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**Neuropsychological Signs Associated With
Cognitive Styles in Young Offenders**

**Doctoral Dissertation
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Running Head: Neurological Signs in Young Offenders.



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ABSTRACT

This study provides evidence suggesting that male Young Offenders (YOs) ($n = 40$) can be significantly discriminated from male Non-Young Offenders (NYOs) ($n = 40$) on the basis of various neuropsychological measures of executive functioning. More specifically, YOs had lower factor scores than NYOs on measures reflecting higher order cognitive functioning ($r^2 = .17$), verbal fluency ($r^2 = .07$), cognitive flexibility ($r^2 = .05$), and spatial/perceptual functioning ($r^2 = .04$). A linear discriminant function ($r^2 = .33$) provided an overall classification hit rate of 73.75 %. Factor scores of Property offenders derived from demographic variables were moderately correlated ($r = -.48$) with higher order cognitive factor scores, suggesting that greater cognitive deficits are associated with a poorer socialization outcome, more frequent and versatile criminal activity, and a greater dependence on alcohol and drugs. No significant correlations were noted for Violent or Sexual offenders, suggesting these type of offenders did not display any cognitive deficits per se. Based on these findings, a neuropsychologically evidence-based developmental hypothesis of criminality is proposed.

Overview

The notion that moral reasoning can be linked to the evolution of the frontal lobes has enjoyed popularity, yet has been difficult to fully establish (Chapman & Wolff, 1959; Halstead, 1947; Hebb, 1945; Lashley, 1929; Rylander, 1939). Similarly, the idea that crime has any direct link with intelligence has proven to be an overly simplistic view (Caplan, 1965). Subsequently, interest both in global intelligence as a central theme in the study of crime and frontal-lobe functioning has waned. Recently, a few criminologists and correctional psychologists have focused attention on certain specific cognitive deficits that may be observed in offender populations (Baxter, Motiuk, & Fortin, 1995; Moffitt, Lynam & Silva, 1994; Ross & Fabiano, 1985), and neuropsychologists have examined the executive functions associated with the prefrontal lobes (Petrides & Milner, 1982; Stuss & Benson, 1984). Many clinicians and researchers have commented on the cognitive and behavioural similarities among criminals and patients with frontal-lobe damage (Pontius, 1972; Elliott, 1978; Schalling, 1978). Various investigators have also provided some neuropsychological evidence suggesting that delinquent, criminal, and psychopathic populations may display signs of frontal-lobe dysfunction (FLD) (Gorenstein, 1982; Lueger & Gill, 1990; Pontius & Ruttiger, 1976; Yeudall, Fromm-Auch, & Davies, 1982).

Despite these positive findings, methodological issues, such as inadequate sample sizes, use of unstandardized test instruments, failure to use the most sensitive measures of FLD, inadequate statistical analyses, and failure to control for such confounding variables as sex, age, and alcohol and drug abuse have limited the conclusions that can be drawn from these studies. Additionally, the neuroanatomical models of antisocial (criminal) behaviour offered by these studies have generally not provided an adequate explanation of how brain-related cognitive deficits may contribute specifically to the development of antisocial behaviour.

Historically, criminologists have explained behaviour from a sociological standpoint, neglecting the contribution of psychological factors (Andrews & Wormith, 1989). In contrast, neuropsychologists have relied heavily on psychological measurements to explain brain and behaviour relationships (Luria, 1966). In both instances, behaviour is more clearly understood when psychological functioning is considered within a social context. Thus, the integration of neuropsychological findings with theories of social and cognitive criminology seemed like a worthwhile endeavour.

Inferring cognitive deficits by measuring overt behaviour is one of the functions of neuropsychology.

Neuropsychological tests and instruments are suitable for testing hypotheses about the psychological functioning of criminals. A cognitive model of juvenile delinquency proposed by Ross and Fabiano (1985) emphasizes that some or perhaps many delinquents display cognitive deficits that reflect a certain degree of impaired executive functioning (Stuss & Benson, 1986). Their model is an excellent example of a reasonable hypothesis that has limited empirical support but is clearly amenable to neuropsychological investigation.

The Ross and Fabiano model suggests that as a group, delinquents tend to think in a concrete versus an abstract fashion, lack critical thinking ability, fail to use social cues to moderate their behaviour, lack cognitive flexibility, lack empathy, display poor goal orientation, and demonstrate poor problem-solving abilities. The composite of these cognitive styles likely contributes to impulsive, unpredictable, and socially disinhibited behaviour. Such cognitive deficits, and associated behavioural patterns, are precisely what one would expect to be displayed by individuals who have a limited capacity for executive functioning.

The intent of the present study was not to demonstrate that delinquents, or Young Offenders (YOs) as they are now called in Canada, exhibit neurological

impairment equivalent to FLD patients. Rather, the purpose was to show by means of neuropsychological measures that a certain proportion of YOs display deficits in their executive functioning. It is not suggested that YOs are "brain damaged" per se, but rather that immature cognitive development may be reflected in less effective executive functioning, which, in turn, may facilitate antisocial behaviours. The general hypothesis is that some closed-custody YOs exhibit various deficits, including cognitive inflexibility; failure to use feedback to alter an ongoing behaviour in the face of changing environmental demands; poor planning, conceptualization, and abstraction abilities; limited critical thinking ability; and social immaturity.

This study also served as a test of the cognitive model of juvenile delinquency proposed by Ross and Fabiano (1985). In order to adequately test this model, the cognitive deficits outlined by these authors were translated into more clear and precise neuropsychological terms (executive functions), and tested with appropriate instruments designed to assess these functions.

These indices of executive functioning were then examined in relation to the degree of socialization, criminal history, and history of alcohol and drug dependence. Finally, the results are discussed in the

context of recent developmental theories of maladaptive antisocial behaviour (Fishbein, 1990; Patterson, Capaldi, & Bank, 1991).

Prior to presenting the methodological details of the present study, a rationale for conducting this research is developed in two separate sections. The first section summarizes the cognitive model of juvenile delinquency (Ross & Fabiano, 1985), and discusses the significance of general intelligence (IQ) and social cognition as risk factors in the development of criminal behaviour. The second section reviews both the positive findings and the limitations of existing studies concerning the presence of FLD in offender populations. The psychometric instruments used in these studies are described briefly when appropriate. Unlike previous FLD studies, the present study focuses on level of executive functioning in YOs, rather than inferring neuroanatomical correlates associated with the cognitive deficits. The parallels drawn between FLD and delinquents are used only to demonstrate the cognitive and behavioural similarities between these two populations, and do not necessarily indicate the same source of variance or etiology.

As a point of clarification, it is important to note that the term "Juvenile Delinquent" is outdated since the Juvenile Delinquency Act was replaced by the Young

Offenders Act during the mid-1980's. There are a number of significant differences in the Acts with regards to age, severity of punishment, and alternative measures. Nevertheless, the terms Delinquent and Young Offender are often considered synonymous since both are meant to describe an adolescent who has been convicted of a criminal offence. The author has used the term delinquency only when the term was used by earlier researchers. The term NYO is used to describe a youth who has not been previously convicted of a criminal offence. In contrast, the term YO is used to describe a youth who has been convicted of a criminal offence committed between the ages of 14 and 17 years.

The Cognitive Model of Juvenile Delinquency

The cognitive model of juvenile delinquency proposed by Ross and Fabiano (1985) was selected to describe the behavioural and cognitive presentation of YOs for several reasons. First, the model seems to be based on a reasonable analysis of how cognitive deficits in this population might predispose them to antisocial behaviour. Second, with a few exceptions (e.g., Glueck & Glueck, 1950), individual factors are generally not considered to be important by criminologists, so the model fills a gap in the delinquency literature by focusing on relatively comprehensive psychological profiles of the offenders. Criminologists have typically adopted a sociological perspective, with an emphasis on crime as a product of societal forces and social inequality (Andrews & Wormith, 1989). Finally, although Ross and Fabiano's model has had only limited empirical validation to date, it lends itself well to being tested by standardized neuropsychological assessment instruments.

Clinical presentation of some juvenile delinquents.

According to Ross and Fabiano's (1985) model, many offenders appear to lack self-control and tend to act impulsively when faced with temptation. They neither consider the consequences of their actions nor evaluate the impact of their behaviour, and they fail to use

feedback to adjust their behaviour. In such a situation, the relationship between consequential thinking and behaviour is not understood (Feuerstein, 1981; Kendall & Finch, 1979).

This lack of self-control may not be simply a failure to delay gratification, but may reflect, instead, a pervasive action-oriented disposition. The basis of this style is likely rooted in a concrete versus abstract thinking style. In this context, behaviour tends to be mediated by environmental stimulation rather than by intrinsic cognitive reflection (Meichenbaum, 1977).

Reasoning, which is contingent upon problem-solving ability, consists of a number of cognitive subsets. This process requires recognizing a problem (conceptualization), gathering pertinent facts in an orderly fashion (organization), drawing parallels between new information and previous knowledge (abstraction), generating hypotheses, predicting the outcome of these alternatives (planning), evaluating the options (judgement), and finally choosing an option. The complexity of this task would suggest it is much easier to act than to think (Spivack, Platt & Shure, 1976).

In fact, acting on the world rather than thinking about it is exactly what many delinquents do. Part of the problem originates from inflexible preset ideas or

learned behaviours (Kipper, 1977). For instance, if someone is foolish enough to leave his wallet unprotected, the immediate reaction of the delinquent is to take it. He then justifies his behaviour by the rationalization that anyone who leaves himself open to this situation gets what he deserves. This example demonstrates how subcultural values may be woven into this cognitive style, and may result in reflexive antisocial behaviour.

Such preset ideas or behaviours may be consolidated in rigid value and belief systems. Changes in these systems may be hard to achieve for various reasons. Perhaps the rewards for the cognitive style and the behaviour patterns are too great to encourage change. It is also possible that cognitive competencies have been insufficiently developed. Alternatively, either the opportunity to develop thinking skills or the motivation to implement such skills may be lacking. Overall, the presence of a concrete thinking style, cognitive rigidity, and an action-oriented disposition can encourage the persistence of antisocial behaviour, despite its inefficiency.

Inefficient behaviour is influenced by cognitive immaturity, which becomes most evident during interpersonal situations. Many delinquents demonstrate

an egocentric level of thinking, which delays the acquisition of role-taking or social perspective-taking skills (Arbuthnot, Gordon, & Jurkovic, 1987; Chandler, 1971). Deficits in these skills predispose individuals to assess people from their own perspective, thus failing to recognize the individuality of feelings, thoughts, and views. They may judge people in a superficial manner and evaluate them strictly on their appearance (Chandler, 1971). Interpersonal weaknesses generally result in a lack of self and social awareness, and impede the development of empathy (Grattan & Eslinger, 1989; Stuss & Benson, 1986).

The composite of these cognitive deficits engenders both personal and behavioural problems. Aggressive, impulsive behaviours, as well as educational, social, and emotional maladjustment, are personal consequences that can result from poorly planned, unregulated, and unmodified behaviour (Dodge & Feldman, 1990; Grattan, 1991). Delinquents who act impulsively and inappropriately, and who are oblivious to the effects of their behaviour will repeatedly draw attention to themselves. The persistence of such behaviour will tend to antagonize or alienate others, and this will contribute to their course of maladjustment (Patterson et al., 1991).

Such maladjustment is also influenced by a series of failures. Many of the failures or lack of achievement encountered by delinquents are related to poor goal orientation (drive) and unrealistic goal setting (e.g., wanting to be a rock star or a racecar driver). Even the attainment of simple goals may prove to be difficult because of poor conceptualization and strategic planning ability. Failures and social alienation may lead individuals to seek out or ally themselves with peers facing the same difficulties, and as a group they may develop and/or reinforce antisocial views and behaviours (Patterson et al., 1991)

In summary, the utility of the cognitive model of juvenile delinquency provided by Ross and Fabiano (1985) is primarily that it provides a heuristic framework for research into several specific cognitive deficits that may be risk factors in the development of antisocial behaviour. Moreover, these deficits can be redefined as executive functions, making them amenable to neuropsychological assessment.

From a neuropsychological perspective, the most striking cognitive deficits and behavioural manifestations mentioned by Ross and Fabiano involve poor planning and organization abilities, inadequate conceptualization and abstract reasoning abilities, inability to generate

alternative plans or to alter an ongoing plan, failure to self-monitor and self-regulate behaviour through the use of feedback, poor goal orientation, impulsive behaviour, and a lack of awareness or unconcern about one's behaviour. All of these features are considered to be higher-order cognitive (executive) functions that are essential in the development and maintenance of self and social awareness (Stuss & Benson, 1984, 1986; Stuss, Gow, & Heatherington, 1992).

The cognitive model presented by Ross and Fabiano (1985) is also amenable to integration with the developmental model of maladaptive behaviour summarized by Fishbein (1990). In Fishbein's model, it is suggested that **insult or trauma** (e.g., resulting from poor nutrition, toxins, head trauma, innate errors of metabolism, physical abuse, stimulus deprivation, substance abuse, physical sensitivities, psychological trauma, etc.) leads to problematic **behavioural responses** (e.g., learning disability, hyperactivity, impulsivity, psychopathy, schizophrenia, aggression, depression, mania, mental dullness, reduced potential, etc.), which leads to **school problems** (e.g., rejection by teachers, peers and family; isolation; underachievement; poor self-concept; frustration; guilt; association with similar peers), and in turn to an **increased likelihood of anti-**

social behaviour.

As comprehensive as this model seems, it would have been enriched by the incorporation of links between specific cognitive deficits and the factors noted. Perhaps the exclusion of such links is a reflection of either the lack of direct evidence for the role of cognitive variables in the development of criminal behaviour, or a reluctance to undertake the necessary studies to provide such evidence.

Intelligence, social cognition, and crime

The relationship between general intelligence (IQ) and crime is not a direct one, nor is general intelligence equatable to social cognition (cf. Baxter et al., 1995). As pointed out by Thorndike (1913), measures of general intelligence do not gauge a person's ability to function socially. This concept is best illustrated by intelligent people who are socially inept, lack understanding of social situations, and cannot seem to read other peoples' feelings.

Although a certain level of general intelligence is required for social intelligence, the two constructs are not the same. Correlational studies of IQ tests and social cognitive ability tests yield significant

statistical relationships, but the magnitude of association is weak (e.g., $r = .30$) (Hunt, Lunneborg & Lewis, 1975; Platt, Spivack & Bloom, 1974). These findings support the independence of general intelligence and social intelligence, and suggest that IQ tests are not particularly sensitive to variations in social cognition.

IQ tests are also relatively insensitive to cognitive deficits resulting from frontal lobe or diffuse brain damage (Reitan & Wolfson, 1992), especially in comparison with the Reitan Impairment Index or the Category Test of the Halstead-Reitan Neuropsychological Battery (HRNB). These results are not surprising, considering that the HRNB tests were designed specifically to identify brain damage whereas IQ measures were devised to measure intelligence. Thus, using IQ tests to draw inferences about social intelligence or about certain neuropsychological functions may be of limited value.

To further illustrate this point, studies conducted by Hebb (1949) found that after extensive removal of frontal tissue, many patients showed little or no disruptions in IQ scores as determined by comparing pre-operative and post-operative scores. In most cases, patients showed normal IQ scores and, in fact, the

surgery sometimes produced higher post-operative scores. One client had a post-operative score of 160 on the Stanford-Binet Intelligence Test. Numerous later studies have confirmed that significant disruptions in IQ are not observed after frontal lobe-damage (e.g., Stuss & Benson, 1986).

On the other hand, a key deficit that is consistently observed in FLD is a change in self-reflective awareness which is not revealed by IQ scores (Stuss et al., 1992). This awareness appears to be a function of judgement and decision-making, and is associated with anterior brain regions. The ability to judge emotional situations correctly and make appropriate emotional and social responses is believed to involve both left and right frontal and temporal regions of the brain (Kolb & Taylor, 1988; Stuss & Benson, 1984). If this is correct, it is likely that executive functions required for the development of adequate social and self-awareness are dependent on the integrity and/or the maturity of these brain regions.

Social disability is the most common debilitating feature associated with FLD in both children and adults. In children, the impact on social behaviour is more subtle than that observed in adults. Nevertheless, a progressive and cumulative disparity between expected and

actual social behaviour is observed as the child matures. Both adults and children seem to suffer a learning impairment that affects social, emotional, and higher cognitive domains, yet spares general IQ, leaving it virtually intact (Grattan, 1991).

