit in psychopaths. It has been suggested, for example, that the verbal deficits observed in psychopaths, including difficulty processing abstract words, are in fact due to right hemisphere deficits (Kiehl et al., 2004). The right hemisphere deficits do not appear in all domains, however, as psychopaths do reasonably well on nonverbal and visual-spatial measures (Gretton, 1997). It may be that design fluency is specific to right frontal lobe functioning as opposed to the right hemisphere generally (Jones-Gotman, 1991). Hence, the MDT may

also be largely related to right frontal lobe function. In addition, random number generation has been related to reduced hemispheric lateralization (Brugger, 1997). For these reasons, it was hypothesized that psychopaths would be more impaired than nonpsychopaths on the MDT.

As part of the investigation of lateralization, participants were also asked about hand preference. Previous studies of lateral dominance have shown that adult psychopaths are not different from nonpsychopaths (Hare & Forth, 1985). Assuming that psychopathy is a chronic personality disorder that starts in childhood or adolescence and continues into adulthood one would expect there to be no hand preference difference in adolescents.

Measures of Schizotypy

The "Wisconsin Scales of Psychosis Proneness" consist of six questionnaires that measure schizotypal beliefs and experiences. Two of these scales, the Impulsive-Nonconformity Scale and the Social Anhedonia Scale, were used in combination with the Infrequency Scale, which is a measure of response validity. The items from each of these scales were randomly intermixed to form one 104-item true/false questionnaire.

The Impulsive-Nonconformity Scale (Chapman, Chapman, Numbers, Edell, Carpenter, & Beckfield, 1984)

The Impulsive-Nonconformity Scale is a 51-item self-report questionnaire that measures the degree to which the individual rejects or flaunts social standards or etiquette and acts with little forethought.

The Revised Social Anhedonia Scale (Eckblad, Chapman, Chapman, & Mishlove, 1982)

The Revised Social Anhedonia Scale is a 40-item self-report questionnaire that measures aspects of a schizoid personality, including indifference to others and an asocial lifestyle.

Infrequency Scale (Chapman & Chapman, unpublished test)

The Infrequency Scale is a 13-item self-report questionnaire used to assess response validity. If more than two of these items are endorsed then the protocol is considered invalid.

Studies using dichotic listening and divided visual fields have indicated that psychopaths have atypical perceptual asymmetries. The dichotic studies, as already mentioned, indicate that psychopaths have a reduced right ear preference (Hare & McPherson, 1984; Raine et al., 1990). Visual field studies have found a reversal in psychopaths of the usual right visual field preference for words. Together with the dichotic studies, the suggestion is that psychopaths have a reduced left hemisphere dominance for processing language. Psychopaths also fail to show the typical left visual field advantage when processing emotional words (Day & Wong, 1996). Individuals scoring high on measures of positive schizotypy have also shown evidence of reduced left hemisphere or increased right hemisphere processing of syllables (Weinstein & Graves, 2002).

These similar patterns of lateralization provide one reason to hypothesize that psychopaths will display elevations on these scales of psychosis proneness. One would also expect, simply on the basis of the constellation of behaviors and personality traits

that comprise the psychopathy construct, that elevations would be seen on measures of social anhedonia, and impulsivity-nonconformity. Social anhedonia, since it measures both interpersonal insensitivity and lack of emotional responsivity, may be elevated due to the narcissism and the emotional shallowness intrinsic to the psychopath. Impulsivity and nonconformity are hallmarks of psychopathy, although the extent to which a group of psychopaths will acknowledge these traits in themselves may be questioned. At least on the surface, there would not appear to be any reason for psychopaths to under-report schizotypal symptoms in comparison to a matched group of nonpsychopathic offenders. However, one may anticipate that psychopaths would over-report symptoms, since lying and a tendency to be dramatic are characteristics of the personality disorder. For this reason, an infrequency scale is added to protect against the over-endorsement of symptoms. Although it seems more probable that psychopaths will over-report than under-report schizotypal symptoms, it should be noted that the Infrequency Scale included here consists of items that protect against both types of invalid responding.

Results[2]

PCL:YV Scores for the Entire Sample

As indicated in Table 5 there was no difference between groups in age or education. None of the youth had been hospitalized for a head injury. Drug use was common, but because of the complexity of assessing its use and the questionable validity of self-report in this area it was not coded. The sample was largely Caucasian (89%), although there were 4 individuals (9%) who identified as First Nations and 1 individual (2%) who identified as East Indian. Ethnicity was not examined as a covariate because of the homogeneity of the sample and because it has not proven to have a sizeable impact on PCL-R scores (Hare, 2003).

Table 5
Demographic Variables for the Nonpsychopathic (NP) and Psychopathic (P) Groups

	NP	P	F	P
Age	16.85 (0.91)	17.18 (.94)	1.23	.273
Education	9.13 (1.04)	9 (.56)	0.20	.656

Results for the two groups, low psychopathy (PCL:YV<25) and high psychopathy (PCL:YV≥25), and the entire sample on the PCL:YV are provided in Table 6. As mentioned previously, this cutoff was chosen on the basis of research indicating this is a useful cutoff for research purposes (Harris, Rice, & Quinsey, 1994). It is important to note that there is a difference of greater than 10 points between the low scorers and the high scorers, a value similar to the group differences suggested in the initial proposal where the low psychopathy group was to have a total score ≤20 and the high group a total score of >30. Lack of differentiation between the groups should therefore not be a concern, assuming the validity of the PCL:YV cutoff selected. Approximately 32% of

[2] With the exception of the Rasch analysis, all statistics were conducted with SPSS 11.5 (SPSS, 2002).

the sample is psychopathic according to this cutoff. While it is not expected that the magnitude of the score difference between the groups will have a great impact on the results, the presence of relatively few individuals with PCL:YV total scores greater than 30 may reduce the likelihood of finding significant differences in cognitive functioning.

Table 6
Means and Standard Deviations for the Psychopathic and the Nonpsychopathic group on the PCL:YV

PCL:YV Scores	N	Mean	SD	Range
Low: Total Score (<25)	30	18.7	4.1	7-24
Low: Factor 1 (/20)		7.4	2.5	2-13
Low: Factor 2 (/20)		11.3	3.1	2-19
High: Total Score (≥25)	14	29.6	3.1	25-36
High: Factor 1 (/20)		13.5	2.3	10-18
High: Factor 2 (/20)		16.1	2.7	12-20
Entire Sample Total	44	22.2	6.4	7-36

In Figure 2, the distribution of PCL:YV scores demonstrates that the majority of individuals had scores in the middle range of the scale with few individuals at either end of the continuum. The absence of individuals at the lower end follows from the fact that the population consists of youth who had already committed an offense(s) of sufficient severity or with sufficient frequency to warrant a sentence in custody. The limited number of individuals at the upper end of the scale is a reflection of the high ceiling of the PCL:YV.

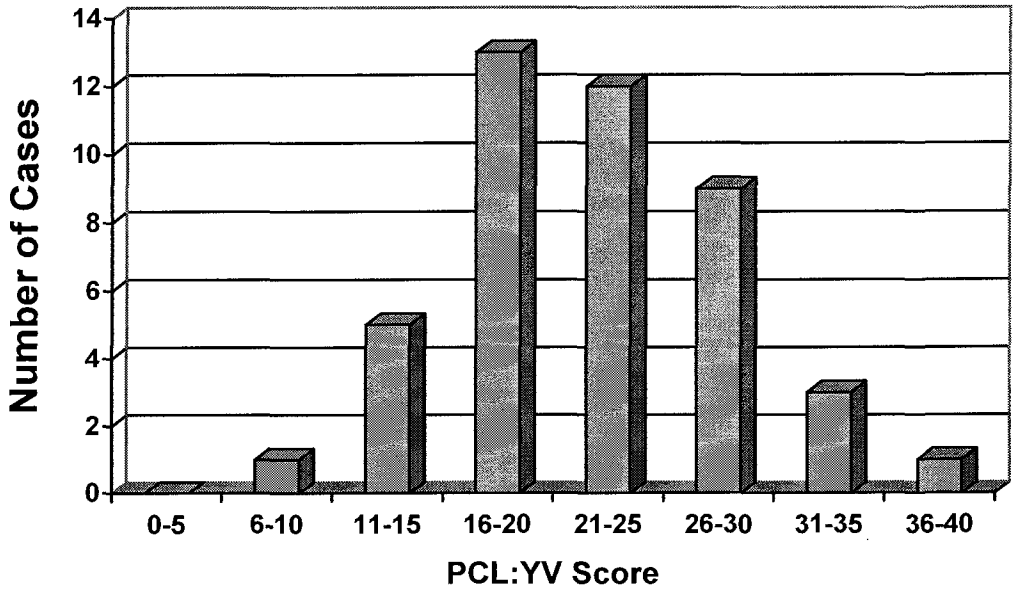

Figure 2. The Distribution of PCL:YV Scores.

