University of Alberta

Intellectual Functioning Among Children and Adolescents Prenatally Exposed to Alcohol

By

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Dedication

To a friend and mentor, Dr. John Stewart

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Abbreviations

ARND	Alcohol Related Neurodevelopmental Disorder
CMMS	Columbia Mental Maturity Scale
FAE	Fetal Alcohol Effect
FAS	Fetal Alcohol Syndrome
FSIQ	Full Scale Intelligence
FDI	Freedom From Distractibility Index
KABC	Kaufman Assessment Battery for Children
PEA	Prenatal Exposure to Alcohol
PIQ	Performance Intelligence
POI	Perceptual Organization Index
PSI	Processing Speed Index
SB-LM	Stanford Binet – Form LM
VCI	Verbal Comprehension Index
VIQ	Verbal Intelligence
WISC	Wechsler Intelligence Scale for Children
WISC-R	Wechsler Intelligence Scale for Children – Revised
WAIS-R	Wechsler Adult Intelligence Scale – Revised
WISC-III	Wechsler Intelligence Scale for Children – Third Edition
WPPSI	Wechsler Preschool and Primary Scale of Intelligence
WPPSI-R	Wechsler Preschool and Primary Scale of Intelligence

Chapter One

Introduction

Fetal alcohol syndrome (FAS) and Fetal alcohol effects (FAE), currently referred to as alcohol related neurodevelopmental disorder (ARND), are developmental disabilities that result from fetal alcohol exposure (Streissguth, 1997). Empirical evidence supporting the adverse effects of alcohol on the developing fetus was first documented by a group of French researchers in 1968 (Lemoine, Harousseau, Borteyru, & Menuet). Several years later, in 1973, a second report was published in the United States in support of these findings (Jones, Smith, Ulleland, & Streissguth). Shortly thereafter, Jones and Smith (1973) defined the presenting conditions as FAS and FAE. This initial discovery marked the beginning of intensive research efforts focused on diagnosis, intervention, and preventative strategies. Current momentum in research focused on FAS and ARND has resulted from increased public awareness as well as recognition of the frequently devastating secondary disabilities associated with prenatal alcohol exposure (Streissguth, 1997).

Traditionally, individuals who have not met the full diagnostic criteria for FAS have been reported as suffering from FAE or a variety of related terms, such as suspected fetal alcohol effects, possible fetal alcohol effects, or prenatal exposure to alcohol (PEA), that are descriptive of individuals exposed to alcohol in utero. The term FAE was not originally intended to be used as a diagnostic label for individual patients and, based upon a review of the literature, there is considerable variation regarding the criteria required to meet this diagnosis (Institute of Medicine [IOM], Stratton, Howe, & Battaglia, 1996). Nevertheless, researchers, clinicians, and the general public have

increasingly employed this term to describe the proliferation of characteristics observed among this population. In 1996, the term FAE was replaced with more explicit terminology, namely ARND, that provides criteria clearly describing the central nervous system and behavioral characteristics prevalent among individuals who suffer from alcohol-related effects. For the purpose of clarity, terms such as FAE and PEA that are employed throughout this document reflect the previous conceptualization and classification of the effects of prenatal alcohol exposure as documented and described in research articles and texts. Alternatively, the term ARND is used primarily within the context of the current investigation. Each of these terms reflect the characteristic features associated with prenatal exposure to alcohol under circumstances that do not permit the diagnosis of FAS.

Incidence and Prevalence Rates

Research studies indicate that cases of FAS and FAE have been documented in diverse countries around the world. For example, global prevalence estimates of FAS and FAE from the early 1980's ranged from 0.4 to 3.1 per 1000 (Abel, 1984). Investigation of a rural Native community in British Columbia in 1987 confirmed a prevalence rate of FAS and FAE of 190 per 1000 between birth and 18 years of age (Robinson, Conry, & Conry, 1987). In 1991, Abel and Sokol estimated that approximately 0.29 to 0.48/1000 live births meet the criteria for a diagnosis of FAS. The incidence rates of FAS among Native American populations have been estimated as high as 2.99/1000 live births (Abel & Sokol, 1991). However, these are conservative estimates and do not reflect the number of children who meet the criteria for FAE. Currently, in North America, it is estimated that the combined incidence rate of FAS and

ARND is 9.1 per 1000 (Sampson, Streissguth, Bookstein, Little, Clarren, Dehaene, Hanson, & Graham, 1997).

Diagnostic Criteria

The probability of a child being born with FAS or FAE is contingent upon the dose, timing, and conditions of exposure as well as the individual characteristics of the mother and fetus. Currently, children suspected of having FAS are diagnosed based upon confirmation of a history of maternal alcohol use during pregnancy and the presence of three primary disabilities: (1) a prenatal or postnatal growth deficiency (height and weight below the 10th percentile for gestational age); (2) a specific pattern of craniofacial malformations including at least two of the following three characteristics: (a) microcephaly (defined as head circumference below the third percentile), (b) microphthalmia or short palpebral fissures, and (c) poorly-developed filtrum, thin vermilion border, and flattening of the maxillary area; and (3) central nervous system (CNS) impairment (neurological abnormality, developmental delay, or intellectual impairment) (IOM et al., 1996; Streissguth, 1997).

Until 1996, children with a confirmed history of maternal alcohol use during pregnancy, and who exhibited central nervous system impairment without the distinctive physical features or growth deficiency, were diagnosed with FAE. Currently, impairments associated with prenatal alcohol exposure, among children who do not exhibit the characteristic pattern of facial anomalies, fall into a category referred to as alcohol-related effects (IOM et al., 1996). Subsumed under this heading are two possible diagnoses including alcohol-related birth defects (ARBD) and ARND. These conditions may co-occur and are intended to more fully describe the effects of alcohol exposure

among individuals who do not meet the full criteria for FAS. In particular, the term ARND is intended to replace the term FAE while the designation of ARBD permits further quantification of the physical anomalies observed among this population. Specifically, ARBD encompasses congenital anomalies including malformations and dysplasias directly affecting the cardiac, skeletal, renal, ocular, and/or auditory systems. Alternatively, ARND is diagnosed when there is: (1) evidence of central nervous system neurodevelopmental abnormalities such as decreased cranial size at birth, structural brain abnormalities (e.g., microcephaly, partial or complete agenesis of the corpus collosum, cerebellar hypoplasia), and neurological hard or soft signs (e.g., impaired fine motor skills, neurosensory hearing loss, poor tandem gait, poor eye-hand coordination), and/or (2) evidence of a complex pattern of behavior or cognitive abnormalities that are inconsistent with developmental level and cannot be explained by family background or environment, including learning difficulties, poor impulse control, deficits in higher level receptive and expressive language, deficits in school performance, problems in social perception, deficits in mathematical skills, poor capacity for abstraction or metacognition (executive functioning), or problems with memory, attention, or judgment. Furthermore, in order to make a diagnosis of either ARBD or ARND, a confirmed history of maternal alcohol consumption during pregnancy must be clearly established.

Additional secondary disabilities that have been consistently associated with FAS and FAE include mental health problems, disrupted school experiences, trouble with the law, inappropriate and often bizarre sexual behavior, and alcohol and other drug problems that typically begin during adolescence and extend throughout adulthood (Streissguth & Kanter, 1997).

Considerable research has focused on the diagnostic criteria used to determine the presence of FAS and FAE. Specifically, empirical evidence has demonstrated that babies born with FAS are often small for their gestational age (Streissguth, Clarren, & Jones, 1985). These growth deficiencies characteristically extend throughout childhood, and commonly into adolescence and adulthood. For example, Streissguth et al. (1991) examined a sample of adolescents and adults with FAS and reported mean height, weight, and head circumference standard deviations of -2.1, -1.4, and -1.9 respectively. Alternatively, examination of height, weight, and head circumference among adolescents and adults diagnosed with FAE resulted in mean standard deviations of -1.7, - 0.4, and -1.5 respectively.

The physical abnormalities used to discriminate FAS from FAE are referred to as craniofacial malformations. These aforementioned features include microcephaly, short palpebral fissures, a poorly-developed philtrum, a thin vermilion border, epicanthal folds, and flattening of the maxillary area (Jones & Smith, 1973). Less noticeable physical abnormalities have also been consistently reported among individuals suffering from FAS and FAE. These include muscular hypotonia, high arched palate, cleft palate, anomalous palmar creases, skeletal and joint anomalies, heart defects, and genital abnormalities (Majewski, 1981). As previously noted, the extent of these physical anomalies is dependent upon the dose, timing, conditions of exposure, and the individual characteristics of the mother and fetus. However, despite the severity of morphological damage characteristically observed at an early age, recent follow-up studies have clearly documented significant improvement in the craniofacial dysmorphism as well as internal

organ malformations and skeletal abnormalities among adolescents and adults diagnosed with FAS (Streissguth et al., 1985).

Lastly, central nervous system impairment among individuals with FAS and FAE has also received considerable attention. For instance, measures of intelligence, academic achievement, activity and attention, learning and memory, language (e.g., expressive and receptive), motor coordination, psychopathology, and visuospatial abilities have been utilized in the assessment of FAS and alcohol-related effects (Mattson & Riley, 1998). Investigation of central nervous system functioning among individuals with FAS and FAE has focused largely on measures of intelligence. The primary mode of investigating FAS and FAE in the 1970's involved single case studies focusing on the quantification of physical anomalies as well as central nervous system impairment; however, due to the increased number of identified cases of FAS and FAE in the 1980's, investigations involving large groups of affected individuals became common practice.

Statement of the Problem

Psychological testing has played a major role in the diagnosis of FAS and FAE among children, adolescents and adults in terms of detecting central nervous system impairment (Mattson & Riley, 1998). Patterns of FSIQ test scores have slowly emerged as being indicative of FAS and FAE; however, researchers have been unable to firmly conclude, solely on the basis of test scores, the presence or absence of FAS and FAE (Streissguth, Randels, & Smith, 1991). Although the likelihood of identifying a single test or battery of tests that will accurately confirm the presence or absence of FAS and alcohol-related effects is minute, researchers have persevered in the hopes that by refining existing test strategies they will increase the probability of accurate diagnosis

and quantification of impairment. Therefore, assessment strategies that provide practitioners with detailed information concerning the specific nature of central nervous system impairment is of great importance. The implications of early detection of FAS or FAE are profound and clearly would enable practitioners and professionals to implement strategies aimed at preventing or offsetting the secondary disabilities that often afflict these individuals.