Criminology studies echo the FLD studies, suggesting that specific deficits in social intelligence are more critical than IQ in the development of criminal behaviour (Arbuthnot, Gordon, & Jurkovic, 1987; Baxter et al., 1995; McKenzie, 1996; Patterson et al., 1991; Quay, 1987; Ross & Fabiano, 1985). The relationship in this case is somewhat different, since both lower IQ and deficits in social cognition may be present in high-risk groups for developing antisocial behaviour, whereas FLD patients may show deficits only in social cognition.

Studies of general intelligence indicate that conduct disordered children tend to have lower IQ scores (8 points full scale IQ) than normals (Huesmann, Eron, Lefkowitz, & Walder, 1984; Lewis, Shanok, & Pincus, 1981), but the impact of low IQ is greatly influenced by other detrimental factors. For instance, parental psychopathology, neurological problems, genetic vulnerability, temperamental disturbances, and impoverished environments may predate both conduct disorder and low IQ. Furthermore, these detrimental

factors can independently influence conduct disorder and IQ (Huesmann, et al., 1984; Olweus, 1979), and result in the development of various noncriminal maladaptive behaviours (Fishbein, 1990).

Thus, the relationship of IQ to the development of criminality is not clear cut, and low IQ should only be considered as a risk factor in the development of maladaptive criminal behaviour. Consistent with this notion is the finding that high-risk children with high IQ scores are more likely to resist involvement in serious antisocial behaviour (Kandel & Mednick, 1988).

Other studies of IQ and criminality have focused on the discrepancies between verbal intelligence quotient (VIQ) and performance intelligence quotient (PIQ) IQ scores, and subtest pattern analysis. Both of these approaches have met with disappointment and are generally considered to be of limited value in identifying lawbreakers or explaining delinquency (Baxter et al., 1995). Additionally, it has been suggested by Quay (1987) that most of the variance in VIQ-PIQ discrepancies can be explained by the presence of poor verbal skills, and that these difficulties underlie deficits seen in interpersonal problem-solving and perspective-taking skills, as well as person-perception and moral reasoning abilities.

The lack of success with these types of studies can probably be attributed to the lack of specificity of the test instruments. One gets the impression that often investigators have administered IQ tests and then developed post hoc hypotheses to account for the results. It would seem more appropriate to develop hypotheses about specific deficits first and then on the basis of these hypotheses to employ or develop instruments to test specific predictors.

In contrast to the IQ studies, investigations using instruments devised to measure specific deficits in social cognitive functioning have met with greater success (Arbuthnot et al., 1987; McKenzie, 1996; Patterson et al., 1991; Quay, 1987; Tweedale, 1991). Consistent with Quay's (1987) contention, deficits in social interpretation, perspective-taking ability, and interpersonal problem-solving skills have been observed in both delinquent and adult offender populations (Arbuthnot et al., 1987; Ross & Fabiano, 1985). Such deficits are also associated with impulsivity, aggression, and other types of maladjustment in children (Dodge & Feldman, 1990; Spivack & Shure, 1974), and are considered to be risk factors associated with peer rejection and later delinquency (Patterson et al., 1991). Based on these findings, Baxter et al. (1995) suggest

that specific deficits in social cognition may be better predictors of antisocial behaviour than general intelligence. This is not surprising, considering that IQ tests are strongly influenced by academic achievement (Reitan & Wolfson, 1992), yet are poor measures of the problem-solving abilities required in interpersonal situations.

Similar conclusions can be drawn from criminological studies and FLD studies regarding social cognition and general intelligence. In both instances, social cognition appears to be a more critical variable than IQ in the manifestation of socially maladaptive behaviour. Although a low IQ may be a risk factor in developing delinquency, the role it plays in the developmental process is not easily specified. In contrast, the role that cognitive deficits might play in the development of socially maladaptive behaviour is more readily delineated.

For instance, the cognitive inflexibility and impoverished empathy displayed by brain-injured patients (Grattan & Eslinger, 1989) and delinquents (Ross & Fabiano, 1985) can either create or exacerbate many social conflict situations. A lack of flexibility reduces one's ability to take the perspective of another, which is an integral component of the interpersonal problem-solving process. Additionally, this lack of flexibility

may be a cognitive prerequisite in the development of empathy. Grattan and Eslinger (1989) report that cognitive rigidity as measured by an increase in the number of perseverative responses on the Wisconsin Card Sorting Test (WCST) correlates negatively ($r = -.63$, $p < .01$) with scores on Hogan's Empathy Scale in brain-injured subjects.

Cognitive rigidity can also impede the development of verbal skills and/or the willingness to engage in verbal communication. A case study (e.g., patient JP) provided by Grattan (1991) provides an excellent illustration of this point. JP was a boy who had bilateral prefrontal atrophy, purportedly from a congenital and idiopathic degenerative process. Cognitive assessment revealed an average intellectual functioning but defective performances on tasks requiring abstraction, planning, cognitive flexibility, self-regulation, and ability to maintain a relatively remote goal. His adult adjustment was marked by poor planning, impulsivity, and irritability in situations where shifting behavioural responses or adaptation was required.

Grattan and Eslinger (1989) suggested that JP's social impairment was influenced by his deficit in cognitive flexibility. Consistent with this notion, JP

reportedly resisted shifts in conversation and became irritated when interrupted during a task. The extent of his cognitive and behavioural rigidity suggested he was extremely stimulus-bound in his behaviour. This type of behaviour is consistent with Ross and Fabiano's (1985) contention that some delinquents are action-oriented and cognitively rigid. In the latter case, it is possible that difficulty in following shifts in conversation may frustrate the delinquent and engender feelings of resentment and anger, which may lead to acts of aggression. Consequently, solving problems through discourse may not be viewed as a viable alternative by the delinquent and therefore may be avoided in conflict resolution situations.

It has also been suggested by Pontius (1972) that cognitive rigidity in some delinquents compromises their ability to interrupt or change an ongoing plan. Take for example the youth who plans to burglarize a house but is interrupted by the tenant. Rather than leave the dwelling, the delinquent may decide to assault the tenant and resume his original plan of burglarizing the house. A more rational decision in this case might be to leave the house and come back when nobody is home.

In summary, although deficits in specific social skills (e.g., perspective taking, interpersonal problem-

solving) have been demonstrated in both delinquent and adult criminals (Arbuthnot et al., 1987; Ross & Fabiano, 1985), the cognitive subsets underlying these skills have not been systematically investigated. It is hypothesized that executive functions associated with organization, abstraction, planning, conceptualization, cognitive flexibility, generating hypotheses, and monitoring and self-regulating behaviour through the use of feedback underlie such social skills, and that deficits in these functions therefore contribute to impulsive, unpredictable, and socially disinhibited behaviour, as well as to impoverished or delayed development of social and self-reflective awareness.

Various neuropsychological instruments have been devised to assess executive functions. The use of such instruments in the study of delinquency and criminality is reviewed in the next section. Earlier investigations emphasized a causal relationship between certain types of delinquent behaviours and a maturational lag of the frontal lobes. Later studies emphasized a causal neurobehavioural theory based on performance of delinquents on neuropsychological measures that are sensitive to FLD.

Neuropsychological investigations of delinquency and criminality

Pontius (1972) was the first to suggest that a maturational lag of the frontal lobes was associated with a certain type of delinquent behaviour. The theory was formulated on the basis of clinical observations of 1000 juvenile and 3000 adult delinquents during a 5-year period of forensic psychiatry. It was suggested that 15-20% of juveniles and 5% of adults who committed delinquent acts displayed a specific pattern of behaviour, marked by the following features: the inability of the individual to implement an overriding abstract idea in the face of more stimulating environmental situations; the inability to plan alternative courses of action; and the failure to change the plan of action in the face of changing environmental demands. In other words, these delinquents were characterized by extreme cognitive rigidity, poor planning ability, and an inability to use feedback to adjust their behaviour in an adaptive fashion.

Pontius (1972) suggested these deficits were related to the inability to use verbal mediation to alter the ongoing behaviour. The theory was based on the finding that this cognitive ability has not yet fully developed in children aged 3 1/2 to 4 years old (Luria & Homskaya,

1964), and that the mental development of such self-regulated behaviour is closely related to the myelination of complex neuronal structures of the frontal lobes. By age 3, neuron and glial counts are fixed, and myelination is approximately 90% of adult values (Yakovlev & Lecours, 1967). Electroencephalographic (EEG) research reveals a pattern of accelerated development of coherence and phase (estimates of the number and strength of cortical connections and the conduction velocity). Between the ages of 4 and 6, this accelerated development occurs in both the left parietal-occipital and frontal-temporal regions, as well as in the right frontal pole. The next noteworthy proliferation of coherence and phase occurs between the ages of 8 and 10 and involves the right temporal-frontal region. The left hemisphere advantage resulting from the first period of enhanced development is consistent with the acquisition of language ability in children, while the second favours the development of spatial-perceptual abilities.

Later, proliferation occurs in anterior brain regions between the ages of 11 and 14, and maturation of these regions continues from 15 into adulthood. The anterior maturation period is bilateral in nature and is related almost exclusively to the development of frontal-lobe connections. These findings are consistent with

Piaget's theory of cognitive development in which formal thought (abstraction) begins to develop fully by age 12. It also indirectly supports Pontius' (1972) theory that a maturational lag in the myelinization of the frontal lobes may underlie the cognitive inflexibility seen in some delinquents.

To substantiate this theory, Pontius and Rüttiger (1976) measured cognitive inflexibility by using the Narratives Test (NT), a spontaneous story-telling task. The test evaluates stories generated by the subject in two ways. The first analysis determines whether the individual is able to switch the principle of action when appropriate. Failure to do so is exemplified by a story that repeats the same type of action (e.g., the boy was playing) for many subsequent characters (e.g., the girl was playing, the mom was playing, etc.). A second type of analysis examines if planning ability is evident in the story. Poor planning is reflected by a story that rambles on, lacks coherence or continuity, and ends abruptly.

Pontius and Rüttiger (1976) studied 132 Australian school children, age 9 to 16, of at least average IQ and without known psychotic or neurologic conditions. The breakdown of subjects was 67 normals, 39 delinquents, and 29 emotionals, that is children diagnosed as having emotional problems. They reported that cognitive

flexibility as measured by the NT, was greater in control subjects in comparison to delinquents but not emotionals, and no difference was observed between emotionals and delinquents.

However, the statistical design and analysis of this study were weak because univariate rather than multivariate statistical procedures were used, group sizes were unequal, and the number of subjects per group was small. Additionally, the NT is an unstandardized psychometric tool with no available information pertaining to reliability and validity, and it provides no empirical evidence to suggest that it measures frontal lobe maturity. The influence of confounding demographic variables, such as age, sex, socioeconomic status (SES), and education, were also unknown. Furthermore, it is possible that impoverished verbal abilities in delinquents may have impaired their performance on this test, but this would not necessarily demonstrate poor mental flexibility per se.

In a subsequent study, Pontius and Yudowitz (1980) examined the performance of 30 adult male convicts (mean age = 22.8 years) on the NT and the Trail Making Test Part B (Trails B). They found that 36% of the offenders tested displayed immature action behaviour on the NT, and 33% of offenders committed one or more errors on

Trails B. A positive correlation $r = .68$ between the NT and Trails B was observed. They concluded that about 1/3 of offenders demonstrated immature action behaviour and cognitive inflexibility.

Although the conclusions drawn from this study appear to be valid, close scrutiny of the procedure used in their statistical analysis challenges their findings. For example, the subjects were grouped into nominal categories on the basis of the NT results (e.g., able to switch and not able to switch principle of action) and by the occurrence of errors on Trails B (e.g., errors, error free). These categories were subsequently analyzed for frequencies using a nonparametric statistic (chi square). Unfortunately, they did not provide criterion validity, therefore creating a circular argument regarding their findings.

The design of the study was also plagued by conceptual difficulties. The first difficulty relates to the rather simplistic assumption that the NT measures the maturity of the frontal lobes, in the absence of any empirical evidence to substantiate this assumption. The second problem arises from the assumption that the number of errors committed by the subjects on Trails B represented cognitive inflexibility, when in fact the number of errors may well have been within the normal

range. In this respect, the occurrence of subjects deemed to be cognitively inflexible in this study may have been equally represented in a normal population. Since a control group was not included in their study, this latter possibility remains unknown.

Although Trails B is a sensitive tool for measuring mental flexibility, adequate performance of this test relies on focused attention, intact motor functioning, and speed of visual search when it is scored by time rather than by number of errors (Lezak, 1983). The Trails B has also been normed with respect to time rather than by the number of errors committed (Reitan & Wolfson, 1992). Thus the inference that the number of errors committed on Trails B represents cognitive flexibility may be erroneous. Furthermore it is not exclusively a measure of frontal lobe functioning, since diffuse brain damage can produce similar results to those in patients with FLD (Reitan & Wolfson, 1992). Considering the lack of standardization of the NT and the flaws in both the design and statistical analysis of the Pontius group, their conclusions can only be considered speculative.

Later studies conducted by Yeudall (1979, 1982) of FLD in delinquent and adult criminals provided several investigations that were much more sophisticated than the earlier studies by the Pontius group. The Yeudall studies

used various neuropsychological tests, including the HRNB, as well as tests of intelligence like the Weschler Intelligence Scale for Children - Revised (WISC-R) and the Weschler Adult Intelligence Scale - Revised (WAIS-R), and electroencephalographic (EEG) recordings. Because of the large number of measures, the data was factor analyzed and reduced to an acceptable subject to variable ratio. Approximately 12 factors were obtained in these studies, with higher cognitive functions (executive functions) contributing the greatest amount of explained variance (17.6%), followed by measures of motor strength and manual dexterity (8.9%). The variety of indices of brain functioning allowed comparisons of posterior versus anterior functioning to be made.

Yeudall and Fromm-Auch (1979) reported the results of three studies. In the first, they compared criminals to depressives and control subjects on the HRNB. The criminals and depressives obtained scores on HRNB tests that are suggestive of anterior neuropsychological dysfunction (including FLD) in comparison to control subjects. Although FLD in criminals was suggested in this study, the similar level of functioning found in the depressive group suggested these deficits were not unique to criminals. Additionally, data regarding demographic variables, such as age, educational level, and SES, were

not reported. Nevertheless, other metabolic studies of depressives (Robinson, 1986) and EEG measures of institutionalized delinquents (Yeudall & Fromm-Auch, 1979) suggest these two groups can be discriminated on the basis of lateralized involvement. For instance, delinquents display a slowing of brain wave activity as measured by EEG recordings in the anterior nondominant (right) hemisphere (Yeudall & Fromm-Auch, 1979), whereas depressives are more likely to experience metabolic hypofunctioning in the dominant (left) anterior hemisphere (Robinson, 1986).

The second study by Yeudall and Fromm-Auch (1979) compared institutionalized delinquents to normal community controls on the HRNB. The test scores, which are sensitive to FLD, suggested a higher incidence of anterior brain dysfunction in delinquents versus nondelinquents. Neuropsychological evidence in this study was supported by data obtained from EEG measures. Unfortunately, the authors failed to include controls for the effects of institutionalization, SES, or level of education, but variables such as age, sex, and handedness were found not to significantly influence the results.

The third study by Yeudall and Fromm-Auch (1979) compared 86 violent criminals to 79 normal control subjects on the HRNB. Consistent with their first two

studies, criminals showed a higher incidence of anterior brain dysfunction (including FLD) than did control subjects. However, since a nonviolent criminal control group was not included in this study, the relationship of FLD to violent and nonviolent criminal behaviour could not be assessed. Unfortunately subjects in this study were matched for age and handedness, but not for SES or education level. This incomplete history of demographic information precluded further estimates of these potentially confounding variables on the results.

In a subsequent study, Yeudall et al.(1982) compared institutionalized delinquents to adolescents from a local school. Using the HRNB, they found that delinquents obtained scores suggestive of more anterior impairment (including FLD) than did the controls. However, they reported no difference between the performance of violent versus nonviolent offenders on the neuropsychological measures. Again, the possible effects of institutionalization or SES on the results were not evaluated. Moreover, drug abuse was identified as a characteristic of the delinquent sample but not the control group, and therefore was not controlled for in the analyses, a serious omission since drug abuse alone has been shown to impair performance on neuropsychological tests (Grant et al., 1978).