In Figure 3, the distribution of PCL:YV score by age is represented. There is no significant association between age and PCL:YV total score or either of the PCL:YV factor scores. Factor 2 tends to be sensitive to age because as the individual gets older he has a greater time period in which to commit the antisocial acts that affect the scoring of this factor. However, the data suggest there is no evidence of a bias in the results, such that it is easier for older subjects to receive higher scores.

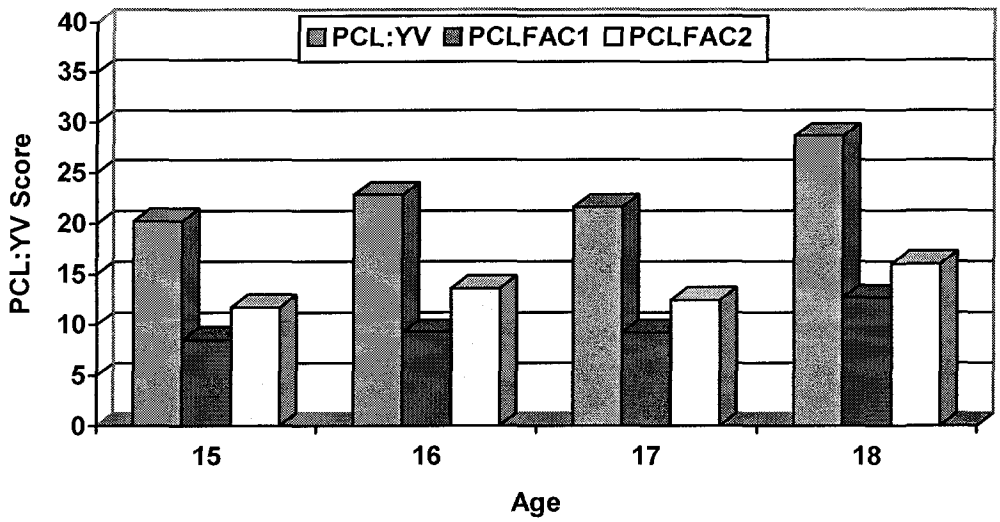

Figure 3. Distribution of PCL:YV Total Score and Factor Scores by Age

Reliability of the PCL:YV

Internal Consistency of Items and Scale

The internal consistency of the PCL:YV, as measured by Cronbach's alpha, is .84. In Table 7, the item total score correlations and descriptive statistics are presented. The corrected item total reliabilities range from .09 (items 14 and 16) to .68 (item 20) for this three-point (0, 1, 2) interval scale with a mean of .42. The PCL:YV technical manual reports item total correlations for an institutional sample that range from .20 to .60, with a mean of .45 for males (Forth, Hare, & Kosson, 2003).

Table 7
Corrected Item-Total Correlations (r) and Descriptive Statistics for Each PCL:YV Item

Item	r	M	SD
Impression Management	.30	.77	.64
Grandiose Sense of Self Worth	.48	1.00	.65
Stimulation Seeking	.37	1.61	.54
Pathological Lying	.44	.84	.57
Manipulation for Personal Gain	.66	1.16	.75
Lack of Remorse	.25	1.18	.62
Shallow Affect	.57	.57	.63
Callous/Lacking Empathy	.52	1.18	.62
Parasitic Orientation	.44	1.11	.58
Poor Anger Control	.34	1.64	.61
Impersonal Sexual Behavior	.55	.84	.71
Early Behavior Problems	.43	.95	.75
Lacks Realistic Goals	.43	1.11	.72
Impulsivity	.09	1.61	.49
Irresponsibility	.38	1.45	.55
Failure to Accept Responsibility	.09	.89	.58
Unstable Interpersonal Relationships	.63	.61	.62
Serious Criminal Behavior	.58	1.23	.64
Serious Violations of Conditional Release	.23	.84	.81
Criminal Versatility	.68	1.57	.59

Note. Correlations are the point biserial correlation of each item with all other items.

Internal Consistency of Factors

The factor structure of the PCL:YV will be discussed in greater detail later, but Table 8 displays the items that load on Factor 1 (lightly shaded items) and Factor 2 (darkly shaded items). Factor 1 of the PCL:YV has a coefficient alpha of .77 and Factor 2 has a coefficient alpha of .76.

Standard Error of Measurement

The standard error of measurement (SEM) of the PCL-YV, which is arrived at with the formula $SD\sqrt{(1\text{-reliability})}$, was calculated to be 2.56 using the coefficient alpha value (.84) as the index of reliability. This compares favorably to the SEM estimate of 2.91 provided in the PCL:YV technical manual (Forth, Hare, & Kosson, 2003).

Validity of the PCL:YV

Due to the nature of the study, certain types of validity are difficult to establish. For example, since recidivism rates were not recorded, this index cannot be used as a measure of predictive validity. Other measures of validity cannot yet be established due to the fact that the PCL:YV is a new instrument. For example, what has been called the "consequential" aspect of validity, which assesses whether aspects of test invalidity are contributing to a negative impact on an individual or group, cannot yet be determined even though it is a critical issue for the PCL:YV (Messick, 1995). Nevertheless, it is possible to adduce certain types of validity. Firstly, since the PCL:YV is so similar to the PCL-R it retains its good coverage of Cleckley's original conceptualization of psychopathy. Given the evidence for the stability of personality through adolescence and

into adulthood discussed above, the adherence of the PCL:YV to Cleckley's conceptualization should still ensure good content validity. Secondly, the psychometric results, including Cronbach's alpha for the overall scale and the separate factors, as well as many of the following analyses that show a scale that fits the Rasch model and has a factor structure similar to the PCL-R, indicate good construct validity. Thirdly, while the majority of the measures used in this research have an uncertain relationship to youth psychopathy, one would predict that the Nonconformity questionnaire of the Psychosis Proneness Scales would show a strong association with psychopathy and the Anhedonia scale may also show an association with Factor 1 which has somewhat similar content. Both questionnaires can therefore be used as an indices of convergent validity and, as indicated below, the relationship in both cases with the PCL:YV was significant. The PCL:YV therefore, as far as can be assessed from the present data, appears to have good construct validity for measuring psychopathy in the population represented by the present sample.

Rasch Analysis of the PCL:YV

The Rasch analysis of the PCL:YV was done with Winsteps version 3.48 (Linacre, 2003). Broadly speaking the objective was to optimize Rasch model fit after excluding outliers, establish the unidimensionality of the PCL:YV scale by reference to a Principle Components Analysis, and then establish item fit and person fit. More specifically, the analysis proceeded in the following stages.

Step 1

The first step in the Rasch analysis was to examine the person statistics for outliers. Fit criteria were selected on the basis of recommendations provided by Bond

and Fox for a rating scale (2001, p.178-179). According to these criteria, major problems with data are indicated if the information weighted mean square of residuals (Infit) is outside the range of 0.6-1.4 together with the Z score for Infit outside of the range of –2 to +2. The Infit statistics for subjects showed that no subject's data failed both of these criteria, which suggests that no subject's data were unacceptable, for example because of miscoding or random score patterns.

Step 2

The second step, an examination of the item statistics, revealed that one item (item 19; MNSQ=1.77 and Z=3.3) violated the fit criteria suggested by Bond and Fox (2001). This item therefore had more variability than the model predicted. Item 19 assesses serious violations of conditional release (e.g., parole/probation violations), which is a relatively non-subjective assessment of the frequency of such violations. There is a tendency for this item to be scored either 0 (i.e., no violations) or 2 (2 or more serious violations) because for those who have been on a conditional release serious violations, such as reoffenses, are quite common even though the individual may not have received additional charges. According to the scoring criteria, offenses that the individual admits to but which are not included in the file information should still be scored a 2, and many individuals in the sample admitted to such non-penalized offenses.

No items had a MNSQ<.6, which indicates that no items had less variability than predicted by the model. To make a determination of whether the fit criteria for item 19 would be improved by allowing the spacing among the 3 scoring categories to differ from the common spacing modeled for all other items, the analysis program was set to classify items into two groups, with item 19 forming one group and the remainder of the items

forming the main group. This improved the fit statistics for the extreme item (MNSQ=1.46, Z=2.2). While these statistics still fall outside the criteria suggested by Bond and Fox (2001) (Infit MNSQ > 1.4, Z> 2.0), other authors adjust the Z score criterion by using a Bonferroni correction based on the number of items. Hence the probability value of .05 was divided by 20 (.0025), resulting in Z=2.81 criterion. According to this adjusted criterion, the fit statistics for item 19 are acceptable. Thus all 20 PCL-YV items could be retained when using the two-group modeling optimized in the Rasch model.

