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Executive Functioning in Young Offenders With Fetal Alcohol Spectrum Disorder

by

Kelly A. Ryan

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "Executive Functioning in Young Offenders with Fetal Alcohol Spectrum Disorder" submitted by Kelly Ryan in partial fulfillment of the requirements for the degree of Masters of Sciences.

Lisa Harpur

Supervisor, Dr. Lisa Harpur,
Division of Applied Psychology

John Mueller

Dr. John Mueller,
Division of Applied Psychology

G Labercane

Dr. George Labercane,
Graduate Division of Educational Research

December 18, 2002

Date

ABSTRACT

The present study examined executive functioning in young offenders with and without Fetal Alcohol Spectrum Disorder (FASD). Executive functioning skills of 39 young offenders (17 FASD, 22 non-exposed) were evaluated using the Planning and Attention scales of the Cognitive Assessment System (CAS), (Das and Naglieri, 1991). There was no significant difference between groups for IQ as measured by the WISC III and WAIS III. A multivariate analysis revealed significant group differences between FASD and non-exposed young offenders. T-tests determined executive functioning for the FASD young offenders, as measured by the Planning and Attention scales of the CAS, was significantly lower than the standardized norms. Deficits in executive functioning for the FASD group were not correlated with intelligence and were found in the absence of basic intellectual skill deficits. Scores of Planning and Attention for the non-exposed young offenders were not significantly different from the standardized norms. Questions for further research are discussed as well as suggestions for early intervention.

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER ONE: INTRODUCTION

The purpose of this study was to gain a better understanding of the executive functioning skills of young offenders with prenatal exposure to alcohol, known as Fetal Alcohol Spectrum Disorder (FASD). Performance on tasks of Planning and Attention (Das and Naglieri, 1991) were compared between young offenders with FASD, norms, and a non-exposed young offender sample.

The teratogenic effects of alcohol are currently recognized as the most common identifiable cause of mental retardation (Abel & Sokol, 1987). Although statistics do not yet exist for Alberta, the incidence of Fetal Alcohol Spectrum Disorder (FASD) is estimated at 9.1/1000 births annually in the U.S. (Sampson, Streissguth et.al., 1997). FASD can have varying degrees of consequence on a child's central nervous system including deficits in executive functioning, particularly concept formation, reasoning, and planning (Mattson, Goodman, Caine, Delis & Riley, 1999: Mattson & Riley, 1998; Mattson, Riley, Deelis, Stern & LyonsJones, 1996; Uecker & Nadel, 1998). For example behaviors commonly associated with FASD include impulsivity, poor planning and organization skills and inability to generalize information learned to different situations and settings. Moreover, the incidence of youths with a diagnosis related to prenatal alcohol exposure in the Canadian Justice System is thought to be 10 to 40 times higher than the accepted worldwide incidence (Fast et al., 1999). As a result of this disproportionate representation, the Canadian Federal Government Young Offenders Act recommends a review of resources, specialized program support, and remedial services for those with Fetal Alcohol Spectrum Disorder (Task Force on Youth Justice, 1996).

Research suggests that early identification and intervention is one of the strongest protective factors in decreasing many effects of central nervous system dysfunction and related secondary disabilities (Streissguth et al., 1997). To provide appropriate support and remedial services, it is necessary to understand the effects prenatal alcohol exposure will have on an affected child's cognition and behavior. Therefore, it seems likely that an in-depth understanding of both the normal development and FASD-related deficits of executive functioning are fundamental in learning to ameliorate the impact of these deficits for those diagnosed with FASD.

CHAPTER TWO: LITERATURE REVIEW

Diagnosis of Fetal Alcohol Syndrome

Fetal Alcohol Syndrome (FAS) was first diagnosed as a birth defect in 1973. At that time, prenatal alcohol exposure was presumed to be the cause of observable physical findings of children with mothers identified as chronic alcoholics (Jones & Smith, 1973). Streissguth, Barr, Kogan and Bookstein (1997) suggest the FAS diagnosis involves four primary characteristics: 1) a clear history of prenatal alcohol exposure; 2) dysmorphic features including short palpebral fissures (eye openings), an elongated midface, long and flat philtrum (area between the nose and mouth), thin upper vermilion (lip), flattened maxilla (cheeks), and hypoplasia (flattening) of the nasal bridge; 3) growth retardation for height and/or weight below the 10^{th} percentile of normal growth; and 4) central nervous system (CNS) dysfunction. Over the past three decades research has progressed and now declares the substantial teratogenic effects alcohol can have on a developing fetus. The label of teratogen defines a substance, such as alcohol, that causes significant damage to the developing fetus. In general, physical traits associated with FAS are normally associated with exposure to higher doses of prenatal exposure to alcohol (Streissguth and O'Malley, 2000). However, studies have found that children prenatally exposed to alcohol of various amounts, even small amounts, are also at risk for serious cognitive and behavioral problems even though they did not fit all the diagnostic criteria to warrant an FAS diagnosis (Mattson & Riley, 1997).

There have been many labels for those individuals who have a clear history of prenatal alcohol exposure and CNS dysfunction, but do not exhibit all physical features necessary for an FAS diagnosis. These basic labels include Fetal Alcohol Effect (FAE), Alcohol Related Birth Disorder (ARBD), and Alcohol Related Neurological Disorder (ARND) (Mattson & Riley, 1997). European clinicians refer to mild, moderate, and severe forms of FAS according to degree to which each individual meets the diagnostic criteria for FAS, specifically the criteria of physical and facial features (Streissguth and O'Malley, 2000). The implication that these individuals have a less severe diagnosis, therefore diminished disabilities, is misleading.

Earlier studies focused on the full diagnostic criteria of FAS and addressed the structure of the diagnosis rather than the function of the disabilities. As a result, early research did not target the majority of those who were affected. Thus, those identified with a "less severe" disability (i.e., absence of physical anomalies) were subsequently not identified for intervention. Therefore, identification of these individuals is the focus of much future research to define the effects of prenatal alcohol exposure for those who do not meet full FAS diagnostic criteria (Mattson & Riley, 1997). Recent studies (Streissguth, Barr, Bookstein, Sampson and Carmichael-Olsen, 1999) refer to this population as PEA, prenatal exposure to alcohol, as a result of their confirmed exposure to alcohol prenatally but lack of full diagnostic criteria for a FAS diagnosis. The FASD term, put forth by Streissguth and O'Malley (2000), is inclusive of the differing degrees of physical, cognitive, and behavioral deficits caused by various degrees of prenatal alcohol exposure. For ease of reading, the term FASD will be adopted for this paper. Current research interest now focuses on the CNS dysfunction of FASD individuals.

Streissguth and O'Malley (2000) argue that researchers have devoted too much energy examining structure when they should be trying to understand functional deficits in those with prenatal alcohol exposure. It is the dysfunction of the brain-based behavior and all related secondary disabilities of prenatal alcohol exposure that are the greatest challenges for the affected child. Research has suggested that these disabilities are of equal severity in the absence of characteristic physical features. In fact, Magnetic Resonance Imaging demonstrates that children with prenatal exposure to alcohol show a decrease in brain volume, with or without the characteristic facial features (Mattson, Riley, Jernegan, Garcia, Kaneko, Ehlers, & Jones, 1994). Furthermore, as children with FAS get older, the characteristic facial features are attenuated, making diagnosis of "pure FAS" even more difficult.

CNS dysfunction can have varying degrees of severity as there is no one neuropsychological profile for the individual with FASD (Carmichael-Olson et al., 1998). However, there are many common cognitive and behavioral deficits reported in the current literature. CNS dysfunction can have multifarious effects on an individual's level of general cognitive ability, resulting in a wide range of intelligence as measured by standardized intelligence tests (Kerns et al., 1997; Streissguth et al., 1994). However, studies that focus on the comparison of neuropsychological deficits of the FASD individuals compared to controls of a similar range of IQ scores (Carmichael-Olson et al., 1998) indicate many FASD specific deficits that are not fully explained by general lowering of IQ. In addition to lowered IQ, CNS dysfunction will often include areas of achievement (Kearns et al., 1997, Goldschmidt et al., 1996, Streissguth et al., 1990), attention (Coles et al., 1997, Streissguth et al., 1994), executive functioning (Mattson et al., 1999; Sampson et al., 1997), memory (Uecker et al., 1998; Mattson et al., 1996; Streissguth et al., 1994; Becker et al., 1990), visuospatial abilities (Mattson & Riley, 1997; Streissguth et al.,1994), behavior (Kodituwakku et al., 1995; Mattson et al., 2000;

Thomas et al., 1998; Steinhausen et al., 1998), and language (Mattson & Riley, 1997; Korkman et al., 1998; Carney & Chermak, 1991). All deficits can be assessed according to standardized measures selected for their sensitivity to the types of deficits frequently observed in individuals with FASD. For the purposes of this paper, the author will examine the effects FASD may have on a child's executive functioning skills.