The possibility that the apparent neuropsychological impairment was related to actual brain injury should have also been explored. Because the orbital frontal and inferior temporal brain regions lie over the sphenoid process, these structures are most vulnerable to being damaged when excessive force moves the brain over this bony protuberance (deCourville, 1942; Richardson, 1979). Considering the prevalence of neuropsychological signs of fronto-temporal involvement amongst delinquents (Yeudall & Fromm-Auch, 1979; Yeudall et al., 1982), it is possible that a certain degree of brain injury may be associated with their precarious lifestyles. For instance, delinquents have a greater incidence of head injuries and emergency room visits than do nondelinquents, and these incidents are often related to violent or high-risk behaviours, such as driving recklessly or physical conflicts (Lewis & Shanok, 1981).

Another interesting possibility that needs further investigation relates to the type of offender and the degree of FLD. In the Yeudall et al. (1982) study, violent and nonviolent offenders could not be discriminated on this basis, but it is important to note that this sample consisted mostly of nonviolent offenders. In contrast, Tarter, Hegegus, Winsten, and Alterman (1984) found that violent/abused delinquents

were significantly more cognitively impaired and committed significantly more violent offences than the nonabused/nonviolent delinquents. Tarter et al. (1984) suggested that the cognitive impairments seen in the abused/violent delinquents could be localized to anterior brain regions including the frontal lobes. This assertion, however, is debatable because their evaluation of FLD was based largely on the results of standardized IQ tests. As previously noted (Hebb, 1949; Stuss & Benson, 1984), IQ tests are not particularly sensitive to FLD. Furthermore, whether the findings were related to the abuse per se or to individual characteristics associated with violent behaviour was not established.

A recent study conducted by Lueger and Gill (1990) found that institutionalized YOs displayed cognitive impairments that were characteristic of FLD. Using some of the neuropsychological tests that are most sensitive to frontal-lobe functioning, they were able to correctly classify delinquent and nondelinquent groups on the basis of test scores with an overall hit rate of 85.37%. One linear discriminant function, Wilks' $\lambda = .566$, $\chi^2(3) = 21.51$, $p < .001$, was identified with loadings on three variables - WCST perseverative errors, SMT errors, and hand movements. The linear relationship between the three predictor variables and the criterion of group

membership was high, (cannonical correlation = .66). Differences were not found on tests less sensitive to frontal-lobe functioning. Factors such as age and verbal intelligence were used as covariates, and their contribution to the explained variance was partialled out.

Additional analyses suggested alcohol and drug use did not influence the results. However, the scores on the Socialization (So) scale of the California Psychological Inventory (Megargee, 1972) were correlated with measures of frontal-lobe functioning, $r = -.33$ to $r = -.37$, as were scores on the Quay Behaviour Checklist (Quay & Peterson 1975) and the Connors Teacher Questionnaire (Goyettte, Connors & Ulrich, 1978), $r = .44$, $r = .40$, respectively. The So scale and the Quay instrument have both proved to be reliable independent predictors of later delinquency and recidivism (e.g., Andrews & Wormith, 1989; Baxter et al., 1995).

The Lueger and Gill (1990) study was designed to improve on previous studies with adolescents by using the most sensitive measures of frontal-lobe functioning, namely the WCST and the Sequential Matching Memory Test (SMMT). Other less sensitive measures of FLD included the Kaufmann Assessment Battery for Children (K-ABC), the Hand Movement Test, Trails B, and the Auditory Verbal

Learning Test (AVLT). The WCST (Grant & Berg, 1948) is a measure of abstraction ability and cognitive flexibility, and it provides subjects with ongoing feedback about their performance. The K-ABC (Kaufman & Kaufman, 1983) includes a measure of sequential motor memory, whereas the SMMT measures sustained attention (Lezak, 1983). Trails B (Spreeen & Strauss, 1991) is purported to measure speed for visual search, attention, mental flexibility, and motor function. The AVLT was included in the study to evaluate the theoretical relevance of frontal-lobe functioning in the sense that it is a measure of one's ability to profit from repeated exposure (learning) and provides an indication of memory organization (Lezak, 1983).

Lueger and Gill selected conduct-disordered adolescents on the basis of the diagnostic criteria of the Diagnostic and Statistical Manual III (DSM III, 1980). The influence of possible confounding variables such as verbal fluency, educational level, racial background, and SES of the family were also controlled for. Overall, this study was well designed, and the statistical analyses were complete, but the rather small sample ($n = 41$) limits generalization of the findings. Nevertheless, the results were consistent with previous findings that suggested delinquents tend to display

performances marked by perseverative thinking (cognitive rigidity) and by sequential memory and motor errors that are also typical of patients with FLD.

In summary, of the FLD studies of delinquency and criminality reviewed here, the evidence seems to suggest that delinquents can be discriminated from nondelinquents on the basis of various neuropsychological measures sensitive to frontal-lobe functioning. Nevertheless, methodological difficulties such as inadequate sample size, the use of unstandardized test instruments, failure to use the most sensitive measures of FLD, inadequate statistical analyses, and failure to control for possible confounding variables such as sex, age, education, SES, or alcohol-drug abuse limit the conclusions that can be drawn from these studies (see Table 1). In addition, the relationship between the type of crime (e.g, violent, property, sexual) and FLD needs to be elucidated.

Table 1

Summary of Neuropsychological Studies

1. Pontius (1972)

Test: none

Function: none

Statistics: none

2. Pontius and Ruttiger (1976), (total n = 132)

Sample = Delinquents vs. Normals vs. Emotionals

Test: Narratives Test

Function: Cognitive flexibility

Statistics: Univariate Comparisons

- Delinquents vs. Normals ($\chi^2 = 4.3$, $p < .02$)
 - Delinquents vs. Emotionals ($\chi^2 = 1.3$, $p > .20$)
 - Normals vs. Emotionals ($\chi^2 = .75$, $p > .80$)
-

3. Pontius & Yudowitz (1980)

Sample = Adult Male Convicts (n = 30)

i. Test: Narratives Test

Function: Cognitive Flexibility

ii. Test: Trails B

Function: Cognitive flexibility

Statistics: Association Between Tests, coeff. = $-.68$,
 $p < .001$

(table continues)

4. Yeudall, Fromm-Auch, Davies (1982)

Sample = Young Offenders (n =99) Controls (n =47)

Test: Halstead-Reitan Neuropsychological Battery
(Factor Analysis and Discriminant Analysis)

Statistics:

- Cannonical correlation = .66, $p < .001$
 - Higher Cognitive Functions, $\chi^2 = .17$
 - Motor Strength and Dexterity, $\chi^2 = .09$
-

5. Tarter et al. (1984)

Sample = Abused vs. Non-Abused Delinquents (total n = 101)

Statistics description: Univariate Statistics

i. Tests: WAIS-R

WISC-R

Function: Cognitive Abilities

Statistics: (F = 2.90, $p = .09$)

ii. Test: Trails A

Function: Visual Scanning

Attention

Statistics: (F = 5.47, $p, < .02$)

iii. Test: Pegboard ND Hand

Function: Manual Dexterity

Statistics: (F = 5.20, $p, < .02$)

iv. Test: Word Fluency

Function: Ideational Flexibility

Statistics: (F=3.01, $p = .08$)

(table continues)

v. Test: Boston Aphasia Screening Test

Function: Aphasias

a. Subtest: Test Error Score

Statistics: ($F = 3.21$, $p = .08$)

b. Subtest: Sentence Writing Errors

Statistics: ($F = 3.85$, $p = .06$)

Note: Abused delinquents had an inferior performance on all of these tests in comparison to Non-Abused delinquents, but not all of these were statistically significant.

 6. Lueger and Gill (1990)
Sample = Conduct Disordered ($n = 21$) vs. Controls ($n = 20$)

i. Test: Frontal Lobe Measures

Function: Linear Discriminant Function

Statistics: Canonical Correlation = .66 , $p, < .001$

Statistics description: Univariate Statistics

a. Subtest: WCST perseverative responses

Function: Cognitive Flexibility

Statistics: ($F = 8.97$, $p, < .005$)

b. Subtest: WCST perseverative responses

Function: Cognitive Flexibility

Statistics: ($F = 7.34$, $p, < .008$)

c. Subtest: SMT errors

Function: Sustained Attention

Statistics: ($F = 5.58$, $p, < .02$)

d. Subtest: K-ABC Hand Movements

Function: Sequencing

Statistics: ($F = 10.03$, $p, < .003$)

(table continues)

e. Subtest: AVLT

Function: Memory Organization

Statistics: ($F = 4.75$, $p < .035$)

f. Subtest: Trails B

Function: Cognitive Flexibility

Statistics: ($F = 1.29$, ns)

ii. Test: Non-Frontal Lobe Measures

a. Subtest: WCST Non-perseverative errors

Statistics: ($F = .11$, ns)

b. Subtest: WCST Categories

Statistics: ($F = 1.33$, ns)

c. Subtest: Trails A

Functions:

- Visual Scanning
- Attention
- Sequencing

Statistics: ($F = 1.52$, ns)

Pilot Study

The pilot study was exploratory in nature, but served as an initial test of the cognitive model of juvenile delinquency proposed by Ross and Fabiano (1985). The model suggests that some YOs demonstrate various cognitive deficits in the areas of self-control, locus of control, critical thinking ability, abstract reasoning, cognitive rigidity, and empathy. These hypothesized deficits and the instruments employed to measure them in the pilot study are briefly described below. More detailed information about administration, scoring, reliability and validity of these measures are discussed later in the Main Study.

Method

Subjects

A total of 55 subjects between the ages of 14 and 19 were used in the pilot study. The experimental group consisted of 36 male YOs who had been previously convicted of a criminal offence(s) and were residents of the Cecil Facer Closed Custody Training School. The control group consisted of 19 male students without criminal records, drawn from a local public high school in Sudbury, Ontario.

Cognitive Measures

Self-Control/Impulsivity

According to the Ross and Fabiano model, many offenders fail to stop and think before they act, neglecting to consider the consequences of their actions. Unfortunately, impulsive behaviour is somewhat difficult to assess because of conceptual and theoretical issues regarding the definition and measurement of impulsivity (McKenzie, 1996).

Q-score Porteus Mazes. The qualitative score (Q-score) of the Porteus Maze has proven successful in discriminating juvenile delinquents from non-delinquents in a number of studies (cf. Quay, 1967). Despite these consistent findings, an adequate explanation of what the Q-score measures has been difficult to establish. Some investigators suggested it measured impulsivity, whereas others believed test scores reflected personality and emotional functions (cf. Quay, 1967). Both of these positions seem quite speculative with little or no concrete evidence favouring either hypothesis. From a neuropsychological perspective, successful performance on the Porteus Mazes requires adequate visual planning (foresight) and motor functioning to get through the mazes. Additionally, minimizing errors and maintaining a quality performance requires adequate mental capability

to carry out a plan of action while maintaining several rules in mind.

From this perspective, the task demands are clearly equivalent to executive functioning of the prefrontal lobes (Stuss & Benson, 1986). Although Ross and Fabiano (1985) suggest the Q-score may be used as an index of impulsivity, for the purpose of this study we prefer to consider the Q-score as a measure of executive functioning.

Locus of Control

Ross and Fabiano (1985) suggest that many delinquents are externalizers, believing that events happen due to chance, fate, or luck. They believe they are powerless, having little control over what happens to them.

I, P & C Levenson Scales. Of the many measures of locus of control available, the I, P & C scales by Levenson (1973) were chosen because in addition to measuring an individual's perceptions of his behaviour as being due to himself (internal) or powerful others (external), it also assesses whether the individual believes events happen due to chance or luck or fate. Each scale consists of eight items measured using a seven-point Likert format. High scores on each subscale are interpreted as indicating high expectations of

control by the given source (internal, external).

Internal consistency estimates are moderately high ranging from .64 for the 'I' scale to .77 and .78 respectively for the 'C' and 'P' scales. Test-retest reliabilities are in the .60 to .79 range (Levenson, 1973).

Concrete versus Abstract Thinking

Ross and Fabiano (1985) have claimed that some offenders are concrete in their thinking style, making it difficult for them to understand the views, thoughts, and feelings of others.

Conceptual Level: Paragraph Completion Method. An appropriate measure for assessing conceptual level and social maturity is provided by the Paragraph Completion Method. This semi-projective test requires the subject to give his ideas or feelings about 6 topics that are suited for measuring social maturity. Responses are then rated for their conceptual level, yielding a conceptual level score. Immature, concrete responses are given a low score, while mature, abstract responses are given high scores.

Conceptual Rigidity

According to the Ross and Fabiano model, the thinking style of many offenders is inflexible and rigid. Because of this, they may persist in behaviours that are ineffective, and may have difficulty in developing empathy because they cannot view situations from another's perspective.

Gough's Rigidity Scale. This scale is part of the California Personality Inventory (CPI) and purports to measure the flexibility and adaptability of an individual's thinking and social behaviour. There are 22 true or false items reflecting tolerance for ambiguity or uncertainty, and dogmatic statements. Although Ross and Fabiano (1985) suggest it may be useful in assessing an offenders degree of conceptual rigidity, Gough's rigidity scale is the least valid of the CPI scales (Gough, 1957). Gough's scale correlates negatively with other similar measures of conceptual rigidity, but it fails to relate positively to performance tests of cognitive flexibility that require conceptual shifting (Spren & Strauss, 1993).

Trail Making Test B. The Trail Making Test B is an appropriate measure of cognitive flexibility because it is a performance test that requires conceptual shifting throughout the test (Lezak, 1983). Such a test is a purer

measure of cognitive flexibility than Gough's rigidity scale which is more or less a measure of one's attitudes, values and beliefs (Gough, 1957).

Empathy

Empathy is an area that has not been sufficiently studied among offenders. Ross and Fabiano (1985) define empathy as the ability to understand another's view and feelings, and not simply the capacity to share another person's feelings. Their view of empathy suggests cognitive maturity influences empathic capability.

Hogan's Empathy Scale. Hogan's Empathy Scale, which was designed to measure the intellectual comprehension of another's state of mind without necessarily experiencing that person's feelings, is also part of the CPI. The scale consists of 64 true or false items. Correlational studies indicate adequate concurrent validity and reliability, with coefficients ranging between .71 and .84 (Hogan, 1975).

Critical Reasoning

The thinking of many offenders lacks self-criticism, and is often illogical. Consequently, behaviour is more often mediated by a poorly conceived decision making process. The Watson-Glaser Critical Thinking Appraisal was selected for inclusion in this preliminary study because it is a well standardized instrument that has

been used successfully in various settings (e.g., training programs, educational institutions) to measure gains in critical thinking ability. Additionally, it has been normed for high school populations, making it suitable for use with YOs.

Conditioned Spatial Association Task (CSAT). The CSAT is an experimental procedure developed by Petrides and Milner (1982) and Petrides (1985) to assess the role of the prefrontal lobes in regulating behaviour via external stimuli. Petrides & Milner (1982) demonstrated that frontal lobe patients were impaired on this test. Subsequently, they concluded that these patients failed to use nonverbal external cues to guide their behaviour. They also suggested that the right frontal area was dominant for external ordering (Petrides & Milner, 1982; Petrides, 1985). This finding was an extension to Luria's (1966) original suggestion that FLD patients failed to use verbal mediation to alter their behaviour. As an exploratory measure, the CSAT can provide inferential information regarding the ability of YOs to use spatial cues to monitor the effect of their behaviour during social interactions.

Results

A stepwise discriminant function analysis was performed using the raw scores from the cognitive measures as predictors of membership in the YO and NYO groups. The predictors used in the analysis consisted of executive functioning (Q-score), locus of control, concrete versus abstract reasoning, conceptual rigidity (Trails B and Gough's Rigidity Scale), critical reasoning, and empathy.

Evaluation regarding assumptions of linearity, multicollinearity or singularity, and homogeneity of variance-covariance matrices revealed no threat to multivariate analysis. There were no missing cases, and only a few outliers on normal looking distributions. Skewness and kurtosis were within acceptable levels (+1 through -1), and a regression procedure (SPSS^x) confirmed the absence of multivariate outliers.

One significant linear discriminant function, Wilk's Lambda = .44, $\chi^2 (5) = 41.5$, $p < .0001$, was identified with loadings on 5 variables: Trails B, trials to criterion on the CSAT, Q-score, conceptual level, and critical thinking. The linear discriminant function (LDF) between the five predictor variables and the criterion measure of group membership was strong, canonical correlation = .75. Higher cognitive functions (critical reasoning,

conceptual level) contributed the greatest amount of explained variance (36% and 8%, respectively) followed by spatial perception and memory (CSAT) (7%), visual planning and visuo-motor functioning (Q-score) (3%), and finally mental flexibility (2%). The discriminant function correctly classified 17 out of 19 NYOs (89.5%) and 32 out of 36 YOs (88.9%) for an overall hit rate of 89%. Standardized coefficients for the 5 variables are presented in Table 2, and their means and standard deviations can be seen in Table 3.