Step 3

The scale was examined with Winsteps Principal Components Analysis (PCA) to ensure unidimensionality. One superordinate component with two distinct subcomponents was revealed through the PCA. This is consistent with the research on the PCL-R, which indicates a large first factor followed by two separate factors. In the present analysis, the first component accounts for about 54.8% of the variance and the second component accounts for 7% of the variance and therefore the ratio of the first to the second component is 7.8 to 1. Cronbach's alpha is .84. No items were deleted at this stage.

The eigenvalues from the Principal Components Analysis (PCA), provided by Winsteps, are displayed in Figure 4. The presence of a large first component provides evidence that the PCL:YV is unidimensional for Rasch analysis purposes.

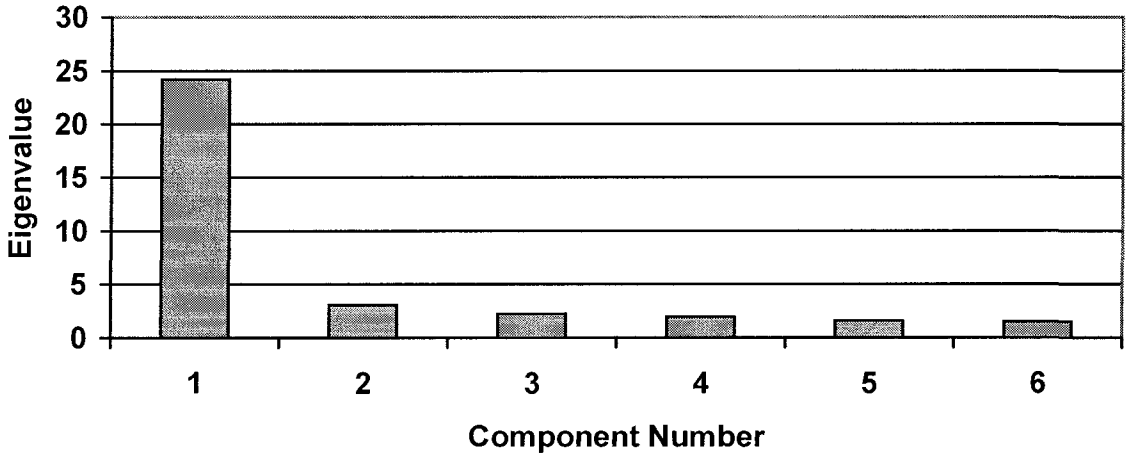

Figure 4. Eigenvalues from the Principal Components Analysis of the PCL:YV

Winsteps provides a table indicating those items that load positively versus those that load negatively on the second component, which indicates the two factors beyond the common main factor. This provides an opportunity to examine how well the components obtained from this sample follow the two factor structure of the PCL-R and the published version of the PCL:YV. Provided in Table 8 are the loadings for the two components derived from the PCL:YV technical manual. All items load on one or the other of the two components. In the PCL-R and the PCL:YV, items 11 and 17 do not load on either of the two factors and item 9 loads on the second factor. Other than these differences, the factor structure in this sample follows the factor structure of the PCL:YV and the PCL-R, which is provided in the technical manuals. Some of the loadings in this sample are weak and these items could be considered for removal, but since there is an established factor structure for the PCL:YV further analyses will use this structure with all items retained. Therefore, the two dimensions can also be described as an interpersonal dimension (component 1) and a behavioral-antisocial dimension (component 2).

Table 8
Loadings for the Winsteps Principal Components Analysis of the PCL:YV Items

	Item	Component 1	Component 2
1	Impression management	.58	
2	Grandiose sense of self worth	.14	
3	Stimulation seeking		-.50
4	Pathological lying	.30	
5	Manipulation for personal gain	.26	
6	Lack of remorse	.63	
7	Shallow affect	.36	
8	Callous/lacking empathy	.23	
9	Parasitic orientation	.02	
10	Poor anger control		-.03
11	Impersonal sexual behavior		-.04
12	Early behavior problems		-.61
13	Lacks goals		-.03
14	Impulsivity		-.34
15	Irresponsibility		-.44
16	Failure to accept responsibility	.55	
17	Unstable interpersonal relationships	.16	
18	Serious criminal behavior		-.59
19	Serious violations of conditional release		-.48
20	Criminal versatility		-.42

In order to ensure that there is utility in preserving the PCL:YV factor structure, the two factors were examined separately in relation to the psychopathy groups. Figure 5 highlights this differentiation between the groups. It is clear that individuals high on psychopathy (total score) tend to have elevated scores on both components and those with low scores tend to be low on both components, although there are some exceptions. The correlation between factor scores was r=.37, resulting in a Spearman-Brown split-half reliability estimate of r=.54. This reduction in r for the split-half indicates a greater difference between the factors than a random splitting of items (which is what the alpha = .84 represents) and hence argues for the legitimacy of the factors.

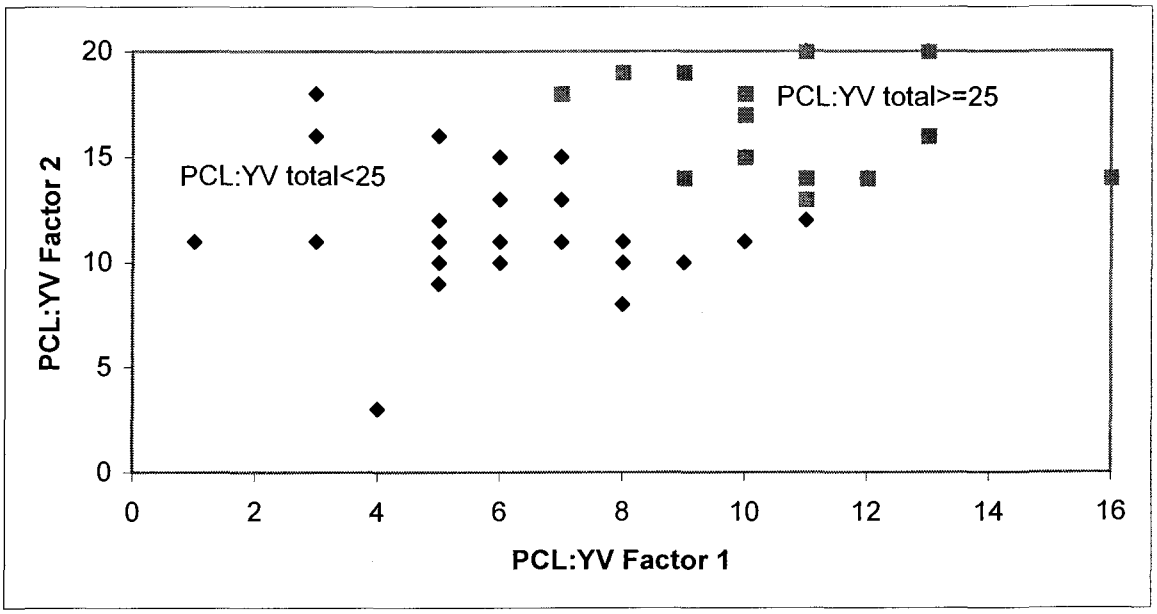

Figure 5. Group Differences According to PCL:YV Factor Scores

The map displaying the distribution of participants and PCL:YV items is shown in Appendix F. The PCL:YV, according to results from this sample, is a unidimensional scale that yields data fitting the Rasch model. There was no compelling evidence from

this analysis that any item or any person needed to be deleted to satisfy the Rasch fit criteria.

Cognitive Performance as Related to Psychopathy

Hart et al. (1990) have criticized previous studies concerning the cognitive characteristics of psychopaths for failing to adequately control for Family-Wise Type I Error resulting from the use of many statistical tests to compare psychopaths to non-psychopaths on many different variables. This is a legitimate criticism and concern. However, control of Type I (alpha) error by Bonferroni type correction of the probability level for statistical significance will lead to an increase in Type II error (beta) because of loss of power. The best approach to this problem is to reduce the number of variables as much as possible. In this study, the approach taken was to consider that there were several distinct hypotheses and to treat each of these as a family with control of Type I error to .05 within each family. It is acknowledged that this does lead to an increase in Type I error across the entire study but this approach is taken to balance the competing demands of also reducing Type II error. Thus, the psychopathy and nonpsychopathy groups are compared according to each of 5 primary hypotheses: OPFC sensitive measures, DLPFC sensitive measures, hemispheric lateralization as represented by performance on dichotic listening and the Mental Dice Task, and schizotypy. Essentially, this entails only 5 distinct statistical tests at the .05 level, one for each of the 5 primary hypotheses. Additional tests are treated as post-hoc analyses for exploratory purposes.