Several studies (Mattson, Riley, Gramling, Delis, & Jones, 1997; Steinhausen, Willms, & Spohr, 1993; Streissguth & Dehaene, 1993; Streissguth, Randels et al., 1991; Streissguth, Aase, Clarren, Randels, LaDue, & Smith, 1991) have investigated intellectual functioning among children and adolescents with FAS and FAE and many, although not all (Shaywitz, Cohen, & Shaywitz, 1980), have documented consistently lower scores on measures of FSIQ, VIQ, and PIQ functioning as compared to normal controls. Of these children and adolescents, those individuals with FAS have evidenced the greatest impairment in central nervous system functioning as measured by intelligence tests (Mattson & Riley, 1998; Steinhausen et al., 1993; Streissguth & Dehaene, 1993; Streissguth, Randels et al., 1991; Streissguth, Aase et al., 1991). However, despite this emphasis on the assessment of intellectual functioning, only three documented studies (Mattson et al., 1997; Streissguth, & Sampson, 1990; Shaywitz et al., 1980) have investigated beyond FSIQ, VIQ, and PIQ to report performance on factor scores and individual subtests.

Therefore, the overall purpose of this retrospective study was to systematically investigate intellectual functioning through examination of the score profiles and score differences (e.g., individual subtest, FSIQ, VIQ, and PIQ scores) on the Wechsler

Intelligence Scale for Children - Third Edition (WISC-III; Wechsler, 1991) among children and adolescents who have been diagnosed with FAS or ARND. As well, this investigation examined the Verbal Comprehension Index (VCI), Perceptual Organization Index (POI), Freedom from Distractibility Index (FDI), and Processing Speed Index (PSI) scores as additional measures of central nervous system functioning. Specifically, the analysis will focus on the differences within the FAS and ARND groups and, more importantly, differences between the two groups in an effort to provide a detailed and descriptive account of performance patterns among these populations.

This study was carried out to answer the following questions.

Research Question 1

What are the characteristics of this Canadian sample of children and adolescents who suffer from FAS and ARND? Specifically, do they present with similar difficulties with academic achievement, experience poor adaptive functioning, problematic behaviors, mental health impairments, and family dysfunction as compared to research findings reported in the literature?

Research Question 2

What is the mean performance of children and adolescents diagnosed with FAS and ARND on the various composite, factor, and subtest scales of the WISC-III (Wechsler, 1991) based on Canadian standardization (Wechsler, 1996)? Is their performance as a group significantly below that expected given their chronological age? What are the strengths and weaknesses on the specific subtests among this population?

Research Question 3

Do children and adolescents diagnosed with FAS and ARND demonstrate significantly different performance on the composite (VIQ, PIQ, FSIQ), factor (VCI, POI, FDI, PSI), and individual subtest scores on the WISC-III (Wechsler, 1991)? Is there a level of performance characteristic of FAS and ARND populations?

Null Hypothesis (H_{01}): Children and adolescents diagnosed with FAS and ARND will not demonstrate statistically significant differences on composite, factor, and subtest scores as measured by the WISC-III (Wechsler, 1991).

Significance of the Study

The problem of accurate diagnosis of FAS and FAE has been under investigation for over 30 years (Lemoine et al., 1968). Numerous instruments have been employed in an effort to quantify the central nervous system impairments demonstrated by individuals with FAS and FAE, nevertheless, the assessment of intellectual functioning has remained a common approach to the problem. This finding is most likely attributable to two reasons. First, intelligence tests, for the most part (e.g., Wechsler, 1991) adhere to the notion that intellectual functioning is comprised of a number of factors as represented, for example, by the various subtests on the WISC-III (Wechsler, 1991). As such, these measures provide a global assessment of functioning. Second, intelligence tests have been, and continue to be, the major component of standard psychological assessment batteries (Sattler, 1992). Children, adolescents, and adults presenting with a variety of issues, ranging from learning disorders to traumatic head injuries resulting from automobile accidents, are assessed via intellectual tests. This form of assessment is reasonably efficient and yields important diagnostic information. Thus, it has become the

standard assessment tool in a wide variety of circumstances. Therefore, it appears that continued investigation of intellectual functioning among populations with FAS and ARND is of great practical significance. Clearly, the use of complex neuropsychological measures has been a welcome addition to this field of research; however, acquisition of this form of assessment, along with the appropriate expertise in administration and interpretation, is often a difficult and costly venture. Based on an exhaustive review of the literature, it is clear that the full extent of research in the area of prenatal alcohol exposure and its effects on intellectual functioning has not yet been realized.

It is the intent of this study to advance the findings cited in Mattson et al. (1997) through the implementation of the WISC-III (Wechsler, 1991) and an increased sample size. To date, the WISC-III has only been cited on two occasions (Mattson, Goodman, Caine, Delis, & Riley, 1999; Thomas, Kelly, Mattson, & Riley, 1998) in the recent literature in relation to the assessment of central nervous system functioning (e.g., intelligence) among children and adolescents with FAS and ARND. In each of these aforementioned investigations, the focus was not on intellectual functioning. Instead, IQ results were used as a descriptive variable and method of selection for the sample under study. Although the diagnosis of FAS and ARND, based on the analysis of composite, factor, and individual subtest scores on the WISC-III, is not a plausible outcome of this investigation, it is hoped that research in this area will add further diagnostic value to the assessment of intelligence among populations with FAS and ARND. From a clinical perspective, it is imperative to provide a more detailed description of intellectual functioning, based upon current tests (e.g., WISC-III) and Canadian standardization, among children and adolescents who suffer from FAS and ARND. The objective of this

study is to rectify some of the methodological problems limiting previous research that describes intellectual functioning among individuals prenatally exposed to alcohol.

Furthermore, it is the goal of this investigation to augment the early detection and quantification of impairment among individuals diagnosed with FAS and ARND and, therefore, enable health care professionals, community agencies, and educational institutions to implement appropriate intervention strategies aimed at curtailing the development of debilitating secondary disabilities characteristically confronted by these individuals.

Chapter Two

Review of the Literature

Assessment of intelligence has been the major focus among researchers examining the effects of fetal alcohol exposure (Mattson & Riley, 1998). To date, a variety of instruments have been employed for the expressed purpose of describing the intellectual and developmental functioning of individuals with FAS and alcohol-related effects. For example, the Bayley Scales of Infant Development (Bayley, 1969), the Stanford-Binet Intelligence Scale, Form L-M (Terman & Merrill, 1960), the Columbia Mental Maturity Scale (CMMS; Burgemeister, Blum, & Lorge, 1972), the Wechsler Intelligence Scale for Children (WISC; Wechsler, 1949), the Wechsler Adult Intelligence Scale (WAIS; Wechsler, 1955), the Wechsler Preschool and Primary Scale of Intelligence (WPPSI; Wechsler, 1967), the Wechsler Intelligence Scale for Children - Revised (WISC-R; Wechsler, 1974), the Wechsler Adult Intelligence Scale - Revised (WAIS-R; Wechsler, 1981) the Wechsler Preschool and Primary Scale of Intelligence - Revised (WPPSI-R; Wechsler, 1989), the Wechsler Intelligence Scale for Children - Third Edition (WISC-III; Wechsler, 1991) the McCarthy Scales of Children's Abilities (McCarthy, 1972), and the Kaufman Assessment Battery for Children (K-ABC; Kaufman & Kaufman, 1983) have received considerable attention in recent years.

This chapter is divided into three principle sections including: (1) primary and secondary features associated with FAS and ARND, (2) profile analysis, and (3) intelligence among children and adolescents diagnosed with FAS and ARND. For the purpose of this investigation, the review of the literature focuses primarily on the

assessment of intellectual functioning among children and adolescents between the ages of 6 and 16 years.

Primary and Secondary Features Associated with FAS and ARND

The pattern of alcohol use among mothers who give birth to children with FAS and ARND is multifaceted. Researchers have demonstrated that the dose, peek blood-alcohol concentration, pattern and timing of intake, as well as length and severity of alcohol use are important variables that largely determine the cognitive, physical, and behavioral deficits observed among this population (IOM et al., 1996). In addition, the literature identifies a significant number of exacerbating factors that have readily been associated with the incidence of prenatal alcohol exposure. For instance, problems within the home environment including alcoholism among caregivers, child abuse and neglect, low level of social support, absence of maternal follow-up, and multiple foster and adoptive placements are common. Furthermore, low socioeconomic status, little or poor pediatric care, inadequate nutrition, lack of education, and limited social services for the child have also been identified.

The ongoing difficulties that individuals who are diagnosed with FAS and ARND typically incur are referred to as primary and secondary disabilities. Primary disabilities describe the functional deficits that reflect the central nervous system dysfunction typically observed among individuals prenatally exposed to alcohol (Striessguth, Barr, Kogan, & Bookstein, 1999). For example, primary disabilities include cognitive and behavioral deficits such as poor intellectual functioning, memory impairments, impairment in executive functions, difficulties with impulse control, attention and concentration deficits, learning difficulties, deficits in school performance, as well as

impaired receptive and expressive language skills. Furthermore, central nervous system neurodevelopmental abnormalities also include impaired fine motor skills, neurosensory hearing loss, poor tandem gate, and poor eye-hand coordination.

Alternatively, secondary disabilities include problems that arise after birth that could potentially be avoided or minimized provided appropriate interventions and support systems are available (Streissguth et al., 1999). Secondary disabilities include mental health problems, disrupted school experience, trouble with the law, inappropriate sexual behavior, alcohol and drug abuse, dependent living, and problems gaining competitive employment.

Medical complications have also been observed among individuals prenatally exposed to alcohol (Hagerman, 1999). Cardiac problems include atrial septal defects, ventricular septal deficits, aberrant great vessels, and Tetralogy of Fallot. Skeletal abnormalities are also common and include hypoplastic nails, shortened fifth digits, redioulnar synostosis, flexion contractures, hemivertebrae, and scoliosis. Renal difficulties such as hypoplastic kidneys, horseshoe kidneys, ureteral duplications, as well as hydronephrosis are often reported as problematic for individuals who suffer from FAS and ARND. Furthermore, ocular deficits in the form of strabismus, retinal vascular anomalies, nystagmus, and refractive problems secondary to small globes typically interfere with visual perception.

