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# Neuropsychological correlates of psychopathic traits among delinquent adolescents

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### **Abstract**

*Objective:* This master thesis aimed to study neuropsychological functioning and psychopathic traits among delinquent adolescents within a Juvenile Justice Institution (JJI) in the Netherlands. The research question ‘In what way is neuropsychological functioning related to psychopathic traits among delinquent adolescents?’ was explored through three hypotheses; delinquent adolescents with higher Verbal IQ and Verbal Comprehension Index scores show more traits of the interpersonal domain (1), delinquent adolescents with better performance on sustained attention show more traits of the affective domain (2), and delinquent adolescents with lower inhibition scores show more traits of the behavioural domain (3).

*Method:* Fifteen adolescents were tested for IQ (WISC-III, WAIS), sustained attention (Bourdon-Vos), impulsivity/inhibition (Stroop) within the JJI. The Youth Psychopathic trait Inventory (YPI) was used to assess psychopathic traits. Performance on the neuropsychological tests was compared with the interpersonal domain, affective domain and the behavioural domain (YPI). Regression analyses were used to investigate whether the significant correlations predicted variance in psychopathic traits.

*Results:* Among other significant correlations between IQ scores and psychopathic traits that were found, a significant positive correlation was found between Verbal Comprehension and Dishonest Charm (interpersonal domain YPI). Verbal Comprehension did not predict variance in Dishonest Charm. No relationships were found between sustained attention, inhibition/impulsivity and psychopathic traits.

*Discussion:* Little research had been done on the relationship between psychopathic traits and neuropsychological functioning, but some of the findings in this study were in line with prior research. Most studies were done in the general population and this study is the first in the Netherlands to include detained adolescents. Main limitations were the small group size and the refusal of some adolescents to cooperate, which could result in a bias. Future recommendation is to conduct a longitudinal study which includes normal controls, focussing upon the relationship between IQ, psychopathic traits and the severity of the crime committed. The results of this study can be taken into consideration when diagnosing delinquent adolescents and when starting treatment.

### **Introduction**

This study aimed to investigate neuropsychological functioning and psychopathic traits among delinquent adolescents within a Juvenile Justice Institution (JJI). According to some researchers, the uninhibited, antisocial behaviour of adult psychopaths could possibly be based in subtle cognitive differences (Hiatt, Schmitt, & Newman, 2004; Salekin, Neumann, Leistico, & Zalot, 2004; Loney, Frick, Ellis, & McCoy, 1998). Past research with adolescents has described differences in IQ, attention and impulsivity between delinquent adolescents with and without psychopathic traits (Salekin, Lee, Schrum Dillard, & Kubak, 2010; Fritz, Wiklund, Kuposov, af Klinteberg, & Ruchkin, 2008; Colledge, & Blair, 2001). The focus of this research is thus to explore these neuropsychological differences further, by studying IQ, sustained attention and inhibition/impulsivity, and their relation with psychopathic traits in delinquent adolescents in the Netherlands. Are there differences in neuropsychological functioning between delinquent adolescents with and without psychopathic traits? To further investigate whether neuropsychological functioning plays an underlying role in the manifestation of psychopathic traits, the predictive value of the neuropsychological correlates will be explored.

### **Psychopathic traits**

Adult psychopathy is a constellation of traits which is commonly described in literature. It is a distinctive pattern of interpersonal, affective, and behavioural symptoms (Hart, & Hare, 1997). Psychopaths are often described as people who are manipulative, shallow, lacking in empathy and who use their dishonest charm for personal gain. They show no remorse or anxiety, are irresponsible and are likely to behave in antisocial ways. These traits are commonly clustered in three domains in literature; the interpersonal domain (1), the affective domain (2) and the behavioural domain (3). The interpersonal domain reflects the manipulative, charming, egocentric behaviours of the psychopath. Traits such as callousness, lack of empathy and lack of remorse belong to the affective domain. The irresponsible, impulsive behaviours and the proneness to seek novelty are addressed within the behavioural domain (Hare, 1999).

Although psychopathy is not an official DSM-IV diagnosis (American Psychiatric Association, 2000), it resembles the DSM-IV diagnosis Anti-Social Personality Disorder (ASPD). The relationship between ASPD and psychopathy is an asymmetric one. People with ASPD are impulsive, manipulative, show disregard for feelings of others and frequently lack empathy, the

same way psychopaths do. The presence of antisocial behaviour with ASPD is what differentiates the two from one another. People with psychopathy do not always engage in criminal conduct, although this has often been linked to psychopathy (Crocker, Mueser, Drake, Clark, Mchugo, Ackerson, & Alterman, 2005). Hildebrand and de Ruiter (2004) compared the presence of ASPD and psychopathy within a Dutch forensic psychiatric institution. They concluded that 81% of the people who met the criteria for psychopathy also met the diagnostic criteria for ASPD. Furthermore, a minority of the people who received the diagnosis ASPD (38%) also met the criteria for psychopathy (Hildebrand, & de Ruiter, 2004). Moreover, it is known that adolescents with psychopathic traits show a tendency towards developing conduct disorder (CD) (Loeber, Burke, & Pardini, 2009), which is a well known precursor of ASPD (American Psychiatric Association, 2000).

Obviously, psychopathy does not suddenly arise among adults. Precursors of psychopathy can and do exist in children and adolescents (Hare, 1993). This study focuses upon the psychopathic traits among delinquent adolescents. In line with the suggestion of Loeber et al. (2009) the term psychopathic traits will be used in this thesis, for children and adolescents are still developing and only at the age of 23 the personality is considered to be fairly stable. Psychopathic traits can appear at a relatively young age. Research has shown the presence of psychopathic traits in children from age 9 years and even in children of 6 years of age (Hawes, & Dadds, 2007; Waschbuch, Carrey, Willoughby, King, & Andrade, 2007). According to Salekin, Rosenbaum and Lee (2008) the three domains that are present with adult psychopathy are applicable to children and adolescents. Especially the traits of the affective domain, the callous-unemotional traits, are considered to be fairly stable from adolescence into adulthood (van Baardewijk, Stegge, Bushman, & Vermeiren, 2009).