Individuals high on the PCL:YV generally scored lower on the WASI than those low on the scale. Raw scores for each group on the WASI are presented in Table 9.

Table 9
Means and Standard Deviations for the Psychopathic and the Nonpsychopathic groups on the WASI (Vocabulary and Matrices are measured in T scores)

	WASI	Mean	SD	Range
Low PCL:YV (<25)	IQ	99.6	6.5	88-112
N=30	Vocabulary	47.4	7.2	32-67
	Matrices	52.4	4.5	43-61
High PCL:YV (≥25)	IQ	93.1	6.4	81-104
N=14	Vocabulary	43.3	7.5	30-53
	Matrices	48.4	5.5	36-55
Total PCL:YV	IQ	97.5	7.1	81-112
N=44	Vocabulary	46.1	7.5	30-67
	Matrices	51.1	5.2	36-61

The intercorrelations (two-tailed) among the primary cognitive measures are presented in Table 10 and the lack of association between the measures sensitive to OPFC and DLPFC functioning indicates that meaningful associations between these measures are not present and therefore a factor analysis is unwarranted.

Table 10
Intercorrelations between Cognitive Measures

	WASIV	WASIM	WASIT	AST	SINT	PMV	GNGC	TOLI	TOLT
WASIM	-.12								
WASIT	.80***	.50**							
AST	.13	-.18	.01						
SINT	-.17	.04	-.13	.14					
PMV	-.20	-.01	-.18	-.28	.08				
GNGC	.20	.18	.29	-.13	.07	-.12			
TOLI	.31*	-.38*	.04	-.09	-.21	-.08	-.04		
TOLT	-.06	.04	-.03	-.28	-.25	-.03	.02	.34*	
SOPT	.38*	.09	.38*	-.02	-.12	-.11	.03	-.11	.08

Note. Signs of correlations have been adjusted so that the measures of performance are consistent (e.g., PMV sign was reversed to be consistent with AST). Shaded cells indicate correlations between measures related either to OPFC functioning or to DLPFC functioning. WASIV = Wechsler Abbreviated Scales of Intelligence Vocabulary Subtest; WASIM = Wechsler Abbreviated Scales of Intelligence Matrices Subtest; WASIT = Wechsler Abbreviated Scales of Intelligence Total; AST = Alberta Smell Test; SINT = Stroop Interference Score; PMV = Porteus Mazes Violations Score; GNGC = Go/No-Go Commissions; TOLI = Tower of London Initiation Score; TOLT = Tower of London Total Moves Score.

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

Table 11 shows results of comparisons between the psychopathic and nonpsychopathic groups on measures of cognitive functioning. Results of One-way ANOVAs are presented for descriptive purposes - actual statistical tests of hypotheses will be presented later. Significant differences between groups were found for the WASI total score, the Matrix Reasoning subtest, and GNG commissions. These findings were unaffected by partialling out the influence of FSIQ. Differences between groups on the WASI will be discussed with the results for measures of lateralization and the GNG commissions will be discussed with the results for the executive functioning measures.

Table 11
Mean Scores and Group Differences for the Nonpsychopathic (NP) and Psychopathic (P) Groups on Cognitive Measures

Tasks	Variables	NP	P	F	Cohen's d
WASI	Total	99.8 (7.5)	91.6 (8.3)	10.54*	1.04
(T Scores)					
	Vocabulary	47.4 (7.2)	43.3 (7.5)	2.98	0.56
	Matrices	52.4 (4.5)	48.4 (5.5)	6.71*	0.8
AST	Total	13.3 (2.9)	12.5 (3.4)	0.64	0.25
GNG	Omissions	0.4 (.9)	0.1 (.27)	1.69	0.47
	Commissions	2.8 (2.4)	1.0 (1.4)	6.81*	0.92
PMT	Task Violations	6.4 (6.2)	6.6 (6.2)	0.01	0.03
Stroop	Interference	2.5 (.8)	2.2 (.9)	1.06	0.28
SOPT	Errors	6.5 (2.6)	7.2 (2.2)	0.70	0.29
TOL	Total Moves	39.9 (19.0)	31.6 (14.8)	1.97	0.49
	Initiation Time	17.5 (13.3)	21.8 (13.0)	0.97	0.33
MDT	Count Z score	2.2 (1.7)	2.9 (2.1)	1.39	0.37

*$p<.05$.

Executive Functioning

The initial plan for controlling Family-Wise Type I Error Rate while maintaining statistical power was to reduce the number of variables, as recommended by Cohen (1988), by combining the OPFC and DLPFC sensitive measures into two composite variables. The intercorrelations (Table 10), however, provide little support for the initial supposition that the various tests were measuring a common construct. Therefore, some

other strategy of reducing the number of variables was required. From the 5 measures thought to reflect the OPFC functioning construct, the test that showed the largest effect size in previous studies was the Go/No-Go commission errors measure. Accordingly, this measure was selected for an *a priori* statistical test. There was a significant difference between groups on the GNGC measure; however, contrary to expectation, the group high on psychopathy made fewer commission errors than the nonpsychopathic group. For the two measures thought to be sensitive to DLPFC function (SOPT, TOLT), neither had been investigated in previous studies with psychopaths and there was therefore no obvious reason to choose one over the other. Accordingly, both were retained and Type I error was controlled by using a Bonferroni correction to $p<.025$ for two tests of the DLPFC function hypothesis. Neither test was significant. These results did not vary by controlling for IQ differences.

Figure 6 provides the Z scores for those executive functioning measures on which normative comparisons are possible. Both the psychopathic and nonpsychopathic groups performed better than a normative sample of slightly older orthopedic patients (20-29 years of age) on the AST (Green & Iverson, 1998). Two individuals (5%) had scores below the 5th percentile, one in each of the two groups. Both groups also performed better than a slightly older segment (17-29 years of age) of the normative sample on the Stroop (Spreen & Strauss, 1998). Eleven individuals (25%) were below the 5th percentile and three of these were in the psychopathic group. Both groups performed worse on the primary two indices, total number of moves and initiation time, from the Tower of London than the normative sample from the manual (Culbertson & Zilmer, 2001). No individuals were below the 5th percentile on initiation time for the TOL because of the

large standard deviation in the normative sample. Eleven (26%) of the 43 individuals who completed the TOL were below the 5th percentile on total number of moves, two of whom were in the psychopathic group. The GNG task was identical to the version used in the Roussy and Toupin (2000) study and so allowed for direct comparisons with their psychopathic and nonpsychopathic groups. The nonpsychopathic group in the present study made more commission errors, while the psychopathic group made fewer commission errors in comparison to the data presented by Roussy and Toupin (2000), although it is important to note that the all of the raw scores were very small. For example, the psychopaths in the Roussy and Toupin (2000) study made an average of only 2.09 commission errors. From the nonpsychopathic group there were 17 individuals who performed below the 5th percentile compared to the Roussy and Toupin nonpsychopathic data and 1 psychopathic individual who performed below the 5th percentile. Interestingly, both groups in the present study outperformed the normative sample on the AST and the SINT.