In summation, individuals prenatally exposed to alcohol typically suffer from considerable central nervous system dysfunction that contributes to the development of secondary disabilities. The purpose of this brief review is to highlight the global difficulties experienced by this population. Furthermore, the goal of this present study is

to focus on the primary disabilities, namely intellectual functioning, as demonstrated by children and adolescents diagnosed with FAS and ARND.

Profile Analysis

Profile analysis has been a topic of debate for a number of years due to the variability of results as represented by the literature. According to Davison and Kuang (2000), there are several statistical techniques employed by researchers in an attempt explore and further explain the nature of subtest patterns. For instance, complex statistical techniques including Q-factor analysis, configural frequency analysis, multidimensional scaling, and multistage cluster analysis have been employed in a number of investigations. In particular, research by Hale and Raymond (1981) utilizing the WISC-R (Wechsler, 1974) was conducted in an attempt to determine profile patterns. Specifically, they identified 10 profiles describing strengths and weaknesses of children as measured by the various subtests on the WISC-R. However, they concluded that their findings did not prove clinically useful in the diagnostic process.

In 1989, McDermott, Glutting, Jones, Watkins, and Kush conducted a cluster analysis on 2200 children and adolescents ranging in age from 6.5 to 16.5 years of age. The results revealed a total of 7 profiles characteristic of their performance on the subtest of the WISC-R (Wechsler, 1974). However, the authors concluded that the profiles did not provide increased clinical utility above and beyond composite and factor scores.

Another prominent study by Konold, Glutting, McDermott, Kush, and Watkins (1999) examined the nature of profiles using the WISC-III (Wechsler, 1991). Again, 2200 children and adolescents were included in the study ranging from 6-0 to 16-11 years of age. This particular investigation resulted in the identification of 8 profile types as

defined according to population prevalence, ability level, and configuration of subtest scores. However, the authors firmly state that, overall, there is a lack of empirical evidence to support the use of profile analysis as a method of generating hypotheses regarding children's problems. They further highlight the variability of research findings in addition to methodological shortcomings prevalent in the published literature.

Alternatively, researchers such as Zachary (1990) advocate that profile analysis is a useful method for generating hypotheses in conjunction with good clinical judgment. This line of thinking is also expressed by Kamphaus (1993). Specifically, Kamphaus notes that subtest profiles can be a very useful source of information when conducting an assessment and should not be totally abandoned.

A number of studies using profile analysis have been conducted in an attempt to increase the likelihood of diagnosing exceptionalities. For example, disorders such as learning disabilities (LD) and attention-deficit/hyperactivity disorder (ADHD) have been associated with low subtest scores on Arithmetic, Coding, Information, Digit Span (ACID), Arithmetic, Coding, Information, Digit Span, Symbol Search (ACIDS), as well as Symbol Search, Coding, Arithmetic, Digit Span (SCAD) (Prifitera & Dersh, 1993; Ward, Ward, Hatt, Young, & Mollner, 1995;). However, results are rather inconsistent and, in many cases, the incidence of these profiles for specific populations of LD and ADHD children and adolescents is no greater as compared to normal control groups and the standardization sample. As a result, there is considerable controversy amongst researchers and clinicians regarding the diagnostic utility of these profiles.

Among practitioners, profiles of performance on measures of intellectual functioning are typically examined using a sequential process that begins with more

global scores and concludes with a description of subtest strengths and weaknesses. Kaufman (1994) proposes a seven-step process aimed at providing a thorough analysis of intellectual functioning specific to the WISC-III (Wechsler, 1991).

The first step, according to Kaufman (1994), involves examining the most global and reliable score, namely Full Scale intellectual functioning. Specifically, Kaufman advocates identifying the confidence interval and ability level for the score in question followed by comparison of the obtained score with the normative sample to determine if the discrepancy is statistically significant from the mean.

The second step involves determining if the VIQ and PIQ discrepancy is statistically significant. This process is carried out by comparing the resulting IQ scores with the appropriate statistical norms located in the WISC-III (Wechsler, 1991) manual. Specific age-by-age values are provided for comparison; however, Kaufman (1994) further clarifies that a difference of 11 points and 15 points correspond with the .05 and .01 levels of statistical significance respectively. As a result, Kaufman strongly advocates that any discrepancy of 11 points or more for all ages should be considered a statistically significant difference.

Thirdly, further examination of the VIQ and PIQ discrepancy must be carried out to determine if the overall profile is interpretable based on these scores. If not, then it is recommended that the VCI and POI factor scales provide the basis for interpretation as they reflect a factorially purer measure of verbal and performance abilities. For the verbal scale, this determination involves evaluating if there is a significant difference between the VCI and FDI factor scores (13 or more points) as well as identification of abnormal scatter (7 or more points) among the five verbal subtests used to compute VIQ.

If either of these conditions is present, it is highly suggested that the VCI factor score should be interpreted as a measure of verbal functioning rather than VIQ. For the performance scale, the difference between the POI and PSI factor scores (15 or more points required) is evaluated along with analysis of the scatter (9 or more points required) among the subtests that comprise PIQ. Again, if either of these conditions is met, it is prudent to interpret the POI factor score as reflective of performance based functioning rather than the PIQ composite score. If there are no significant differences and subtest scatter is within normal limits, Kaufman suggests that VIQ and PIQ composite scores likely reflect the best estimate of overall functioning in each respective area.

Once the above determinations are made, a fourth question must be answered. Specifically, this question pertains to the magnitude of the verbal versus performance discrepancy. Kaufman proposes that determining whether or not a difference is abnormally large is an important component when analyzing and interpreting a profile of scores on the WISC-III (Wechsler, 1991). Kaufman states that a minimum of 19 points between verbal and performance intellectual functioning must be observed in order to conclude that the magnitude is abnormal.

Step five involves interpreting the meaning of the global verbal and performance scores in light of the results of the first four stages noted above. The central focus of this process is determining the meaning of the results from a clinical, theoretical, and numerical perspective. Essentially, this stage involves interpreting strengths and weaknesses based on the nature of observed statistical differences and fluctuations addressed in the first four steps.

Interpretation of the significant strengths and weaknesses among the subtests is the focus for the sixth step. Although there is considerable literature that does not support the analysis of subtest profiles (e.g., Cahan, & Cohen, 1988; McDermott, Fantuzzo, & Glutting, 1990; McDermott, Fantuzzo, Glutting, Watkins, & Baggaley, 1992; Watkins, 1999; Watkins & Worrell, 2000), Kaufman (1994) advocates an ipsative interpretation of subtest scores for individual profiles. This procedure involves computing separate mean scaled scores for the verbal and performance subtests. Next, each subtest score is compared with the mean score to determine a difference score. The results can then be compared with a table constructed by Kaufman based on values contained in the WISC-III (Wechsler, 1991). Kaufman suggests that a difference of 3 points on the verbal subtests and 4 points on the performance subtests can be used as a rule of thumb when making comparisons. Alternatively, a fairly common practice of using the group mean of 10 and standard deviation of 3 may be more appropriate in determining subtest strengths and weaknesses particularly when comparing large samples of individuals.

Lastly, Kaufman (1994) proposes that clinicians should generate hypotheses based on the fluctuations observed in the WISC-III (Wechsler, 1991) subtest profile. Accordingly, these hypotheses should guide the development and implementation of behavioral and educational strategies employed to help address any deficits observed.

Kaufman's (1994) approach to evaluating scores on the WISC-III provides a statistical basis for comparisons as well as an opportunity to exercise clinical judgment and hypothesis testing. Therefore, it appears to reflect both a quantitative and qualitative perspective regarding test interpretation specific to profile analysis. In light of the

considerable inconsistency in the literature regarding the use of profile analysis, this systematic practical approach appears to be a suitable method of profile analysis for this present study.

Intelligence Among Children and Adolescents Diagnosed with FAS and ARND

The WISC-R (Wechsler, 1974) has been utilized in a number of studies investigating children and adolescents diagnosed with FAS and alcohol-related effects. For example, Streissguth, Herman, and Smith (1978a) conducted one of the first investigations involving a group of children with FAS. This study specifically examined the relationship between the severity of dysmorphogenesis and intellectual functioning among 20 children with FAS ranging in age from 9 months to 21 years. All subjects exhibited visible signs of fetal alcohol exposure. Intelligence quotients were derived using either the Bayley Scales of Infant Development (Bayley, 1969), the Stanford-Binet, Form L-M (Terman & Merrill, 1960), the WISC-R (Wechsler, 1974), or the Wechsler Adult Intelligence Scale (Wechsler, 1955). The mean IQ was 65 with a range of 16 to 105. A total of 60% of the children had IQs two or more standard deviations below the mean. Furthermore, the results clearly indicated that the severity of dysmorphogenesis was related to IQ functioning. For instance, those subjects considered to have severe dysmorphogenesis had a mean IQ of 55.2. Individuals classified as moderate to severe evidenced a mean IQ of 58.2 whereas the mean IQ for those in the moderate and mild-moderate ranges was 68.3. Lastly, children considered to have mild to very mild dysmorphogenesis had a mean IQ of 81.8. These findings clearly indicated that the severity of dysmorphogenesis is predictive of the degree of intellectual impairment. In

addition, this study indicated that children who exhibited only mild morphological manifestations of FAS displayed significant intellectual impairments.

Shortly thereafter, Streissguth, Herman, and Smith (1978b) investigated the stability of intelligence among a clinical sample of 17 FAS patients. All patients were administered standardized, individual, age-appropriate intelligence tests including the Bayley Scales of Infant Development (Bayley, 1969), the Stanford-Binet Intelligence Scale, Form L-M (Terman & Merrill, 1960; Thorndike, 1972), the WISC (Wechsler, 1949), the WISC-R (Wechsler, 1974), and the Wechsler Adult Intelligence Scale (Wechsler, 1955).