Psychopathic traits in children and adolescents are related to conduct problems, delinquency and aggression (Frick, & White, 2008; Fritz et al., 2008; Kotler, & McMahon, 2005). The callous-unemotional traits (of the affective domain) designate an important subgroup of antisocial and delinquent youth and are related to the development of ASPD (Frick, & White, 2008; Kimonis, Frick, Skeem, Marsee, Cruise, Munoz, Aucoin, & Morris, 2008; Pardini, & Loeber, 2008; Viding, Frick, & Plomin, 2005). On top of that, these traits are considered to be fairly stable from adolescence into adulthood, as was mentioned before.

The interpersonal and affective traits of psychopathy are associated with a socially deviant lifestyle, which includes irresponsible and impulsive behaviour (Hare, 1999). Furthermore, certain psychopathic traits, such as impulsivity (behavioural domain), grandiosity (interpersonal domain) and lack of empathy (affective domain), are related to the likelihood of criminal behaviour and increase the risk of not inhibiting this behaviour. These symptoms also result in more impulsive, poorly planned criminal acts for which the possibility of being caught is relatively high. Adult psychopaths commit about 50% more offences than non-psychopaths (Hart, & Hare, 1997).

The prevalence of psychopathic traits among adolescents in juvenile justice institutions (JJI) in the Netherlands varies around 20% (Das, de Ruiter, Doreleijers, & Hillege, 2009; Andershed, Köhler, Loudon, & Hinrichs, 2008). Das et al. (2009) found that 19.8% (N = 98) of the incarcerated boys within a JJI in the Netherlands scored high on psychopathic traits (Psychopathic Checklist-Youth Version, PCL-YV, cut-off score: 30), and 56.8% of the boys scored moderately (PCL-R cut-off scores between: 20-30). According to Lynam, Loeber, and Stouthamer-Loeber (2008) a moderate stability between psychopathic traits in adolescence and psychopathy in adults exists, which becomes clear when comparing prevalence rates of psychopathic traits between delinquent adolescents and delinquent adults. Prevalence rates of psychopathy among adults within forensic psychiatric facilities in the Netherlands are similar to those of psychopathic traits in adolescents within JJI and vary around 20% (PCL-R cut-off score: 30) (Decuyper, de Fruyt, & Buschman, 2008; Hildebrand, & de Ruiter, 2004).

### *Psychopathic traits and neuropsychological functioning*

Because psychopathic traits, and especially the callous-unemotional traits of the affective domain, have strong relationships with delinquency and aggression and are considered to be fairly stable, a closer look at certain factors that may play a role in the development of these traits is needed. Are psychopathic traits based in neuropsychological functioning? Hart and Hare (1997) described adult psychopaths as people who have sufficient cognitive abilities to understand that their behaviour is inadmissible and have abilities to inhibit this behaviour, but simply choose not to. Some researchers debate this, saying that possibly there are subtle cognitive differences underlying the uninhibited, antisocial behaviour of psychopaths (Hiatt, Schmitt, & Newman, 2004; Salekin, Neumann, Leistico, & Zalot, 2004; Loney, Frick, Ellis, & McCoy,

1998). The emphasis of this study lies on these kinds of differences, focussing on the relationship between psychopathic traits and neuropsychological functioning. Two aspects of neuropsychological functioning are studied: cognitive functioning (IQ) and executive functioning (i.e. attentional control). In the next paragraphs research on these functions and possible relations to delinquency and psychopathic traits is described.

### **Cognitive functioning**

Many researchers conclude that delinquent adolescents perform less well on intelligence tests than nondelinquents (Syngelaki, Moore, Savage, Fairchild, & van Goozen, 2009; Vreugdenhil, Vermeiren, Wouters, Doreleijers, & van den Brink, 2004; Vermeiren, de Clippele, Schwab-Stone, Ruchkin, & Deboutte, 2002; Moffitt, 1990). In general, delinquent adolescents also score significantly lower on the verbal subtests than on the performance subtests (Anckarsäter, 2005; Stevens, Kaplan & Hesselbrock, 2003; Vermeiren et al., 2002; Moffitt & Caspi, 2001; Loney et al., 1998; Henry & Moffitt, 1997). The dichotomy is largest for adolescents, compared to adults and children, and is mainly caused by a low verbal IQ score and not so much by a high Performance IQ score (Isen, 2010). Thus, according to Raine, Moffitt, Caspi, Loeber, Stouthamer-Loeber, and Lynam (2005), verbal deficits are related to delinquency. Vermeiren et al. (2002) provides several explanations for the relationship between verbal deficits and delinquent behaviour in adolescents. The presence of verbal deficits could have a negative effect on academic performance because the ability to learn is affected. This could have effects on the motivation to go to school and thus result in truancy. Furthermore, the adolescent might have trouble learning which behaviours are acceptable or not. Verbal deficits can also have an effect on the ability to verbalise emotions, and therefore the ability to express these emotions in an adequate way, which can have a negative effect on developing aspects of self-control strategies (e.g. delay gratification, anticipation of consequences) (1); interpreting the emotions of others (2); limiting the response to threatening and socially difficult situations making a more impulsive and aggressive response more likely (3). In line with these explanations, Vermeiren et al. (2002) conclude that higher intelligence in general, and higher verbal abilities specifically, serve as promotive factors to reduce the likelihood of delinquent behaviour.

The role and relationship of psychopathic traits and IQ among delinquent adolescents remains unclear. Several researchers conclude that an average to above average total intelligence quotient

is needed for the establishment of psychopathic traits, such as the manipulative and deceptive behaviours of the interpersonal domain (Barkataki, Kumari, Das, Hill, Morris, O'Connell, Taylor, & Sharma, 2005; Salekin et al., 2004; Brower, & Price, 2001). When looking at Verbal IQ, Salekin et al. (2010) found a positive relationship between psychopathic traits and verbal IQ with delinquent adolescents. However, according to Muñoz, Frick, Kimonis, and Aucoin (2008) there is no relationship between verbal ability and the callous-unemotional traits (affective domain) or narcissistic traits (interpersonal domain) among delinquent adolescents. DeLisi, Vaughn, Beaver, and Wright (2010) also found no relations between verbal IQ and the interpersonal domain of psychopathy, and adolescent antisocial behaviour, but did find negative relationships between verbal IQ with the affective domain and the behavioural domain. Similar contradictory results are present with adults. Vitacco, Neumann and Wodushek (2008) found that the interpersonal factor of psychopathy, characteristics as superficiality, grandiosity and deceitfulness, are related with higher levels of intellectual functioning and show strong links with violence with adults. However, Johansson and Kerr (2005) found no relationships between IQ, verbal IQ and performal IQ with psychopathy.