Executive Functioning

Each day we form intentions and make appropriate decisions regarding how to act on those intentions at the appropriate time. Our cognitive functions ask "What" or "How much" a person knows, whereas it is our executive functions that ask "If" or "How" a person will go about a task (Lezak, 1983). Executive functioning is a term used to describe several higher order cognitive processes, which includes cognitive planning, initiation, cognitive flexibility, decision making, judgment, feedback utilization, self-perception, and working memory.

Lezak (1995) defines executive functioning through four particular domains: volition, planning, purposive action, and effective performance. Integration of all domains is necessary for socially responsible, self-serving behavior. Furthermore, defective executive behavior will not isolate one particular domain. Rather, all aspects of executive functioning will be affected, likely with a deficiency of one or two domains being more prominent. Each domain of executive functioning plays an equally vital role in enabling us to act intentionally, live independently, and work productively in normal social relationships.

To initiate executive functioning, one must have the capacity and motivation to form a goal or intention, which Lezak (1995) refers to as volition. A person with even a slight impairment in this ability can attempt usual chores, routine games, and familiar hobbies without prompting, but will be unable to appreciate abstract goals or long-term responsibility. Following this, one must have the ability to identify the steps needed to carry out intentions or achieve goals, which is the planning stage of executive functioning. To plan, a person must have the foresight to abstractly view the environment and conceptualize change from the present, conceive alternatives, and make realistic intentions. A purposive action is the effective translation of the intention into a self-serving behavior by a deliberate action. One must have the ability to initiate, maintain, switch, and stop sequences of behavior. Finally, one must have the ability to evaluate his or her final performance, including perception and evaluation of mistakes. It is because of our executive functioning skills that we are capable of acting intentionally in light of the situations in our world. However, when our executive functioning skills are impaired, our behavior will be adversely affected.

Impairments of executive functioning tend to exhibit themselves in global aspects of behavior including a defective capacity for self-control, emotional lability or excitability, difficulty shifting attention, or deterioration in personal grooming (Lezak, 1983). Moreover, more subtle behaviors including decreased capacity for pleasure, motivation, planned, or intentional activity, and defects in carrying out an activity sequence to achieve a goal-directed behavior are a result of executive function impairment. Cognitive loss alone does not necessarily affect independence, productivity, or self-serving behavior. However, when executive functioning is impaired, a person may not be capable of self-care, independent productive work, or normal social relationships (Lezak, 1983; Streissguth et al., 1997). Kolb and Wishaw (1995) stress that an individual can have impaired executive functioning without any impairment or change in general intellectual status.

Deficits in higher levels of cognitive activity will likely result in a deterioration of behavior. Lack of judgment about abstract issues or complex social problems will be compounded by diminished self-control. Such impairments of behavior and personality are often a result of frontal lobe damage (Lezak, 1983). It is the frontal lobe where pathways meet, connecting information from the external environment to information about internal states. Recently, FASD research has connected frontal lobe damage, specifically the basal ganglia, to prenatal alcohol exposure (Mattson & Riley, 1997; Mattson et al., 1994).

Executive Functioning and FASD

Anomalies of the basal ganglia are commonly associated with deficits in motor behavior prevalent in such diseases as Parkinson's disease (Pinel, 1993). However, deficits can also be seen in short-term memory, concept formation, and mental flexibility (Lezak, 1983). Although the specific teratogenic effect alcohol has on the basal ganglia is unclear, studies have documented a decreased volume of the basal ganglia following prenatal alcohol exposure (Mattson et al., 1994).

Mattson and colleagues (1994) found overall brain size and volume of the basal ganglia to be most severely affected by gestational alcohol exposure. Moreover, these differences were found to be present even in the absence of a full FAS diagnosis. They concluded that, if the study results are indicative of the larger FASD population, the behavioral patterns common to FASD may be related to basal ganglia dysfunction. Therefore, it seems likely that FASD will adversely affect executive functioning.

When assessing reasoning ability of FAS, PAE, and control groups, Mattson and colleagues (1999) found that both the FAS and PAE groups differed from the control group but not from each other. Moreover, these differences were not entirely explainable by deficits in basic intelligence. In their study, 28 subjects between the ages of eight and fifteen years were evaluated and categorized as Fetal Alcohol Syndrome (FAS, n=10), Prenatal Alcohol Exposure (PAE, n=8), or Non-exposed controls (NC, n=10). The mean FSIQ scores were 85.6, 83.4, and 116 for each group respectively. The California Word Context Test was used to measure the verbal domain of reasoning and concept formation. This test consists of a practice trial and ten items, each item consisting of five sentences, each with a nonsense word given in place of a target word. The subject must analyze clues given by the context, meaning, and structure of the sentence to identify the target word. The dependent variable of the study was the number of clues given to guess the nonsense word while the subject's errors were also analyzed.

The results of the study (Mattson et al., 1999) suggested the alcohol-exposed students displayed impairments in abstract thought as the FAS and PAE groups required more sentences and made more errors. Furthermore, there was no correlation between reasoning ability and IQ for these two groups. However, there are other possible correlating factors. The required tasks are heavily influenced by previously acquired knowledge and verbal ability, skills that recently were found to be affected in this population in both receptive and expressive measures (Mattson & Riley, 1998). In addition, when IQ scores of the NC group were included, there was a significant correlation between scores of the California Word Context Test and IQ. Thus, further investigation of reasoning ability and FASD is warranted. The assessment of reasoning ability was part of a larger research project evaluating the four domains of executive functioning including planning ability, response inhibition, and cognitive flexibility.

The Tower of California Test was used to measure planning ability in the FAS, PAE, and control groups (Mattson et al., 1999). The test apparatus consists of five disks of increasing size that differ in shade and a horizontal wooden board with three vertical pegs. The subject must move the disk from the starting point on the pegs to match a target arrangement while adhering to two rules: 1) Only one disk must be moved at a time using one hand, and 2) A larger disk may never be placed on top of a smaller disk. Items are discontinued according to time limits, and the dependent variables for the study were number of items passed and number of rule violations. Results indicated that both alcohol-exposed groups differed from controls but not from each other. Such results suggest that prenatal alcohol exposure alone, not the facial and physical characteristics necessary for a diagnosis, is related to executive functioning impairments. Moreover, the dependent variables are consistent with real-life difficulties of planning, understanding consequences, and response inhibition.

The California Stroop Test further assesses response inhibition (Mattson et al., 1999). The four conditions of the Stroop Test include 1) color patch naming (red, blue, green), 2) word reading (the words red, blue, green printed in black ink, 3) inference (naming the ink color in which the color word is printed, e.g., the word red printed in blue ink, and 4) set-shifting (read the word or the color depending on specific conditions, e.g., printed in a box, not printed in a box). Errors and set-losses were both analyzed but time to complete was the main dependent variable.

Again, both groups differed from controls but not from each other in most conditions (Mattson et al., 1999). This suggests that prenatal alcohol exposure is related to deficits in response inhibition that occurs over and above the deficits in component skills. However, for set-shifting there was only a significant difference between the FAS group and the control group; the PAE group did not differ from either group on this measure. Similar patterns were found on the California Trail Making Test when used to measure cognitive flexibility.

The California Trail Making Test measures cognitive flexibility (Mattson et al., 1999). It consists of visual scanning (cancel all occurrences of the Number 3 on two pages of randomly placed numbers), number sequencing (connect numbers in ascending order), letter sequencing (connect letters in alphabetical order), and number-letter sequencing (connect numbers and letters in order switching between number and letter). The dependent variable for this test is time.

Again, the PAE group showed more difficulty than controls on most categories suggesting further evidence that executive functioning is impaired in both PAE and FAS (Mattson et al., 1999). Similar to the California Stroop Test though, the California Trail Making Test did show differences between the PAE and FAS group for one category; namely number-letter switching. However, the lack of differences between the FAS and PAE groups makes the relative importance of these findings unclear. One possibility may be that the combination of alternating and remembering may be more difficult for the FAS group.

Overall, the study provides significant evidence of the deficits in executive functioning with prenatal alcohol exposure, not entirely explainable by deficits in basic intelligence or skills including reading or motor speed (Mattson et al., 1999). As subjects were matched for IQ, the deficits in executive functioning were seen in the absence of mental retardation with or without the diagnosis of FAS. Furthermore, these results are consistent with real-life and further empirical reports of deficits in behavioral control such as illogical thinking with little understanding of cause and effect, difficulties predicting consequences of their behaviors which may result in poor judgment, and difficulties planning, making the necessary connections and completing long-term, ongoing projects (Mattson & Riley, 1998; Kodtuwakku et al., 1995).

Kodtuwakku et al. (1995) hypothesized that actions of the person with FASD are more likely triggered by preceding actions and perceptual cues in the environment resulting in perseverations and distractibility, respectively. Moreover, this behavior is likely impaired as a result of a difficulty in manipulating information in working memory. The study compared ten FASD subjects (8 FAS, 2 FAE) and ten non-exposed controls on a battery of tests including the Wisconsin Card Sorting Test, a test used to measure ability to utilize feedback to modify behavior. The Wisconsin Card Sorting Test (WCST) (Heaton et al., 1993) is sensitive to prefrontal dysfunction as it requires an ability to develop and maintain an appropriate problem-solving strategy throughout changing stimulus conditions to achieve a future goal. Like other assessment tools of executive functioning, the WCST requires strategic planning, modulating impulsive responding, organized searching, and directing behavior toward achieving a goal. However, unlike other tools, the WCST also analyzes specific sources of difficulty on the task including perseveration, inefficient learning across stages of the test, failure to maintain cognitive set, and inefficient initial conceptualization.