The mean IQ score on test 1 for all subjects was 66 with a range of 15-99 and median of 68. Test 2 (retest interval ranged from 1-4 years) resulted in a mean IQ score of 67 with a range of 10-96 and median of 71. The median age of individuals on test 1 was 3 years 5 months and for test 2 the median age was 6 years 8 months. Overall, IQ scores for most of the subjects changed very little from test 1 to test 2. A total of 77 percent of scores on the second test remained within 1 standard deviation of test 1 scores. In sum, the authors concluded, on the basis of these findings, that the IQ level of individuals diagnosed with FAS is significantly lower than normals and remains relatively stable over time.

An intriguing study on behavior and learning difficulties in children of normal intelligence who were born to alcoholic mothers was carried out by Shaywitz et al. (1980). The sample consisted of 11 boys and 4 girls ranging from 6.5 to 18.5 years of age. There was a uniform distribution of at least two dysmorphic facial features, characteristic of FAS, among the sample. In terms of postnatal growth characteristics,

60% evidenced head circumference and height below the tenth percentile and 74% maintained weight below the twenty-fifth percentile. The Stanford-Binet Intelligence Scale, Form L-M (Terman & Merrill, 1960; Thorndike, 1972) and the WPPSI (Wechsler, 1967) were each employed on one occasion. The remaining children between the ages of 6 and 16 were assessed using the WISC (Wechsler, 1949) and those exceeding 16 years were administered the Wechsler Adult Intelligence Scale (Wechsler, 1955).

The mean FSIQ of the entire sample was 98.2 with scores ranging from 82-113. Examination of subtest performance on the Wechsler Scales revealed frequent high scores on Similarities, Comprehension, Object Assembly, and Block Design. Alternatively, low subtest scores were evident on Coding, Arithmetic, Digit Span, and Information. Statistical analysis on the subtest scores was not carried out.

Overall, the authors pointed out that fetal alcohol exposure resulted in dysmorphogenesis as well as central nervous system impairment in the form of behavioral and learning deficits. Although intellectual development was measured within the normal range of performance, these children experienced severe and debilitating learning problems and impaired behavioral and social functioning.

A brief description of intellectual functioning among 63 subjects with FAS ranging in age from 1 day to 23 years was reported by Iosub, Fuchs, Bingol, and Gromisch (1981). Several age-appropriate measures of intelligence were administered, including the Bayley Scales of Infant Development (Bayley, 1969), the Denver Developmental Screening Test (Frankenburg & Dodds, 1967), the Stanford-Binet Intelligence Scale, Form L-M (Terman & Merrill, 1960; Thorndike, 1972), and the Wechsler Intelligence Test (unspecified) as part of a battery examining speech

abnormalities, dysmorphogenesis, and maternal characteristics. Overall, IQs ranged from 50 to 97, however, most of the subjects had IQs between 65 and 70 and were classified as Mildly to Moderately Retarded. A total of 3 patients had an IQ of 50 and 14 of the 30 patients older than 3 years of age were classified as Mentally Retarded. Intellectual functioning, for the purpose of this study, was a descriptive measure of the sample under investigation and was not examined for significant relationships with other aspects of functioning.

In 1985, developmental, perceptual, and behavioral characteristics of children with FAS were examined in a sample of 21 Swedish children (Aronson, Kyllerman, Sabel, Sandin, & Olegard). The 11 boys and 10 girls ranged in age from 1.5 to 9 years and included 5 pairs of siblings. Their intellectual development was assessed using the Griffiths Mental Developmental Scales (Griffiths, 1970), and the WISC (Wechsler, 1949). A total of 13 case-control pairs were administered the Griffiths Mental Developmental Scales and 8 pairs were assessed using the WISC.

The 13 children with FAS, who were administered the Griffiths Mental Developmental Scales (Griffiths, 1970), had a mean IQ score of 92 ± 11 in comparison to the 13 controls in this group who had a mean IQ score of 111 ± 11. This difference of 1.7 standard deviations was significant at the $p < 0.001$ level. The 8 children with FAS who were given the WISC (Wechsler, 1949) had a mean IQ of 99 ± 13 in comparison to the 8 controls who evidenced a mean IQ of 114 ± 10. These scores differed by 1.5 standard deviations and were significant at the $p < 0.01$ level. Combined scores from the Griffiths and WISC for the FAS group resulted in a mean IQ of 95 ± 12 as compared to a score of

112 ± 10 for the combined controls. These scores were statistically significant at the $p < 0.001$ level.

Overall, the study group displayed significantly lower scores on IQ measures in comparison to the control group. Interestingly, there was no evidence for IQ differences between study group children who remained in their biological homes versus those raised in foster homes. As well, the study group exhibited severely disturbed visual and auditory perception. Behavioral characteristics of the study group included hyperactivity, attention deficits and perseverations.

In 1987 Aronson and Olegard studied the living environment, physical growth, and psychological development among children, adolescents, and adults who were prenatally exposed to alcohol. Specifically, the authors conducted a retrospective study, matched control study, and a prospective study in an effort to gather more information on this population. The retrospective study examined 99 individuals ranging in age from 2.5 years to 30 years. Data was gathered through examination of social security files, medical charts, observations from child and school health workers, and interviews conducted with social workers, psychologists, medical doctors, teachers, and nurses. The cognitive capacity of a total of 50 individuals involved in the study was measured through testing while the overall cognitive functioning of the remaining 45 individuals was estimated based on school performance. The specific tests used for the 50 individuals who were evaluated was not disclosed. Results from this portion of the study found that 50 (53.4%) individuals were classified as normal, 33 (34%) were diagnosed with borderline mental retardation, while the remaining 12 (12.6%) were diagnosed with

mild to severe mental retardation. It was further noted that the mothers' cognitive functioning was significantly higher as compared to their offspring.

The matched control study focused on cognitive and motor skills development of 12 males and 11 females. In particular, the intellectual functioning of the children was assessed using the Griffiths Mental Development Scales (Griffiths, 1970) and the WISC (Wechsler, 1949). Results from this investigation indicated that the study group demonstrated significantly lower performance on the above noted measures as compared to the control group.

The prospective study described in this research paper focused on 26 children who were divided into groups dependent upon the duration of alcohol consumption reported by their biological mother while pregnant. Five of the mothers ceased alcohol consumption prior to the 12th week of gestation. A total of 7 mothers stopped using alcohol midway through their pregnancy, whereas the remaining 13 women continued to abuse alcohol throughout the pregnancy. Again, the children were assessed using the Griffiths Mental Development Scales (Griffiths, 1970) and the WISC (Wechsler, 1949) in addition to a number of tests of visual motor coordination and perception. The results suggested that children who were exposed to alcohol during the second and third trimesters demonstrated significantly more difficulties with cognitive and behavioral functioning. In addition, those children who were exposed to alcohol throughout the pregnancy had more physical health problems including growth deficits. Alternatively, children whose mother stopped drinking prior to the 12th week of gestation had normal physical growth and cognitive development at 18 and 36 months of age. It was concluded from this study that increased presence of physical health difficulties, such as

abnormal growth, was highly related to poorer performance on measures of cognitive functioning, visual perception, as well as motor performance.

Neuropsychological deficits were the focus of investigation among a clinical sample of 19 school-aged Native children diagnosed with FAS and FAE (Conry, 1990). Subjects were compared with age- and sex-matched controls on a number of measures including the WPPSI (Wechsler, 1967), WISC-R (Wechsler, 1974), WAIS-R (Wechsler, 1981), and a number of achievement and neuropsychological measures. The 13 subjects diagnosed with FAS, ranging in age from 5.2 - 18.5 years, had a mean IQ score of 60.1. Alternatively, the 6 subjects with FAE, ranging in age from 5.2 - 15.8 years, had a mean IQ score of 86. The combined range of IQ scores for individuals with FAS and FAE was 40-101. Results from this investigation proved consistent with previous findings in terms of the distribution of IQ scores found among populations with FAS and FAE.

In 1990, Streissguth et al. examined the effects of moderate prenatal alcohol exposure on intelligence and learning problems among children ranging from 6.5 to 8.5 years of age with a mean of 7.5 years. The results of this study are reported as part of the Seattle Longitudinal Prospective Study on Alcohol and Pregnancy that was initiated in 1974 by Streissguth and colleagues. The method of assessment included the WISC-R (Wechsler, 1974) in combination with measures of achievement and neuropsychological functioning. The sample size consisted of 482 children who were divided into two groups based on the estimated average ounces of absolute alcohol per day (AAD) of exposure. The group of heavier drinkers (AAD $\geq$ 1) had a mean and median AAD of 1.7 and 1.3 ounces respectively whereas the infrequent drinkers (AAD < 1) had a mean and median AAD of 0.16 and 0.03 ounces. The mean IQ score for the entire sample was

107.6 ± 14.4. Further analysis of these data clearly indicated that the IQ scores (FSIQ, VIQ, and PIQ) of children in the group of heavier drinkers, who were exposed to more than 1 ounce of alcohol per day during midpregnancy, had a mean IQ 6.7 points lower than children exposed to less than 1 ounce of alcohol per day (infrequent group of drinkers). Results from this study further identified two variables, lower father education and increased number of children in the household, as indicators of lower IQ functioning among the offspring of mothers who consume alcohol during pregnancy. Streissguth et al. (1990) also reported lower scores on the Arithmetic and Digit Span subtests of the WISC-R among those children exposed to higher levels of alcohol.

Both the WISC-R (Wechsler, 1974) and the WAIS-R (Wechsler, 1981) were employed in a study of adolescents and adults diagnosed with FAS and FAE (Streissguth, Aase et al., 1991). The sample consisted of 61 subjects (38 males and 23 females) ranging in age from 12 to 40 years. Forty-three were adolescents ranging in age from 12 to 17 years whereas the remaining 18 patients were adults ranging from 18 to 40 years. The average IQ for the entire sample was 68 and scores ranged from 20 to 105. A total of 58% of the patients had an IQ score of 70 or below. Further analysis indicated that those patients with FAS evidenced a mean IQ score of 66 as compared to those diagnosed with FAE who had a mean IQ of 73. For both the group with FAS and the group with FAE, the mean verbal scale IQ was approximately 10 points lower than the performance IQ score.