Because of the contradictory results in prior research, this thesis-study investigates performance on IQ tasks, looking at IQ profiles in relation to the three domains of psychopathic traits. In line with previous research by Barkataki et al. (2005), Salekin et al. (2004), Brower & Price (2001) and Vitacco et al. (2008), the expectation is to see higher scores on Verbal IQ and the IQ Index Verbal Comprehension with more reported psychopathic traits of the interpersonal domain, such as dishonest charm, grandiosity, lying and manipulation.

### **Executive functioning**

Executive functioning includes attention and concentration, abstract reasoning and concept formation, formulating goals, anticipating and planning, self-monitoring and self awareness, taking the perspective of others, and inhibiting unsuccessful, inappropriate or impulsive behaviours. This holds consequent implications for social judgment, self-control, responsiveness to punishment and ethical behaviour (Vermeiren et al., 2002; Morgan, & Lilienfeld, 2000). This thesis focuses on two aspects of executive functioning: sustained attention and impulsivity.

According to Muris, van der Pennen, Sigmond, and Mayer (2008) effortful control plays an important role in explaining delinquency and involvement in criminal activities. Effortful control

in their view consists of two components which are related to criminal behaviour: inhibitory control and attentional control. Inhibitory control concerns the ability to inhibit one's behaviour if necessary. Attentional control on the other hand is the ability to focus and shift attention when needed. Effortful control develops as a result of brain maturation, especially in the frontal lobes, and in interaction with the environment. Improvement in effortful control enables children to regulate emotions and to control their own behaviour, which may have positive effects on their social interactions with other children. Children who have little effortful control by nature, or fail to develop this trait may be more vulnerable to develop behavioural problems, according to Muris et al. (2008). Prior research has tried to clarify the relationship between attention, inhibition/impulsivity and psychopathic traits / adult psychopathy, which will be discussed first.

### *Attention*

In one of the scarce studies done in adolescents, Colledge and Blair (2001) found that reported inattentive symptoms of Attention-Deficit/Hyperactivity Disorder (ADHD) are related to psychopathic traits. Pham, Vanderstukken, Philippot, and Vanderlinden (2003) concluded that adult psychopaths have a selective attention deficit. They found that adult psychopaths made more errors on the D-II cancellation test, a test of selective attention and visual scanning, than normal controls. However, Mayer, Kosson and Bedrick (2006) found that adult psychopaths and normal controls are equally affected by the introduction of distractors (auditory or visual) in a computerised attentional task which was designed to allocate visuospatial attention resources on the basis of auditory or visual linguistic cues. The finding of Mayer et al. (2006) suggests that adult psychopaths do not have an attention deficit.

This thesis-study investigates the relation of sustained attention with affective psychopathic traits. Although it has not been investigated by research, one might suggest that when an adolescent does not have feelings of empathy and is callous, it's sustained attention will not be derived by these thoughts of concern. Thus, the expectation is that higher sustained attention scores will be found with more affective psychopathic traits such as remorselessness, unemotionality and callousness.

### *Impulsivity – inhibitory control*



Research among delinquent adolescents in Russia showed that impulsiveness, among other factors such as anger and verbal aggression, could differentiate between delinquents with and without psychopathic traits. Delinquent adolescents with psychopathic traits were more impulsive, which did not necessarily mean that their impulsiveness was also reflected in their violent behaviour (Fritz et al., 2008). Colledge and Blair (2001) also found in their study that the impulsive symptoms with ADHD are related with psychopathic traits in adolescents using teacher-report forms on ADHD. Furthermore, delinquent adolescents with psychopathic traits (and adult psychopaths) made more commission errors on the Go/no-go task, a task which measures the ability to inhibit a dominant response (Roussy, & Toupin, 2000; Lapierre, Braun, & Hodgins, 1995). Lapierre et al. (1995) therefore concluded that adult psychopaths are characterized by a deficit affecting the inhibition process and have problems inhibiting dominant responses. Other studies on adult psychopaths showed that their performance on the Stroop-Color-Word-Task, a task that also measures the ability to inhibit a dominant response, was no different than normal controls (Dvorak-Bertsch, Sadeh, Glass, Thornton, & Newman, 2007; Hiatt et al., 2004; Pham et al., 2003). Research by Blair, Newman, Mitchell, Richell, Leonard, Morton, & Blair (2006) showed similar results, adult psychopaths performed comparable to normal controls on the Number-Stroop task, a measure for impulsivity.

This study focuses upon the relationship between impulsivity (inhibitory control) and the behavioural psychopathic traits, such as impulsivity. In line with Fritz et al. (2008), the hypothesis is that inhibition scores will be lower with more behavioural psychopathic traits.

### **Hypotheses**

The research question of this thesis “*In what way is neuropsychological functioning related to psychopathic traits among delinquent adolescents?*” is explored through three different hypotheses.

*Hypothesis 1:* Delinquent adolescents with higher Verbal IQ and Verbal Comprehension Index scores will show more dishonest charm, grandiosity, lying and manipulation traits (interpersonal domain).

*Hypothesis 2:* Delinquent adolescents with better performance on sustained attention will show more remorselessness, unemotional and callous traits (affective domain).

*Hypothesis 3:* Delinquent adolescents with lower inhibition scores will show more thrill-seeking, impulsiveness and irresponsibility traits (behavioural domain).

## **Method**

### **Design**

This thesis was part of a large research project on screening and diagnosing psychopathology in adolescents in Juvenile Justice Institutions. In this project several questionnaires, tests and interviews were administered.

Part of the participants in this thesis-study were tested within a pilot study involving neuropsychological factors and scores on the Youth Psychopathic trait Inventory (YPI). Additionally, several participants were tested within an eligibility screening for an fMRI-study. The goal of this thesis-study was to explore the relationship between neuropsychological functioning and psychopathic traits.

### **Participants**

Participants were 15 delinquent adolescents incarcerated in JJI Teylingereind (Sassenheim, the Netherlands). In total 74 delinquent adolescents were asked to participate in neuropsychological testing. Some of these could not participate, because their IQ had already been tested recently, and sometimes their results were untraceable. Sometimes adolescents declined participation because they feared IQ results could influence the outcome of their trial. Adolescents could also be negatively influenced by group members. Other reasons for not participating included practical issues; adolescents weren't able to be assessed due to leaves, interrogations or court appointments. Participants and non-participants did not differ significantly on age and ethnic background.