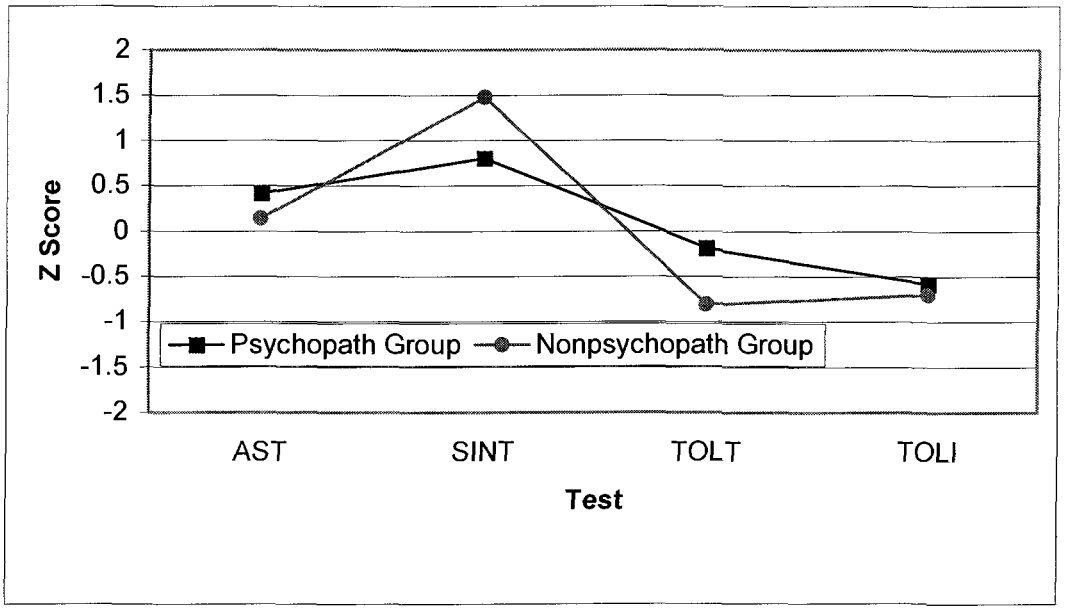

Figure 6. Normative Comparisons for Psychopathic and Nonpsychopathic Groups

Hemispheric Lateralization

Of the many possible ways of analyzing the dichotic listening data, the one considered beforehand to be the most sensitive to overall hemispheric differences was the left minus right ear hit rate, which reflects both correct identification of the target syllable and correct localization of the signal to the side of presentation. Results showed a non-significant difference between groups $F(1, 38) = 1.61$, $p = .21$. Table 12 shows a more detailed look at the data from a post-hoc perspective. This shows that the psychopathic group committed fewer left-sided false positives to a non-present signal than did the nonpsychopathic group. The fact that the psychopathic group was also significantly better at recognizing when the signal was not present (Correct Non-identification) is simply a function of their committing fewer false positives.

Table 12
Mean Scores and Group Differences for the Nonpsychopathic (NP) and Psychopathic (P) Groups on Dichotic Listening Raw Score Results

		NP	P	F	P
Left ear	Hits	7.7 (2.7)	7.1 (2.4)	0.49	.489
	Detection	14.4 (2.7)	13.2 (2.2)	1.75	.194
	Misses	5.6 (2.7)	6.8 (2.2)	1.75	.194
Right ear	Hits	8.5 (2.7)	9.4 (2.8)	1.88	.355
	Detection	15 (2.6)	13.8 (2.9)	1.95	.171
	Misses	5 (2.6)	6.2 (2.9)	1.95	.171
No signal	Correct Non-identification	9.6 (4.0)	12.5 (3.2)	5.14*	.029
	LFP	5.3 (2.8)	3.5 (1.9)	4.17*	.048
	RFP	5.1 (2.3)	4.0 (2.1)	2.12	.154

Note. Hits = correct localization of signal to either right or left side; Detection = hits plus mislocalization of signal; Misses = non-identification of signal; LFP = left side false positive; RFP = right side false positive.

* $p<.05$.

Tables 13 and 14 provide the correlations (two-tailed) between dichotic listening detection and localization arrived at using the signal detection theory analyses. As can be seen, the only significant correlations are with left ear detection sensitivity and Factor 1 and right ear localization sensitivity and overall localization sensitivity to Factor 1, the latter of which is primarily accounted for by the increased right ear advantage in localization. Interestingly, these associations are only present with Factor 1 as opposed to Factor 2 of the PCL:YV. The interpersonal characteristics of psychopathy therefore

appear to be specifically contributing to improved right ear localization sensitivity on the dichotic task. However, it should be kept in mind that the signal detection analyses generated 16 distinct results and those that are significant should be considered post-hoc findings. It may appear confusing that psychopaths made fewer left ear false positives and had better right ear localization. The left ear performance indicates that, when there was no signal, psychopaths rarely mistakenly reported that there was a signal to the left ear. The right ear localization performance indicates that the psychopathic group correctly localized signals to the right ear more often than the nonpsychopathic group. One of these statistics has to do with performance during a nonsignal and the other with performance during a signal.

Since the MDT has been associated with frontal lobe laterality, while dichotic listening reflects temporal lobe laterality, these two tests are treated separately. There were two MDT variables considered and a Bonferroni correction to $p<.025$ was thus used. There were no significant associations between the PCL:YV and the results of the MDT. Post-hoc exploration of bivariate correlations (two-tailed) of the MDT with the executive function variables revealed a significant association between the number of repetitions and the GNGC ($r=.30$). Interestingly, the MDT variable "rule breaks", which may be thought of as a measure of impulsivity, was significantly related to both the nonconformity ($r=.328$, $p<.05$) and the anhedonia ($r=.338$, $p<.05$) schizotypy questionnaires.

Table 13
Intercorrelations between Psychopathy and Dichotic Listening Detection

	PCLTOT	PCLFAC1	PCLFAC2
LES	.20	.37*	.04
RES	-.02	.08	-.06
RLS	-.20	-.24	-.10
OS	.09	.26	-.04

Note. LES = left ear sensitivity; RES = right ear sensitivity; RLS = right - left sensitivity, OS = overall sensitivity.

* p<.05.

Table 14
Intercorrelations between Psychopathy and Dichotic Listening Localization

	PCLTOT	PCLFAC1	PCLFAC2
LES	.14	.19	.07
RES	.31	.44**	.14
RLS	.13	.18	.04
OS	.26	.36*	.13

Note. LES = left ear sensitivity; RES = right ear sensitivity; RLS = right - left sensitivity, OS = overall sensitivity.

* p<.05. ** p<.01.

It is also worth considering the significantly inferior performance of the psychopathic group on the Matrix Reasoning subtest of the WASI here. Since Matrix Reasoning is putatively a spatial task, one could be led to propose a right hemisphere

impairment in the psychopathic group. However, although the correlation with Vocabulary in this sample was relatively low, Matrix Reasoning has shown high correlations with verbal measures in other studies (Dugbartey, Sanchez, Rosenbaum, Mahurin, Davis, & Townes, 1999). For this reason, it will not be examined as a measure of lateralization.

Schizotypy

All individuals completed the schizotypy scales. No individuals had to be excluded on the basis of an elevated score (2 or more items endorsed) on the Infrequency Scale. Because there were two schizotypy dimensions to be compared with two PCL dimensions, resulting in four comparisons, a Bonferroni correction to .05/4 =.0125 was used. Since the direction of correction was predicted, one-tail tests were used. Both of the clinical measures of schizotypy administered, Social Anhedonia and Impulsivity/Nonconformity, showed significant correlations with the PCL:YV as shown in Table 15. Interestingly, each of these scales was related to different factors of the PCL:YV, a finding that makes sense when one considers the content of the scales involved. Thus, the antisocial behavior captured by Factor 2 is related to nonconformity and the interpersonal dimension of Factor 1, which includes items such as shallow affect and callousness, is related to a lack of pleasure in normally enjoyable events (anhedonia).

Table 15
Intercorrelations between Psychopathy and the Schizotypy Scales

	PCLTOT	PCLFAC1	PCLFAC2	Anhedonia
PCLFAC1	.80***			
PCLFAC2	.84***	.37*		
Anhedonia	.31*	.39**	.09	
Nonconformity	.41**	.27	.39**	.14

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

Together the two psychosis proneness scales accounted for nearly 23% of the variance in the PCL:YV total scores, $r(44)=.48$, $p<.01$. Looking at each of the factors separately, the two Psychosis Proneness Scales accounted for 22% of the variance of Factor 1 and 15% of the variance of Factor 2.

Discussion

The identification of the neuropsychological correlates of youth psychopathy will be an important aspect to the biological understanding of this personality disorder and to the consideration of effective modes of treatment. From a theoretical standpoint, one would expect that the regions of the brain involved in impulse control and social comportment, namely the OPFC and associated limbic regions, would have a relationship to psychopathy, since these are keys areas in which psychopaths have difficulty. This expectation has received empirical support in the adult population (Lapierre et al., 1995). On the one hand, one may expect differences in the youth population because of the protracted period of cerebral maturation, particularly in the prefrontal cortex. On the other hand, there is evidence that personality traits are relatively stable through adolescence and into adulthood, suggesting that perhaps the neurobiology that subserves these traits is also relatively stable. The results of this study therefore have implications for the conceptualization of psychopathy and its development.

This study investigated the relationship between performance on a variety of cognitive measures and the results of the PCL:YV, which is based on a semi-structured interview and a review of the correctional file information. The sample consisted of a group of young offenders, ranging in age from 15-18, who were recruited during a stay in custody, either in a correctional facility in Victoria or another facility in Ottawa.