A test-retest study of intelligence among individuals diagnosed with FAS and FAE was carried out by Streissguth, Randels et al. (1991). The sample consisted of 40 patients, 24 males and 16 females. The mean age at test 1 was 8 years 4 months with a

range of 6-12 years of age. Mean age at test 2 was 16 years 7 months with a range of 13 to 31 years of age. Overall, the mean test-retest interval for the subjects with FAS (N=27) and the subjects with FAE (N=13) was 9 and 7 years respectively. The majority of subjects were administered the WISC-R (Wechsler, 1974) for test 1 and the WAIS-R (Wechsler, 1981) for test 2. However, in some instances patients were first administered the Stanford-Binet Intelligence Scale, Form L-M (Terman & Merrill, 1960) or the Wechsler Adult Intelligence Scale (Wechsler, 1955).

The 27 patients with FAS (mean age of 8 years) had a mean IQ score of 66 $\pm$ 17.7 with a range of 29-105 on the first assessment. At the second testing, 8.9 years later (mean age of 16.9 years), the mean IQ for the group was 66.7 $\pm$ 15.7 with a range of 20-91. The 13 subjects diagnosed with FAE (average age of 9 years) had a mean IQ score of 79.5 $\pm$ 15.9 with a range of 56-101 on the first assessment. The mean IQ score 6.9 years later at the second testing (average age of 16 years) was 82.2 $\pm$ 15.4 with a range of 65-114.

Results of these data indicate that the test-retest stability for IQ among adolescents and adults with FAS and FAE is relatively high, and that tests administered during childhood should maintain good predictive validity for intellectual functioning throughout adolescence and adulthood. As well, the authors pointed out that these results were consistent for both genders.

The investigation of language development among American Indian children with FAS was the focus of a study conducted by Carney and Chermak (1991). The specific purpose of this investigation was to examine the expressive and receptive language functioning of American Indian children with FAS. The FAS group was comprised of 10

American Indian children with a mean age of 9.6 years. The reported mean on the FSIQ, as measured by the WISC-R (Wechsler, 1974), was 79 with a range of 50-91. Further analysis of these scores was not reported nor did the authors employ the results from the WISC-R in their statistical analysis of expressive and receptive language functioning. Results of the analysis of language functioning strongly suggested that older children with FAS incurred difficulties primarily in the area of syntax whereas the younger children with FAS displayed more global language deficits.

Intellectual functioning for a sample of 149 individuals, diagnosed with FAS and FAE, was examined by LaDue, Streissguth, and Randels (1992). Their ages ranged from 12 to 42 with a mean of 18.4 years. A total of 77% of the sample were American Indian, 20% were white, and 3 % were black. Eighty-two of the participants were administered the WISC-R (Wechsler, 1974) while the remaining 67 were assessed using the WAIS-R (Wechsler, 1981). The mean FSIQ for the entire sample was 70 with a range of 20 to 108. As well, the investigators reported a mean VIQ and PIQ of 65 and 79 respectively. Further analysis of these date revealed that 33% had a PIQ Minus VIQ discrepancy of 20 points or more and this pattern of results was observed for both the FAS and ARND groups.

A study of FAS and FAE among twins born of alcoholic mothers was reported by Streissguth and Dehaene (1993). A total of 16 pairs of twins, 5 monozygotic and 11 dizygotic, were evaluated using either the WAIS-R (Wechsler, 1981), the WISC-R (Wechsler, 1974), the Stanford-Binet Intelligence Scale, Form L-M (Terman & Merrill, 1960), the French translation of the Terman-Merrill, Form L (Terman & Merrill, 1960), the Bayley Scales of Infant Development (Bayley, 1969), or the Brunet-Lezine Scales

(unspecified). The age range of this sample was 2 to 30 years and all were heavily exposed to alcohol prenatally. A total of 12 subjects (4 monozygotic and 8 dizygotic) were diagnosed with FAS and had a mean IQ score of 69.6. Alternatively, 7 were diagnosed with FAE and had a mean IQ score of 93. Lastly, the remaining 10 subjects diagnosed with Prenatal Exposure to Alcohol (no diagnosis) had a mean FSIQ score of 91.7. The within-pair average IQ discrepancy for monozygotic twins was 5 IQ points while dizygotic twins had an average discrepancy of 11 IQ points.

The authors pointed out that there was some variability in the degree of impairment among alcohol-exposed offspring. Clearly, not all offspring exposed to alcohol were affected in this study nor did every functionally disabled subject exhibit the physical characteristics of FAS. Overall, monozygotic twins were more concordant for diagnosis and were more similar in terms of IQ in comparison to dizygotic twins.

Caruso and ten Bensel (1993) reported on a review of 46 patients examined at the University of Minnesota Hospital and Clinic who were identified as having prenatal alcohol exposure. A total of 38 were diagnosed with FAS and 7 were classified as having FAE. A large percentage of these children, who were evaluated late in childhood or adolescence, reported significant behavioral and social problems. Twenty-seven were identified with mental retardation or developmental delay. The mean intelligence score for 15 of the children with FAS, as measured by the WAIS-R (Wechsler, 1974), was 69.7. This report was clearly descriptive in nature and did not provide further information concerning scores on the VIQ or PIQ scales.

The long-term psychopathological and intellectual outcome of children with FAS was investigated by Steinhausen et al. (1993). Psychological examination included the

CMMS (Burgemeister et al., 1972), the WPPSI (Wechsler, 1967), and the WISC-R (Wechsler, 1974). The collection of data for this longitudinal study took place between 1977 and 1991.

At the first period of assessment, subsample A (N=15), which was comprised of preschool children and a small number of early school-aged children, had a mean age of 64.1 months with a range of 45-95 months. A total of 7 (46.7%) individuals scored between 86 and 115. The remaining 8 (53.3%) obtained IQ scores between 71 and 85. The second assessment period for subsample A took place during middle childhood at a mean age of 104.9 months and a range of 84-154 months. A total of 5 (33.3%) individuals scored between 86 and 115, whereas 9 (60%) had IQ scores between 71 and 85. The 1 (6.9%) remaining individual's IQ score fell between 51 and 70.

Subsample B (N=16) was comprised primarily of preschool-aged children and included a small percentage of early school-aged children at their first assessment period. The mean age at this assessment was 65.5 months with a range of 48-95 months. A total of 7 (43.8%) individuals scored between 86-115 on the measure of IQ. Alternatively, 6 (37.5%) individuals scored between 71-85 whereas 3 (18.8%) performed between 51-70. At follow-up, subsample B was mainly comprised of adolescents with a mean age of 180.7 months and a range of 154-234 months. Intelligence scores were more diverse with 5 (31.3%) individuals falling between 86-115, 5 (31.3%) between 71 - 85, 4 (25%) between 51-70, and the remaining 2 (12.5%) between 36 and 50.

Individuals comprising subsample C (N=31) were initially assessed during middle childhood and had a mean age of 118.4 months with a range of 84-155 months. A total of 10 (32.3%) individuals had IQs between 86-115, 14 (45.2%) between 71-85, 6 (19.4%)

between 51-70, and 1 (3.2%) between 36-50. Follow-up assessment of this subsample took place during adolescence with a mean age of 157.7 and a range of 123-229. Eleven (35.5%) adolescents had an IQ score between 86-115, 15 (48.4%) between 71-85, 4 (12.9%) between 51-70, and 1 (3.2%) between 36-50.

Steinhausen et al. (1993) further noted that a number of individuals were not testable due to severe mental retardation and were subsequently excluded from the study. Overall, the authors concluded that there was substantial evidence of the extensive, long-term behavioral and intellectual impairments incurred by individuals diagnosed with FAS.

The correlates of psychopathology and intelligence, among children diagnosed with FAS, was the focus of a study conducted by Steinhausen, Willms, and Spohr (1994). The data utilized in the study was a subset taken from a cohort of 158 children diagnosed with FAS between 1977 and 1991. A total of 48 preschool aged and 68 school aged children were employed in this study. The mean age of the preschool aged children was 65.4 months while the mean age for the school aged children was 134.3 months. Each child underwent a psychiatric assessment and a total of 51 children, with a mean age of 113.6 months, completed intelligence testing. The psychiatric assessments were based on structured interviews for preschool children (Richman & Graham, 1971) as well as school aged children (Rutter, Tizard, & Whitmore, 1970). The psychological tests employed in this study included the CMMS (Burgemeister et al., 1972), WPPSI (Wechsler, 1967), and the WISC-R (Wechsler, 1974). Results of these measures of intellectual functioning were based on German standardization.

Those classified as suffering from mild morphological damage (N = 24) had a mean IQ score of 81.3 while those suffering from moderate morphological damage (N = 17) had a mean IQ score of 76.1. Furthermore, those classified as suffering from severe morphological damage (N = 8) demonstrated a mean IQ score of 59.4. In terms of milieu, children residing with their biological parents (N = 16) had a mean IQ score of 82.9 whereas those living with foster or adoptive parents (N = 13) had a mean IQ score of 80.8. Institutionalized children (N = 6) had the lowest IQ score of 51.3 while those who experienced various changes of milieu (N = 15) had a mean score of 77.2. With regard to gender, males (N = 31) demonstrated a mean IQ score of 74.5 while females (N = 20) had a mean score of 79.7.

A number of conclusions were drawn from this study. The authors observed that the severity of morphological damage was positively related to increased psychopathology. Specifically, it was noted that children who demonstrated more severe morphological damage were more likely to suffer from problems such as enuresis, encopresis, speech disorders, and depression. In terms of milieu, those children who were residing in an institutional setting also suffered from increased psychopathology including the presence of speech disorders, depression, dependency problems, relationship problems, conduct disorders, and hyperkinetic disorders. In addition, males were found to be at increased risk for developing psychopathology and moderately to severely mentally retarded children had far more psychiatric problems than those who were mildly mentally retarded. More specifically, children who demonstrated intellectual functioning below 50 had a significant number of psychiatric problems at preschool age

including speech disorders, eating disorders, depression, dependency problems, and hyperkinetic disorders.

Kopera-Frye and Zielinski (1995) carried out a study examining the patterns of performance on tests measuring intellectual and visual motor abilities. The sample consisted of 64 children ranging between 5 to 12 years of age with a mean age of 8.2 years. A total of 14 children, with a mean age of 9.2 years, comprised the group diagnosed with FAS. Fifty children, with a mean age of 7.9 years, were diagnosed with possible fetal alcohol effect. Fifty-seven percent of the FAS group were male while 54% of the FAE group were male. The mean grade level for the FAS and FAE groups was 2.8 and 1.8 years respectively. A total of 78.6% of the FAS group were Caucasian while 60% of the FAE group were Caucasian.