The mean age of this research group was 16 years old, with a range of 14-17 years old (see table 1). All the group members were males, due to the fact that there are no females in this JJI. Four of the group members had the Dutch nationality, two group members had the Moroccan nationality, and two had the Turkish nationality. For seven of the group members records on nationality were unavailable. Mean IQ score of this group is 81 (below average), with a standard deviation of

10,49 and a range of 70-104. Mean Total YPI score is 2 (does not apply well), with a minimum score of 1 (does not apply at all) and a maximum score of 3 (applies fairly well).

**Table 1. Descriptive statistics of study group**

	<i>Mean (<math>\mu</math>)</i>	<i>Standard deviation (<math>\sigma</math>)</i>	<i>Range (min.-max.)</i>
Age	16,07	1,22	14-17
Total IQ	81,64	10,49	70-104
Total YPI	1,78	0,29	1,32-2,64

To compute the mean Total IQ score, a filter is usually used to exclude the adolescents with a greater difference than 15 points between Verbal IQ score and Performal IQ score (a disharmonic profile) which makes it *clinically* unreliable to interpret the Total IQ score. Based on this 4 boys, with a VIQ-PIQ difference greater than 15, should be excluded from the Total IQ analyses. However since the group size is relatively small, the decision had been made to include these boys in the analyses for this study. Also the group size for Working Memory Index was very small (N = 4), due to the fact that this score can only be calculated with the adult IQ-tests.

### **Procedure**

For this study, data from two different research projects were used. The instruments that were used in this study were mostly administered as part of standard mental health intake at this JJI. Therefore, informed consent is only warranted for purposes of repeated measurements. An elaborate assessment at admission in the JJI, which the current overarching project promotes, is somewhat new, but generally seen as very important (Inspectie Jeugdzorg, Onderwijs, Gezondheidszorg & Sanctietoepassing, 2010; Inspectie Jeugdzorg, Onderwijs, Gezondheidszorg & Sanctietoepassing, 2007). A lot of the adolescents suffer from psychiatric disorders and have intellectual disabilities that need special attention. Parents and youths were informed by the JJI that data assembled during the adolescents' stay were available for evaluative scientific research. Part of the data was gathered as part of eligibility screening for an fMRI-study (Güroğlu, van den Bos, & Crone, 2009), which did include an explicit informed consent procedure. The data were processed anonymously.

This thesis concentrated on neuropsychological tests and the YPI. The participants were all incarcerated in JJI Teylingereind (Sassenheim, the Netherlands). Participants were assessed from November 2009 – June 2010 and they were tested in a private room. When adolescents first enter the JJI, screening questionnaires are administered by computer. Within a week several other questionnaires and interviews, including the YPI, are filled in by the adolescents.

Neuropsychological testing was planned at a convenient time during the stay of the adolescent. The neuropsychological tests were done in the following order: WISC-III/WAIS, Bourdon-Vos, Stroop. The neuropsychological testing took around 3 hours for each participant. The instructions for the neuropsychological tests were given as described in the appropriate manuals.

#### Approval of ethic committee

The assessment is standard procedure in JJI. Therefore an approval of the ethic committee was not necessary.

For the fMRI-study the Medical Ethical Committee of the LUMC gave approval.

#### **Variables**

The dependent variable was the outcome of scores on the YPI. The independent variables were the scores on the neuropsychological tests (WISC-III, WAIS, Bourdon, Stroop).

#### **Measures**

*Youth Psychopathic trait Inventory (YPI)*: The YPI is a self-report questionnaire which uses several items to tap the core psychopathic traits, based on the three-factor model described in the introduction (Hare, 1999; Salekin et al., 2008). The YPI uses a 4-point Likert response scale (1: does not apply at all, 2: does not apply well, 3: applies fairly well, 4: applies very well) and consists of 50 items organised into 10 subscales, with 5 items in each subscale. Each subscale reflects the traits within the three different domains. Questions like '*I don't let my feelings affect me as much as other people's feelings seem to affect them*' are asked. (Andershed, Hodgins, & Tengström, 2007). The YPI consists of three domains: the Interpersonal domain consists of the subscales dishonest charm, grandiosity, lying, manipulation; the Affective domain consists of the subscales remorselessness, unemotionality, callousness; and the Behavioural domain consists of the subscales thrill-seeking, impulsiveness, irresponsibility. Total scores, domain and subscale scores are computed by summing the appropriate items and calculating mean scores, resulting in minimum scores of 1, and maximum scores of 4. Chronbach's  $\alpha$ 's vary between 0.61 and 0.84. Whilst psychopathic traits are considered to be dimensional, no cut-off scores were used (Andershed et al., 2007; Andershed, Kerr, Stattin & Levander, 2002).

*Wechsler Intelligence Scale for Children-III-NL (WISC-III-NL)*: The WISC-III was used to assess the cognitive abilities of the juvenile younger than 16 years of age. It contains 13 subtests. Three IQ scores and three indices can be calculated. In the general population the IQ score has a mean of 100 and a standard deviation of 15. Reliability and validity proved to be sufficient as was tested by the Commission Testmatters Netherlands (COTAN, 2005). The overall score is Total IQ (TIQ). Verbal IQ (VIQ) was calculated with Information, Similarities, Arithmetic, Vocabulary, and Comprehension. Perforal IQ (PIQ) was calculated with Picture Completion, Coding, Picture Arrangement, Block Design, and Object Assembly. Furthermore, the indices were calculated: Verbal Comprehension Index (VCI – Information, Similarities, Vocabulary and Comprehension), Perceptual Organisation Index (POI – Picture Completion, Picture Arrangement, Block Design and Object Assembly) and Processing Speed Index (PSI – Coding and Symbol Search). Chronbach's  $\alpha$ 's vary from 0.66 to 0.94. As the subtests Coding and Symbol Search are a measure of speed, calculation of the Chronbach's  $\alpha$  was not possible (Wechsler, 2005).