Table 2

Discriminant Analysis of Variables Differing Significantly Between YOs and NYOs

Measure and variable	Pooled within group correlations	Standardized discriminant function coeff.
Critical reasoning	.66	.76
Conceptual level--	.61	.72
Social maturity		
Spatial perception--	.23	.63
Memory (CSAT)		
Visuo-motor planning (Q-score)	-.28	-.37
Trail Making Test B	-.20	-.26

Table 3

Means, Standard Deviations and Univariate Statistics of Predictors for YOs and NYOs

Measure	YO (n = 36)	NYO (n = 19)	F	p
1. Trails B (in seconds)				
M	75.5	67.7	5.01	.03
SD	32.6	18.6		
2. Porteus Maze Q-score				
M	55.1	29.9	13.31	.0001
SD	28.4	11.1		
3. Conceptual Level - Social Maturity				
M	0.8	1.5	47.01	.0001
SD	0.3	0.4		
4. Critical Thinking				
M	39.0	48.8	25.07	.0001
SD	15.0	16.5		
5. Conditioned Spatial Association Task				
Trials to Criterion				
M	11.9	9.5	7.2	.01
SD	4.6	4.2		

Summary

The results of the pilot study support Ross and Fabiano's (1985) suggestion that some YOs display specific cognitive deficits that contribute to their antisocial behaviour. Deficits in critical reasoning and the ability to conceptualize ideas reflecting social maturity significantly differentiated YOs from NYOs. YOs also exhibited deficits in the ability to use external cues to alter ongoing behaviour. Additionally, YOs showed poorer ability for visual planning (Q-score) and poorer cognitive flexibility than did NYOs.

Variables that did not enter the linear discriminant function were Hogan's Empathy Scale, Gough's Rigidity Scale, and Levinson's Locus of Control scale. McKenzie (1996) also reported a lack of success using these latter measures; thus they were subsequently dropped as predictors in the main study. Later, the linear discriminant function derived from the pilot study successfully predicted group membership in the Main Study, correctly classifying 28 out of 40 (70%) NYOs and 28 out of 40 (70%) YOs for an overall hit rate of 70%.

Main Study

As noted, the present study examined the performance of YOs versus NYOs on neuropsychological tests of executive functioning rather than on IQ tests for several reasons. First, studies using IQ as a measure of cognitive competency have proven to be of limited value in identifying lawbreakers or explaining the influence of IQ on the development of antisocial behaviour. In contrast, the neuropsychological instruments selected for this study provided specific measures of psychological functions that are likely to be prerequisites for the development of cognitive and social competency.

The purpose of the study was not to develop or test a neuropsychological theory of delinquency, but rather to investigate how specific deficits in executive functioning might contribute to the development of maladaptive antisocial behaviour. As such, this study served as a test of the cognitive model of juvenile delinquency proposed by Ross and Fabiano (1985), and the results of the study are used to expand existing developmental models of maladaptive antisocial behaviour (e.g., Fishbein, 1990; Patterson et al., 1991). Thus, theoretical formulations about the relevance of cognitive deficits in a social context follow.

The general hypothesis for the study was that certain executive functions are essential for the development of adequate interpersonal problem-solving and social perspective-taking skills, as well as the development and maintenance of both self-reflection and social awareness. In the first level of analysis, specific executive functioning deficits were predicted to be more prevalent in YOs. These deficits include cognitive inflexibility; failure to use feedback to alter an ongoing behaviour in the face of changing environmental demands; poor planning, conceptualization and abstraction abilities; limited critical thinking ability; and social immaturity. These executive functions and the psychometric tools selected to measure these inferences are listed in Table 4. Two additional measures (Trails A, and categories achieved and nonperseverative errors on the WCST) were included in the study to determine if less sensitive inferential neuropsychological measures of prefrontal lobe damage improved the discrimination between the groups. Other more general tests were included to provide an estimate of general intelligence (vocabulary-block design subtests), temporal lobe (Newcombe Word Fluency Test) and posterior cerebral functioning (Benton Visual Retention Test). This second group of variables also served as

"comparators" and as controls for nonspecific deficits.

In the first level of analysis all the variables noted above were factor analyzed, and factor scores were then employed in a Stepwise Discriminant Analysis to determine which factors most strongly predicted group membership (YOs vs. NYOs). If the general hypothesis is valid, then variables from the first group should enter the function first, and should explain most of the variance.

The second level of analysis explored the shared sources of variance (via a factor analysis) for the multiple demographic variables including official criminal history (e.g., frequency and type of offences), self-reported criminal history, drug and alcohol use, degree of socialization, educational level, age, and ethnic origin.

The third general analysis correlated the factor scores derived from the second level of analysis (demographics) with the factor scores derived from the first level of analysis (neuropsychological measures). A number of considerations such as homogeneity of variance, multicollinearity, heteroscedasticity, univariate and multivariate outliers, missing values, skewness and kurtosis were evaluated with respect to the violation of assumptions, which are essential considerations in

conducting multivariate statistics.

All of the statistical procedures were conducted using the SPSS^x package on a VAX 780 computer provided by Laurentian University, Sudbury, Ontario.

The subjects, all volunteers, signed a consent form stating that they participated on a voluntary basis, that they could withdraw from the study at any time, that they had received a description of the type of testing that they were asked to perform, and that they would receive feedback on the results of the experiment (see Appendix E). Because YOs are wards of the crown, only individual consent was required, whereas NYOs required parental consent to participate in the experiment (These procedures were approved by the Ministry of the Solicitor General and Correctional Services Research and Ethics Committee.)

Table 4

Neuropsychological Measures of Executive Functioning

Inference	Measure
Cognitive flexibility, attention, speed for visual search, and motor functioning.	Trail Making Test
Cognitive flexibility, abstraction, maintenance of set, use of feedback in changing the ongoing conceptual set.	Wisconsin Card Sorting Test
Visual motor planning, and foresight.	Porteus Maze Test
Critical thinking.	Watson-Glaser Critical Thinking Appraisal
Regulating behaviour via external stimuli (feedback).	Conditioned Spatial Association Task
Conceptualization, abstraction, social maturity.	Conceptual Level by Paragraph Completion Method

Method

Subjects

The subjects for the main study consisted of two groups of 40 individuals each. All subjects were between the ages of 14 and 19 years old. The experimental group consisted of male YOs who had been convicted of a criminal offence(s) and were residents of the Cecil Facer Closed Custody Training School. The control group consisted of students without criminal records that were drawn from high schools in Sudbury and Sault Ste. Marie, Ontario. A social history was taken, and any subjects with a positive psychiatric, neurological, or mental deficiency history were excluded from the study.

Executive Functioning Measures

Trail Making Test (TMT). The Trail Making Test (Spreeen & Strauss, 1991) is purported to measure speed for visual search, attention, mental flexibility, and motor function. Part A of the test requires the connection of circled numbers (1-25), by drawing penciled lines in order, beginning with number 1 through to 25. Part B requires the connection of 25 numbers and letters in alternating but sequential order. That is, first subjects draw a line from the number 1 to the letter A, then from the letter A to the number 2, then from number 2 to the letter B, and so on. Scoring for both forms consists of

latency and number of errors. Lezak (1983) reported test-retest reliability coefficients of .98 for Part A and .67 for Part B. Retest reliability after a one-year period was .64 for Part A and .72 for Part B in 100 subjects, (Snow, Tierney, Zorzitto, Fisher, & Reid, 1988).

Construct validity studies (desRosiers & Kavanagh, 1987; Ehrenstein, Heister, & Cohen, 1982) reveal the test to be loaded heavily on "rapid visual search" and "visuospatial sequencing." Correlation coefficients ranged from .36-.93 with object-finding and hidden-patterns tests, and did not correlate highly with verbal tests (e.g., Token Test or Picture Naming). The test is highly sensitive to brain damage (O'Donnell, 1983), including closed head injury (desRosiers & Kavanagh, 1987). It appears as though Part B is the more sensitive part of the test, since it requires more processing of information ability (Lewinsohn, 1973); the ability to shift set during ongoing activity (Pontius & Yudowitz, 1980), and the ability to handle more than one stimulus simultaneously (Eson, Yen, & Bourke, 1978). Both part A and B of the TMT were used in this study.

Wisconsin Card Sorting Test (WCST). The WCST is believed to measure abstraction ability, cognitive shifting (cognitive flexibility), and maintenance of set (Grant & Berg, 1948). The test comprises two decks of

response cards (64 each) and one set of four stimulus cards. Each card is marked by only one type of symbol (triangle, star, cross, or circle) and colour (red, green, yellow, or blue), but the cards vary in the number of symbols appearing (one to four). The subject is instructed to match response cards with stimulus cards. The examiner comments only on the correctness of the sorting principle being used (i.e., "correct" or "incorrect", with no details as to why it is incorrect). Incorrect responses are left in place, and the subject moves on to the next card. The task for the subject is to determine the "concept" of the sorting rule currently operating for the test. The sorting principles are ordered by colour, form, and number. The sorting principle changes without warning after 10 consecutive correct responses.

Relevant measures of frontal-lobe dysfunction are derived from the number of perseverative responses and the number of perseverative errors. Perseverative responses may reflect the inability to abandon an old sorting principle for a new one, or an inability to generate alternative hypotheses. Perseverative errors are perseverative responses that are also errors. From a diagnostic perspective, the perseverative response measure provides the best predictor of brain damage and

focal frontal-lobe pathology. The number of categories achieved and the number of nonperseverative errors do not appear to be associated with frontal-lobe pathology (Heaton, 1981).

Information on reliability is currently unavailable for the WCST. Despite this drawback, a number of studies have demonstrated its usefulness as an indicator of frontal lobe dysfunction (Bornstein, 1986; Drewe, 1974; Hermann, Wyler, & Richey, 1988; Milner, 1965; Taylor, 1979). Milner (1965) and Taylor (1979) have suggested the test is especially sensitive to damage to the dorsolateral areas of the frontal lobes, especially the left side.

The WCST cannot be used by itself as a predictor of focal frontal lesions, because diffuse brain-damaged individuals perform about the same as focal frontal patients (Robinson, Heaton, Lehman, & Stilson, 1980). It is suggested by Heaton (1981) that evidence from other sources is necessary to reach such a diagnosis.

Normative data is available for children (Chelune & Baer, 1986), adults below the age of 60 (Heaton, 1981), and for the elderly, ages 60-94 (York Haaland, Vranes, Goodwin, & Garry, 1987). Children's performance are similar to those of adults. After about age 10, a significant decline in performance is not seen until

about age 80. Finally, various studies have found the WCST to be slightly correlated (.11 - .35) both with IQ and educational level (Heaton, 1981).

The Porteus Maze Test (PMT). The PMT is believed to measure visual-motor planning and foresight. It requires the ability to perceive the unity of a complex situation, and devise and carry out a plan of action that anticipates and avoids errors (Porteus, 1950; Walsh, 1978). As such, it appears to test abilities considered to be executive functions.

The test comprises a series of mazes of increasing difficulty. The subject must begin the trial at the indicated starting point and find the most direct route to get to the end of the maze. The rules prohibit the subject from entering blind alleys, crossing the boundaries of the lines, or lifting the pencil from the paper. Once a blind alley is entered, that trial ends and another trial is attempted. Two types of scores are obtained: test age (TA) quotient, which is derived by subtracting the unsuccessful trials from the highest maze level achieved, and a qualitative score (Q-score), which is measured by the quality of reproduction (crossed lines, pencil lifts, cut corners, and wavy lines).

There is a paucity of information on reliability of this test. The only study found by this author was an

inter-rater reliability study, which reported correlation coefficients ranging from .87 to .94 (Porteus, Barclay, Culver, & Kleman, 1960). To compensate for practice effects, the Porteus Maze Extension and the Porteus Maze Supplement series were developed (Porteus, 1965). Each of these series increases in difficulty, beginning with the original Vineland series, followed by the Extension series, and ending with the Supplement series.

The Q-score has proven to be the most useful measure for discriminating frontal lobe patients from patients with localized lesions in other cortical areas (Corkin, 1965; Milner, 1965; Walsh, 1978). It is suggested that the frontal patients understand the rules but do not follow them: They are unable to use verbal mediation to alter their behaviour. Consequently, they persevere, making the same errors on repeated trials, breaking the rules, and failing to change their ineffective strategy, even though they can verbalize their mistakes.

Similar findings have been consistently found with delinquent populations (Docter & Winder, 1954; Porteus, 1945, 1950, 1965; Fooks & Thomas, 1957). The Q-score values reported in these studies were remarkably consistent, with delinquent populations hovering around a mean of 48, and nondelinquents scoring a mean of approximately 22. The Porteus studies found that 80% of

male delinquents had a score higher than 29. Docter and Winder (1954) reported similar findings, with 70% of delinquents and 20% of nondelinquents obtaining scores higher than 29.

In summary, the results of these studies suggest that FLD patients and delinquents may experience similar difficulties in the Porteus Mazes in meeting the task demands. The Porteus Maze Test requires strategic planning, the use of feedback to monitor the plan of action, maintenance of the plan of action, and the capacity to consider the rules during the ongoing activity. An inability in any of these areas of executive functioning could result in a poor performance. The Q-score is the measure of interest in the present study.

Critical Thinking Appraisal (CTA). The CTA (1980) is a test that relies heavily on executive functioning. Critical thinking, as defined by Dressel and Mayhew (1954) and researched by Houle (1943) and Morse and McCune (1957), comprises the following abilities: defining a problem; selecting pertinent information for its solution; recognizing stated and unstated assumptions; selecting relevant and promising hypotheses; and drawing valid conclusions. In the context of executive functioning, the task demands of the CTA seem to require the following elements: organization, conceptualization,

and depth of processing of information; adequate working memory; hypothesis testing; and finally judgement. As such, the CTA appears to be a challenging test of executive functioning.

The CTA consists of reality-based problems, statements, arguments, and interpretations, within the areas of work, the classroom, and current events. A total of 100 items measure the degree of truth and falsity of inferences drawn from the given data; the recognition of unstated assumptions in given statements; deduction of whether certain conclusions follow the given premises; interpretation of the evidence in deciding if generalizations or conclusions are warranted on the basis of the data; and evaluation of arguments which distinguishes between strong relevant arguments and weak irrelevant arguments.

The CTA is a paper and pencil test that can be administered individually or in a group. The duration of administration is about 40 minutes, and it is intended to be a power test, rather than a test of speed. Alternate Forms A and B are available.

American norms are available for high school, college and university students, and various professional groups (Watson & Glaser, 1980). The reliability studies reported here were obtained from these reference groups.

Split-half reliability coefficients ranged from .69 to .85; test -retest reliability after three months was .73; and alternate-form reliability was .75.

Validity studies have focused mainly on evaluating gains in critical ability thinking resulting from educational programs (Agne & Blick, 1972; Burns, 1974; Sorenson, 1966) and industrial settings (Sherman, 1978). The CTA is correlated with general intelligence (.41-.68) and achievement tests (.43-.75) (Watson & Glaser, 1980). Factor analytic studies including the CTA, IQ, and achievement measures have consistently shown that despite some overlap, the CTA always loads on one factor (Follman, Miller, & Hernandez, 1969; Comrey, 1974; Landis, 1976), suggesting that the CTA is measuring a unidimensional aspect of ability.

Conditioned Spatial Association Task (CSAT). The CSAT is an experimental procedure which has been used by Petrides and Milner (1982) and Petrides (1985) to assess the role of the frontal lobes in regulating behaviour via external stimuli. On a trial and error basis, the subject is required to learn the relationship between six identical cards arranged horizontally and six blue lamps that are randomly arranged. Subjects are told that a light will come on, and they are to point to one of the cards. The examiner then says "This is a special test,

since I can only tell you whether you are right or wrong." The test is scored by the number of errors and correct responses, and the number of trials required to meet the criteria of 2 consecutive trials completed without error.

Petrides and Milner (1982) demonstrated that frontal lobe patients were impaired on this test. They concluded that these patients failed to use nonverbal external cues to guide their behaviour. They also suggested that the right frontal area was dominant for external ordering (Petrides & Milner, 1982, 1985). This finding was an extension to Luria's (1966) original suggestion that FLD patients failed to use verbal mediation to alter their behaviour.