The subjects in this investigation were administered either the WPPSI-R (Wechsler, 1989) or the WISC-R (Wechsler, 1974) depending upon their age. All children were given the Bender Gestalt Test of Visual Motor Ability and the results were based upon the Kippitz (1964) scoring system. The FSIQ for the entire sample ranged from 50 to 142 with a mean score of 90.7. The mean score on the PIQ scale for the sample was 94.5 while the mean VIQ score was 88.7. As for visual motor abilities, the mean score on the Bender was 82.7 and results of the emotional indicator summary scores ranged from 1to 8 with a mean of 3.7.

Further breakdown of the scores revealed a mean FSIQ score of 79.1 for the FAS group. Mean PIQ and VIQ functioning for the FAS group was 82.4 and 79.4 respectively. The mean Developmental Error Summary Score on the Bender for the FAS group was 10.2. In addition, the mean Developmental Standard Score as well as

Emotional Indicator Error Summary Score for the FAS group was 80.0 and 3.4 respectively. Alternatively, the FAE group mean FSIQ was measured at 93.9. Mean PIQ and VIQ functioning for the FAE group was 97.8 and 91.3 respectively. In terms of visual motor functioning, the mean Developmental Error Summary Score for the FAE group was 9.5. The mean Developmental Standard Score for the FAE group was 83.8 while the mean Emotional Indicator Error Summary Score for the FAE group was 3.8.

Comparison of mean FSIQ, PIQ, and VIQ functioning between the FAS and FAE groups resulted in statistically significant findings. In other words, the FAE group performed significantly better on the FSIQ, VIQ, and PIQ scales as compared to the FAS group. However, no significant differences were observed between the two groups on the Bender. The authors concluded that reliance on one specific test, such as a measure of intelligence, for quantifying the degree of cognitive impairment and decision-making may result in misleading conclusions.

In 1997, Kerns, Don, Mateer and Streissguth examined the performance of nonretarded adults diagnosed with FAS on measures of intellectual functioning, academic achievement as well as tests of attention, memory and learning, and executive functioning. The sample size consisted of 7 men and 9 women, ranging in age from 16 to 27, who were divided into two groups. Eight individuals comprised the average to above average IQ group while the remaining 8 participants fell within the borderline to low average IQ range. The WISC-R (Wechsler, 1974) and the WAIS-R (Wechsler, 1981) were employed as measures of intellectual functioning. However, it was not indicated how many of the participants were administered the WISC-R versus the WAIS-R. In addition, the authors employed a variety of tests to measure aspects of attention and

concentration, memory, and executive functioning. Specifically, the Wide Range Achievement Test – Revised (WRAT-R; Jastak & Jastak, 1978), the California Verbal Learning Test (CVLT; Delis, Kramer, Kaplan, & Ober, 1987; Delis, Freeland, Kramer, & Kaplan, 1988), the Brown-Peterson Consonant Trigrams Task of Auditory Memory (CTT; Brown, 1958; Peterson & Peterson, 1959), the APT Test (Mateer, Sohlberg, & Barber, 1990), the Controlled Oral Word Association Test (COWAT; Benton, 1968; Benton & Hamsher, 1976), and the Ruff Figural Fluency Test (RFF; Ruff, 1988).

Results from the intellectual assessment for the average IQ group indicated a mean FSIQ of 97.13 with a range of 90-118. The mean VIQ and PIQ scores were 100 (88-118) and 95.25 (88-114) respectively. Alternatively, the below average IQ group had a mean FSIQ score of 75 and ranged from 70-86. The mean PIQ score was 81.5 with a range of 74 to 102 whereas the mean VIQ score was 72.5 ranging from 65-79. In terms of academic achievement, attention, verbal memory and learning ability, and executive functioning, both the average IQ and below average IQ groups performed lower than expected given their overall measured intellectual functioning. As expected, the below average IQ group demonstrated more significant deficits on these additional measures as compared to the average IQ group, however, the discrepancies revealed further deficits that were not identified through the sole use of an intelligence test. The authors highlight the importance and advantage of employing a comprehensive test battery when assessing the overall cognitive abilities of individuals who have been prenatally exposed to alcohol.

Assessment of general intellectual functioning in children with histories of heavy prenatal alcohol exposure, both with and without physical features, was carried out by Mattson et al. (1997). A total of 47 children with fetal alcohol exposure and 47 control

subjects, matched for age, sex, and ethnicity, were included in the study. Thirty-four of the children with fetal alcohol exposure were diagnosed with FAS whereas the remaining 13 did not evidence the characteristic pattern of facial features nor prenatal or postnatal growth deficiency that support a diagnosis of FAS. For the purposes of the study, this group was referred to as the PEA group. The mean age of the normal control, prenatal exposure to alcohol, and FAS groups were 8.6, 8.5, and 8.5 years respectively.

The mean FSIQ scores, based on the WPPSI-R (Wechsler, 1989) and the WISC-R (Wechsler, 1974), for the normal control, PEA, and FAS groups were 109.0, 83.6, and 74.4 respectively. Detailed examination of scores via use of Newman-Keuls tests indicated that IQ scores for the FAS and prenatal exposure to alcohol groups were both significantly different from the normal control group as well as from each other ($p < 0.05$).

A total of 23 (48.9%) subjects from the normal control group had IQ scores greater than or equal to 110, 21 (44.7%) fell between 90-109, and 3 (6.4%) fell between 70-89. Alternatively, 1 (7.7%) individual in the PEA group obtained a score ≥ 110, 4 (30.8%) fell between 90-109, 5 (38.5%) fell between 70-89, and 3 (23%) were ≤ 69. Lastly, 4 (30.8%) individuals in the FAS group had IQ scores between 90-109, 5 (38.5%) were between 70-89, and the remaining 11 (32.4%) were ≤ 69.

Further breakdown of these data revealed mean normal control, PEA, and FAS VIQ scores of 107.4, 83.5, and 75.3 respectively. Alternatively, mean PIQ scores for the normal control, PEA, and FAS groups were 108.3, 86, and 77.9 respectively. The Newman-Keuls tests on both the VIQ and PIQ scales indicated a significant difference

between the normal control group and the PEA and FAS groups ($p < 0.05$); however, there was no significant difference between the two fetal alcohol-exposed groups.

Mattson et al. (1997) also examined group differences on subtest scores separately for both those who were administered the WPPSI-R (Wechsler, 1989) as well as for those given the WISC-R (Wechsler, 1974). For the WPPSI-R, Newman-Keuls tests indicated that the normal control group scores were significantly higher than the two alcohol-exposed groups ($p < 0.05$) on each of the subtests excluding Comprehension, Picture Completion, Sentences, and Similarities. The prenatal exposure to alcohol and FAS subtest scores did not differ significantly. Alternatively, Newman-Keuls tests performed on the group of scores obtained from the WISC-R, indicated that the normal control group performed significantly better than the FAS group on all measures. As well, the normal control group differed from the prenatal exposure to alcohol group on all subtests except Similarities, Object Assembly, and Mazes. Differences between the prenatal exposure to alcohol and FAS group were evidenced on all subtests excluding Similarities, Vocabulary, and Digit Span.

Overall, results of this study indicate that all children exposed to heavy drinking during pregnancy, including those that do not exhibit the characteristic facial features and growth deficiencies associated with FAS (e.g., PEA group), are subject to a high risk of intellectual impairment.

A study examining the long-term behavioral, intellectual, and psychopathological outcome of children diagnosed with FAS was conducted by Steinhausen and Spohr in 1998. The sample size for this study was 70 individuals drawn from a total of 158 children who comprised a longitudinal project carried out in Germany beginning in the

early 1970's. All of the children involved in the study suffered from a formal diagnosis of FAS. However, the duration of time between assessments was not specified. A number of measures were employed in this investigation including structured psychiatric interviews for preschool children (Richman & Graham, 1971) and for school-aged children (Rutter et al., 1970). In addition, the Child Behavior Checklist (CBCL; Achenback, 1978) was also employed. As a measure of intellectual functioning, the CMMS (Burgemeister et al., 1972), the WPPSI (Wechsler, 1967) and the WISC-R (Wechsler, 1974) were administered.

The results of these measures of intellectual functioning were based on German standardization. Of particular interest is the overall measured level of intellectual functioning upon retesting as compared to initial assessment. Upon follow-up, 20 (28.5%) individuals obtained an IQ score between 86 and 115, 27 (38.5%) scored between 71 and 85, 9 (12.8%) fell between 51 and 70, 6 (8.5%) performed between 36 and 50, 3 (4.2%) obtained a score ranging between 21 and 35, while 5 (7.1%) individuals had an IQ score below 20. As compared to their initial intellectual assessment, most of the children's IQ score remained stable. However, a total of 5 children improved whereas 15 demonstrated lower intellectual performance upon retesting.

In terms of mental health and behavior, the results indicated that many psychiatric disorders among children diagnosed with FAS tend to persist over time. Namely, sleep disorders, emotional disorders, abnormal behaviors, conduct disorders, as well as hyperkinetic disorders were prevalent upon reassessment. The most pervasive problem was hyperkinetic disorders followed by social and interpersonal difficulties. Results

further suggested that enuresis, encopresis, and eating disorders tended to remit over time.

Thomas et al., (1998) focused their investigation on the social abilities of children diagnosed with FAS. The intellectual functioning among the children in this study was assessed using either the WISC-R (Wechsler, 1974) or the WISC-III (Wechsler, 1991). However, it was not specified as to the number of children who received the revised version versus the third edition. To measure social abilities, the social skills domain from the Vineland Adaptive Behavior Scales (VABS; Sparrow, Balla, & Cicchetti, 1984) was administered.