*Wechsler Adult Intelligence Scales (WAIS)*: The WAIS-III-NL was used to assess the cognitive abilities of the juvenile aged 16 and older. It contains 16 subtests; three IQ scores and four indices can be calculated. In the general population the IQ score has a mean of 100 and a standard deviation of 15. Reliability and validity proved to be sufficient as was tested by the COTAN (COTAN, 2002). The overall score is Total IQ (TIQ). Verbal IQ (VIQ) was calculated with Vocabulary, Similarities, Arithmetic, Digit Span, Information, Comprehension and Letter-Number Sequencing. The Perforal IQ (PIQ) was calculated with Picture Completion, Coding, Block Design, Matrix Reasoning, Picture Arrangement, Symbol Search and Object Assembly. Furthermore, the indices were calculated: Verbal Comprehension Index (VCI – Information, Similarities and Vocabulary), Perceptual Organisation Index (POI – Picture Completion, Block Design and Matrix Reasoning), Processing Speed Index (PSI – Digit Symbol - Coding and Symbol Search) and Working Memory Index (WMI – Digit Span, Arithmetic and Letter-Number Sequencing) (Stinissen, Willems, Coetsier, & Hutsman, 1970). Chronbach's  $\alpha$ 's vary between 0.79 and 0.98. As the subtests Coding and Symbol Search are a measure of speed, a calculation of the Chronbach's  $\alpha$  was not possible (Wechsler, 2004).

*Bourdon-Vos*: This test is used for the assessment of sustained attention and gives scores for velocity and accuracy (Vos, 1992). The participant will be handed a paper with small groups of 3,

4 or 5 dots on it, and has to draw a line through a group of 4 dots but not through a group of 3 or 5 dots, as quickly and accurately as possible. Scores lower than 100 are signs of good sustained attentional skills. Vos reported a strong internal consistency ( $\alpha = 0.98$ ) (Meijer, Habekothé, van den Wittenboer, 1999; Vos, 1992; Vos, 1977). Reliability and validity proved to be sufficient as was tested by the COTAN (COTAN, 1997).

*Stroop*: This test is used for the assessment of the executive functioning, the ability to concentrate, working memory and the response time. The Stroop is easy to use and gives a good impression whether the participant is capable to inhibit certain impulses (i.e. read the word instead of naming the colour) and to follow certain rules (Blair et al., 2006; MacLeod, 1992). With this test the participant receives a paper with names of colours written in the same or different colour. There are three different papers. On the first paper, there are only words (names of colours) written in black. The participant has to read all the words out loud. On the second paper there are only coloured squares and the participant has to name all the different colours on the paper. On the third paper, there are different words (names of colours), written in different colours. The participant then has to read the colour (i.e., the name of a word), and must not say the colour of the writing. High interference scores are signs of impulsiveness. Reliability and validity proved to be sufficient as was tested by the COTAN (COTAN, 2003).

### **Data analysis**

The independent variables were the scores on the neuropsychological tests and these were interval. The dependent variable was the score on the domains and subscales of the YPI, i.e. psychopathic traits, and this score was also interval. Because the group size was small ( $N = 15$ ), two-tailed Spearman correlations were used because two-tailed Pearson correlations would not be reliable within such a small group. To further investigate whether neuropsychological functioning formed a basis for psychopathic traits, linear regression was used with the significant correlations. This provided the predictive value of neuropsychological factors with the different domains of psychopathic traits. The data were analyzed using SPSS Statistics 17.0 for Windows (2008).

## Ethical remarks

Caution is necessary when looking at adolescents within the JJI. These are often very vulnerable adolescents who are still developing, and can therefore not be classified as psychopaths. To just sum up the scores and try to differentiate between ‘psychopaths’ and ‘nonpsychopaths’, would therefore be wrong and could have devastating consequences. Among other practical reasons (e.g. small group size), this thesis therefore takes a look at psychopathic traits in a dimensional way and does not use cut-off scores.

## Results

### Descriptives

The descriptives for the neuropsychological tests results are displayed in table 2. The descriptives for the YPI results are displayed in table 3. The mean Total IQ (TIQ) in this group of delinquent adolescents was below average with a mean of 81 and a standard deviation of 10,49. Minimum TIQ score was 70, below average, and the maximum score was 104, average. The mean Verbal IQ score (VIQ) in this group was below average (80) and the mean Performat IQ score (PIQ) was average (90). The indices all showed below average mean scores, except Processing Speed with an average mean score (94). Sustained attention, assessed with the Bourdon, was below average in this group with a mean score of 108. However, the inhibition skills of these adolescents were average, with a mean interference T-score of 51. All of the mean YPI scores fell between 1 (does not apply at all) and 2 (does not apply well).

Table 2. Descriptives – Neuropsychological test results

Variable	N	Min.	Max.	Mean ( $\mu$ )	St. Dev. ( $\sigma$ )
IQ – Total (TIQ) *	11	70	104	81,64	10,49
IQ – Verbal (VIQ) *	10	66	96	80,20	9,90
IQ – Performat (PIQ) *	10	75	119	89,70	14,30
IQ – Verbal Comprehension *	9	67	91	77,78	8,38
IQ – Perceptual Organisation *	9	75	115	88,22	11,71
IQ – Processing Speed *	8	77	117	93,75	13,97
IQ – Working Memory *	4	72	103	86,00	15,38
Bourdon – score	15	81	146	108,40	16,73
Stroop interference – sec	15	2	82	33,47	23,87
Stroop interference – T-score	15	36	70	51,60	10,97

\* Qualification: 80-89 = below average, 90-109 = average, 110-119 = above average

Table 3. Descriptives YPI results: Score 1-4\*

YPI Domains	N	Min.	Max.	Mean	St. Dev.
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				( $\mu$ )	( $\sigma$ )
Interpersonal	15	1,05	2,45	1,41	0,35
Affective	15	1,13	2,60	1,63	0,42
Behavioural	15	1,53	3,00	2,08	0,41
<i>YPI Subscales</i>					
Total	15	1,32	2,64	1,78	0,29
<i>Interpersonal domain</i>					
Dishonest Charm	15	1,00	3,00	1,37	0,51
Grandiosity	15	1,00	2,40	1,51	0,43
Lying	15	1,00	2,80	1,43	0,53
Manipulation	15	1,00	2,40	1,33	0,39
<i>Affective domain</i>					
Remorselessness	15	1,00	2,60	1,63	0,48
Unemotionality	15	1,00	3,60	1,93	0,67
Callousness	15	1,60	2,80	2,32	0,34
<i>Behavioural domain</i>					
Thrill-seeking	15	1,40	3,40	2,21	0,50
Impulsiveness	15	1,00	2,80	2,16	0,52
Irresponsibility	15	1,00	2,80	1,88	0,47

\*Score: 1 = does not apply at all, 2 = does not apply well, 3 = applies fairly well, 4 = applies very well

### Relation neuropsychological results and psychopathic traits

To answer the first hypothesis, Spearman correlations were computed for several WISC/WAIS IQ scores and indices with the YPI domains and subscales, focussing upon the relationship between Verbal IQ, Verbal Comprehension Index and the interpersonal domain (see table 4). A positive relationship between Verbal Comprehension scores and Dishonest Charm (interpersonal domain YPI) score was found;  $\rho = 0.670$ ,  $p = 0.048$ . Other correlations between Verbal IQ, Verbal Comprehension and the YPI were not found. To further investigate whether Verbal Comprehension to predict variance within Dishonest Charm, regression analysis was computed (see table 5). As is seen in table 5, Verbal Comprehension did not predict variance within Dishonest Charm;  $F(1, 7) = 4.465$ ,  $p = 0.072$ .