In comparison to the control group, the FASD group made more perseveratory errors on the WCST, in turn not completing as many trials (Kodtuwakku et al., 1995). Such results suggest FASD subjects demonstrate difficulty in shifting response sets, utilizing feedback, and modifying behavior. The researchers proposed that dysfunctions in the ability to manage goals, hold and manipulate information in working memory are the underlying mechanisms for a range of deficits of higher order cognitive and executive difficulties. However, the generalization of the study is limited because of the small sample size and the lack of available history for some subjects.

The WCST was also used to measure the ability to abstract information and shift attentional set in a study by Carmichael-Olsen et al., (1998). Scores of nine FAS diagnosed subjects were compared to scores of a group of IQ matched controls. In support of results found by Kodituwakku et al., (1995) the study found the FAS group performed more poorly than IQ matched controls. In addition to the large percentage of errors seen in the FAS group, the subjects appeared to work a very long time to achieve criterion and showed disorganization and perseveration in their responses. Therefore, it seems likely that the FAS subjects demonstrated ineffective reasoning abilities and inefficient learning strategies. Accuracy and speed are daily living skills that have also been researched within the FASD population.

A speed-accuracy trade off was found on the spatial-visual reasoning task (Sampson et al., 1997). Many daily activities value both speed and accuracy. However, speed is not considered to be efficient when it comes at the expense of errors, property damage, injury or bad decisions. In addition, Sampson et al., (1997) suggest those people who spend the “right” amount of time on certain daily activities are often most efficient.

Sampson et al. (1997) have measured the speed/accuracy trade off using the Nissen Sequence Learning Task (SLT) (declarative and procedural learning), the Spatial-Visual Reasoning Task (SVRT) (tracking of different objects simultaneously), and the Rapid Single Visual Presentation (RSVP) (reading speed, comprehension, and memory). The study presents a 14-year follow-up of 462 adolescents exposed to a broad range of maternal drinking patterns before birth including heavy drinkers, infrequent drinkers, and abstainers who are currently involved in a longitudinal study.

Sampson et al. (1997) found significant effects for a speed-accuracy trade off on spatial-visual reasoning tasks for those affected by maternal drinking. Their results revealed that higher alcohol exposure was associated with less time studying and fewer correct responses. Higher alcohol exposure was also associated with spending less time on the last word of a sentence. The results of this study supported the hypothesis of an interaction between processing time and accuracy, a deficit which has implications for many daily activities including mathematical computation, reading, and occupational tasks such as dishwashing, delivering a pizza, or painting woodwork. Therefore, it seems likely that, in addition to impairment in verbal reasoning, non-verbal reasoning measured by the speed-accuracy trade off will signal greater difficulties in successful daily functioning. Cognitive estimation is a another measure of reasoning skills shown to be affected by PEA.

A number processing battery, including a cognitive estimation task, was used by Kopera-Frye et al. (1996) to measure number processing and abstraction. The test battery consisted of 11 pencil and paper number processing tasks including number reading, writing, comparison, approximation, and cognitive estimation. For the cognitive-estimation task, the subjects were asked to answer 30 questions giving a reasonable estimation of unknown quantities (i.e., "What is the length of a dollar bill?"). Subjects with frontal-lobe lesions will likely produce widely unrealistic answers suggesting impairments in planning an adequate answer-finding strategy, verifying a given answer, or both. In addition, subjects affected by prenatal exposure to alcohol will likely have increased difficulty as a result of difficulty understanding numerical quantities. The study results suggested the cognitive-estimation task was the best distinction between the FAS/E subjects and the normal control group. Of the FAS/E subjects, 48 percent gave impaired responses on the cognitive-estimation task, of which six subjects demonstrated problems exclusively with that task. The results suggest that, although the degree and pattern of impairment is clearly variable among FAS/E subjects, it appears as though there is a particular difficulty with cognitive estimation.

In summary, the converging evidence indicates definite impairments in executive functioning among those prenatally exposed to alcohol. The research demonstrates the child with executive functioning impairments will exhibit difficulty, or perhaps inability, in executing deliberate actions including planning ability, response inhibition and concept formation (Mattson et al, 1999). In addition, Kodtuwakku and colleagues (1995) demonstrated that actions of the exposed group will likely be triggered by preceding actions and perceptual cues in the environment, rather than deliberate, planned behaviors. In fact, these deficient skills are found to be associated with behavioral problems of alcohol exposed children (Streissguth et al., 1998). In light of this information, it seems necessary to evaluate the outcome of executive function impairment as it relates to behavior and delinquency.

FASD and Deficits in Executive Functioning in Relation to Delinquency

When children with FASD are rated using instruments such as the Child Behavior Checklist (CBCL), they are typically described as having behavior and emotional problems (Mattson & Riley, 2000). PAE children matched for Verbal Intelligence Quotient (VIQ) and Socioeconomic Status (SES) with non-exposed controls, were rated as being more often in the clinically significant range in externalizing behaviors including social problems, attention problems, and aggressive behavior than the non-exposed control group. In addition, Thomas et al. (1998) found FAS subjects were impaired on interpersonal relationship skills when parents and caregivers used the Vineland Adaptive Behavior Scale (VABS).

Mattson and Riley's (2000) 45 subjects matched for VIQ, age, and SES were assessed using the VABS. The study found that the FAS subjects did poorly on interpersonal items indicating difficulty following simple rules and interaction with others. Furthermore, these problems were noted to be more pronounced over time. The results suggest that a possible deficit in a cognitive ability critical to the development of social skills underlies the subject's social skills deficit. Although it is important to note that the stability of home life and other postnatal factors are possible confounding variables when assessing behavior, it seems likely that a deficit in executive functioning skills including abstract reasoning, planning, and evaluating can have a profoundly negative affect on the development of appropriate social skills. Those prenatally exposed to alcohol often lack social skills although they demonstrate a high need for interaction with others (La Due & Dunne, 1997). This often presents difficulty for those alcohol affected children in distinguishing between strangers and friends, and a further difficulty structuring their own lives and behaviors.

Brier (1989) described how social perception difficulties in interaction with inattentive, impulsive, and aggressive behavior are key elements for a high-risk profile. Brier theorized that deficits in conceptualization, comprehension, and judgment contribute to the possibility that an individual with learning disabilities will become delinquent. The deficits and behavioral difficulties related to executive functioning suggest those with FASD are surely at an increased risk of involvement with the justice system.

The percentage of youths with an FASD diagnosis in the Canadian justice system in British Columbia is estimated to be 23.3 percent (Fast et al., 1999). As previously noted, this number is 10 to 40 times the accepted worldwide incidence. Such numbers clearly indicate that this group is disproportionately represented in the justice system. Earlier studies have recognized the increased risk of youth with Attention Deficit Hyperactivity Disorder and Learning Disabilities becoming involved with the justice system (Brier, 1989). Furthermore, current prevalence rates clearly signal the increased risk of involvement with the justice system for those with FASD (Fast et al., 1999). As a result of the nature of FASD related disabilities and the disproportionate representation in the incarcerated population, considerations for the identification and special needs of these individuals must be considered.

In 1984, the Juvenile Delinquent Act (JDA) was replaced with the Young Offenders Act (YOA) in Canada. The YOA was to focus on the protection of rights of youth as well as crime deterrence through punishment (Leschied, 1988). This trend also presented a de-emphasis on treatment and rehabilitation in the justice system in favor of crime deterrence and as such, treatment is to be considered an option rather than a mandate. The implementation of the YOA was seen to have the greatest impact on the special needs population (Lescheid, 1988). Lescheid reports that many special needs youth were declining treatment under the YOA, and in turn the special-needs population showed higher recidivism with the YOA than with the JDA. Moreover, the special needs population showed higher recidivism rates than the non-special needs population under the YOA. Therefore, it seems likely that the special needs population requires a greater balance of rehabilitation and punishment in order to facilitate effective reintegration with society. "Interventions which ignore causes or motives of behavior are less able to show positive benefits." (Leschied, 1988, p. 327).

A review of the Young Offenders Act (1996) addressed the need for special attention to the FASD population among young offenders. The FASD population presents several challenges to the youth justice system including the need for on going program support and intervention, interagency coordination, and multidimensional service planning. The report recognized the possible counter-productive nature of the general resources of the justice system for those with FASD. Moreover, it acknowledged that the effectiveness of the program for this special needs population is, at this time, unknown. The report recommended further studies of prevalence among the young offender population, review of resources to diagnose FASD, and specialized program support and remedial services for those with FASD.