An examination of the psychometric properties of the PCL:YV scale indicated that it was reliable and valid as far as could be determined with the data collected for this study. However, while the range of scores spanned much of the 40-point spectrum, in fact very few individuals scored at either extreme of the continuum. For this reason, one

may expect that this restriction in the PCL:YV range will reduce the likelihood of finding significant correlations. A Principal Components Analysis indicated that the grouping of the items closely followed the factor solution of the PCL-R, with a large first factor and two subfactors representing the dimensions of interpersonal style and antisocial behavior.

The Rasch analysis indicated that the PCL:YV data fit the Rasch model and no items or persons needed to be excluded. Items from the first subcomponent (the equivalent of the interpersonal factor from the PCL-R) appeared to be more closely related to the psychopathy construct. This was also found in the IRT analysis of the PCL-R (Cooke & Michie, 1997). Some researchers have argued that the primary clinical objective of the PCL scales is the prediction of recidivism and that therefore Factor 2, which has the strongest association with recidivism, could be used to the exclusion of Factor 1 (Quinsey, Harris, Rice, & Cormier, 1998). The results of the Rasch analysis presented here, and the IRT analyses of the PCL-R, argue against this perspective. Factor 1 appears to be more prototypical of psychopathy.

The results were analyzed using psychopathy as a continuous variable when appropriate and at other times with the results of the PCL:YV broken into two groups. The first primary cognitive measure was the estimate of IQ provided by the WASI, which indicated that the high psychopathy group significantly underperformed the low psychopathy group. Due to the strong relationship between IQ and other cognitive measures, the effect of this difference between groups had to be considered in other analyses of neuropsychological performance.

The first hypothesis that psychopathy would show an inverse relationship with performance on measures sensitive to OPFC functioning was not supported. When the

measures sensitive to OPFC functioning were examined independently, the results indicated that only the GNGC was related to psychopathy and this occurred in the reverse of the expected direction. In other words, the high psychopathy group committed fewer commission errors than the low psychopathy group. There was no relationship between psychopathy and the DLPFC measures, consistent with expectation. There are at least five possible reasons for this failure to find significance with the measures sensitive to OPFC functioning: (1) neurodevelopmental changes in the prefrontal cortex, (2) a restriction of the range of psychopathy, (3) a non-meaningful separation between groups in their levels of psychopathy, (4) heterogeneity in the psychopathic population, and (5) characteristics of the executive functioning measures.

Firstly, as mentioned earlier, the prefrontal cortex is the last region in the brain to fully develop. For this reason, it is possible that this lack of development influenced the executive functioning results and that this explains the difference between these findings and those in the adult population. More specifically, perhaps the neurodevelopmental trajectory of the dorsolateral and orbital regions is similar during adolescence. However, with age the dorsolateral region develops as expected, while the orbital region remains underdeveloped in those individuals with psychopathic traits. In the current study, the psychopathic group often outperformed the nonpsychopathic group, even on OPFC measures thought to be sensitive to impulse control. This study therefore suggests much smaller effect sizes among youth psychopaths than those seen among adult psychopaths. A comparison of the two studies most similar to the present study also supports this observation. As shown in Table 3, Lapierre et al. (1995) found an average effect size for their OPFC sensitive measures of $d = 1.46$, while Roussy and Toupin provided an

average effect size for the same measures of d = .39. The latter study had one measure that was nonsignificant, but the other two measures that did reach significance only had an effect size of d = .58. This provides some evidence that the OPFC deficits in psychopaths increase over time. Neuroanatomically, there is evidence that the OPFC region is still developing well into adolescence, but the DLPFC region appears to have an even more protracted development (Sowell et al., 1999). This does not preclude the possibility of insufficient development specifically in the OPFC region, but verification would require direct neuroimaging comparisons between psychopaths and nonpsychopaths.

In addition, it has been suggested that psychopaths may have deficits in amygdala function early in development. In support of this idea is the finding that psychopathic children appear to be impaired on tasks that elicit activation of the amygdala, such as fear recognition (Mitchell et al., 2002). Over time, the orbitofrontal cortex may be impacted through a reduction in afferent input from the amygdala. This would help to explain the greater evidence for OPFC dysfunction in adults than in adolescents. This combined limbic-prefrontal cortex dysfunction may also explain differences between individuals with acquired damage to the OPFC and psychopaths, with the former characterized by reactive aggression and the latter by proactive or instrumental aggression (Blair, Morris, Frith, Perrett, & Dolan, 2000). In lieu of limbic contributions to emotional processing, psychopaths may have to use other regions of the brain for this purpose. For example, psychopaths appear to compensate for reduced limbic activation on an emotional memory task with activation in regions of the lateral frontal cortex (Kiehl et al., 2001). Importantly, the groups in this latter study did not differ in their task performance. Thus,

although psychopaths may perform within normal limits on psychological measures, they may be processing the task requirements in very different ways than do nonpsychopaths. Since neural imaging was not part of this study it is impossible to know if the psychopathic group recruited different brain areas than the nonpsychopathic group during task performance.

Secondly, there was a restriction of the range of psychopathy in this study with relatively few individuals at either extreme of the scale. This may have reduced the likelihood of finding significant differences between the two groups. To further test this hypothesis the very low and very high scorers on the PCL:YV were compared to one another. An examination of those individuals with scores greater than 30 and those with scores equal to or below 20 only indicated that the group with elevated scores on psychopathy showed greater response latency in initiating their first move on the Tower of London. Again this is suggestive of greater inhibitory capacity on the part of the psychopathy group. Two of the previous studies on psychopathy differ from the current results. In both cases the samples were larger and, in particular, had a greater proportion of individuals in the elevated range of psychopathy. Lapierre et al. (1995) found significant differences in comparing a group with a PCL-R score greater than 30 with a second group with a PCL-R score less than 20. Roussy and Toupin (2000) maintained these large differences between adolescent offenders on the PCL-R. The present finding of a lack of significant differences between groups on measures sensitive to DLPFC functioning was consistent with these previous studies.

Thirdly, and related to the second point, the groups were quite similar in many ways. In addition to their scores being closer than they have been in previous studies,

they were all in custody and all within a fairly narrow age range. These similarities may have contributed to obscuring the differences between the groups.

Fourthly, there has been some discussion in the literature about the heterogeneity of psychopathy and how this may explain some of the inconsistent research findings. Brinkley, Newman, Widiger, and Lynam (2004) suggest subtypes of psychopathy based on anxiety level, while Murphy and Vess (2003) propose narcissistic, borderline, sadistic, and antisocial subtypes. Regardless of the classification schema, it may be that the different subtypes have distinct neurocognitive profiles. This heterogeneity may explain how different studies, particularly those with small sample sizes, arrive at different conclusions. Population heterogeneity may also explain the inconsistent findings concerning executive function deficits in those diagnosed with Conduct Disorder (Teicher & Golden, 2000). Frick (1998) has suggested that conduct-disordered youth can be divided into those with callous/unemotional traits and those with a history of impulsive behaviors. While this distinction closely follows the factor structure of the PCL scales, the specific designation of an impulsivity component that may or may not be present in a 'fledgling psychopath' is important. While psychopaths are commonly perceived as impulsive, their impulsivity on cognitive measures may be mitigated by a lack of test-taking anxiety and a disinterest in impressing the examiner as capable. In other words, the measurement of impulsivity is particularly sensitive to an individual's eagerness to do well and respond quickly and the lack of that desire may deflate the measured level of impulsivity.

The fifth and final point relates to the measurement of executive functioning and test characteristics. Executive functioning tasks have been difficult to relate to one

another because of low intercorrelations (Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). This also proved to be the case in this study with no correlations on different executive tasks that were above .3. The putative OPFC measures were no more related to one another than they were to the putative DLPFC tasks. Whether these low correlations indicate genuine independence between the measures or not is unclear. It is possible, for example that nonexecutive cognitive processes, such as verbal abilities, influence performance on certain executive tasks and not others, or that the functional separation between different anatomical locations in the prefrontal cortex is more theoretical than real. For this reason, the tests may not have clustered into tests sensitive to DLPFC or OPFC functioning. Another concern regarding the measurement of executive functioning is the low test-retest reliability of many of the measures (Denckla, 1996). This may be due to different people applying different strategies and, in turn, different regions of the brain to perform the tasks. The importance of this issue will likely be clarified once neuropsychological testing is combined with neuroradiological imaging. Regardless of the basis of the poor reliability of the EF measures, the intercorrelations will for this reason be limited.