A total of 45 children aged 5 years 11 months to 12 years 11 months were divided into one of three groups. The first group was comprised of 15 children diagnosed with FAS who demonstrated a mean VIQ score of 76.8, a mean PIQ score of 75.5, and a mean FSIQ score of 74.3. The second group of 15 children was compiled of children who suffered from low cognitive functioning who were not exposed to alcohol in utero. The mean VIQ score for this group was 77.7 while the mean PIQ score was 80.2. In addition, the mean FSIQ score was 77.2. The third and final group was made up of normal controls who had a mean VIQ and PIQ score of 111.7 and 112.3 respectively. The mean FSIQ score for this latter group was 113.2.

Results from this study indicated that, over time, the social skills deficits among individuals diagnosed with FAS become more pronounced. Overall, it was concluded that children with FAS have more social kinds of problems than other children with the same or greater level of cognitive functioning.

A follow-up study of 24 children born to alcoholic mothers, ranging in age from 11.5 to 14 years, was the focus of an investigation carried out by Aronson and Hagberg (1998). The sample consisted of 16 boys and 10 girls who were part of an ongoing broader study. The children were divided into one of four groups depending upon the duration of alcohol consumption during gestation reported by their mother. The first group consisted of 2 boys and 3 girls whose mother reportedly ceased consumption of alcohol sometime between weeks 5 and 12. Group 2 was comprised of 6 boys and 1 girl who were reportedly exposed to alcohol for approximately the first 20 to 25 weeks. The mothers of the 5 boys and 4 girls in group 3 continued to abuse alcohol throughout pregnancy. Furthermore, the mothers who gave birth to the children in group 4 (3 boys and 2 girls) were not followed throughout their pregnancy but were added to the study as their was a confirmed history of maternal alcohol consumption throughout pregnancy.

All but one child was administered the WISC-R (Wechsler, 1974) sometime between the age of 11.5 and 14 years and the results were compared with the Griffiths Mental Developmental Scales (Griffiths, 1970) that was carried out several years prior. Four of the children were classified as mildly mentally retarded upon retesting with the WISC-R and their scores ranged from 51 to 70. The remaining 19 children had IQ scores of 73 or greater with a mean IQ of 91. Overall, the authors concluded that there was a clear relationship between the level of cognitive functioning and duration of exposure to alcohol in utero.

Table 1 provides a chronological summary of the studies that primarily examine intellectual functioning among children and adolescents suffering from fetal alcohol

exposure. The summary includes the authors, tests employed, age, sample size, diagnosis as well as results from the measures of intellectual functioning.

Table 1

Summary of Intellectual Functioning Among Children and Adolescents Prenatally Exposed to Alcohol as Reported in the Literature

Authors	Tests	Age	Sample Size	Mean IQ	IQ Range
Streissguth, Herman, & Smith (1978a)	Bayley Scales Stanford-Binet WISC-R WAIS	9 mo – 21 yrs	20 (FAS)	65 (FSIQ)	16-105
Streissguth, Herman, & Smith (1978b)	Bayley Scales Stanford-Binet WISC WISC-R WAIS	3 mo, 5 yrs (Test 1) 6 mo, 8 yrs (Test 2)	17 (FAS) 17 (FAS)	66 (FSIQ) 67 (FSIQ)	15-99 10-96
Shaywitz, Cohen, & Shaywitz (1980)	Stanford-Binet WPPSI WISC WAIS	6.5-18.5 yrs	15 (PEA)	98.2 (FSIQ)	82-113
Iosub, Fuchs, Bingol, & Gromisch (1981)	Bayley Scales Denver Scales Stanford-Binet Wechsler Scales	1 day-23 yrs	63 (FAS)	Not Reported	50-79

Table 1 Continued

Authors	Tests	Age	Sample Size	Mean IQ	IQ Range
Aronson, Kyllerman, Sabel, Sandin, & Olegard (1985)	Griffiths WISC	1.5-9 yrs	21 (FAS) 13 (FAS – Griffiths) 8 (FAS – WISC)	95 ± 12 (FSIQ) 92 ± 11 (FSIQ) 99 ± 13 (FSIQ)	Not Reported Not Reported Not Reported
Aronson & Olegard (1987)	Not Reported	2.5-30 yrs	99 (PEA)	53.4% (Average) 34% (Borderline) 12% (Mild to Severe)	Not Reported Not Reported Not Reported
Conry (1990)	WPPSI-R WISC-R WAIS-R	5.2-18.5 yrs 5.2-18.5 yrs	13 (FAS) 6 (FAE)	60.1 (FSIQ) 86 (FSIQ)	Not Reported Not Reported
Streissguth, Bar, & Sampson (1990)	WISC-R	6.5-8.5 yrs	482 (PEA)	107.6±14.4 (FSIQ)	Not Reported
Streissguth, Aase, Clarren, Randels, LaDue, & Smith (1991)	WISC-R WAIS-R	12-40 yrs	61 (FAS & FAE) FAS Group FAE Group	68 (FSIQ) 66 (FSIQ) 73 (FSIQ)	20-105 Not Reported Not Reported
Streissguth, Randels, & Smith (1991)	WISC-R WAIS-R Stanford-Binet WAIS	8 yrs (Test 1) 16.9 yrs (Test 2) 9 yrs (Test 1) 16 yrs (Test 2)	27 (FAS) 27 (FAS) 13 (FAE) 13 (FAE)	66±17.7 (FSIQ) 66.7±15.7 (FSIQ) 79.5±15.9 (FSIQ) 82.2±15.4 (FSIQ)	29-105 20-91 56-101 65-114

Table 1 Continued

Authors	Tests	Age	Sample Size	Mean IQ	IQ Range
Carney & Chermak (1991)	WISC-R	9.6 yrs	10 (FAS)	79 (FSIQ)	50-91
LaDue, Streissguth, & Randels (1992)	WISC-R WAIS-R	18.4 yrs	149 (FAS & FAE)	70 (FSIQ) 65 (VIQ) 79 (PIQ)	20-108 Not Reported Not Reported
Streissguth, & Dehaene (1993)	WAIS-R WISC-R Stanford-Binet Terman-Merril Bayley Scales Brunet Lezine	2-30 yrs	12 (FAS) 7 (FAE) 10 (PEA)	69.6 (FSIQ) 93 (FSIQ) 91.7 (FSIQ)	Not Reported Not Reported Not Reported
Caruso & ten Bensel (1993)	WAIS-R	Not Reported	15 (FAS)	69.7 (FSIQ)	Not Reported
Steinhausen, Willms, & Spohr (1993)	CMMS WPPSI WISC-R	64.1 mo (Test 1) 104.9 mo (Test 2) 65.5 mo (Test 1) 180.7 mo (Test 2) 118.4 mo (Test 1) 157.7 mo (Test 2)	15 (FAS) 15 (FAS) 16 (FAS) 16 (FAS) 31 (FAS) 31 (FAS)	Not Reported Not Reported Not Reported Not Reported Not Reported Not Reported	71-115 51-115 51-115 36-115 36-115 36-115

Table 1 Continued

Authors	Tests	Age	Sample Size	Mean IQ	IQ Range
Steinhausen, Willms, & Spohr (1994)	CMMS WPPSI WISC-R	113.6 mo	24 (Mild Dysmorphology) 17 (Mod. Dysmorphology) 8 (Severe Dysmorphology)	81.3 (FSIQ) 76.1 (FSIQ) 59.4 (FSIQ)	Not Reported Not Reported Not Reported
Kopera-Frye & Zelinski (1995)	WPPSI-R WISC-R	9.2 yrs	14 (FAS)	79.1 (FSIQ) 79.4 (VIQ) 82.4 (PIQ)	Not Reported Not Reported Not Reported
		7.9 yrs	50 (FAE)	93.9 (FSIQ) 91.3 (VIQ) 97.8 (PIQ)	Not Reported Not Reported Not Reported
			64 (FAS & FAE)	90.7 (FSIQ) 88.7 (VIQ) 94.5 (PIQ)	50-142 Not Reported Not Reported
Kerns, Don, Mateer, & Streissguth (1997)	WISC-R WAIS-R	16-27 yrs	8 (FAS)	97.1 (FSIQ) 100 (VIQ) 95.2 (PIQ)	90-118 88-118 88-114
			8 (FAS)	75 (FSIQ) 72.5 (VIQ) 81.5 (PIQ)	70-86 65-79 74-102

Table 1 Continued

Authors	Tests	Age	Sample Size	Mean IQ	IQ Range
Mattson, Riley, Gramling, Delis, & Jones (1997)	WPPSI-R WISC-R	8.5 yrs	34 (FAS) 13 (PEA)	74.4 (FSIQ) 75.3 (VIQ) 77.9 (PIQ) 83.6 (FSIQ) 83.5 (VIQ) 86 (PIQ)	Not Reported Not Reported Not Reported Not Reported Not Reported Not Reported
Steinhausen & Spohr (1998)	CMMS WPPSI WISC-R	Not Reported	65 (FAS) 5 (FAS)	Not Reported Not Reported	21-115 Below 20
Thomas, Kelly, Mattson, & Riley (1998)	WISC-R WISC-III	5 -11 to 12-11 yrs	15 (FAS)	74.3 (FSIQ) 76.8 (VIQ) 75.5 (PIQ)	Not Reported Not Reported Not Reported
Aronson & Hagberg (1998)	WISC-R	11.5 – 14 yrs	19 (PEA) 4 (PEA)	91 (FSIQ) Not Reported	73+ 51-70

Summary

Review of empirical findings provides increased awareness of research methodology, sample sizes, and measures of intellectual functioning utilized in the area of diagnosing central nervous system impairment among individuals with FAS and alcohol-related effects. In addition, this review clearly indicates that the assessment of intellectual functioning has played a significant role in a variety of investigations involving samples of children and adolescents with FAS and alcohol-related effects. However, a number of shortcomings can be readily identified. First, many of the studies report results based upon a very limited number of participants. Secondly, the majority of studies do not restrict their investigation to a clearly delineated age range and, instead, draw conclusions based on samples that include infants, children, adolescents, and adults.