The previous research suggests the behavioral implications and subsequent involvement with the justice system for those with FASD. This involvement is likely a result of deficits in executive functioning skills. Therefore it seems likely that any specialized programming for FASD should attempt to target executive functioning skills. However, in order to implement 'specialized' program support and remedial services for those with FASD, we must understand the young offender population. Specifically, we should evaluate the executive functioning skills of the young offender population.

Executive Functioning and Young Offenders

Patterns of neuropsychological deficits similar to the FASD population have been noted among the general young offender population. Moffitt (1993) evaluated the collective research of executive functioning in young offenders. Despite the diversity of the studies, Moffitt reported that the research consistently found a deficit in both verbal and executive functions. Specifically, incarcerated delinquents demonstrated significant deficits in cognitive flexibility (as measured by Trails and Porteus Mazes) and selective attention (as measured by the Stroop test) when compared to the standardized norms. Furthermore, Moffitt commented on the similarities of behavior between the young offenders and those with frontal lobe damage.

When evaluating the behaviors of young offenders, it is important to acknowledge any specific cognitive differences and possible neurological impairments. For example, Chretien et al., (2000) found that, although intelligence did not differ between 36 incarcerated youths and 19 age-matched non-incarcerated youths, the incarcerated group did display more impulsivity, lower conceptual level, less conceptual flexibility, and poorer critical-thinking skills. Chretien found that young offenders display deficits for tasks of self-monitoring functions of the prefrontal cortices. Tests of critical thinking, conceptual level, and conditioned spatial association demonstrated group differences of

89 percent when all three tasks were combined and controlled for educational deficits and intelligence. In support of Chretien's findings, studies suggest that young offenders, as well as children with serious emotional disturbances, are likely to have executive functioning deficits as measured by the Planning and Attention subtests of the Cognitive Assessment System (Naglieri and Das, 1997; Enns,1998).

Naglieri and Das (1997) sampled 17 children (10 males and 7 females) ranging in age from 8 to 17 years (average age 12 years, 5 months), all with serious emotional disturbances. Overall the mean Full Scale score was measured to be close to one standard deviation below the normative population (86.1). Moreover, the Planning and Attention subtests were reported to be the lowest means, more than one standard deviation below the norm for the subtest of Attention (83.6). The Simultaneous and Successive subtests were reported to be the highest means, the mean score for Successive processing being close to the norm at 97.2. These results are supported by Enns (1998) research with the young offender population.

Enns (1998) suggested that delinquent adolescents can be differentiated from non-delinquent adolescents on the basis of overall functioning, executive process, and verbal skills. The Wechsler Intelligence Scale for Children III (WISC III) and the CAS were administered to 14 adolescent males admitted for psychiatric assessment or treatment under the Young Offenders Act. The subjects had committed a variety of offences including break and enter, assault, threats, and failure to comply. The delinquent adolescents were found on the WISC III Full Scale scores to be one-half standard deviation below the standardized norms as well as significantly lower Verbal than Performance scores. These results are consistent with previous findings (Moffit, 1993), which represent one of the neuropsychological differences between young offenders and the normal population. It should be noted that differences in school attendance and academic achievement, which were not controlled for, are possible reasons why there was a discrepancy between delinquent and non-delinquent adolescents.

Enns also found scores of the offender population to be significantly lower than the normal population using the CAS Full Scale score. Means of the sample population for scaled scores measuring Planning and Attention were also significantly lower than the population norms. Enns states that lower scores of the CAS Full Scale, particularly the Planning and Attention subtests, are more likely to represent the actual differences in the neuropsychological patterns of the delinquent population than scores of the WISC III due to what he perceives the heavy influence of school attendance and academic achievement on the WISC III. Therefore, the study supports the previous findings that the delinquent population can be distinguished from the non-delinquent population on the basis of executive deficits related to planning and attention.

The evidence suggests that both incarcerated populations and those with serious emotional disturbances will show deficits in executive functioning, likely independent of school attendance and academic achievement. Although there is some disagreement about overall intelligence between the delinquent and non-delinquent population, it is highly unlikely that executive functioning skills would be affected by intelligence scores only one standard deviation below the normal population (Kolb and Wishaw, 1995).

<u>The Cognitive Assessment System</u>

Common tests of intelligence are found to correlate well with achievement. However, Naglieri (1997) suggests a limitation of traditional intelligence tests (i.e., WISC-III, K-ABC) is their lack of theoretical definition. As a result, researchers have attempted to develop a new theory and assessment tool to accurately and effectively measure a person's cognitive abilities (e.g. Naglieri and Das, 1990). Das and Naglieri attempt to explain human cognitive abilities through a synthesis of neuropsychology, cognitive psychology, and psychometrics (Naglieri, 1997). They have subsequently developed a theory of cognitive processing, the PASS model, on which they have based the Cognitive Assessment System (CAS).

PASS Theory

A key factor in developing the PASS theory of cognitive ability is Luria's concept of intelligent functioning, which is a necessary integration of the social environment and physical structures of the individual (Naglieri and Das, 1990). According to Luria (1973, as cited Naglieri and Das, 1990), the cognitive activity of the brain can be divided into three functional units. The first functional unit, associated with the upper brain and limbic system, is responsible for vigilance and discrimination among stimuli (attention), whereas the second functional unit is associated with the posterior parts of the brain and is responsible for the analysis of information (simultaneous and successive processing). Finally the third functional unit, associated with the anterior parts of the brain, is responsible for the development of programs, regulating and controlling actions, and regulation of vigilance and attention to make that behavior consistent (planning). Described as a "function," each system is understood as separate in its contribution to the cognitive activity but works in connection with the other systems; that is, human behavior requires coordination of all three functional units, each playing its own clearly defined role.

Similarly, Das and Naglieri's PASS theory involves the coordination (although separate function) of four cognitive processes, Planning, Attention, Simultaneous and Successive Processing (PASS). The PASS theory suggests these four processes form an integrated system that interacts with an individual's base knowledge and skills to result in human cognitive functioning (Naglieri and Das, 1997). Subsequently, Naglieri and Das (1997) define intelligence as consisting of three component parts. "First is attentional processes that provide focused cognitive activity; second is information processes of two types (simultaneous and successive); and third is planning processes that provide (a) the control of attention, (b) use of information processes, internal and external knowledge, and cognitive tools, and (c) self-regulation to achieve desired goals" (Naglieri, 1997, pp. 249). The following is information on the CAS subtests as defined by Naglieri and Das (1997).

Planning

The Planning processes of the PASS theory provide the individual with the means to efficiently understand how to solve a problem. The individual will solve a problem by developing a plan of action, evaluating its effectiveness, applying impulse control and regulating voluntary actions. The individual will search his or her knowledge base for an effective solution; if one is not available, a new plan will be devised. The planning process applies to both simple and complex tasks and will also include attentional, simultaneous, and successive processes.

Attention

The Attention process allows the individual to efficiently and selectively focus, attend to, and respond to a particular stimulus while inhibiting a response to a competing stimulus. Inhibition of a response becomes increasingly difficult as non-target stimuli become more salient than target stimuli. Therefore, attention not only refers to the directed activity, but also the resistance of the non-directed activity.

Simultaneous

Simultaneous processing requires the integration of the stimuli into a coherent whole. As such, each aspect of the stimulus must be interrelated with every other aspect. Simultaneous processing can involve both spatial and grammatical components and therefore, involve the integration of visual images to a whole or the integration of words into ideas to obtain meaning. As a result, these processes are subject to inspection through activity or memory.

Successive

Successive processing involves integration of stimuli in a serial manner or a chain like progression. The elements of successive processing are linearly related and therefore related only to the one that follows. Skilled movement, narrative speech, and articulation of sounds require processing in a consecutive series.

Planning Subtests

Naglieri and Das (1997) suggest, “planning is a mental process by which the individual determines, selects, applies, and evaluates solutions to problems” (p. 2). Any situation requiring intentionality and a need to solve a problem will also require self-monitoring, impulse control, and plan generation. The student must create a plan, apply that plan to the presenting problem, verify that the plan will efficiently solve the problem, and finally modify the plan if it is not recognized to be successful. The Planning subtests

(Matching numbers [MN], Planned Codes [PCd], and Planned Connections [PCn]) measure how the child meets the relatively easy demands of the task.

Matching numbers was used in the CAS as a result of the subject's need to efficiently determine the matching numbers from the group of numbers (Naglieri and Das, 1988; Naglieri, Prewett, & Bardos, 1989). Naglieri and Das (1988) administered a group intelligence test (Matrix Analogies Test- Short Form), which included the Matching Numbers Planning subtest. The results demonstrated that the first factor could be labeled Planning as a result of consistently high loadings from the subtests of Matching Numbers, Trails Visual Search, and Trails. The varimax solution gives further evidence to the successful labeling of the Matching Numbers, Trails, and Visual Search as Planning. Naglieri, Prewett and Bardos (1989) produced similar results from their study, which also included Planned Codes as a Planning subtest.