**Table 4. Correlations: Verbal IQ, Verbal Comprehension – YPI**

YPI results	Verbal IQ		Verbal Comprehension	
	Corr. ( $\rho$ )	Sig. ( $p$ )	Corr. ( $\rho$ )	Sig. ( $p$ )
Interpersonal domain	0.341	0.334	0.294	0.442
Dishonest Charm	0.306	0.389	<b>0.670*</b>	<b>0.048</b>
Grandiosity	0.389	0.267	0.426	0.253
Lying	0.072	0.843	-0.310	0.416
Manipulation	0.152	0.676	0.461	0.212

\* Correlation is significant at 0.05 level (2-tailed).

**Table 5. Regression analyses: Verbal Comprehension – Dishonest Charm**

	<i>R</i>	<i>R Square</i>	<i>Adjusted R Square</i>	<i>Std Error of the estimate</i>
Verbal Comprehension	0.624	0.389	0.302	1.105



	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig. (p)</i>
Regression	5.452	1	5.452	4.465	0.072
Residual	8.548	7	1.221		
Total	14.000	8			

The analyses of the other WISC/WAIS IQ scores and indices with the YPI domains and subscales also showed interesting results (see table 6). Perceptual Organisation scores were significantly lower when adolescents scored higher on Remorselessness (affective domain YPI);  $\rho = -0.667$ ,  $p = 0.050$ . A negative relationship was also found between Total IQ (TIQ) scores and Remorselessness scores (affective domain YPI);  $\rho = -0.746$ ,  $p = 0.008$ . Furthermore, higher scores on Processing Speed were significantly related to higher scores on Callousness (affective domain YPI);  $\rho = 0.732$ ,  $p = 0.039$ .

To compute whether variance in Remorselessness could be predicted by Total IQ and Perceptual Organisation, multicollinearity, which exists when the correlation between the two variables Perceptual Organisation and Total IQ is  $\rho \geq 0.9$ , had to be ruled out first. The relationship between these two variables was too strong ( $\rho = 0.895$ ,  $p = 0.001$ ) which in turn makes it hard to determine whether variance in Remorselessness is explained by either of the two (see table 7). Therefore the analyses were done separately. Variance in Remorselessness could be predicted by Perceptual Organisation and Total IQ, as is seen in table 8 and 9. Perceptual Organisation significantly predicted 45.7 % of the variance in Remorselessness: Adjusted R Square = 45.7%;  $F(1, 7) = 7.729$ ,  $p = 0.027$ . Since the group size was small, the Adjusted R Square must be used to tell how much variance is predicted. Total IQ predicted 44.4% of the variance in Remorselessness: Adjusted R Square = 44.4 %;  $F(1, 9) = 8.982$ ,  $p = 0.015$ . The predictive value of Processing Speed for Callousness (affective domain YPI) was also explored through regression analyses. Processing Speed did not predict variance of Callousness (see table 10),  $F(1, 6) = 2.872$ ,  $p = 0.141$ .

**Table 6. Significant correlations: IQ - YPI**

Correlations		<i>Corr. (ρ)</i>	<i>Sig. (p)</i>
IQ – score	YPI score		
Perceptual Organisation	Remorselessness (aff. domain)	<b>-0.667**</b>	<b>0.050</b>
Total IQ	Remorselessness (aff. domain)	<b>-0.746*</b>	<b>0.008</b>

Processing Speed	Callousness (aff. domain)	<b>0.732**</b>	<b>0.039</b>
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\* Correlation is significant at the 0.01 level (2-tailed).

\*\* Correlation is significant at 0.05 level (2-tailed).

**Table 7. Multicollinearity Total IQ – Perceptual Organisation**

	Total IQ score		
	<i>N</i>	<i>Corr. (ρ)</i>	<i>Sig. (p)</i>
Perceptual Organisation	11	<b>0.895</b>	<b>0.001*</b>

\* Correlation is significant at 0.01 level (2-tailed)

**Table 8. Regression: Perceptual Organisation - Remorselessness**

	<i>R</i>	<i>R Square</i>	<i>Adjusted R Square</i>	<i>Std Error of the estimate</i>
Perceptual Organisation	0.724	0.525	0.457	1.282

  

	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig. (p)</i>
Regression	12.710	1	12.710	7.729	<b>0.027*</b>
Residual	11.512	7	1.654		
Total	24.222	8			

\* Regression is significant at 0.05 level.

**Table 9. Regression: Total IQ - Remorselessness**

	<i>R</i>	<i>R Square</i>	<i>Adjusted R Square</i>	<i>Std Error of the estimate</i>
Total IQ	0.707	0.500	0.444	1.671

  

	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig. (p)</i>
Regression	25.066	1	25.066	8.982	<b>0.015*</b>
Residual	25.116	9	2.791		
Total	50.182	10			

\* Regression is significant at 0.05 level.

**Table 10. Regression: Processing Speed – Callousness**

	<i>R</i>	<i>R Square</i>	<i>Adjusted R Square</i>	<i>Std Error of the estimate</i>
Processing Speed	0.569	0.324	0.211	1.645

  

	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig. (p)</i>
Regression	7.769	1	7.769	2.872	0.141
Residual	16.231	6	2.705		
Total	24.000	7			

Although some correlations between IQ test results and the amount of psychopathic traits were not significant, they are worth mentioning (see table 11). There was a negative trend between a higher Working Memory Index score and a lower score on Remorselessness;  $\rho = -0.949$ ,  $p = 0.051$ . A negative trend has also been found with PIQ scores and scores on Remorselessness;  $\rho = -0.624$ ,  $p = 0.054$ . Also a negative trend between a higher VIQ score and a lower

Remorselessness score was found;  $\rho = -0.570$ ,  $p = 0.086$ . Another positive trend involves the subscale Thrill-Seeking (behavioural domain YPI); a higher Processing Speed score was related to a higher score on Thrill-Seeking;  $\rho = 0.679$ ,  $p = 0.064$ . And last, a positive trend was found between a higher PIQ and higher Total YPI score  $\rho = 0.596$ ,  $p = 0.069$ .