Paragraph Completion Method (CPM). The PCM (Hunt, Butler, Noy, & Rosser, 1978) is a semiprojective method of assessing Conceptual Level (CL). The responses are considered to reflect thinking style, level of abstract reasoning, and social maturity. The PCM consists of six topics introduced by the following instructions: "On the following pages you will be asked to give your ideas about several topics. Try to write at least three sentences on each topic. There are no right or wrong answers, so give your own ideas or opinions about each topic. Indicate the way you really feel about each topic,

not the way you think you should feel. You will have about three minutes for each page."

The topics, each on a separate page consist of:

1. What I think about rules...
2. When I am criticized...
3. What I think about parents...
4. When someone does not agree with me...
5. When I am not sure...
6. When I am told what to do...

The topics were selected to reflect a sample of how the respondent handles conflict or uncertainty, and how he/she views rule structure and authority relations. Conceptual level is defined by (1) increasing conceptual complexity as indicated by discrimination, differentiation, and integration and (2) increasing interpersonal maturity as indicated by self-definition and self-other relations.

The CL score is obtained in a two-step procedure. The first is to assign a score from 0-3 to each of the six responses. The second is to average the three highest scores to obtain a total CL score. In the scoring procedure, half scores of .5, 1.5 and 2.5 are also considered.

Hunt et al. (1978) provide a training manual with elaborate instructions for scoring and numerous examples

necessary for the naive test administrator to become fluent with the scoring procedure. They also provide normative data for various groups, including students from grade 6 to 13, college, undergraduate and graduate university students.

The psychometric properties of the PCM have been extensively studied and seem to indicate that it is a valuable research tool. In 30 studies quoted by Hunt et al. (1978), the inter-rater reliability is sufficient and ranges from .68 to .96., with the majority of studies hovering around .90. Test-retest reliability has been estimated at .67 after a three-month interval (Gardiner & Schroder, 1972). In 12 studies described by Hunt et al. (1978), the PCM is moderately correlated with IQ and achievement tests, ranging from $r = .15$ to $r = .43$. Most estimates hover in the $r = .35$ range.

General Measures of Cerebral Functioning

The measures described under this heading are included in the study to determine if the predicted deficits in executive functioning are simply a reflection of more general deficits in cerebral functioning.

Vocabulary-Block Design (Voc-Bloc) Subtests. The Voc-Bloc are subtests of the WAIS-R that have been suggested for use as an estimate of general intelligence (Gregory, 1983). The Vocabulary subtest requires the

subject to give definitions of words, thus providing an estimate of verbal comprehension and expressive vocabulary. The Block Design subtest requires the subject to construct replicas of constructions made by the examiner or of designs provided in a booklet. Block Design loads on a perceptual organization factor, where smooth visual motor skills are an asset in performing the task. As a general rule, Gregory (1983) suggests that abbreviated forms should correlate at the .90 level with full scale scores in order to provide an adequate estimate of general intelligence. In a psychiatric population, the Voc-Bloc combination yields a coefficient of .89 with full scale IQ on the WAIS-R (Priaterini, 1979).

Benton Visual Retention Test (BVRT). The BVRT has three alternate forms (C,D, and E) which are roughly of equivalent difficulty. The forms are composed of 10 designs; the first two designs consist of one geometric figure and the remainder consists of two major figures and a peripheral figure. Administration A requires the design to be exposed for 10 seconds and then it is withdrawn. In administration B the design is exposed for only five seconds. Administration C requires the subject to copy each design while looking directly at them. In administration D, the designs are exposed for 10 seconds,

and then they are reproduced after a 15 second delay.

Scoring consists of the number of correct reproductions and the error score. Scores are either 1 or 0. A quantitative and qualitative analysis of the subjects performance can be made. Six major types of errors consist of omissions, distortions, perseverations, rotations, misplacement, and size errors. The interscorer agreement for the number of correct responses and total error score is high (above .95) (Swan et al., 1990), as is retest reliability (.85) (Benton, 1974).

Performance is intended to measure nonverbal memory, but some of the geometric figures can be verbalized (Arenberg, 1978). Factor analyses reveal that the BVRT loads heavily on a visual-perceptual-motor factor (Larabee et al., 1985). The BVRT is sensitive to brain damage, but its predictive ability is not high (Benton, 1974; Tamkin & Kuncze, 1985). There is some evidence to suggest that it is sensitive to brain damage of the right posterior region, and performance on the BVRT correlates moderately with intelligence (.70) (Benton, 1974). Normative data adjusted for education, age, and sex are provided by Speen and Strauss (1991), and they suggest the performance of a 13 year old is equivalent to that of an adult. Administration A will be used in this study.

Newcombe Word Fluency Test (NWFT). The NWFT requires the subject to spontaneously produce words from semantic categories (e.g., objects, animals, animal/color) within a limited amount of time (60 seconds). For the latter category, the subject can use a particular animal or color only once (Newcombe, 1969). The score is the sum of admissible words and combinations. Patients with right-hemisphere lesions do not show serious impairment on this test (Cavalli et al., 1981). A positron emission topography (PET) scan study (Parks et al., 1988) with normal volunteers indicated that word fluency activates bilateral temporal and frontal lobes.

Research Questionnaires

Demographic Data. Basic information regarding date of birth, ethnic background, highest or current level of education was obtained from subjects, and verified through educational transcripts and institutional records.

Criminal History. Information regarding the number and type (property, sexual, violent) of offences committed by YOs were compiled from institutional records. Additionally, the number of incarcerations in both closed and open custody were recorded (see Appendix B). Self-reported criminal activity was also obtained for YOs.

Self-Report Protocol (SRP). This questionnaire asked respondents to indicate the type of criminal or delinquent acts that they had committed (see Appendix C). These measures are referred to as self-report indices of delinquency. It has been suggested that such measures provide a broader perspective on delinquent behaviour than do official records (Tolan & Lorion, 1988). The SRP used in this study was developed by Thompson (personal communication, 1988) and should be considered an experimental measure in the absence of psychometric evaluation and development. The SRP supplies four lists of categories of antisocial acts: offences against a person (5 acts), property offenses (6 acts), offences related to illegal substances (3 acts), and less serious delinquent acts (7 acts). A unique aspect of this protocol is that the subjects are asked to indicate only the number of acts that they have committed in each category. This format was devised with the intention that more truthful responses would be provided because of a certain degree of privacy being offered. The SRP yields subtotals for each category and an overall total (see Appendix C).

Drug Abuse Screening Test (DAST). The drug use questionnaire is a self-report measure of problems related to drug abuse (Skinner, 1982). Drug abuse is

defined as the use of prescription drugs for nonmedical purposes, inhalation of solvents, or the use of street drugs (e.g., hashish, marijuana, cocaine, etc.). The DAST consists of 20 items that are answered in a yes or no format. Skinner (1982) reports respectable psychometric properties for the DAST, which can order individuals along a continuum in terms of the degree of their drug involvement. Wording of several items was modified to apply to teenagers (e.g., "Have you been in trouble at work because of drug use?" became "Have you been in trouble at work or school because of drug use?").

Michigan Alcoholism Screening Test (MAST). The MAST measures the degree of problems associated with the use and abuse of alcohol. The questionnaire was initially developed by Selzer (1971) and revised by Skinner (1982). The MAST consists of 24 items that are answered in a simple yes or no format. Skinner (1979) reports sound psychometric properties with his unit scoring system. Some of the MAST items were modified to apply to teenagers (e.g., "Does your wife, husband, a parent or other near relative ever worry or complain about your drinking?" became "Does your girlfriend (or parents) ever worry or complain about your drinking?").

Test of Adult Basic Education (TABE). The TABE (1987) are normed referenced tests that were designed to

measure educational achievement in reading, mathematics, language and spelling. These tests focus on basic skills required to function in society.

There are four overlapping levels and two parallel forms offered for each level. The levels and estimated grade ranges are as follows:

Level	Range
E (easy)	2.6 - 4.9
M (medium)	4.6 - 6.9
D (difficult)	6.6 - 12.9
A (advanced)	8.6 - 12.9

For the purpose of this study, the reading score comprising of test 1 (vocabulary), and test 2 (comprehension) were the measures of interest. Each test contains 15 items that are easily administered within 10 minutes, yielding a grade equivalent score. The TABE was included as a screening device to ensure reading competence in the YO sample was adequate to complete the paper and pencil tests.

Socialization Scale. The Socialization (So) scale is purported to measure social conformity and the acceptance and internalization of social values (Megargee, 1972). This 54-item scale (answered by yes or no) was developed independently and later incorporated in the California Personality Inventory (CPI). As such it is suitable to

use as an independent measure, and is considered to be one of the best univariate psychometric tools available to predict criminality and psychopathy (Andrews & Wormith, 1989; Baxter et al., 1995). The So scale has been successful in discriminating delinquent and offender populations from various control groups (Arbuthnot et al., 1987; Schalling, 1978) and in predicting later delinquency in school-aged boys (Schalling, 1978).

Results

Factor analysis of raw neuropsychological variables

Principal factors extraction with varimax rotation was performed on the 18 raw neuropsychological variables for YOs and NYOs combined. Principal components were used prior to factors extraction to estimate the number of factors, the absence of multicollinearity, and factorability of the correlation matrix. A survey of histograms plotting individual factor scores revealed a few univariate outliers on normal looking distributions. Regression procedure suggested multivariate outliers were absent.

Five factors were extracted, and communality values tended to be high (range = .41 to .92). Of the 18 raw variables included in the analysis, only one variable (Benton Visual Retention Test) was dropped since its

communality value did not meet the criterion cut-off point of .45. Factor 5 was subsequently dropped since the only significant loadings on this factor were Trails A (.81) and the Benton Visual Retention Test (-.36).

Tolerance values ranged from .98 to .99, suggesting the absence of multicollinearity. An orthogonal rotation was used to simplify interpretation, and variables were subsequently ordered and grouped by the size of their loadings on each factor (see Table 5). Loadings under .30 are not shown in Table 5, but interpretive labels are provided.

Factor 1 reflects cognitive flexibility as indicated by the loadings of the Wisconsin Card Sorting Test (WCST) and the Trails B on this factor. Both the number of perseverative responses and errors on the WCST and the time required to successfully complete the Trails B are purported to measure cognitive flexibility. A weak loading of the Porteus Maze Q-score with this factor is also consistent with the task demands of the Trails B. On both these latter measures, attention, visuo-motor planning and functioning are required for successful performance. The negative relationship of the categories achieved with the various types of errors on the WCST suggest this test possesses adequate internal consistency.

Factor 2 loads on higher order cognitive functions (organization, conceptualization, abstraction, planning, and critical thinking), estimated IQ, and social maturity. The interdependence of these variables is consistent with the notion that adequate intellect and intact executive functioning are prerequisites for the development and maintenance of both self and social awareness (Stuss & Benson, 1986). A loading of the Porteus Maze Q-score with factor 2 suggests that this measure and the Trails B both require sufficient visual perceptual and motor functioning for successful task performance.

Factor 3 identifies the Newcombe Word Fluency Test as an independent task. All three components of this test (objects, animals, animals/colour) yield similar correlations ranging from .55 to .74. Factor 4 identifies a perceptual factor measuring spatial memory and the use of external ordering to alter the response set. A weak loading of the Porteus Mazes Q-score on this factor suggest that intact visual planning and visuo-motor functioning also pertain to this perceptual factor.

Table 5

Factor Analysis Loadings and Interpretive Labels Extracted from Raw Neuropsychological Variables

Measure and variable	Loading	Interpretation
		Factor 1
Wisconsin Card Sorting Test		Cognitive Flexibility
Errors	.93	
Perseverative errors	.89	
Perseverative responses	.89	
Categories achieved	-.71	
Non-perseverative errors	.69	
Trail Making Test B	.54	
Porteus Maze Q-score	.30	
		Factor 2
Conceptual Level-Social Maturity	.83	Higher Order
Critical Reasoning	.81	Cognitive Functions
Estimated IQ	.80	
Word Fluency for Objects	.63	
Porteus Maze Q-score	-.47	
		Factor 3
Newcombe Word Fluency Test		Word Fluency
Colour/animal	.74	
Animals	.64	
Objects	.55	

(table continues)

Measure and variable	Loading	Interpretation
Factor 4		
Conditioned Spatial Association Task		Spatial Planning, Perception, & Memory
Trials to Criterion	.87	
Errors	.81	
Porteus Maze Q-score	.38	
Trail-Making Test B	.38	

Prediction of group membership using factor scores
derived from raw neuropsychological variables.

A stepwise discriminant function analysis was performed using the factor scores extracted from the raw neuropsychological variables as predictors of membership in the YO and NYO groups. Predictors were cognitive flexibility, conceptual level; social maturity, word fluency, spatial perception; memory and visual planning; and motor functioning.

There were no missing data cases, and only a few univariate outliers on normal looking distributions for the four extracted factors. Multivariate outliers were absent, thus all cases were included in the analysis. Evaluation regarding assumptions of linearity, multicollinearity or singularity, and of homogeneity of variance-covariance matrices revealed no threat to

multivariate analysis.

One significant linear discriminant function, Wilks' $\lambda = .67$ $\chi^2 (4) = 30.00$, $p < .0001$ was identified with loadings on four factor variables: // cognitive flexibility, conceptual level - social maturity, word fluency, spatial perception - memory and visual planning - motor functioning. The standardized coefficients for the four factor variables are presented in Table 6. The linear relationship between the four predictor variables and the criterion measure of group membership was fairly high, canonical correlation = .57. Factor 1 measuring conceptual level and social maturity made the greatest contribution to the discrimination, ($r^2 = .17$) followed by word fluency (factor 2), ($r^2 = 7\%$), cognitive flexibility (factor 3) ($r^2 = 5\%$) and spatial perception and memory (factor 4) ($r^2 = 4\%$), respectively. The discriminant function correctly classified 28 of 40 YOs (70%) and 31 of 40 (77%) NYOs for an overall hit rate of 73.75%. Using raw neuropsychological variables as predictors of group membership yields essentially the same results as that obtained from using factor scores (see Table 7 for means, standard deviations and univariate statistics).

Table 6

Discriminant Analysis of Factors Differing Significantly Between Yos and NYOs

Measure and variable	Pooled within group correlations	Standardized discriminant function coeff.
Conceptual Level-Social Maturity	-.63	-.78
Word Fluency	-.38	-.52
Cognitive Flexibility	.34	.48
Spatial Perception-Memory (CSAT)	.30	.43

Table 7

Means, Standard Deviations, and Univariate F Values of the Most Sensitive Neuropsychological Measures of Executive Functioning for YOs and NYOs

Measure	YO (n = 40)	NYO (n = 40)	F	p
1. Trails B				
M	76.9	62.9	6.01	.01
SD	31.3	17.7		
2. Porteus Maze Q-score				
M	49.5	28.7	29.97	.0001
SD	18.7	14.9		
3. Conceptual Level--				
Social Maturity				
M	0.8	1.3	25.29	.0001
SD	0.4	0.5		
4. Critical thinking				
M	36.1	42.9	14.11	.0003
SD	7.3	8.5		
Wisconsin Card Sorting Test				
5. Perseverative responses				
M	15.7	9.9	9.11	.003
SD	10.2	6.5		

(table continues)

6. Perseverative errors

<u>M</u>	14.2	9.0	7.44	.007
<u>SD</u>	10.3	6.4		

7. Conditional spatial association task correct responses

<u>M</u>	52.8	53.4	.01	ns
<u>SD</u>	20.1	16.2		

8. Errors

<u>M</u>	49.9	50.0	.0002	ns
<u>SD</u>	30.4	32.9		

9. Trials to criterion

<u>M</u>	11.5	9.1	6.7	.01
<u>SD</u>	4.8	2.9		

Table 8

Means , Standard Deviations, and Univariate F Values of General Cerebral Functioning and Estimated IQ for YOs and NYOs

Measure	YO (n = 40)	NYO (n = 40)	F	p
1. Trails A				
M	19.6	17.8	.8	ns
SD	11.8	10.8		
Word Fluency				
2. Animals				
M	20.8	21.2	.13	ns
SD	5.8	4.2		
3. Objects				
M	28.3	30.1	1.81	ns
SD	5.0	6.7		
4. Colour/animals				
M	17.7	17.8	.01	ns
SD	3.7	3.2		
Wisconsin Card Sorting Test				
5. Categories				
M	5.7	5.5	.33	ns
SD	1.0	1.2		
6. Non-perseverative errors				
M	16.3	13.9	1.2	ns
SD	10.8	8.6		

(table continues)

Measures	YO	NYO	F	p
Wisconsin Card Sorting Test				
7. Errors				
<u>M</u>	30	23	4.69	.03
<u>SD</u>	16.9	13.7		
8. Estimated IQ				
<u>M</u>	94.3	101.5	3.7	.05
<u>SD</u>	12.6	20.3		
9. Benton Visual Retention Test (errors)				
<u>M</u>	1.5	1.6	.01	ns
<u>SD</u>	.9	.9		

Controlling for educational achievement, estimated IQ, and proficiency in reading and comprehension

A multiple regression was employed to determine if the addition of the four factor scores derived from the raw neuropsychological variables improved prediction of group membership afforded by the highest level of education achieved (grade level) by the subjects and their estimated IQ.