Planned Codes has been used as a measure of planning in early army mental tests (Naglieri and Das, 1997). Thus, Naglieri, Prewett and Bardos (1989) chose to demonstrate the fit of Planned Codes within the Planning subtests. Naglieri et al. (1989) individually administered nine tasks including the Planned Codes subtest in group form. Naglieri and his colleagues (1989) argued that planning efficiency requires a greater cognitive effort than a simple timed task including a speed word-reading task. For example, the Selective-Attention task was identified as speed whereas the analysis of the Planned Codes identified both speed and cognitive effort. The results of the study (Naglieri, Prewett and Bardos, 1989) identified Planned Codes as an appropriate measure of planning ability. Naglieri et al. (1989) also included Planned Connections as a measure of planning ability.

Planned Connections has also been used as a measure of planning in early army mental tests (Naglieri et al., 1989; Naglieri and Das, 1997). The Trails subtest was found in both Naglieri et al. (1989) and Naglieri and Das (1988) to be identified as Planning. Furthermore, the Trails test is commonly used as a measure of executive functioning in neuropsychological assessment (Lezak, 1995). Lezak suggests the factor analysis of these subtests gives direct support for their use as measures of planning ability. Moreover, Lezak offers further evidence of their validity by demonstrating the increase in these scores from Grade 2 to Grade 10, suggesting a development of planning ability.

Attention Subtests

Naglieri and Das (1997) define attention as "a mental process by which the individual selectively focuses on particular stimuli while inhibiting responses to competing stimuli presented over time" (p. 3). They propose that a person must demonstrate selected and sustained attention to successfully complete the tasks of the Attention subtests. Selected attention requires the subject to give direct concentration to a stimulus while inhibiting responses to other non-target stimuli. Furthermore, they stress attention must be sustained; such that, the subject's performance will vary over time according to the variation of effort required to successfully complete the task. The CAS Attention subtests include Expressive Attention (EA), Number Detection (ND), and Receptive Attention (RA).

The Expressive Attention subtest measures selectivity and the ability to shift attention. Both selectivity and the ability to shift attention are measured by the Expressive Attention subtest. This developmental measure of attention is similar to the Stroop test used in other studies of executive functioning [e.g., Mattson et al. (1999), Das (1970)].

Results from these studies suggest the task is sensitive to attending to selected stimuli while ignoring interference and set shifting. Items are administered first without interference. The subtest then establishes interference to measure the child's ability to ignore the habitual feature while attending to the non-familiar feature. Finally, the last item of the subtest requires the child to suppress an automatic way of responding in order to respond in a correct manner. The conflict occurs at the moment of expression and is therefore called "expressive attention." Expressive attention is measured differently from receptive attention.

To measure receptive attention, the subtest requires the child to make a physical and lexical comparison of a stimulus. Again, the subject must demonstrate both selective and sustained attention to avoid distractors over a period of time. These tasks are similar to tasks used by Posner and Boises (1971). Posner and Boises (1971) used variations of the Letter Matching (receptive attention) subtest to determine an effective measure of alertness, selectivity, and processing capacity. The study found that both alertness and selectivity were found to improve performance on the Letter Matching task. Furthermore, Das (1993) has demonstrated the lexical matching requirement of the receptive attention subtest to be sensitive to attention disorder. Das (1993) identified children who have deficiencies in selective attention at the reception stage using Posner's Letter Matching tasks.

The Number Detection subtest requires the subject to demonstrate selectivity, to shift attention, and to resist distraction. The Number Detection subtest is a variation of a multidimensional stimuli attention task described by Schneider, Dumais, and Shiffrin (1984). The task measures the subject's ability to reject irrelevant messages while focusing to addend on target information. Naglieri, Braden, Gottling et al. (1993) also demonstrated a correlation between high scores on the Number Detection task and the ability to focus attention despite distractors. In addition, scores of inattention from the Child Behavior Checklist (short attention span, distractibility, and hyperactivity) were negatively correlated with Attention subtests including Number Detection in this study.

Criticisms

The CAS subtests were designed to measure the process that had the greatest contribution in fulfilling the task. Each of the CAS Planning and Attention subtests were developed to best measure the efficiency of the child's planning and attention abilities (Naglieri and Das, 1997; Naglieri, 2000). However, some research has questioned the validity of the PASS theory, particularly the Planning and Attention subtests.

Kranzler and Keith (1999) attempted to fit nonhierarchical models and found the PASS model had the best fit although not a strong fit. They did find that the (PA)SS model had a similar fit, suggesting Planning and Attention fit together and Simultaneous and Successive Processing fit together. They contest that all subtests on both the Planning and Attention Scales are tests of speed and the subsequent scores are essentially speed of performance. They, therefore, suggest that the planning subtest is a measure of cognitive speediness or cognitive processing speed rather than planning ability. Examination of factor solutions of the study suggest that Planning and Attention are virtually indistinguishable, correlating more than 0.90 with the least amount of correlation between Planning and Attention found to be 0.88 for 5 to 7 year olds. Furthermore, the Planning, Attention, and Simultaneous factors were also found to have little unique variance indicating these factor scores are not independently interpretable.

Kranzler and Keith reinterpreted the factor scores using a third order hierarchical model using the three-stratum theory of cognitive abilities. Evaluating the requirements of these subtests within the (PASS) theory, the authors hypothesized that Planning could be interpreted as Perceptual Speed, Attention as Rate of Test Taking, and the second order factor of Planning/Attention as Processing Speed. Overall, the findings did not support the construct validity of the CAS and the Planning subtests.

Carroll (1995) attempted to replicate the PASS theory with a reanalysis of the data from Naglieri et al. 1991 and 1993. Using a Confirmatory Factor Analysis and Exploratory Factor Analysis, Carroll was unable to replicate the data produced by Naglieri et al. 1991 and 1993. Furthermore, Carroll found the Planning subtest was actually a measure of processing speed. Noting these criticisms, Carroll questions if the CAS consistently measures the concepts Das and Naglieri suggest it measures.

Naglieri (1999) refutes Carroll's (1995) claims that the Planning subtests are a measure of processing speed. Naglieri describes a pure speed test as repeating a simple task as fast as possible and notes that such tests have a low correlation with general intelligence. He argues that the Planning subtests require a greater degree of cognitive difficulty and thus require the use of plans or strategies. Furthermore, the scores of Planning and Attention are affected by both speed and accuracy. If a subject completes the task quickly but incorrectly, their score will be adversely affected. Naglieri (1997) suggested that although the Planning subtests are not overly difficult tasks, it is how the student attempts the task that derives their Planning score. The score attempts to measure the efficiency of the method to solve the problem rather than the speed to complete the task such that lower scores reflect less efficient strategies. In addition, Naglieri (1999) suggests there is a correlation of planning with achievement in comparison to a correlation of speed with achievement, which suggests planning is a more cognitively demanding task than speed.

Naglieri and Das (1997) provided evidence for a relationship between PASS and achievement using the CAS and the Woodcock-Johnson Revised Tests of Achievement. They found that Planning accounts for considerably more variance than Perceptual Speed. Furthermore, the correlation between math and Planning demonstrates the increased importance of Planning with age. Therefore, Naglieri suggests the use of strategies on Planning subtests. In addition, the strong correlation between Planning subtests and math achievement do not indicate the Planning subtests are a measure of Processing Speed.

Naglieri (2000) suggested the theoretical background of the test provides a better assessment of cognitive ability than the traditional IQ tests. He commented that the CAS uniquely provides a measure of Planning and Attention in addition to Simultaneous and Successive Processing more common with other measures of intelligence such as the WISC III and the WAIS III. Naglieri further suggested the CAS uniquely measures cognitive ability independent of previous achievement or school experience, a caveat of other traditional intellectual assessments. Despite the fact that independent researchers have raised questions about the validity of the CAS, all assessment tools, particularly new assessment tools, are required to undergo careful scrutiny. For example, Sattler (2001) suggested there are many tests that continue to be widely used and accepted although they receive noteworthy criticisms including the WISC III and the WAIS III. Sattler reported that many researchers query the four-factor model of the WISC III. There is some supporting evidence that this model, particularly the Freedom from Distractibility factor, is not a valid measure of attention and concentration in children, therefore affecting the overall Full Scale IQ score (Sattler, 2001). In addition, there are also concerns about the validity of the WAIS III among certain ethnic populations. Factor analysis of the WAIS III suggested that there are possible variations in factor loading for African American populations (Sattler, 2001). Even with these concerns of test validity, the WISC III and the WAIS III continue to be two of the most widely accepted measures of intelligence among children and adults. Thus, we can expect to see more researchers examining the validity of the CAS. For the purposes of this research, only two well researched subtests of the CAS will be used, Planning and Attention.

Using the CAS to evaluate executive functioning skills for those prenatally exposed to alcohol may facilitate understanding of its validity. Subtests on the Planning and Attention scales are very similar to subtests commonly used to measure constructs of cognitive flexibility (e.g., California Trail Making Test) and response inhibition (e.g., Stroop Test). These tests have demonstrated significant impairment in executive functioning skills for the FASD population (Mattson et al., 1999). As previously stated, the Planning subtests of the CAS attempt to measure an individual's ability to plan, evaluate and apply impulse control, and the Attention subtests attempt to evaluate an individual's ability to efficiently and selectively focus, attend and respond. These skills are all fundamental in executive functioning abilities. Furthermore, the PASS theory suggests the skills most predominately tapped by the Planning and Attention subtests originate in the anterior and upper parts of the brain, respectively.