**Table 11. Correlation trends: IQ – YPI**

Correlations		<i>Corr. (<math>\rho</math>)</i>	<i>Sig. (<math>p</math>)</i>
IQ – score	YPI score		
Working Memory	Remorselessness (aff. domain)	-0.949	0.051
Perfomal IQ	Remorselessness (aff. domain)	-0.624	0.054
Verbal IQ	Remorselessness (aff. domain)	-0.570	0.086
Processing Speed	Thrill-Seeking (behav. domain)	0.679	0.064
Perfomal IQ	Total YPI	0.596	0.069

To investigate the second hypothesis, the Spearman correlations between the sustained attention scores (Bourdon-Vos) and the YPI subscales were computed (see table 12). No significant correlations were found.

**Table 12. Correlations: Sustained attention (Bourdon) - YPI**

	Bourdon	
YPI results	<i>Corr. (<math>\rho</math>)</i>	<i>Sig. (<math>p</math>)</i>
Affective domain	0.088	0.755
Remorselessness	0.046	0.870
Unemotionality	0.140	0.620
Callousness	-0.439	0.102

In order to answer the third hypothesis, the Spearman correlations between inhibition scores (Stroop) and the behavioural domain and it's subscales (YPI) were computed (see table 13). No significant correlations were found.

**Table 13. Correlations: Inhibition (Stroop) - YPI**

	Stroop	
YPI results	<i>Corr. (<math>\rho</math>)</i>	<i>Sig. (<math>p</math>)</i>
Behavioural domain	-0.012	0.967
Thrill-seeking	0.154	0.585
Impulsiveness	-0.196	0.483
Irresponsibility	-0.322	0.242

## **Discussion**

### **Main findings**

The main objective of this study was to explore the neuropsychological correlates of psychopathic traits within detained adolescents. Furthermore this study explored whether these

correlates had a predictive value, and thus whether neuropsychological functioning plays an underlying role with psychopathic traits. The general research question “*In what way is neuropsychological functioning related to psychopathic traits among delinquent adolescents?*” was explored through three different hypotheses; delinquent adolescents with higher Verbal IQ and Verbal Comprehension Index scores will show more traits of the interpersonal domain (1), delinquent adolescents with better performance on sustained attention will show more traits of the affective domain (2), and delinquent adolescents with lower inhibition scores show more traits of the behavioural domain (3).

The first hypothesis was partly confirmed. Higher scores on Verbal Comprehension related to significantly higher scores on Dishonest Charm (interpersonal domain). However, Verbal Comprehension scores did not predict variance in Dishonest Charm. The second and third hypothesis were both rejected, for no significant correlations were found.

Thus, verbal comprehension skills were positively related to Dishonest Charm traits. The exact direction of this relationship, whether Verbal Comprehension is needed for Dishonest Charm or that Dishonest Charm enhances the development of verbal comprehension skills, could not be studied. It could be that delinquent adolescents need a particular amount of verbal comprehension skills to understand the situation enough to use their dishonest charm for their advantage. The finding of this positive relationship supports the findings of Muñoz et al. (2008), who found that the deceptive and manipulative traits (i.e. Dishonest Charm of the interpersonal domain) rely on intact verbal abilities.

### *Cognitive functioning*

Analyses for WISC/WAIS IQ scores and indices, showed a few significant correlations with IQ-indices and the affective domain, in line with findings of DeLisi et al. (2010). Perceptual Organisation and Total IQ had a significant negative relationship with Remorselessness (affective domain), and these two IQ scores also predicted variance in Remorselessness. Furthermore, a few negative trends were found with Perforal IQ, Verbal IQ and Working Memory on the one hand and Remorselessness on the other hand.

To explain why there is a significant negative correlation between Perceptual Organisation and Remorselessness, a closer look is needed at the Index Perceptual Organisation. One important subscale of Perceptual Organisation is Picture Completion, resembling the ability of non-verbal

communication with respect to social behaviour. A high score on this subscale means good understanding of social behaviour and that the adolescent is able to empathize, which is contradictory to affective traits such as Remorselessness. Furthermore, adolescents with a higher Perceptual Organisation score could be inclined to use a more holistic approach and therefore have more insight in certain empathic situations, which suppresses the Remorselessness score.

This might also concern the negative relationship between TIQ and Remorselessness. It could be that an adolescent with a higher TIQ score could have more capabilities to reason upon- and show more insight in certain situations, one's own actions and behaviour of others. These two explanations might also explain the negative trend that was found between Performat IQ and Remorselessness.

However, the finding of a negative trend between Working Memory and Remorselessness cannot be explained by these two theories. One could argue that when scoring high on subscales of the affective domain, such as Remorselessness and Callousness, the adolescent would not be distracted by worries about other people's thoughts and opinions. This could result in better performance on sustained attention and thus higher scores on the Working Memory Index.

Furthermore, this theory might also concern the positive correlation between Processing Speed Index and Callousness (affective domain). Processing Speed did not however predict variance in Callousness. This finding was also not consistent with literature describing adult psychopaths suffering from speed processing problems (Barkataki et al., 2005). Furthermore, people with a more holistic approach, and a higher Perceptual Organisation score, also commonly show a higher Processing Speed. In line with this thought, one might expect a negative relationship between Processing Speed and Callousness. However, this is not the case. These findings need to be replicated.

Another negative trend that was found between Verbal IQ and Remorselessness (supporting findings of DeLisi et al., 2010) contradicts with the findings of Muñoz et al. (2008), who argue that there is no relationship between the callous-unemotional traits (such as remorselessness) and verbal ability. However, Muñoz et al. (2008) argue that the callous-unemotional traits (affective domain) are related to the severity of delinquency and aggression when the delinquent adolescents have relatively higher verbal intelligence quotients. Higher intelligence scores could thus moderate the relationship between psychopathic traits, severity of delinquency and violence. However, severity of delinquency and aggression was not taken into account in this study.