A final measurement issue that may have contributed to the failure to identify OPFC impairments among the psychopathic group was the lack of sensitivity of the OPFC measures to actual impulse control deficits. This study provides some evidence of this discrepancy: while the Rasch analysis indicated that the impulsivity item (#14) on the PCL:YV was one of the most frequently endorsed, there was little evidence that impulse control deficits dramatically affected either group on psychological testing. The PCL:YV impulsivity item is rated on the basis of behavioral evidence of the trait in

multiple real world contexts (e.g., employment, schooling etc.). In contrast, the OPFC sensitive measures assess impulsivity through tasks that are performed in a highly structured environment that is devoid of many of the affective and interpersonal influences that characterize the decision-making contexts encountered in the real world. The development of more ecologically valid measures of impulse control would likely help to distinguish between the psychopathic and nonpsychopathic populations. Video games that elicit emotional arousal and impose costs on the impulsive player could be a fruitful line of research in this regard.

The second hypothesis, that the high psychopathy group would display a reduced ear asymmetry, was not supported. In fact, psychopaths displayed greater ear asymmetry than nonpsychopaths, although this difference was not significant. Earlier studies on dichotic listening have used different paradigms, including emotionally valenced words (Hiatt, Lorenz & Newman, 2002) as opposed to consonant vowel stimuli and different analytic techniques (Raine et al., 1990) and these differences may partially account for the differences in the results with the present study. Using the signal detection theory analyses, it appeared that Factor 1 was especially related to right ear localization sensitivity. Previous studies have presented evidence that psychopaths are less lateralized than nonpsychopaths; however, they have failed to consider the relationship between lateralization and the psychopathy factor scores. One could argue that Factor 1 scores are more likely to capitalize on verbal abilities with items like grandiosity, impression management, and pathological lying and that this is perhaps reflective of the strong left hemisphere functioning seen on the dichotic listening task.

The Mental Dice Task, which has been related to hemispheric dominance and specifically to right prefrontal function, did not provide any indication of a difference between groups. Considering the task demands, the MDT appears to require strategy, working memory and response monitoring abilities, all of which would fit with DLPFC father than OPFC functioning theories. It may be that any deficits that psychopaths have in right hemisphere areas are not the same areas that mediate performance on the MDT.

As indicated in the Results section, each of the schizotypy scales was related to a different component of the PCL:YV. The anhedonia measure was related to Factor 1 and the nonconformity measure was related to Factor 2. These associations make sense since the anhedonia questionnaire and Factor 1 are both sensitive to emotional shallowness and the nonconformity questionnaire and Factor 2 are both sensitive to the attributes of antisocial behavior. It has often been stated that a self-report measure of psychopathy would not be reliable because of the tendency of psychopaths to dissimulate and deceive. On the other hand psychopaths are considered to be impulsive and to have difficulty inhibiting the drive to disclose the sensational aspects of their lives. For this reason, a self-report measure may in fact capture many of the characteristics evaluated in the semi-structured interview and file review format of the PCL:YV. Indeed a self-report inventory entitled the Psychopathic Personality Inventory has shown fair sensitivity and excellent specificity in relation to classifications of psychopathy with the PCL-R (Poythress, Edens, Lilienfeld, 1998).

Limitations of the Study

There are a number of study limitations worthy of note. The generalizability of the results is limited by the small sample size. This is particularly a concern at the high end of the psychopathy spectrum, since there were only a small number of individuals who met the clinical cutoff for psychopathy. Although the *a priori* power analysis suggested that this sample size would be sufficient to detect significant differences, the limited number of studies upon which the effect size was calculated constrained the robustness of the estimate. The relevant previous studies may have had sample specific characteristics that were not replicated in this study. Only additional studies, particularly those with larger samples, will help to clarify the effect sizes for neuropsychological functioning in psychopathy.

Furthermore, while the groups in this study differed by more than 10 points on the PCL:YV, previous studies of the neuropsychological characteristics of psychopathy have had groups that differed by, in one case, more than 15 points (Roussy & Toupin, 2000) and in another by more than 20 points (Lapierre et al., 1995). Perhaps the groups were not sufficiently separated from one another on the PCL:YV to detect significant neuropsychological differences. The analysis of the more extreme cases of this sample was not suggestive that this was the case, but since the numbers were small it remains possible that a larger separation between groups would have led to different results. In addition, both of the above mentioned studies defined psychopathy as a score of 30 or more and this may have also improved the likelihood of finding significant differences.

There are also a number of participant specific factors that could have influenced the results. Specifically, other clinical concerns, such as Attention-Deficit Hyperactivity

Disorder, traumatic brain injuries, and drug use, can affect the integrity of the prefrontal cortex. A disproportionate prevalence of one or more of these factors in either of the two groups could have altered the results. However, while having experienced blows to the head was relatively common among the young offenders, no participant had a history of a head injury in the moderate to severe range. Similarly, while drug abuse was quite common among the sample, no individual had been hospitalized because of drug use and the history of their use was rarely more than 3 or 4 years. The presence of ADHD could only be grossly estimated because of the uncertain histories. Many of the youth reported having been prescribed a psychostimulant when they were young, but this information was not reported in the collateral information available. Other youth were unsure if they had been given this diagnosis. Still other youth presented with the signs and symptoms of ADHD but had never been diagnosed because of limited contact with medical professionals. It is possible this had some effect on the results, but since psychopathy has been linked to ADHD (Lynam, 1996), it is more likely it would have adversely influenced those with elevated scores on the PCL:YV. This would therefore not explain the better performance of psychopaths on several measures.

The participants in this study were assessed while in custody, and certainly the prevalence of psychopathy would vary based on whether the young offenders were seen in the community versus in custody. The prevalence of psychopathy would further depend on the type of custody setting and its associated level of security. Variability in ethnicity would be expected to change in relation to the region of the assessment; however, the PCL:YV has been found to be valid across many distinct cultural groups (Hare, 2003), and there is therefore no reason to believe that these results are

unrepresentative to other groups with different cultural compositions. The generalizability to offenders with different rates of drug use or head injuries may be limited.

Lastly, the PCL:YV was a new and clinically unproven measure at the time of this study. The extent to which it captures the psychopathy construct as well as the PCL-R does remains to be seen. Certainly, the limited history of adolescents will tend to lower scores on the behavioral dimension of Factor 2, but it is also possible that the incomplete ego development and increased egocentricity of an adolescent could elevate Factor 1 scores. What effect these differences may have on the stability of psychopathy is uncertain, but as mentioned previously the stability of other personality assessment tools gives one reason to be optimistic about the stability of the psychopathy construct from adolescence into adulthood.

In sum, this study examined a relatively new scale for the assessment of psychopathy, the PCL:YV, and investigated the cognitive and personality characteristics of young offenders in relationship to their scores on that scale. A number of objectives were achieved. Firstly, no IRT analysis has to this point been published on the PCL:YV. This study therefore helps to fill that gap and provides support for the reliability and validity of this instrument. Secondly, there was no indication that psychopaths were more impaired on measures sensitive to either OPFC or DLPFC functioning and this raises questions about the development of the putative OPFC dysfunction in psychopaths. Further research will need to investigate the neurological development of psychopathy with a wide variety of approaches including functional and structural imaging. Thirdly, no evidence of a deficit in hemispheric dominance in psychopaths was obtained and

further research with dichotic listening may choose to use stimuli that have a higher likelihood of being affected in the psychopathic population (e.g., emotional words). Finally, this study provided only the second investigation of schizotypy and its relationship to psychopathy and indicated that the self-report measures of Nonconformity/Impulsivity and Social Anhedonia are related to different factors from the PCL:YV. This provides an interesting link to a personality style that is not typically associated with psychopathy and encourages further research into the placement of psychopathy within the larger framework of personality disorders.