After entering grade level and estimated IQ in step 1, $r^2 = .09$, $F(2, 77) = 3.88$, $p < .02$. After entering the four factor scores in step 2, $r^2 = .36$, $F(6, 73) = 6.9$, $p < .0001$. These results suggest that both grade level achieved and estimated IQ contributed only a marginal

effect (9% explained variance) in comparison to neuropsychological factor scores (36% explained variance) in discriminating YOs from NYOs.

Univariate F ratio statistics ($F = 5.19$, $p < .02$) revealed a significant difference in mean grade level achieved (10.20) by YO in comparison to NYOs (10.77). Estimated IQ in the NYOs was statistically significantly higher ($F = 3.7$, $p < .05$) by an average of 8 points. Proficiency in reading and comprehension as measured by the TABE in the YO population (mean grade equivalent = 9.82) was fairly consistent with their level of educational achievement (10.20). Thus it is unlikely that difficulty in reading or comprehension of test materials confounded the results of this study.

Inter-rater reliability of Q-scores and Conceptual Level scores

To establish inter-rater reliability, two independent raters, (both with a Masters degree in psychology) blindly scored the Q-score of the Porteus Maze and the Conceptual Level score derived from the Paragraph Completion Method. Pearson correlation coefficients indicated a high level of agreement ($r = .98$, $p < .01$, $r = .97$, $p < .01$) for the Q-score and conceptual level score, respectively.

Factor analysis of demographic variables and their relationship to neuropsychological factor scores

Principal factor extraction with varimax rotation was performed on 11 demographics variables for YOs, and subsequently correlated with the factor scores derived from the raw neuropsychological variables. Demographic variables were purported to measure the degree of socialization (SO) amongst YOs, their level of alcohol (MAST) and drug (DAST) dependence, their history of self-reported criminality (SRV-violent acts, SRTV-theft & vandalism, SRD-drug related offences, SRM-mischief), their ethnic background (English, French, or Native Canadians), and the type of offender they were (violent, sexual, or property). The latter two nominal variables were recoded as dummy variables.

Three factors were extracted, and communality values tended to be high (range = .53 - .86). Procedural checks for violation of assumptions were unrevealing, posing no threat to the factor analysis. Factor 1 suggests property offenders are the least socialized, have a greater dependence on drugs and alcohol, and report engaging in theft, vandalism, mischief, and drug trafficking more frequently than either violent or sexual offenders. Factor 2 suggests violent offenders report engaging in violent crimes most often, and to a lesser

degree in acts of vandalism, mischief, and theft. Factor 3 suggests the prevalence of sex offenders varies amongst various ethnic groups. Analysis of variance [$F(2, 37) = 5.89, p < .01$] confirms this hypothesis, and Tukey's post hoc $p < .05$ reveals the prevalence of sexual offenders is greater amongst Native YOs in comparison to English or French speaking YOs.

Variables are ordered and grouped by the size of their loadings on each factor (see Table 9).

Table 9

Factor Analysis Loadings and Interpretive Labels Extracted from
Demographic Variables

Variable	Loading	Interpretation
Factor 1		Property Offenders
1. SRM	.81	
2. MAST	.80	
3. DAST	.79	
4. SRTV	.78	
5. SRD	.77	
6. SOC	-.75	
7. Property off.	.73	
8. SRV	.54	
Factor 2		Violent Offenders
1. Violent offenders	.92	
2. SRV	.66	
3. SRTV	.35	
4. SRM	.35	
Factor 3		Sexual Offenders
1. Sexual offenders	.77	
2. Ethnicity	.70	

The degree of association between demographic and neuropsychological variables was assessed via the Pearson correlation method. Factor scores derived from the raw

neuropsychological variables were correlated with the factor scores derived from the demographic variables. Results indicated two statistically significant correlations. Factor 2 (Higher Cognitive Functions) was negatively correlated with factor 1 (Property Offenders) ($r = -.48$, $p < .01$), suggesting property offenders experience more difficulties with alcohol and drug dependence, engage in more frequent and versatile criminal activity, and are less socialized than other types of offenders; these particular characteristics are associated with greater deficits in higher order cognitive functioning. A weak correlation of factor 1 (Cognitive Flexibility) with factor 3 (Sexual Offenders) ($r = .29$, $p < .05$) suggest sex offenders may be more cognitively rigid than other types of offenders, and may subsequently be more perseverative in their behaviour.

Textual analysis of Conceptual Level by Paragraph Completion Method

An SPSS[®] computer program (Whissell, 1994) was used to conduct a textual analysis of the verbatim responses of 30 YO's and 30 NYOs on the Conceptual Level by Paragraph Completion Method. Text was analyzed on the dimensions of pleasantness and arousal of words, word length, word frequency, total number of words, and sentence length. Scores generated by the software program

served as predictor variables of group membership in a discriminant analysis.

One significant linear discriminant function, Wilks' $\lambda = .47$ $\chi^2 (6) = 40.38$, $p < .0001$ was identified with loadings on all six variables. The linear relationship between the six predictor variables and the criterion measure of group membership was high, canonical correlation = .72. The discriminant function correctly classified 27 of 30 YOs (90%) and 26 of 30 NYOs (87%) for an overall hit rate of 88.5%.

YOs used fewer number of words, shorter sentence lengths, shorter words, and the same words less frequently than did NYOs. They also used words that were less pleasant and words that had a higher arousability than did the NYOs. (See Table 10.)

Table 10

Means, Standard Deviations, and Univariate F Values of Textual Analysis Variables

Measure	YO (n = 30)	NYO (n = 30)	F	p
1. Sentence Lengths				
<u>M</u>	8.4	12.4	44.9	.0000
<u>SD</u>	1.9	2.6		
2. Number of Words				
<u>M</u>	82.3	145.8	27.10	.0000
<u>SD</u>	24.7	62.1		
3. Word Frequency				
<u>M</u>	813.7	912.9	8.1	.006
<u>SD</u>	145.4	123.1		
4. Word Length				
<u>M</u>	3.6	3.9	3.9	.05
<u>SD</u>	.23	.19		
5. Pleasantness of Words				
<u>M</u>	4.4	4.5	8.5	.005
<u>SD</u>	.17	.16		
6. Arousability of Words				
<u>M</u>	4.2	4.0	8.4	.005
<u>SD</u>	.29	.14		

Discussion

The results of both the pilot study and the main study indicate that some YOs display deficits in their executive functioning that significantly discriminate them from NYOs. The deficits are analogous to some of the cognitive deficits outlined by Ross and Fabiano (1985) in their cognitive model of juvenile delinquency. Most notably, some YOs showed deficits in a higher order cognitive factor associated with organization, conceptualization, abstraction, planning, and critical thinking abilities. Additionally, YOs tended to score lower on measures of estimated IQ and social maturity.

The interdependence of these variables is consistent with the notion that adequate intellect and intact executive functioning are prerequisites for the development and maintenance of self- and social-awareness (Stuss & Benson, 1986). Awareness is an ongoing process that is influenced by changing environmental and social situations. Continued adjustment is critical to socially acceptable human behaviour. Executive functioning mediates the organization, integration, and ultimately the decision making process about incoming cognitive, emotional, and social information.

Other significant predictors of lower and descending order of magnitude included word fluency, mental

flexibility, and a spatial/perceptual factor. YO's had lower test scores than did NYO's on all of these factors.

Estimated IQ scores loaded on the higher cognitive factor, but those scores and educational achievement were secondary (9% explained variance) in comparison to executive function factor scores (36% explained variance) in discriminating the two groups. Estimated IQ using a combined score from the Vocabulary and Block Design subtests yields a coefficient of .89 with full scale IQ on the WAIS-R (Priaterini, 1979). Mean estimated IQ scores ($M = 94.3$, $SD = 12.6$) obtained by YO's were approximately 7 points lower than NYO's scores ($M = 101.5$, $SD = 20.3$); however both groups scored in the normal range of intellectual functioning.

Considering the normal intellectual functioning of both groups and the strength of discrimination provided by neuropsychological tests scores, it is suggested that intellectual functioning and educational achievement did not strongly influence neuropsychological test scores in the present study.

Higher cognitive factor scores were negatively and moderately correlated ($r = -.48$) with being a Property Offender. In comparison to Violent and Sex Offenders, Property Offenders tended to be the least socialized and reported a greater dependence on drugs and alcohol than

did other types of offenders. Additionally, they engaged in more frequent and versatile criminal activity including thefts, acts of vandalism and mischief, and drug trafficking. Lueger and Gill (1990) also reported a moderate correlation between Socialization (So) scale scores and neuropsychological measures of higher order cognitive functioning ($r = -.37$), thus supporting our finding that undersocialized offenders demonstrate greater cognitive deficits.

Violent criminals reported committing mostly violent crimes, but they also engaged in acts of vandalism, mischief and theft to a much lesser degree. Sex Offenders reported that they mostly committed sexual offences.

The significant correlation between the higher order cognitive factor scores and factor scores for the Property Offenders suggests that this may be a homogenous group displaying greater cognitive deficits and more impaired social functioning than Violent or Sexual Offenders. The lack of association amongst Violent Offenders and executive functioning suggests that other determinants such as emotional problems or perhaps psychopathic tendencies may underlie their offending behaviour rather than cognitive deficits per se. However, this speculation could not be evaluated from our data

base.

Classification of offenders was made solely on the basis of their current convictions, providing only a loosely based inclusion criteria. Nevertheless, despite some overlap of various self-reported criminal behaviours amongst Property and Violent Offenders, the type and frequency of criminal activity reported by these groups were consistent with their classification. Furthermore, the factor analysis conducted on the demographic variables separated the three groups, suggesting particular characteristics were associated with the various offender types (see Table 9).

These findings are particularly interesting in light of recent research suggesting that criminality and recidivism can be accurately predicted based on the presence of various risk indicators. Andrews, Leschied, and Hoge (1992) report that predictions of recidivism can be made within an 80 to 95% range of accuracy by using a classification tool called the Level of Service Inventory - Ontario Revised (LSI - OR). The LSI-OR measures the presence of various risk indicators and yields a total risk score. Remarkably, the probability of recidivism increases linearly as a function of total risk scores. Empirical evidence supporting the LSI-OR is so impressive that the province of Ontario has now implemented its

mandatory use with all incarcerated young and adult offenders.

The LSI-OR taps the best known predictors of criminality which include criminal history (diverse and extensive), criminal thinking (attitude/orientation), association with criminal companions, a pattern of antisocial lifestyle, chronic substance abuse, poor education and employment history, impoverished family/marital situation, aimless use of leisure time, and a lack of involvement with organized activities.

Our findings suggest the presence of several of these risk indicators amongst the Property Offender group. Most notably, this group reported more frequent and versatile criminal activity, greater reliance on substances; as well, they had lower scores on the So scale and on neuropsychological measures of executive functioning than the other groups. Since the So scale is considered one of the best independent predictors of later delinquency and recidivism (Andrews & Wormith, 1989; Baxter et al., 1995), our findings imply that cognitive deficits are associated with increased risk for criminal behaviour. These deficits were not related to substance abuse. Non parametric correlations of the MAST and DAST scores with individual raw neuropsychological variables revealed no statistically significant

correlations.

More general comparisons of our results with previous findings suggest that as a group, our YO sample demonstrated similar cognitive impairments reported by other investigators (Lueger & Gill, 1990; Tarter et al., 1984; Yeudall et al., 1979, 1982). For instance, neuropsychological studies measuring higher order cognitive functioning consistently reported this factor as the strongest discriminating variable (Lueger & Gill, 1990; Tarter et al., 1984; Yeudall et al., 1979, 1982), followed by mental flexibility (Lueger & Gill, 1990; Pontius & Ruttiger, 1976, Pontius & Yudowitz, 1980), non-dominant hemisphere spatial/perceptual difficulties (Tarter et al., 1984; Yeudall et al., 1979, 1982), and verbal fluency (Lueger & Gill, 1990; Tarter et al., 1984).

In the main study the higher order cognitive factor scores accounted for 17% of the explained variance in the discriminant analysis, which is precisely what Yeudall, Fromm-Auch and Davies (1982) reported in their study. The discriminant function in the main study was also boosted by word fluency, mental flexibility, and spatial/perceptual factor scores, which accounted for an additional 7%, 5%, and 4%, respectively, of the explained variance. However, when verbal fluency was assessed via

a textual analysis (Whissell, 1988) and subjected to a linear discriminant analysis, verbal fluency emerged as a stronger predictor of group membership (88.8% overall hit rate) than the neuropsychological factor scores (73.5% overall hit rate) in the main study. These results suggest that computerized textual analysis (Whissell, 1988) may be a sensitive method of measuring fundamental ability for receptive and productive language.

Deficits in verbal ability amongst offender populations have been repeatedly noted (Baxter et al., 1995), with most studies reporting on the difference between VIQ and PIQ scores. Most findings suggest that VIQ scores in offenders tend to be 8-10 points lower than their PIQ scores. VIQ scores estimate "what" and "how much" an individual knows, and common interpretations suggest the lag in verbal ability may be due to a lack of educational opportunity, student/teacher conflicts, and/or truancy. Such explanations seem reasonable; however, they do not explore the possibility that verbal deficits may reflect a more basic deficit in information processing.

The textual analysis of verbatim responses via a computerized program (Whissell, 1988) conducted in this study provided a quantitative measure of language ability that allowed an inference to be made regarding the

processing of verbal information. YOs used fewer words, shorter words, and had shorter sentences than did NYOs. Additionally, the conceptual level of their response was significantly lower than that of NYOs. Taken together, it was inferred that YOs conceptual level was reflective of their receptive and expressive verbal ability. Consistent with this inference is the importance of language in the logical analysis, conceptualization, abstraction, and storage of information (Reitan & Wolfson, 1992).

Language also plays an important role in the development of self-awareness. Jaynes (1976) hypothesized that awareness is a relatively recent human acquisition that resulted when the cognitive functions of the two cerebral hemispheres became more specialized. Self-awareness in his view was related to language skills associated with the dominant hemisphere. Consistent with this idea, Quay (1987) suggested that most of the variance in VIQ-PIQ discrepancies in offender populations could be explained by the presence of poor verbal skills, and that these difficulties underlay deficits seen in interpersonal problem-solving and perspective taking skills, as well as person perception and moral reasoning.

There seems to be some agreement that verbal skills are related to social competence (Jaynes, 1976; Quay, 1987) and that many offenders display a tendency towards

being verbally weak (Andrews, Leschied, & Hoge, 1992). In addition, the importance of verbal skills in the development and maintenance of antisocial behaviour can be logically explained within the context of executive functioning. At a primary level, language is required for receptive and expressive communication with the outside world. It is also an essential component in the organization of memory (Lezak, 1983), and as such provides an infinite data bank for storing cognitive, social, and emotional information.

Verbal ability is considered to be an organized fixed functional system that is an integral part of executive functioning. Other such systems include sensory motor functions, visual-spatial ability, attention, memory, and general cognitive abilities (Stuss & Benson, 1986). Although each system has been studied independently, the brain acts as a unit, integrating all of these systems. Therefore executive functions cannot be adequately assessed by narrowing in on just language, memory, or other functional systems separately.

The posterior/basal functional systems described above are considered to be the first level in a hierarchical model of progressively more abstract executive functioning. In parallel with the posterior/basal functional systems, Stuss and Benson

(1986) proposed two anterior counterparts. These are designated as (1) sequence, set, and integration; and (2) drive and motivation.

Sequencing refers to the ability to organize bits of information into meaningful sequences, which is an important feature in the formulation and production of language (Albert, 1972). Two other functional systems that are closely related, and exert greater control than sequencing, are called set and integration.

Set refers to the active process of extracting related data from bits of information and then forming sets of new, more complex information from sequential data. Beyond set formation lies a similar but more complicated function: the ability to extract pieces of information from related and unrelated sets and to integrate this data into novel information or into an understanding of complex situations. Integration is obviously an essential function in the interpretation of social situations.