Lezak (1995) suggested that impairments of executive functioning are often a result of frontal lobe damage. Previous FASD research suggests those prenatally exposed to alcohol will demonstrate specific frontal lobe impairments, including deficits in executive functioning skills, as a result of prenatal brain damage. Scores of Planning and Attention using the CAS have been found to be significantly lower than a matched group for children with traumatic brain injury (Gutenatg, S., Naglieri, J., Yeates, K., 1998). Therefore, it seems likely that scores of Planning and Attention on the CAS will be indicative of deficits in executive functioning skills for those prenatally exposed to alcohol.

Research Questions

Question One

Research suggests that deficits in executive functioning will lead to behavior and delinquency for both the FASD and non-exposed young offender population (Streissguth et al., 1998; Thomas et al., 1998; Brier, 1989, Moffitt, 1993). Moreover, Fast et al. (1999) demonstrated the possible over-representation of the FASD group within the Canadian justice system (Fast et al., 1999). However, information comparing executive functioning skills of young offenders with FASD and non-exposed young offenders is non-existent and the CAS has never been used to measure executive functioning for FASD. Therefore, in order to effectively identify and provide appropriate intervention for these groups it is important to evaluate the executive functioning skills of young offenders with FASD, as compared to the non-exposed young offender population. Based on this information, the following research question is proposed:

1) Is there a significant difference between the executive functioning skills of FASD and non-exposed young offenders?

Questions Two and Three

Research evaluating the executive functioning of those with FASD suggest deficits including reasoning, concept formation, planning ability, and response inhibition. These deficits are found in the absence of a full FAS diagnosis (Mattson et al., 1999; Kodtuwakku et al., 1995; Carmichael-Olsen, 1998; & Sampson et al., 1997) and are seen in the absence of Mental Retardation (Mattson et al., 1999). Therefore, it seems likely that FASD has definite effects on executive functioning.

However, limitations of these studies warrant further investigation. For example, tests used in Mattson and colleagues research (1998) are noted to have been heavily influenced by previously acquired knowledge and verbal ability. Both previous knowledge and verbal ability have shown to be affected by both receptive and expressive measures in the FASD population (Mattson and Riley, 1998). Also, IQ scores of the non-exposed control group for one study were found to correlate with executive functioning (Mattson et al., 1999). Finally, conclusions of each study were based on small sample size of 28, 20, and 18, respectively (Mattson et al., 1999; Kodtuwakku et al., 1995; Sampson et al., 1995).

In addition, deficits in executive functioning have been identified in young offenders (Moffitt, 1993; Chretien, 2000; Enns, 1998). Since the likelihood that previous studies of young offenders included young offenders with FASD, it is possible that their results may be confounded. Based on past research findings, the following research questions are asked:

2) Will young offenders with FASD have significantly lower scores in executive functioning compared to the standardized norms of Planning and Attention?

3) Will young offenders without FASD have significantly lower scores in executive functioning compared to the standardized norms of Planning and Attention?

Planned Analysis

In order to determine whether there is a significant difference between groups, a multivariate analysis of variance (MANOVA) will be used. A MANOVA is designed to evaluate differences among two or more groups (FASD, non-exposed) in terms of their effect on the dependent variable (Planning, Attention) (Tabachnick and Fiddell, 2001). Significance level is set at $p = 0.05$ to decrease the chance of a Type I error and to increase power (Tabachnick and Fiddell, 2001). Following that, t-tests will be conducted to evaluate if the FASD group or the non-exposed group differ from the norm on tests of Planning and Attention.

CHAPTER THREE: METHODS

Subjects

This research was part of a larger study exploring neurobehavioral and affective consequences of prenatal alcohol exposure in incarcerated youth. The sample included 39 volunteer adolescents (33 males and 6 females) at the Calgary Young Offender Center. Of the subjects, 17 were identified as having FASD from information obtained from parents and caregivers. Amount, duration, or period of exposure to alcohol during pregnancy was not determined. None of the subjects had a confirmed diagnosis of FAS. There were 22 subjects confirmed not to have had prenatal alcohol exposure. Subjects had been sentenced to the Calgary Young Offender Center for a variety of offences. Table 1 includes demographic information of age and grade level.

Table 1

Demographic Information of FASD and Non-Exposed Young Offenders

	Age
FASD (n = 20)	
Mean	16.30
S.D.	1.13
Range	14-18
Non-Exposed (n = 26)	
Mean	16.69
S.D.	1.16
Range	14-18

Demographic information was obtained as part of the larger study and therefore included more subjects than the Planning and Attention scores. Subject ages ranged from 14 to 18 for both FASD and the non-exposed group. The mean age of the FASD group was 16.30 and the mean age for the non-exposed group was 16.69. Table 2 includes frequencies of Grade levels for the FASD and the non-exposed group.

Table 2

Frequencies of Grade Levels for the FASD and the Non-exposed Young Offenders

Grade	Frequency	Percent	Cumulative Percent
FASD (n = 20)			
7	1	5.0%	5%
9	4	20.0%	25%
10	7	35.0%	60%
11	7	35.0%	95%
12	1	5.0%	100%
Non-Exposed (n = 26)			
9	4	15.4%	15.4%
10	2	7.7%	23.1%
11	11	42.3%	65.4%
12	9	34.6%	100%

The FASD subjects included grades 7, 9, 10, 11, and 12 at 5%, 20%, 35%, 35%, and 5%, respectively. The non-exposed group included 15.4% of subjects from Grade 9, 7.7%

from Grade 10, 42.3% from Grade 11, and 34.6% from Grade 12. Table 3 includes information on subject ethnicity.

Table 3

Frequencies of Ethnic Groups for FASD and Non-Exposed Young Offenders

Ethnic Group	Frequency	Percent	Cumulative Percent
FASD (n = 20)			
Caucasian	14	70%	70%
Native	5	25%	95%
Hispanic	1	5%	100%
Non-Exposed (n = 26)			
Caucasian	19	73.1%	73.1%
Native	3	11.5%	84.6%
Asian	3	11.5%	96.2%
Hispanic	1	3.8%	100%

The FASD group consisted of 70% Caucasian subjects, 25% Native subjects, and 5% Hispanic subjects. The non-exposed group consisted of 73.1% Caucasian subjects, 11.5% Native subjects, 11.5% Asian subjects, and 3.8% Hispanic subjects. Table 4 includes demographic information of intelligence scores as measured by the WISC III (age 14-16) or the WAIS III (age 17-18) of FASD and non-exposed subjects.

Table 4

Full Scale IQ Scores for FASD and Non-Exposed Young Offenders

	n	Mean	SD
WISC III			
FASD	9	91.67	15.92
Non-Exposed	9	88.00	11.14
WAIS III			
FASD	10	88.20	11.63
Non-Exposed	15	98.87	9.25

The IQ means scores for the FASD group are 91.67 (SD =15.92) for the WISC III and 88.20 (SD = 11.16) for the WAIS III. For the non-exposed group, the means scores are 88.00 (SD = 11.14) for the WISC III and 98.87 (SD = 9.25) for the WAIS III. *T*-tests were calculated to determine significance of IQ between groups. As seen in table 3, there is no significant difference between FASD and non-exposed young offenders on intelligence as measured by the WISC III ($p = 0.091$) or the WAIS III ($p = 0.417$).

Table 5

T-test for Equality of Means for FSIQ for WISC III and WAIS III

Test	df	F	p
FSIQ WISC III	16	3.242	0.091
FSIQ WAIS III	23	0.683	0.417

*p<0.05

The purpose of the study was explained to each participant and his or her caregiver, informed consent for participation was given, and all volunteers were informed that they could withdraw from the study at any time without penalty. Testing was conducted over a ten-month period.

Measures

The Cognitive Assessment System (CAS) (Naglieri and Das, 1997) measures planning, attention, simultaneous and successive processing with 12 subtests. Raw scores are converted to scaled scores for each subtest. All subtest scaled scores have a mean of 10 and a standard deviation of 3. Scaled subtest scores are then summed and a further scaled score is then calculated for each of the four summary scales. A Full Scale score is calculated by adding all subtest scaled scores then converting this value to a scaled score. The Full Scale score has a mean of 100 and a standard deviation of 15.

Test-retest reliability coefficients range from 0.95 to 0.97 across age groups for the Cognitive Assessment System. Average reliabilities for the subtests are 0.88 for Planning, 0.88 for Attention, 0.93 for Simultaneous processing, and 0.93 for Successive processing. Factor analysis suggests the CAS validity ranges from 0.90 to 0.96 for ages 5 to 17.

Planning Subtests

Matching Numbers (MN)

The Matching Numbers subtest is a four-page paper and pencil test. Each page or item has eight rows of numbers with six numbers per row including two matching numbers in each row. The child is asked to underline the matching numbers in each row. The numbers increase in complexity from one digit in the first row of Item 1 to seven digits on the last row of Item 4. Each row is designed to maximize the benefits of strategy use. The child is given a 150 second time limit for Items 1 to 3 and a 180-second time limit for Item 4. The child's score is calculated by using an accuracy score considering both the time and the number correct. In addition, the strategy used to complete the task is recorded.