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Appendix A

Glossary of Terms

Abbreviation	Term/Phrase
AST	Alberta Smell Test
DLPFC	Dorsolateral prefrontal cortex
FFM	Five Factor Model of personality
GNG	Go/No-Go Test
GNGO	Go/No-Go Omissions
GNGC	Go/No-Go Commissions
Infit/Mnsq	The weighted standardized residual mean square
IRT	Item Response Theory
MDT	Mental Dice Task
MDTZ	Mental Dice Task Z score
NP	Non-psychopaths
OPFC	Orbital prefrontal cortex
P	Psychopaths
PCA	Principal Components Analysis
PCL-R	Psychopathy Checklist – Revised
PCLFAC1	Psychopathy Checklist Youth Version Factor 1
PCLFAC2	Psychopathy Checklist Youth Version Factor 2
PCLTOT	Psychopathy Checklist Youth Version Total score
PCL:YV	Psychopathy Checklist Youth Version
PFC	Prefrontal cortex
PIQ	Performance (nonverbal) intelligence quotient
PMT	Porteus Mazes Test
PMV	Porteus Mazes (Rule) Violations
SINT	Stroop Interference score
SOPT	Self-Ordered Pointing Test
TOL	Tower of London
TOLI	Tower of London Initiation score
TOLT	Tower of London Total score
VIQ	Verbal Intelligence Quotient
WASI	Wechsler Abbreviated Scale of Intelligence
WASIM	Wechsler Abbreviated Scale of Intelligence – Matrix Reasoning
WASIV	Wechsler Abbreviated Scale of Intelligence – Vocabulary
WASIT	Wechsler Abbreviated Scale of Intelligence – Total score

Appendix B

PCL:YV Item Descriptions

#	Item	Brief Descriptions
1	Impression Management	An insincere and shallow interactional style with a tendency to present self in a positive light.
2	Grandiose sense of self worth	An inflated view of self-worth. Problems are attributed to external factors.
3	Stimulation seeking	A chronic and excessive need for activities, which are often risky in nature.
4	Pathological lying	A chronic pattern of lying and deceit.
5	Manipulation for personal gain	The use of deceit to obtain money, sex or other items of personal value.
6	Lack of remorse	A general lack of concern for the negative consequences of their behaviors.
7	Shallow affect	The presentation of a limited range of emotion, or the expression of emotions inconsistent with their present situation.
8	Callous/lack of empathy	The expression of a callous disregard for the feelings of others.
9	Parasitic orientation	A tendency to exploit others by depending on them for social assistance, while avoiding gainful employment.
10	Poor anger control	A tendency to take offense easily and become quickly angered.
11	Impersonal sexual behavior	Sexual relations that are frequent, casual, transient, and may be aggressive in nature.
12	Early behavior problems	Externalized behaviors that include cheating, theft, robbery, fire-setting etc.
13	Lacks goals	An inability or unwillingness to make plans and commit to them.
14	Impulsivity	A tendency to act with little forethought, and with a lack of consideration of the potential effect on others.
15	Irresponsibility	A failure to meet obligations in domains such as work, school, and the legal arena (e.g., probation appointments).
16	Failure to accept responsibility	An unwillingness to accept responsibility for one's actions or their consequences.
17	Unstable interpersonal relationships	A tendency to have superficial and turbulent extrafamilial relationships.
18	Serious criminal behavior	Charges and convictions for serious offenses including violent offenses and some nonviolent offenses (e.g., arson, fraud, trafficking etc.)
19	Serious violations of conditional release	A violation that has led to revocation of conditional release or the commission of criminal acts while on release.
20	Criminal versatility	The commission of a variety of types of offenses (e.g., property, violent, sexual etc.)

Appendix C

Revised Social Anhedonia Scale

1. I could be happy living all alone in a cabin in the woods or mountains.
2. I prefer hobbies and leisure activities that do not involve other people.
3. I don't really feel very close to my friends.
4. If given the choice, I would much rather be with others than be alone.
5. Making new friends isn't worth the energy it takes.
6. When others try to tell me about their problems and hang-ups, I usually listen with interest and attention.
7. When things are going really good for my close friends, it makes me feel good too.
8. Having close friends is not as important as many people say.
9. My emotional responses seem very different from those of other people.
10. When I move to a new city, I feel a strong need to make new friends.
11. I prefer watching television to going out with other people.
12. I feel pleased and gratified as I learn more and more about the emotional life of my friends.
13. I like to make long distance phone calls to friends and relatives.
14. I have always enjoyed looking at photographs of friends.
15. Although I know I should have affection for certain people, I don't really feel it.
16. A car ride is much more enjoyable if someone is with me.
17. I find that people too often assume that their daily activities and opinions will be interesting to me.
18. I attach very little importance to having close friends.
19. I have often found it hard to resist talking to a good friend, even when I have other things to do.
20. When someone close to me is depressed, it brings me down also.
21. My relationships with other people never get very intense.
22. When things are bothering me, I like to talk to other people about it.
23. Knowing that I have friends who care about me gives me a sense of security.
24. Although there are things that I enjoy doing by myself, I usually seem to have more fun when I do things with other people.
25. People often expect me to spend more time talking with them than I would like.
26. It's fun to sing with other people.
27. Just being with friends can make me feel really good.
28. When I am alone, I often resent people telephoning me or knocking on my door.
29. Playing with children is a real chore.
30. It made me sad to see all my high school friends go their separate ways when high school was over.
31. There are few things more tiring than to have a long, personal discussion with people.
32. I never had really close friends in high school.
33. People who try to get to know me better usually give up after awhile.
34. In many ways, I prefer the company of pets to the company of people.
35. I am usually content to just sit alone, thinking and daydreaming.
36. I sometimes become deeply attached to people I spend a lot of time with.
37. People sometimes think that I am shy when I really just want to be left alone.
38. People are usually better off if they stay aloof from emotional involvements with most others.
39. There are things that are more important to me than privacy.
40. I'm much too independent to really get involved with other people.

Appendix D

Impulsive-Nonconformity Scale

1. If I burped loudly while having dinner at the house of someone I knew, I would be embarrassed.
2. Thinking things over too carefully can destroy half the fun of doing them.
3. When I want something, delays are unbearable.
4. I always let people know how I feel about them, even if it hurts them a little.
5. I avoid trouble whenever I can.
6. I frequently overeat and wonder why later.
7. I often do unusual things just to be different from other people
8. I usually consider different viewpoints before making a decision.
9. I would probably purchase stolen merchandise if I knew it was safe.
10. It is important to save money.
11. I have had to invent some good excuses to get out of work or taking exams.
12. Most people say "please" and "thank you" more often than is necessary.
13. My friends consider me to be a cool, controlled person.
14. I let go and yell a lot when I'm mad.
15. No one seems to understand me.
16. It would embarrass me a lot to have to spend a night in jail.
17. I rarely act on impulse.
18. My parents often objected to the kind of people I went around with.
19. I always stop at red lights
20. People who drive carefully annoy me.
21. I usually find myself doing things "on impulse".
22. In school, I sometimes got in trouble for cutting up.
23. I usually laugh out loud at clumsy people.
24. My way of doing things is apt to be misunderstood by others.
25. When I really want something, I don't care how much it costs.
26. I have never been in trouble with the law.
27. It worries me if I know there are mistakes in my work.
28. I usually quit before finishing one activity in order to start something else.
29. Being in debt would worry me.
30. I think people spend too much time safeguarding their future with saving and insurance.
31. Long-term goals are not as important for me as living for today.
32. Most people think of me as reckless.
33. I break rules just for the hell of it.
34. I like to use obscene language to shock people.
35. I liked to annoy my high school teachers.
36. I wouldn't worry much if my bills were overdue.
37. I sometimes do dangerous things just for the thrill of it.
38. I almost always do what make me happy now, even at the expense of some distant goal.
39. During one period when I was a youngster, I engaged in petty thievery.
40. Most of the mourners at funerals are just pretending to be sad.
41. I prefer being spontaneous rather than planning ahead.
42. I try to remember to send people birthday cards.
43. I find it difficult to remain composed when I get into an argument
44. I usually control my feelings well.
45. As often as once a month, I have become so angry that I have had to hit something or someone to relieve my anger.
46. I often get so mad that I lose track of some of the things that I say.
47. I never get so angry I can't speak coherently.
48. I do many things that seem strange to others but don't seem strange to me.
49. I don't have much sympathy for people whom I can push around and manipulate easily.
50. When I start out in the evening, I seldom know what I'll end up doing.
51. I usually act first and ask questions later.

Appendix E

Infrequency Scale

1. I find that I often walk with a limp, which is the result of a skydiving accident.
2. I cannot remember a single occasion when I have ridden on a bus.
3. At times when I was ill or tired, I have felt like going to bed early.
4. I believe that most light bulbs are powered by electricity.
5. Sometimes when walking down the sidewalk, I have seen children playing.
6. I cannot remember a time when I talked with someone who wore glasses.
7. Driving from New York to San Francisco is generally faster than flying between these cities.
8. On some mornings, I don't get out of bed immediately when I first wake up.
9. On some occasions I have noticed that some other people are better dressed than myself.
10. There have been a number of occasions when people I know have said hello to me.
11. There have been times when I have dialed a telephone number only to find that the line was busy.
12. I go at least once every two years to visit either northern Scotland or some part of Scandinavia.
13. I have never combed my hair before going out in the morning.

Appendix F

Map of Person Trait Levels and Question Endorsability Levels for the PCL:YV Rasch Analysis