To summarize, various lower order functional systems (e.g., language, memory, attention, etc.) appear to be dependent on higher order executive functions to organize and maintain pertinent information into fixed sequences, establish related sets of information, and to integrate these data with other information to form new or

meaningful interpretations. Our findings in the main study suggest that some YOs displayed deficits in verbal and spatial/perceptual systems that may have limited the range of executive control exerted on the truncated information obtained from these modalities.

Another important executive function that is consistently disrupted in patients with FLD is drive. Two personality types exhibiting either excessive or reduced drive have been characterized by Blumer and Benson (1975). A patient suffering from excessive drive is described as lacking self-control and displaying socially inappropriate behaviour. Blumer and Benson named this type "Pseudopsychopathic," and suggested that such individuals could be differentiated from psychopaths because they lacked the true personality organization of a psychopath. The other personality type described is that of a "Pseudodepressive," which is marked by apathy. The prevalence of abnormal drive in FLD patients and the diversity of behavioural manifestation suggests drive should be considered as a separate executive function with obvious effects on posterior/basal systems (Stuss & Benson, 1986).

Motivation is closely linked to drive and both are often affected in FLD patients. A distinction between the two functions may be metaphysical; nevertheless,

motivation implies a greater degree of intellectual control, whereas drive represents a more basic energizing force. As with sequence, set, and integration, drive and motivation exert superordinate control on posterior/basal systems. Relatively few quantitative studies estimating drive and motivation in FLD patients have been published, and fewer sound methodologies for quantifying these behavioural traits have been developed (Stuss et al., 1992).

In forensic populations, motivation takes on significance in terms of psychological testing. Since many offenders are not particularly interested in psychological test-taking, controlling for motivation is an important consideration in the interpretation of test results (Ross & Fabiano, 1985). One method of doing so is to examine the level of performance of all tests administered. If YOs are generally unmotivated in test-taking, one would expect a poor performance across all or most of the measures.

Univariate statistics of the main study indicate that YOs scored significantly lower than NYOs on 7 out of 9 tests that were most sensitive to executive functioning, but scored lower on only 2 out of 9 neuropsychological measures of general cerebral functioning (see Tables 7 & 8). Since the YOs' test

scores on measures of general cerebral functioning were generally not statistically significantly different than those scores obtained by NYOs, a deficit in motivation for test-taking is not supported. Otherwise YOs would have performed poorly on all tests in comparison to the control group. In addition, the preponderance of performance tests used in this study are generally preferred by YOs, versus verbal tasks that are heavily loaded on abstract reasoning (Baxter et al., 1995). Considering both the nature of the performance tests used in this study and the varied performance of YOs on measures of executive functioning and general cerebral functioning, it seems unlikely that test-taking motivation was lacking.

In contrast to drive or motivation, the next higher order and apparently independent level of executive functioning is readily measured via neuropsychological testing (Stuss & Benson, 1986). This level of functioning represents the ability to perform everyday, nonroutine, novel behaviours that require adaptive functioning. Behavioural characteristics of this function include goal selection, preplanning (means-end establishment), monitoring, and the use of feedback (if-then statements). Such an executive function is required at the time that a new activity is being learned and active control is

needed; after the activity has been overlearned, the activity can be controlled by other subservient brain areas and executive control is no longer needed (Damasio, 1979). Learning to ride a bicycle provides a good illustration of this function.

The ability to take information from other brain systems and to anticipate, select goals, modify, and act on the information to produce novel responses represents in Stuss and Benson's view (1986) the ultimate mental activity. The culmination of this activity leads to self-awareness. Such awareness allows humans to continually evaluate the position of the self within a social milieu. Although frequently interfunctional, self-awareness and executive functions appear to be separable.

All the aforementioned executive functions, with the exception of drive and motivation, were measured in the main study by using various neuropsychological tests. An inference of social maturity associated with conceptual level was provided by the Conceptual Level by Paragraph Completion Method. Concept formation, abstraction and planning abilities, as well as maintenance of set, and use of feedback to monitor and alter the ongoing behaviour, were measured by the WCST, CSAT, and the Porteus Mazes Q-score. Cognitive flexibility was

measured by the WCST and the Trails B, while verbal fluency was measured by the Newcombe Word Fluency Test and a Textual Analysis of the Conceptual Level by Paragraph Completion Method.

As noted, the results of the pilot and the main study support Ross and Fabiano's (1985) Cognitive Model of Juvenile Delinquency, and the following excerpt cited from Ross and Ross's (1995) most recent book entitled "Thinking Straight," typifies the type of deficits in executive functioning that were measured in our YO samples:

There are of course some basic deficits in information gathering and processing, and in reasoning and communicating which some offenders may evidence which may have prevented them from acquiring an adequate repertoire of cognitive skills. For example, they may be unsystematic in ascertaining the facts and miss important details; they may be imprecise or inaccurate in fact finding; they may gather facts in an unorganized fashion and, therefore, have only a piecemeal, disorganized set of information about the matter at hand; they may fail to define or label the facts they do gather and, therefore, be unable to define

what the situation is or communicate their knowledge to others; they may fail to discriminate between relevant and irrelevant information in observing or analyzing a situation or a problem and, therefore, base their conclusions on only a partial knowledge of the problem; and they may fail to check their conclusions against the facts. They may be unsystematic and imprecise in their approach to understanding their world and may rely on trial-and-error and ineffective cognitive processes. (p. 69)

Ross and Ross's (1995) depiction of some delinquents parallels our findings, suggesting that some YOs have a limited capacity for processing verbal and nonverbal information, and experience difficulties with executive functioning related to sequencing, set and integration, conceptualization and abstraction, goal selection, preplanning, and monitoring and using feedback to check their conclusions. Having drawn parallels between the cognitive deficits outlined by cognitive theorists (Ross & Fabiano, 1985; Ross and Ross, 1995) and the deficits in executive functions measured from our studies, a neuropsychologically evidence-based developmental

hypothesis of criminality is advanced.

Our findings suggest many YOs lack age appropriate social maturity, and that this deficit is the product of lower order deficits in executive functioning abilities. More specifically, as a group YOs scored lower on measures of verbal and spatial/perceptual abilities than did NYOs. Deficits in these fixed functional systems are hypothesized to limit their formulation of well conceived perceptions of social, emotional, and cognitive information. At a higher level of processing, information obtained from verbal and nonverbal sources are subjected to logical analysis, integration, abstraction, and interpretation. Thus a deficit in depth of processing would inevitably result in concrete interpretations of complex social situations. Additionally, inefficient use of feedback from verbal and nonverbal cues would hinder the YOs' ability to monitor and adjust their behaviour according to the demands of the situation. Subsequently, the insensitivity displayed by the youths might increase the opportunity for social conflict to arise. As shall be discussed later, poor social skills elicit social conflict situations, which in turn, contribute to the development of antisocial behaviour.

The suggestion that impoverished verbal abilities

underlie the deficits in interpersonal problem-solving and perspective-taking skills, and person perception and moral reasoning abilities (Quay, 1987) in offender populations is supported by our results, and underscores the importance of language during social interactions. Language allows us to evaluate social situations, set our emotional tone via "self talk" (Meichenbaum, 1977) and verbally mediate our behavioural reaction (Luria, 1966). Heilbrun (1979) suggested that individuals who are deficient in "internal speech" may be more likely to act out feelings of anger and frustration because they are less likely to talk their way out of trouble.

Luria (1966) recognized the importance of verbal mediation in directing behaviour by observing that FLD patients could verbalize their mistakes but could not use verbal mediation to switch their actions to an appropriate response. Using the CSAT, Petrides and Milner (1982) and Petrides (1985) demonstrated that FLD patients were also impaired in the use of nonverbal (spatial) information to regulate ongoing behaviour. They suggested that the right frontal area was dominant for external ordering. This finding was an extension of Luria's (1966) original finding that FLD patients failed to use verbal mediation to alter their behaviour in an adaptive

fashion.

Based on our findings, it is inferred that some YOs do not use spatial cues effectively in monitoring and interpreting the effects of their behaviour during social interactions. In addition, they may not possess an adequate vocabulary to accurately label social situations, extracting only the bits of information that they can verbalize. Given such limitations, the assertion by Ross and Fabiano (1985) that some YOs are prone to acting to the environment rather than thinking about it seems plausible.

Failure to sequence, set, and integrate relevant and irrelevant information, check it with previous knowledge, abstract it into meaningful interpretations, and adjust behaviour accordingly typifies the immature executive functioning (Stuss & Benson, 1986) that may underlie the concrete and rigid thinking styles displayed by some YOs (Ross & Fabiano, 1985). Simply stated, concrete thinking is the product of information that has not been analyzed sufficiently to stimulate abstract thought. Similarly, cognitive rigidity reflects a failure to integrate novel information into new sets of meaningful information.

Conceptual shifting is extremely important in generating alternative interpretations and adaptive

responses to changing environmental demands. Pontius (1972) speculated that 15 - 20 % of juvenile delinquents displayed behaviours marked by the following features: an inability to override an environmentally stimulating situation with a more abstract idea; an inability to plan an alternative course of action; and the failure to change a plan that was no longer feasible with respect to changing environmental demands. A good illustration of this point is the hypothetical situation where a burglar is surprised by the owner of the house. Rather than leave the dwelling and come back later, the offender assaults the owner and resumes his original plan of burglary.

Rigidity can also be problematic during verbal interactions. The offender who cannot follow shifts in conversation may become frustrated, angry, or resentful, which may lead to acts of aggression. Therefore problem-solving via discourse may not be a viable means for the verbally weak offender. Hence an action oriented disposition may be favoured.

The presence of antisocial values, beliefs, and attitudes are amongst the best known predictors of criminality and recidivism (Andrews, Leschied, & Hoge, 1992), and changes in these cognitive sets may be difficult to achieve for various reasons, especially in

the presence of cognitive rigidity. Perhaps the rewards for the cognitive style and the behaviour patterns are too great to encourage change. Alternatively, either the opportunity to develop thinking skills or the motivation to implement such skills may be lacking. Another possibility suggests that cognitive competency may be underdeveloped.

Consideration of developmental lags in cognitive/perceptual abilities has a long history in the study of criminal behaviour, and various explanations have been advanced by psychodynamic, cognitive-behavioural, social learning, and neuropsychological theorists (Bandura, 1973; Chandler, 1973; Gottfredson & Tonry, 1987; Harris, 1989; Pontius, 1972). Each theoretical perspective seemingly characterizes the same phenomena: interpersonal maturity, ego functioning, conceptual level, and self-control are significant factors that contribute to the development of criminality.

Psychodynamic theory suggests the psychologically immature ego and/or superego places an individual at risk for antisocial conduct and generalized difficulties with interpersonal relationships, education/employment, or any endeavour that requires the delay of immediate

gratification for long term gain. A more recent general theory offered by Gottfredson and Tonry (1987) suggests that crime is an expression of weak self-control. Both theories express the same concept, suggesting that disinhibited behaviours are the result of inadequate intrinsic controls. General consensus amongst neuropsychologists suggest that executive functions exert a powerful inhibiting effect on a host of behaviours and disinhibition can result in lewd, impulsive, and socially inappropriate conduct (Damasio, 1979; Stuss & Benson, 1986; Lezak, 1983).

Cognitive development theorists believe that egocentrism impedes the development of role-taking or perspective-taking skills and subsequently places an individual at risk for maladjustment and later delinquency (Chandler, 1973; Harris, 1989; Ross & Fabiano, 1985). Egocentricity, which is related to conceptual level, should diminish as conceptual level increases with age. According to Ross and Fabiano (1985), the egocentricity displayed by some delinquents limits their ability to distinguish between their own thoughts, feelings and views, and those of others, thus limiting the development of empathy.

Conceptual level theory (Harris, 1989) also suggests

that socially immature, concrete thinking youth respond best to a structured learning environment that provides external control, while abstract thinking, socially mature youth are able to respond positively to a less structured environment. These findings are echoed by neuropsychological studies suggesting that individuals who are extremely concrete in their thinking style typically lack self-directing and self-regulating executive functions that are necessary for appropriate, socially responsible and effective self-serving conduct (Lezak, 1983, p.507).

Bandura's (1973) conceptualization of self-efficacy clearly resembles the concept of self-regulation as a product of executive functioning (Stuss & Benson, 1986). In Bandura's view, self-regulation involves bringing one's behaviour in line with one's standard of conduct. Such a process requires setting a standard of conduct, monitoring one's behaviour, comparing the behaviour, and then reinforcing or instructing oneself in order to maintain or change the behaviour according to its efficacy. Bandura has essentially described various executive functions such as goal setting, preplanning, monitoring the behaviour through the use of feedback, and adjusting the behaviour via verbal mediation.

Bandura's notion of standard of conduct is of particular relevance to the study of criminal behaviour, since criminal values, attitudes, beliefs, and association with antisocial companions are amongst the strongest predictors ($r = .48$) of criminality (Andrews, Leschied, & Hoge, 1992). In this context, acceptance of antisocial standards of conduct may not necessitate the acquisition of prosocial skills or self-control. Acquiring such skills may seem like a nuisance to an egocentric, rigid-minded, interpersonally callous individual who is reinforced by his peer group for demonstrating impulsive, rebellious, aggressive, and antisocial behaviours. Although antisocial conduct amongst YOs can be maintained by the encouragement of antisocial companions, the development of such behaviour is likely rooted in pre-existing cognitive deficits and social inadequacies.

Current evidence (Parker & Asher, 1987) suggests that antisocial behaviour arises first in early coercive family dynamics. The children at risk are usually difficult to socialize, and their parents are generally incompetent socializing agents; thus both parties become trapped in an interactive process that reinforces noxious behaviour in each other. Subsequently, these children are

impulsive, mean, aggressive, and unruly in their peer interactions, causing their companions to immediately dislike and avoid them (Dodge, 1983). In time, these failed interactions severely limit the opportunities for constructive socialization with other children. The child's social reputation is tarnished, and various processes occur so that the child's acquaintances are more extreme in their own social inadequacies and antisocial tendencies (Cairns, Cairns, Neckerman, Gest & Gariepy, 1988). Eventually, rejected/aggressive children become affiliated with other children who share the same antisocial sentiments. From this perspective, antisocial behaviour does not begin with associates who are deviant, but rather reflects a common pathway that begins with social failure and being disliked.

Factors that increase the likelihood of a child developing antisocial behaviour can stem from both the parents' and the child's disposition. For instance, poor parental supervision, authoritarian and inconsistent rearing practices, a lack of affection and cohesiveness within the family, parental psychopathology, family violence, and so on, are only a sample of some of the living conditions that high risk children may have experienced in their upbringing (Andrews, Leschied, &

Hoge, 1992). On the other hand, parents of conduct disordered children may have been faced with the challenge of rearing impulsive, aggressive, hyperactive, attention deficit disordered, or learning disabled children (Fishbein, 1990).

One of the primary roles of parents in the socialization process is to shape the child's behavioural and cognitive formation. This process occurs through modelling and contingency based reinforcement or punishment, and generally serves to transmit parental values, attitudes, and beliefs (Bandura, 1973). In this sense, parents exert executive control over their children until they have developed intrinsic control over their own behaviour, or are old enough to establish their own views and standards of conduct.

Although child-parent behavioural interactions are important determinants in the development of antisocial behaviour (Patterson et al., 1991), studies of frontal lobe lesions in children and adults clearly indicate that intact executive functioning is necessary for the development and maintenance of social competence (Benson, 1985; Stuss & Benson, 1986). In this respect, a variety of cognitive deficits in either attention, concentration or memory, as well as developmental delays in verbal and

spatial/perceptual abilities can hinder age appropriate executive functioning, thus contributing to poorly developed social skills.

Attention Deficit Disorder with Hyperactivity (ADHD) is a prevalent condition amongst conduct-disordered children that underscores the detrimental effect that cognitive deficits can have on behavioural, social, and emotional development (Offord et al., 1987). Not surprisingly, neuropsychological studies of ADHD children consistently report deficits in executive functioning (Stuss et al., 1992) amongst these children. A noteworthy estimate generated from the Ontario Child Health Study (Offord et al., 1987) suggests the co-existence of hyperactivity amongst conduct-disordered children in the province of Ontario is as high as 60% in 4-11 year olds, and about 33% in adolescents aged 12-16. These are staggering statistics, suggesting that longstanding difficulties in basic information processing contribute to the development of antisocial behaviour.

Recent evidence indicates that neuropsychological test scores are predictive of persistent male delinquency, especially in the presence of early antisocial conduct (Moffitt, Lynam & Silva, 1994). These investigators followed up a birth cohort of 1,037 New

Zealand children, and used neuropsychological test scores at age 13 to predict delinquent behaviour until the age of 18 years old. Of three predictive factors, the first, measuring verbal, visual-spatial, and memory functions contributed variance to the prediction of delinquency beyond that explained by social disadvantage. The other two factors, motor skills and mental flexibility failed to discriminate delinquents from nondelinquents.