Planned Codes (PCd)

The Planned Codes subtest is also a pencil and paper test, consisting of two pages or items. The top of the page has a legend indicating a correspondence of specific codes (OO, XX, OO, XO) to specific letters (A, B, C, D). The task consists of assigning codes to seven rows and eight columns of un-coded letters. The child is asked to fill in the proper code in the empty box underneath the corresponding letter. Children ages 5 to 7 have 120 seconds to complete each item, and children ages 8 to17 have 60 seconds per item. The child's accuracy score considers both time and number correct to measure the child's efficiency. Additional information includes the child's strategies used in completing the task as the child is encouraged to complete the item in the manner he/she thinks best.

Planned Connections (PCn)

The third planning subtest, Planned Connections, is a paper and pencil test consisting of eight items. Items 1 to 6 require connection of numerical items in sequential order, whereas Items 7 and 8 require alternating connection of numbers and letters in sequential order. The goal of the test is to measure the child's efficiency, and therefore the time needed to complete the test is used for the score. The child's strategy is also recorded.

Attention Subtests

Expressive Attention

Children 8 years of age and older are asked to read 40 color words from the stimulus page including BLUE, YELLOW, GREEN, and RED. The words are presented in black ink in quasi-random order on the page. The next item requires the child to name the colors of a series of rectangles (blue, yellow, green, and red). Again, they are presented in quasi-random order on the page. In the final item the words BLUE, YELLOW, GREEN, and RED are printed in a different color from the name of the words. The child is required to name the color the word is printed in, rather than reading the word. The subtest score is a ratio of the accuracy and time on the final item.

Number Detection

This pencil and paper task requires the child to underline Numbers 1, 2, and 3 when they are printed in outlined typeface amongst distractors. Next the child is to underline the Numbers 1, 2, and 3 when in regular typeface and the Numbers 4, 5, and 6 when they appear in an outlined typeface amongst distractors. There are a total of 15 rows with 12 numbers each with a total of 45 targets (25 percent). Each page must be completed from left to right and from top to bottom.

Receptive Attention

This is a two-page pencil and paper test where the subject is required to underline pairs of letters (t, T; b, B; r. R; e, E; n, N; a, A) that are physically the same (e.g. TT or bb but not Tb). The next task is for the subject to underline the pairs of letters that have the same name or lexical similarity (e.g., Aa not bE). Each page contains 200 letters and 50 targets (25 percent). The child must work from left to right and top to bottom.

CHAPTER FOUR: RESULTS

To address the research questions, statistical analysis was run using SPSS 11.0. Assumptions of normality were determined using descriptive statistics for the variables (FASD, non-exposed, scaled scores of Planning and Attention). Table 6 shows the sample size, mean scores, and standard deviation of the FASD and non-exposed group for CAS Planning and Attention.

Table 6

Means and Standard Deviations for Planning and Attention Tasks for FASD and Non-exposed Young Offenders.

	Planning	Attention
FASD (n = 17)		
Mean	83.82	89.59
SD	15.21	17.65
Non-Exposed (n = 22)		
Mean	100.27	103.77
SD	16.81	16.12

For the FASD group, the means and standard deviations were 83.82 (SD = 15.21) for Planning and 89.59 (SD = 7.65) for Attention. For the non-exposed group, the means were 100.27 (SD = 16.81) for Planning and 103.77 (SD =16.12) for Attention. The CAS uses a mean of 100 (SD = 15) as standardized norms (Das and Naglieri, 1991).

Correlation coefficients were calculated to determine the correlation between age and scores of Planning and Attention. Scores indicated there was a non-significant correlation with age and Planning ($r = 0.308$, $p = 0.056$) and Attention ($r = 0.224$, $p = 0.169$). *T* tests were calculated to determine the significance of gender. Gender did not show to be significant for either CAS Planning ($p = 0.661$) or CAS Attention ($p = 0.540$) using Levene's Test for Equality of Variances. The lack of significance for age and gender indicated that these variables did not have to be factored out in the final analysis. To determine the correlation between Full Scale WISC III and WAIS III scores and executive functioning, correlation coefficients were calculated. Intelligence for the FASD group was not correlated with scores of Planning ($r = 0.467$, $p = 0.068$) or Attention ($r = 0.284$, $p = 0.287$). For the non-exposed group, scores of intelligence were significantly correlated with scores of Planning ($r = 0.645$, $p = 0.002$) and Attention ($r = 0.6971$, $p = 0.001$).

A correlation coefficient was calculated between CAS Planning and CAS Attention. The high correlation between CAS Planning and CAS Attention ($r = 0.7887$, $p < 0.001$) indicated that a multivariate analysis could be performed to determine whether there is any significant group effect. A multivariate analysis was conducted to determine whether there were significant differences between the FASD young offenders and the non-exposed young offenders on measures of Planning and Attention. Results revealed a significant group (FASD) difference [Hotellings *T*-squared = 0.2736, $F(2, 36) = 4.925$, p=0.013]. Univariate analysis showed a significant group effect on both CAS Planning ($F(1, 37) = 9.64$, p=0.003) and CAS Attention ($F(1,37)$= 6.38, p=0.013). Thus, there was a significant difference between the two groups for both Planning and Attention.

In order to determine whether FASD and non-exposed each differed from the norm, t-tests were calculated. Table 7 shows results of t-tests done to compare each group with the standardized norms.

Table 7

T-test for Comparison of FASD and Non-Exposed Young Offender Scores of Planning and Attention with Test Norms (M = 100, SD = 15)

	Mean	SD	df	p
FASD (n = 17)				
Planning	83.82	15.21	16	0.000*
Attention	89.59	17.65	16	0.027*
Non-Exposed (n = 22)				
Planning	100.27	16.81	21	0.940
Attention	103.77	16.12	21	0.285

$^*p < 0.05$

The FASD group were significantly different for Planning (M = 83.8235, SD = 15.212, p = 0.000, two tailed) when compared to the standardized norms (M = 100, SD = 15). Similarly, the FASD group (M = 89.5882, SD = 17.646, p = 0.027, two tailed) was significantly different from the norm for Attention (M = 100, SD = 15). Scores for the non-exposed young offender population were not significantly lower on Planning (M = 100.2727, SD = 16.808, p = 0.940, two tailed significance) or Attention (M = 103.7727, SD = 16.121, p = 0.285, two tailed significance) than the standardized norms (M = 100, SD = 15).

CHAPTER FIVE: DISCUSSION

In this study, executive functioning skills in young offenders with FASD were evaluated using the Planning and Attention scales of the CAS. The goals of the study were (1) to determine the effects of FASD on an affected child's executive functioning skills and (2) to compare the executive functioning skills of the FASD group to non-exposed young offenders. The results supported the expectation that the FASD group demonstrated significant deficits on measures of planning, reasoning, impulse control, and attention when compared to the population norms. Also, the non-exposed young offenders did not demonstrate deficits in executive functioning when compared to the population norms. Furthermore, the means for the WISC III and the WAIS III were not significantly different between groups suggesting that the deficits in executive functioning skills cannot be explained by concurrent deficits in basic intellectual skills.

A deficit in a child's ability to successfully engage in purposeful, independent, and self-serving behavior, compounded by lack of judgment and diminished self-control, will inevitably lead to problems with behavior, normal social relationships, and possible involvement with the justice system. These deficits are consistent with deficits in executive functioning (Mattson et al., 1999; Streissguth, 1988). Low scores for the FASD group on the Planning subtests demonstrated deficits in creating a plan, applying that plan to the presenting problem, verifying that the plan will efficiently solve the problem and finally modifying the plan if it is not successful (Naglieri and Das, 1997). In addition, low scores for the FASD group on the Attention subtests demonstrated deficits in giving direct concentration to a stimulus while inhibiting responses to other non-target stimuli (Naglieri and Das, 1997).

These results, which show executive functioning deficits in the FASD sample, are consistent with findings of Mattson et al., (1999), Kodituwakku et al. (1995), Carmichael-Olsen et al. (1998), and Sampson et al. (1997). Furthermore, these executive functioning deficits were found in the absence of Mental Retardation. Scores of executive functioning and IQ were highly correlated for the non-exposed group. Given that both scores were in the normal range, there are few conclusions that can be drawn from this information. Of importance, is the finding that there was a non-significant correlation between scores of Planning and Attention and IQ for the FASD group. Thus, the results are strengthened by the findings that the deficits in executive functioning are not likely to be explained by concurrent deficits in basic intellectual skills.

Of particular interest are the results from the current study that suggest average levels (within CAS norms) of executive functioning abilities for non-exposed young offenders. These results are inconsistent with findings of Enns (1998), Chretien (2000), and Moffitt (1993). Although the non-exposed young offenders also demonstrate problem behaviors and involvement with the justice system, their scores were not significantly different from the norm on tests evaluating planning and reasoning (Planning), and attention and response inhibition (Attention), suggesting that as a group they exhibited average abilities in executive functioning.