Salekin et al. (2010) however, found that higher intelligence scores neither form a risk factor nor a protective factor for delinquent adolescents with psychopathic traits who are tempted to engage in criminal conduct.

Findings regarding mean IQ scores were consistent with literature (Vreugdenhil et al., 2004; Vermeiren et al., 2002; Morgan & Lilienfeld, 2000; Moffit, 1990). Indeed low average scores, especially for the verbal scores were found with these adolescents. Four of the adolescents presented a significant difference between PIQ and VIQ (as is discussed in the method section). The tendency of scoring lower on VIQ and higher on PIQ is consistent with literature, including the finding that the difference between these scores is not due to a high PIQ, but to a low VIQ (Isen, 2010).

#### *Executive functioning*

The study of Ross, Benning and Adams (2007) could probably offer an explanation for the nonsignificant findings about attention and inhibition scores in this study. They describe two types of psychopaths, which are both, according to Sadeh and Verona (2008), associated with frequent antisocial behaviour and deficient self-regulation. The primary psychopaths are characterized as callous, calculating, manipulative, and deceitful, and their behaviour might not be related to frontal lobe functioning. Thus, showing no results when considering attention and inhibition skills with psychopathic traits. The secondary psychopaths on the other hand suffer from a neurotic disorder that stimulates impulsive behaviour. Secondary psychopathy represents more impulsive behaviour, which in turn may be negatively related to frontal lobe functioning. This implies that when delinquent adolescents score high on the behavioural domain (thrill-seeking, irresponsible, impulsivity), they also score low on the attention and inhibition scores. The discrepancy between these two types might explain why no results were found with attention and inhibition scores when correlated with psychopathic traits, because both types might be represented in this research group.

Although no significant relationships were found between sustained attention, inhibition/impulsivity and psychopathic traits, the analyses of certain IQ Indices did indicate a relationship. The Working Memory and Processing Speed Indices of the IQ-tests are also an indirect measure of attention and inhibition (Wechsler, 2005). The Working Memory Index showed a negative trend with Remorselessness (affective domain). As is mentioned above, a

positive trend was found between the IQ-index Processing Speed and the subscale Thrill-Seeking (behavioural domain). An explanation for this result could be that when a juvenile is easily bored, he has a high Processing Speed and also scores high on Thrill-seeking behaviour (behavioural domain YPI). However, this finding was not consistent with literature describing adult psychopaths suffering from speed processing problems (Barkataki et al., 2005) and thus needs to be replicated.

About 8% of delinquent adolescents within the JJI suffer from ADHD (Vreugdenhil, Doreleijers, Vermeiren, Wouters & van den Brink, 2004). Among the adolescents who were sentenced with the PIJ measure (placement in a youth custodial treatment institution) 31% suffer from ADHD (Vreugdenhil et al., 2004). Thus, the low average sustained attention scores (Bourdon-Vos) found in this research, could be explained by these findings that attention problems with delinquent adolescents are quite common. Based on the fact that ADHD is quite common among delinquent adolescents, the average Stroop inhibition scores of the adolescents were not expected. Also, no correlations between psychopathic traits and inhibition skills were found. The findings in this study are in line with the findings of Dvorak-Bertsch et al. (2007), Hiatt et al. (2004) and Pham et al. (2003), even though their research was among adult psychopaths.

### **Strengths and limitations**

A strong point of this study is that it focuses upon delinquent adolescents in the Netherlands. Few studies exploring the relationship between neuropsychological factors and psychopathic traits have been done in the Netherlands within this subgroup. Furthermore, research on sustained attention and inhibition skills related to psychopathic traits among this subgroup is very scarce. Another strength of this research is that it is within standard practice within the JJI, augmenting the external validity.

The small group size is a limitation, which makes it hard to generalize results and furthermore heightens the probability that the findings are based on chance. Group size was too small to correct for variables that can influence neuropsychological scores, such as ADHD. A lot of adolescents refused to cooperate because they feared IQ-test results could become a factor in the outcome of their trial. Therefore, this study could be biased. Adolescents with psychopathic traits, who also have more severe problems and commit more serious crimes, might be more inclined to refuse to participate. Furthermore, assessing psychopathic traits is hard, because one of the core

symptoms is lying, deceptive and manipulative behaviour. Adolescents with psychopathic traits seem to lack insight in their own behaviour and abilities, making it hard to form an objective opinion about themselves. Thus, the use of a self-report questionnaire to assess psychopathic traits might not be the best option (Andershed et al., 2002). However, items of the YPI, which was used in this study, are formulated in such a way that psychopathic traits seem positive personality qualities. Furthermore, it is hard to differentiate between adolescents with psychopathic traits and their peers, for the impulsive and egocentric behaviours which are also common in puberty can be confused with normal development in adolescents (Frick, 2002; Seagrave, & Grisso, 2002). Therefore Seagrave and Grisso (2002) suggest that in order to conclude if the behaviour reflects psychopathic traits, it should be evident for a longer time period.

### **Recommendations for future research**

Thus, recommendations for future research are to examine a larger group and correct for variables that can influence neuropsychological scores such as substance abuse and ADHD. Furthermore, file information on psychopathic traits, the severity of the crime the adolescents have committed, the amount of violence that was used and the age of onset should be included. Although no relationships were found with Verbal IQ scores, it is interesting to further investigate whether this neuropsychological correlate could be a risk factor for the severity of violence among psychopaths (Frick & White, 2008; Kimonis et al., 2008; Pardini & Loeber, 2008; Viding et al, 2005; Johansson & Kerr, 2005). To overcome the problems of differentiating between normal development in adolescents and psychopathic traits, a control group within the normal population can be included. It is thus recommended to do a longitudinal study which includes normal controls, to find out what the contribution of these neuropsychological correlates are and whether they form a risk or a protection factor for these adolescents. These results could in turn be used in treatment programmes.

### **Recommendations for diagnosis/treatment**

If results are replicated in other studies, the neuropsychological correlates that were found in this thesis can be used to form a neuropsychological profile, which in turn could be used when diagnosing the child or when starting treatment. Delinquent adolescents with higher scores on



Verbal Comprehension Index and the Processing Speed Index, also show higher scores on the subscales Dishonest Charm and Callousness of the YPI. On the other hand, adolescents with higher scores on Total IQ, Perceptual Organisation and Working Memory also show lower scores on the subscale Remorselessness of the YPI.

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