Neuropsychological test scores alone produced mild statistically significant Pearson correlations of future delinquency ($r = .13$ to $.36$), while Hierarchical Regression procedures indicated that prior delinquency and neuropsychological status together explained a greater amount of variance ($r^2 = .41$) of cumulative delinquency records at age 18. Of the original sample, 375 males had significant neuropsychological scores. Of this sample, nine equal-sized groups were divided into thirds by cutting at the thirty-third and sixty-sixth percentile ranks. The 45 boys that constituted the "high" delinquency and "poor" neuropsychological status, self-reported more offenses than the other groups combined by an average of .70 standard deviation. The official criminal records also indicated that this group of boys accounted for 46% of the 251 juvenile offenses on record

and 59% of the 255 convictions in juvenile and adult court. The mean composite neuropsychological z score for this group was 1.27 below average scores for the 375 males.

The results from the main study are consistent with recent findings (Lueger & Gill, 1990; Moffitt et al., 1994) suggesting that cognitive deficits are related to a poor socialization outcome and an increased risk for early, diverse, and persistent antisocial behaviour. In addition, a variety of etiological conditions (Fishbein et al., 1990) can impair executive functioning and ultimately result in social inadequacy, especially in the presence of an impoverished home environment (Andrews, Leschied, & Hoge, 1992; Patterson et al., 1991). Hence, the development of antisocial behaviour seems to be linked to the child's cognitive status and social competence, and the parents' efficacy in minimizing the various risk factors that contribute to the development and maintenance of antisocial behaviour.

During the course of childhood socialization, the acquisition of antisocial values, beliefs, and attitudes appears to be reflected in various cognitive styles described by Ross and Fabiano (1985). These cognitive styles, when redefined as executive functions, are

measurable cognitive deficits by various neuropsychological tests. Despite these positive neuropsychological findings, a major question surrounding the issue of etiology arises. Are these deficits merely reflective of acquired cognitive styles, or do they represent a developmental lag in executive functioning, or permanent Prefrontal Lobe Dysfunction.

To date, current research is not sufficient to answer this debate. Nevertheless, it is clear that neuropsychological tests reveal deficits amongst some YOs, and that the significance of these deficits becomes meaningful in the context of social failure and the development and maintenance of maladaptive antisocial conduct. To address these unknown questions, future studies should include neuropsychological measures of executive functioning as well as concurrent biological measures of brain functioning such as EEG, Magnetic Nuclear Resonance Imaging (MRI) and Positron Emission Topography (PET). In addition, various risk factors associated with the development and maintenance of antisocial behaviour should be monitored. A longitudinal design monitoring subjects throughout childhood, adolescence, and adulthood would be ideal.

As a final point in the discussion, it seems

important to clarify that the intent of this study was not to test causal links of youth crime, but rather to measure cognitive deficits that are associated risk factors in the development of antisocial behaviour. Causal links in this context would be very difficult to establish for several reasons.

First of all, the presence of cognitive deficits is neither a necessary nor sufficient condition to infer causal links. A host of other factors (social, economical, situational, psychological, biological, familial, etc.) are known to be associated with the development of antisocial conduct. Therefore, a variety of conditions may exist which can lead to similar behavioural outcomes, but yet are composed of very different causal links. In such a situation, sweeping generalizations are of limited value, since criminal conduct is specific to interactions amongst situational, individual, and environmental factors.

A second difficulty that arises in determining causality relates to the nature of the topic under study. In this instance the majority of research conducted on YO populations relies on quasi-experimental designs. Hence we have to rely on pre-existing groups of YOs, which do not provide researchers with the luxury of manipulating

experimental variables in order to establish causal links.

A third difficulty that limits this type of research is obviously the practical and ethical considerations associated with conducting this type of research.

Summary and Conclusions

The present study adds some needed information to understanding how neuropsychological deficits are related to the development and maintenance of antisocial behaviour. This study provided a hypothesis of executive functioning which integrated cognitive, developmental, social, and neuropsychological theories into a plausible explanation of delinquency.

Some of the design features of this study improved the confidence of these findings in comparison to previous research by improving on methodological issues such as adequate sample size, using standardized tests that were specific to social competence and executive functioning, conducting multivariate statistics, and assessing the contribution of possibly confounding variables such as substance abuse, IQ, and educational achievement, motivation for test-taking, and determining the relationship between cognitive deficits and the frequency and type of offending behaviours.

The results of this study indicate that some YOs display cognitive deficits in spatial-perceptual and verbal abilities; lack cognitive flexibility; fail to use feedback from spatial information effectively; and demonstrate poor planning, conceptualization, integration

abstraction and critical thinking abilities, which ultimately impede the development and maintenance of self- and social awareness. Subsequently, cognitive deficits and social inadequacies increase the likelihood of developing antisocial conduct. These deficits are more noteworthy amongst Property Offenders, and are associated with poorer socialization outcomes, more frequent and versatile criminal activity, and a stronger dependence on drugs and alcohol.

Theoretical discussions suggest that deficits in executive functioning stemming from a variety of conditions can interact with home environmental factors and result in social inadequacy and increase the risk for future delinquency. Thus antisocial values, beliefs, and attitudes formed during childhood may be reinforced during adolescence and expressed in particular cognitive styles. The composite of individual predispositions, socialization factors, and shaped cognitive and behavioural patterns are reflected in adolescent YOs who demonstrate poor self-control, social immaturity, egocentric thinking, and a more concrete versus conceptual level of thinking.

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Appendix A (General information)

Name: _____

Date of birth: _____

Sex: _____

Ethnic background: _____

Highest grade obtained in school: _____

Current grade attending in school: _____

Level (basic, general, or advanced): _____

Have you ever been diagnosed with the following
conditions:

	yes	No
--	-----	----

psychiatric diagnosis

neurologic condition

learning disability

head injury

Appendix B (Criminal History)

1. Number of offenses
2. Number of incarcerations:
 - a) Closed Custody _____
 - b) Open Custody _____
3. Number of charges or convictions of the following offenses:
 - _____ Shoplifting/Stealing
 - _____ Vandalism/Mischief
 - _____ Break & Enter
 - _____ Assault/Violence
 - _____ Armed Robbery
 - _____ Trespassing/Littering
 - _____ Breach of Probation
 - _____ Sexual Offense/Misconduct
 - _____ Theft (specify amount over or under) _____
 - _____ Possession of Stolen Goods
 - _____ Forgery/Fraud
 - _____ Homicide/Manslaughter
 - _____ Intoxicated in a Public Place/Drinking Under Age

Appendix C (Self-Report Protocol)

Please read carefully the following activities.

Count in your head how many from each list you have done since you were 12 years old.

Place the total number in Box A.

Do not indicate which specific activities you have done and do not write anything else on the questionnaire.

List 1

Have you:

- 1) Used force or threats to obtain sexual acts ?
- 2) Used a weapon (such as a knife, gun, or bat) in order to get money from someone ?
- 3) Used force or threats to get money from someone ?
- 4) Hit another person in a serious effort to hurt him / her ?
- 5) Used any weapon in a fight (like a knife, chain, broken bottle or rock) ?

A. Place the total number on the line _____

List 2

Have you:

- 1) Sold illegal drugs ?
- 2) Used illegal drugs ?
- 3) Smoked cannabis (pot, hashish, oil, etc...) ?

A. Place the number on the line _____

List 3

Have you:

- 1) Purposefully set fire to a building?
- 2) Purposely damaged public property (such as road signs, pay telephones, video machines or vending machines) ?
- 3) Stole something from an open shop or store for over \$ 50.00 ?
- 4) Stole something from an open shop or store for under \$ 50.00 ?
- 5) Broke into a vehicle, house or other building to steal or vandalize the property and contents ?
- 6) Purposely damaged another person's property (vehicle, house, apartment or personal articles) ?

A. Place the total number on the line _____

List 4

Have you:

- 1) Been cruel to animals (so as to injure them) ?
- 2) Driven while under the influence of alcohol ?
- 3) Carried a weapon in case a fight broke out (i.e, knife, bat, gun, or chain) ?
- 4) Pulled a firealarm or called 911 for the fun of it ?
- 5) Taken a vehicle for a drive without permission (borrowing it) ?
- 6) Broke traffic laws (speeding, running stop signs or traffic lights, or driving without a license) ?

A. Place the total on the line _____

Appendix D (Michigan Alcoholism Screening Test)

1. Do you drink more than the average person ?
Yes_____ No_____
2. Have you ever awakened after a night of drinking and found that you could not remember part or all of the evening ?
Yes_____ No_____
3. Does your girlfriend (or parents) ever worry or complain about your drinking practices ?
Yes_____ No_____
4. Do you find it really difficult to stop drinking after 1 or 2 drinks ?
Yes_____ No_____
5. Do you ever feel bad about your drinking ?
Yes_____ No_____
6. Do friends and / or relatives think you are an average drinker ?
Yes_____ No_____
7. Have you attended a meeting of Alcoholics Anonymous (AA) because of your drinking (not including help at the institution) ?
Yes_____ No_____
8. Have you been into fights when drinking ?
Yes_____ No_____
9. Has drinking ever caused problems between you and your parents or girlfriend ?
Yes_____ No_____
10. Has your girlfriend or other family members ever gone for help about your drinking ?
Yes_____ No_____
11. Have you ever lost friends or girlfriends because of your drinking ?
Yes_____ No_____
12. Have you ever been in trouble at work or at school because of drinking?
Yes_____ No_____

13. Have you ever lost a job because of drinking ?
Yes____ No____
14. Have you ever been on a bender for a couple of days, forgetting about anything else ?
Yes____ No____
15. Do you drink before noon ?
Yes____ No____
16. Have you ever been told you have liver or health problems because of your drinking ?
Yes____ No____
17. Have you ever had delirium tremens (DTs), severe shaking, heard voices, or seen things that were not there, after heavy drinking ?
Yes____ No____
18. Have you ever gone to anyone for help for your drinking ?
Yes____ No____
19. Have you ever been to the hospital because of your drinking ?
Yes____ No____
20. Have you ever been in a psychiatric hospital or ward of a general hospital where drinking was a part of the problem ?
Yes____ No____
21. Have you been arrested, and held even for a few hours, because of drunk behaviour ?
Yes____ No____
22. Have you ever been charged with drunk driving ?
Yes____ No____

Appendix E**Drug Abuse Screening Test (Dast)**

1. Have you used drugs other than those required for medical reasons ? Yes_____ No_____
2. Have you abused prescription drugs ? Yes_____ No_____
3. Do you abuse more than one drug at a time ? Yes_____ No_____
4. Can you get through the week without using drugs ? Yes_____ No_____
5. Are you always able to stop using drugs when you want to ? Yes_____ No_____
6. Have you had "blackouts" or "flashbacks" as a result of drug use ? Yes_____ No_____
7. Do you ever feel guilty about your drug use ? Yes_____ No_____
8. Do your girlfriend or parents ever complain about your involvement with drugs ? Yes_____ No_____
9. Has drug abuse created problems between you and your girlfriend and your parents ? Yes_____ No_____
10. Have you lost your friends because of your use of drugs ? Yes_____ No_____
11. Have you neglected your family because of your use of drugs ? Yes_____ No_____
12. Have you been in trouble at work or school because of drug abuse ? Yes_____ No_____
13. Have you lost your job because of drug abuse ? Yes_____ No_____

14. Have you been in fights when under the influence of drugs ?
Yes_____ No_____
15. Have you broken the law to obtain drugs ?
Yes_____ No_____
16. Have you been arrested for possession of illegal drugs?
Yes_____ No_____
17. Have you ever experienced withdrawal symptoms (felt sick) when you stopped taking drugs ?
Yes_____ No_____
18. Have you had medical problems as a result of your drug use (i.e bleeding, memory loss, hepatitis, convulsions, etc.)
Yes_____ No_____
19. Have you gone to anyone for help for your drug problem ?
Yes_____ No_____
20. Have you been involved in a drug program related to drug use ?
Yes_____ No_____

Appendix F**Neuropsychological Signs Associated With
Cognitive Styles Of Young Offenders****CONSENT FORM**

My signature on this consent form indicates my willingness to participate in this research project and further indicates that:

1. I am a volunteer and can withdraw at any time from the study.
2. I have received an explanation about the test material and its purpose.
3. The information I provide will be treated as confidential and maintained securely.

Signature of participant

Date

Signature of guardian

Date

Signature of researcher

Date

Appendix G

Sample Characteristics

Main study:

Young Offender Sample (n = 40 males)

Mean age = 16.95 (2.1)

Mean grade level achieved = 10.20 (1)

Ethnic distribution of subjects:

English (n = 22)

French (n = 12)

Native (n = 6)

Type of offender:

Property (n = 19)

Violent (n = 16)

Sexual (n = 6)

Non Young Offender Sample (n = 40 males)

Mean age = 16.65 (1.5)

Mean grade level achieved = 10.77 (1.1)

Ethnic distribution of subjects:

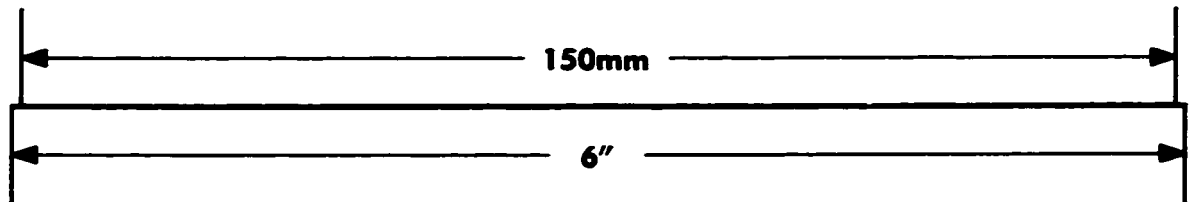
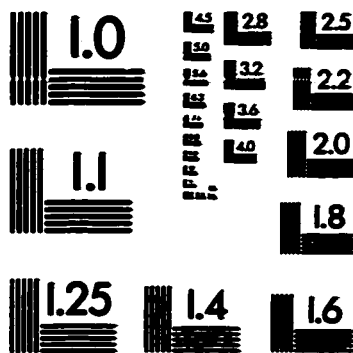
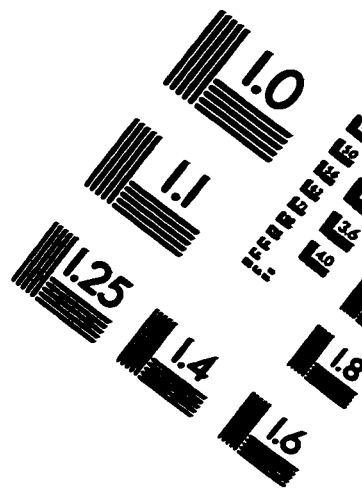
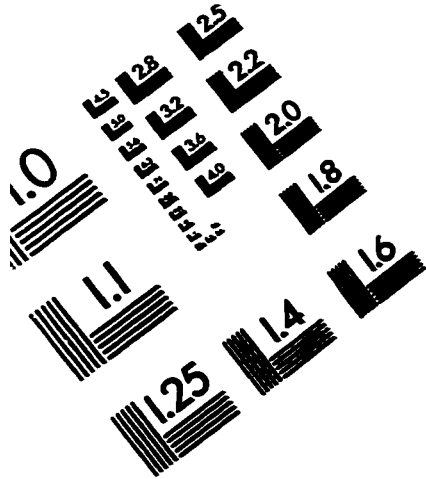
English (n = 26)

French (n = 14)

Appendix B**Procedural Protocol**

All subjects were administered the battery of tests according to the administration procedures described in the method section. Data collection occurred during a 4 month time period. The YO and NYO groups were tested between 9:00 hrs and 15:30 hrs in similar laboratory testing offices. Easier performance tests were administered first, followed by more demanding verbal tasks at the end of the testing session. Average testing time was 2.5 hrs. YOs were recruited after their first plan of care meeting, which occurred after their first month of incarceration. Participants in the study were volunteers, and all subjects were given an explanation of the nature of the study, as well as the opportunity to withdraw at any time. Upon request, subjects were given feedback about their personal results and the findings of the study. Subjects were coded as numbers to ensure confidentiality. The NYO sample was recruited from a local secondary school in Sudbury. During morning announcements students were informed about the planned study and told that parental consent was required if they wanted to participate.

IMAGE EVALUATION TEST TARGET (QA-3)



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