Comparisons

Findings of the current study suggesting impairment in abstract thought in FASD children are consistent with findings of Mattson et al. (1999). Two subtests of the Planning and Attention scales of the CAS (Planned Connections and Expressive Attention) are similar to two of the measures used by Mattson and her colleagues, California Trail Making Test and the California Stroop Test. Both studies demonstrated impairment with these measures for those prenatally exposed to alcohol. A strength of the present study is that the subtests of the CAS do not require verbal ability and previously acquired knowledge. The Mattson (1999) study was limited in that some of the tests measuring executive functioning required verbal ability and previously acquired knowledge. Planning and Attention tasks are designed to measure the cognitive processes of reasoning and attention with little account for academic achievement and school experience. Furthermore, results of the current study are consistent with Mattson et al. (1999), in that these deficits are seen in the absence of Mental Retardation and there was no difference between groups for IQ. Therefore, deficits in planning and response inhibition cannot be explained by an underlying deficit in basic intellectual skills.

The findings are also consistent with Kodituwaku et al. (1995) who used mixed groups of FAS and FAE and matched controls. They found that both alcohol exposed groups differed from the control group but not from each other. This demonstrated deficits in executive functioning skills for those with FAS and prenatal alcohol exposure as measured by the Wisconsin Card Sorting Test. In addition, Carmichael-Olsen et al. (1998) measured deficits in executive functioning for those diagnosed with FAS as measured by the WCST. However, small sample size (8 FAS, 2 FAE and 10 control for Kodituwaku et al. (1995); and 9 FAS and 9 controls for Carmichael-Olsen, (1998)) may affect the ability to generalize the results of these studies. The current study demonstrated similar deficits in executive functioning behavior with a slightly larger sample size. This adds support to the FASD research results for deficits in executive functioning.

Using a larger sample size, Sampson et al. (1997) demonstrated a speed-accuracy trade off for the FASD population. The speed-accuracy trade off deficit argued by Sampson et al. (1997) is consistent with the low scores of the FASD group attained on Planning and Attention in the present study. For these subtests speed is not considered efficient when it comes at the expense of errors. Naglieri (1999) suggested the Planning subtests require a greater degree of cognitive difficulty thus requiring the use of plans and strategies. The scores on both Planning and Attention require effective strategies in order to demonstrate a balance of speed and accuracy. Therefore, low scores on both Planning and Attention suggest impairments with the speed-accuracy trade off for those with prenatal alcohol exposure. Although the findings of the current study are consistent with previous research suggesting deficits in executive functioning as a result of prenatal alcohol exposure, the findings are inconsistent with previous research that emphasizes deficits in executive functioning for young offenders.

Chretien's (2000) suggestion that young offenders demonstrate deficits in executive functioning is inconsistent with the present findings. Although Chretien acknowledges significant deficits in language for the young offender population, many of the measures used to evaluate executive functioning in his study are language based. In addition, grade level was found to be a covariate of critical thinking, conceptual level and conditioned spatial association. Scores of Planning and Attention could be a more accurate measure of executive functioning than measures that require verbal ability, as it is a measure independent of previous achievement or school experience. Enns (1998) also found deficits in executive functioning with the young offender population using the Planning and Attention subtests of the CAS.

Measures of Planning and Attention on the CAS are thought to be independent of school experience and previous knowledge. Thus, Enns (1998) believes the CAS is a better representation of the neuropsychological patterns of the young offender population than traditional measures of intelligence. In the present study, a significant difference from the norm was found only in the FASD group, suggesting the FASD group demonstrated executive functioning impairments in the absence of deficits in basic intelligence skills. The current findings do not support Enns' research, which concludes that the delinquent population can be distinguished from the non-delinquent population on the basis of executive deficits related to Planning and Attention. Enns did not describe whether there were adolescents with FASD in his young offender sample population. Given that there is thought to be a high population of FASD within the young offender population (Fast et al., 1999), group differences among the general young offender population could explain the different findings between Enns (1998) and the present study. Thus, the limited background information of the sample size is a factor in interpreting the data.

The current findings of deficits in scores of Planning and Attention appear to be consistent with previous research on executive functioning for those with FASD. For example, the skills measured by the Planning and Attention subtests are consistent with previous studies measuring planning, reasoning, attention, impulse control, (Mattson et al., 1999; Kodituwaku et al., 1995; Carmichael-Olsen et al., 1998) as well as a speed-accuracy trade off (Sampson et al., 1997). Observation of subjects completing the subtests suggested that those who attempted the task impulsively, with no planning regarding how to complete the task made many errors and consequently received a low score. In contrast, those who attempted the task with a plan and ability to evaluate that plan's efficiency were more successful and received a higher score. Furthermore, these deficits are believed to be consistent with frontal lobe impairment (Mattson et al., 1994), the area of the brain thought tapped by the Planning and Attention subtests. Deficits in executive functioning appear evident in the FASD group using the Planning and Attention subtests of the CAS.

Limitations

Although there are many consistencies with previous FASD research, it is important to acknowledge the limitations of the current study. The FASD subjects were all young offenders, and the results may not generalize to the non-young offender FASD population. Future research may evaluate differences between the FASD young offender and the FASD non-offender population. Also, research examining the effects of FASD without an FAS diagnosis is more recent (Streissguth and O'Malley, 2000). Research evaluating the executive functioning deficits of those with FASD is limited to the articles contained within this paper. Therefore, further studies must be completed to thoroughly understand the effects FASD can have on an exposed child's executive functioning skills.

Future Research

Findings of the present study have provided valuable information regarding the executive functioning abilities of both FASD young offenders and non-exposed young offenders. Future studies could provide more detailed information of the effects FASD can have on the affected child during childhood, adolescence, and as an adult to assist with their coping skills and improve their quality of life.

The present research supports earlier findings that varying amounts of prenatal alcohol exposure, not necessarily amounts resulting in characteristic physical features, can have significant effects on the exposed child's central nervous system functioning. A larger sample size with more specific subject information could demonstrate results more easily generalized to the larger FASD population. For example, studies examining the effects specific amounts and specific times of alcohol consumption during pregnancy could help to identify those at greatest risk.

Future research could explore the comparison between the executive functioning skills of the FASD delinquent population and the FASD non-delinquent population. The present study is the only known research evaluating the executive functioning of young offenders with FASD. Replication of this study evaluating differences in executive functioning of young offenders, separating FASD and non-FASD subjects, could help to support the current research. Evidence evaluating any differences between offenders and non-offenders, FASD and non-FASD, will facilitate better understanding of these populations and more specific treatments and interventions. Also, clearer evidence of the prevalence of FASD in the justice system may give a better indication of the actual representation of the FASD population among young offenders.

Research comparing scores of Planning and Attention with other measures of executive functioning including the WCST may support the use of the Planning and Attention subtests as an effective measure of executive functioning. Clinical experience with the CAS, particularly the subtests of Planning and Attention, has been useful in evaluating students' abilities for specific skills including problem solving, ability to resist distraction or ability to evaluate their mistakes. Future research on the CAS as a measure of executive functioning among the FASD population may provide support for its specificity.

Conclusions

In conclusion, the current study demonstrates deficits in executive functioning skills in young offenders with FASD as measured by the Planning and Attention scales of the CAS. The non-exposed group did not demonstrate these same deficits in executive functioning with the Planning and Attention subtests. As there was no difference between groups for IQ, these deficits are not a result of deficits in basic intelligence skills. Thus, the findings demonstrate deficits in planning, reasoning, cognitive flexibility and impulse control within the sample of FASD young offenders.

To address the challenges presented to those with FASD we must clearly understand an affected child's cognitive abilities and limitations. If a child shows significant impairment in judgment, planning, self-directed behavior and impulse control, then a likely intervention would include on-going support, direction and supervision. Although it is recognized that these deficits are likely a result of brain damage, those with executive functioning impairments could be taught coping strategies to better manage their poor planning skills and impulsive behavior while in the environment that provides structure and supervision. Furthermore, identification and intervention for those at risk in early elementary school could target this high-risk population before they enter the justice system.

If a young offender becomes involved in the justice system as a result of neuropsychological deficits, one must question whether the current laws and punishments are appropriate in addressing this societal problem. Moreover, if the cognitive abilities of the FASD young offender population differ from the non-exposed young offender population, particularly with executive functioning, one must evaluate the appropriateness of a single treatment option for both groups. Perhaps concentration on prevention in the early school grades for those identified at high risk of offending would be a more efficient use of resources.

Based on the results of the current study, FASD and non-FASD young offenders could be identified as two distinctively different groups according to their cognitive abilities. The current research findings suggest that this group of non-exposed young offenders potentially have the ability to make appropriate decisions, and demonstrate effective skills in planning, evaluating and impulse control as measured by the Planning and Attention subtests of the CAS. In contrast, the FASD young offenders do not demonstrate those same abilities. Based on these conclusions, it seems warranted that intervention for children at risk and young offenders include strategies for better planning and problem solving, increasing self awareness and self management, and monitoring their behavior and impulse control.

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