Furthermore, as a result of employing such a broad range of participants, many investigators are required to utilize a wide variety of intellectual measurement instruments that further complicates the analysis as well as generalizability of findings. In addition, it appears that the analysis of IQ scores varies considerably across studies. For example, several studies (e.g., Steinhausen et al., 1993) extensively described the range of FSIQ scores obtained whereas the majority simply report the mean FSIQ for the various groups under investigation. In particular, only 7 studies (Kopera-Frye, & Zelinski,1995; Kerns et al., 1997; LaDue et al., 1992; Mattson et al., 1997; Shaywitz et al., 1980; Streissguth et al., 1990; Thomas et al., 1998) investigated beyond FSIQ and reported scores on the VIQ and PIQ scales as well as individual subtest scores. More specifically, only one study to date (Mattson et al., 1997) has employed statistical analysis to investigate score profiles on an intelligence test, namely the WISC-R

(Wechsler, 1974). Therefore, there appears to be sufficient rationale for further exploration of intellectual functioning among children and adolescents, particularly with respect to the WISC-III (Wechsler, 1991).

Chapter Three

Method

This section describes the various components comprising the method of investigation including: (1) rationale for the present study, (2) research questions and hypothesis, (3) sample, (4) ethical approval, (5) the content and psychometric properties of the WISC-III (Wechsler, 1991), and (6) the method of data analysis.

Rationale for the Present Study

As previously discussed in the introduction of this manuscript, the investigation of intellectual functioning has played a significant role in the detection of cognitive deficits among individuals prenatally exposed to alcohol. This current investigation solely examined the performance of children and adolescents diagnosed with FAS and ARND for three primary reasons. First, although the WISC-III (Wechsler, 1991) has been employed by clinicians and researchers for approximately the past 10 years, it has only been cited in the literature on two occasions with reference to children and adolescents prenatally exposed to alcohol (Mattson et al., 1999; Thomas, et al, 1998). Furthermore, the results of these two studies provided limited insight regarding the performance of children and adolescents with FAS and ARND.

Secondly, given the retrospective nature of this present study, it was extremely difficult to acquire a large sample of children and adolescents with a diagnosis of FAS and ARND who were administered the WISC-III (Wechsler, 1991). Due to differing age norms for various measurement instruments and varying test battery selection methods, analysis of additional measures of cognitive functioning would have further reduced the sample size and would have created a number of methodological problems prevalent in

the literature that this study was attempting to overcome. Specifically, examination of the available cases that were included in this study revealed the presence of a number of different measures of achievement, behavioral functioning, memory abilities, complex problem solving skills, and neuropsychological functioning. The underlying impetus for this study was to examine a sufficiently large sample size and provide a clearer picture of the intellectual strengths and weaknesses among this population.

Third, the goal of this present study was to provide a parsimonious evaluation of intellectual functioning among children and adolescents diagnosed with FAS and ARND. Therefore, inclusion of the results of numerous measures would have been counterproductive as the goal of this present study was to simplify the analysis of intellectual functioning using the most recently developed and widely accepted measurement instrument among a sample of children and adolescents.

The variables that will be examined include VIQ, PIQ, FSIQ as well as the POI, VCI, FDI, and PSI. Furthermore, performance on each of the WISC-III (Wechsler, 1991) subtests will be examined. Comparisons will be made between the FAS and ARND groups. In addition, scores on the composite, factor, and subtest scales will be separated into lower (6-11) and upper (12-16) age groups for further examination.

Research Questions and Hypothesis

In light of research cited in the literature, which is based primarily on samples obtained from the United States and Europe, this current study presents a unique depiction of intellectual functioning among children and adolescents prenatally exposed to alcohol. Specifically, this study is based on a Canadian sample, Canadian

standardization, and the WISC-III (Wechsler, 1991). Therefore, three research questions were postulated.

Research Question 1.

What are the characteristics of this Canadian sample of children and adolescents who suffer from FAS and ARND? Specifically, do they present with similar difficulties with academic achievement, experience poor adaptive functioning, problematic behaviors, mental health impairments, and family dysfunction as compared to research findings reported in the literature?

Research Question 2

What is the mean performance of children and adolescents diagnosed with FAS and ARND on the various composite, factor, and subtest scales of the WISC-III (Wechsler, 1991) based on Canadian standardization (Wechsler, 1996)? Is their performance as a group significantly below that expected given their chronological age? What are the strengths and weaknesses on the specific subtests among this population?

Research Question 3

Do children and adolescents diagnosed with FAS and ARND demonstrate significantly different performance on the composite (VIQ, PIQ, FSIQ), factor (VCI, POI, FDI, PSI), and individual subtest scores on the WISC-III (Wechsler, 1991)? Is there a level of performance characteristic of FAS and ARND populations?

Hypothesis. Based on this concluding research question, it is hypothesized that children and adolescents diagnosed with FAS and ARND will demonstrate statistically significant differences on composite, factor, and subtest scores as measured by the WISC-III (Wechsler, 1991).

Sample

Individuals included in this investigation were selected from a data set located at a private psychological practice in the province of Alberta. This practice is primarily assessment focused and provides clinical and consulting services to a wide range of child and adult client populations including those with head injuries, post-accident concussion, cerebral vascular accidents, attentional deficits, disorders of memory function, learning disorders, developmental disorders and mental handicaps, FAS and ARND, degenerative neurologic disorders, and communication disorders. Typically, individuals assessed at this location are referred through the Department of Social Services, parents/guardians or schools.

Subjects were selected for inclusion in the FAS group based upon the following diagnostic criteria: (1) confirmation of a history of maternal alcohol use during pregnancy; (2) a prenatal or postnatal growth deficiency (height and weight below the 10th percentile for gestational age); (3) a specific pattern of craniofacial malformations including at least two of the following: (a) microcephaly (defined as head circumference below the third percentile), (b) microphthalmia or short palpebral fissures, and (c) poorly developed filtrum, thin vermilion border, and flattening of the maxillary area; and (4) central nervous system impairment (neurological abnormality, developmental delay, or intellectual impairment) (IOM et al., 1996)

Alternatively, inclusion in the ARND group was based upon clear evidence of: (1) confirmation of a history of maternal alcohol use during pregnancy; (2) central nervous system neurodevelopmental abnormalities such as decreased cranial size at birth, structural brain abnormalities (e.g., microcephaly, partial or complete agenesis of the

corpus collosum, cerebellar hypoplasia), and neurological hard or soft signs (e.g., impaired fine motor skills, neurosensory hearing loss, poor tandem gait, poor eye-hand coordination); and/or (3) evidence of a complex pattern of behavior or cognitive abnormalities that are inconsistent with developmental level and cannot be explained by family background or environment, such as learning difficulties, poor impulse control, deficits in higher level receptive and expressive language, deficits in school performance, problems in social perception, deficits in mathematical skills, poor capacity for abstraction or metacognition (executive functioning), or problems with memory, attention, or judgment (IOM et al., 1996).

The sample size for this study consisted of 83 children and adolescents ranging from 6 to 15 years of age who were selected from a group of 174 children and adolescents who had a suspected or confirmed history of exposure to alcohol in utero. The 21 FAS individuals selected for the study met all of the criteria for FAS as set forth by the Institute of Medicine (1996) and were previously diagnosed by a physician specializing in the assessment of FAS. The 62 individuals diagnosed with ARND also met the criteria as described by the Institute of Medicine for ARND and either had an existing diagnosis of ARND or were diagnosed as a result of the assessment carried out by the private firm where this data originated. The remaining 91 cases were not included in this study due to insufficient documentation regarding maternal alcohol consumption during pregnancy, thus resulting in the absence of a formal diagnosis of FAS or ARND. It was the intent of this study to only use those cases that clearly met the diagnostic criteria for either FAS or ARND.

A total of 21 (25.3%) individuals had a diagnosis of FAS whereas the remaining 62 (74.7%) children and adolescents were formally diagnosed with ARND. The mean age for the sample was 11.15 years of age with a range of 6 to 15 years. Seventy-four (89.2%) were right hand dominant while 9 (10.8%) were left-handed. The grade level for the entire sample ranged from Kindergarten to Grade 11.

Ethical Approval

A Graduate Student Application for Ethics Review was completed and submitted to the Faculties of Education and Extension Research Ethics Board on September 11, 2000. Notification was received from the Department of Educational Psychology on September 29, 2000 indicating ethical approval had been granted. The ethical standards advocated by the University of Alberta Ethical Guidelines for Research Involving Human Participants, the College of Alberta Psychologists, and the Canadian Psychological Association were observed throughout the duration of this investigation.

Measure of Intellectual Functioning

The WISC-III (Wechsler, 1991) was the measure of intellectual functioning employed in this study. This individually administered clinical instrument is designed to assess the intellectual ability of children aged 6 years through 16 years, 11 months. The WISC-III is appropriate for a number of purposes such as psychoeducational assessment to help with educational planning and placement, diagnosis of exceptionality among school-aged children, clinical and neuropsychological assessment, and research. This instrument is comprised of FSIQ, VIQ, and PIQ scales, along with four factors (VCI, POI, FDI, PSI), and is based on a mean score of 100 and a standard deviation of 15. Individual subtest scores are based on a mean score of 10 and standard a deviation of 3.

Standardization data were based on a total sample of 1100 cases from each of the 11 age groups from 6 years through 16 years, 11 months. There were 50 males and 50 females in each of the 11 age groups.

Prifitera and Saklofske (1998) report that existing research studies on the WISC-III (Wechsler, 1991) indicate that the scale is not biased against minorities. According to the Canadian WISC-III manual (Wechsler, 1996), the ethnic background of the Canadian sample was consistent with Canadian Census data collected in 1986. Each Canadian sample was categorized as belonging to either British (28.8%), French or European (16.2%), Multiple Origins (44.8%), or Other (10.2%). Those considered British included an ancestry of one or any combination of English, Scottish, Irish, or Welsh. The French designation, whose home language was English, included any one or combination of French, French-Canadian, Acadian, or Quebecois. French-speaking children in Quebec or in any other province were excluded from this group. The European group included any one or combination of German, Dutch, Swiss, or any other country from Europe excluding British and French. Those in the Multiple Origins category consisted of combinations such as British-French, British-European, and French-European. The Other category was characterized by Native, Asian, African, Caribbean, Black, Latin ethnic backgrounds as well as those from the Mideastern and Pacific Islands. In addition, it was also reported by Prifitera & Saklofske (1998) that the psychometric properties of this instrument, as based on Canadian standardization, are consistent with existing data based on U.S. standardization.

This scale is comprised of 14 subtests summarized according to VIQ, PIQ, and FSIQ scores. The VIQ scale consists of Information, Similarities, Arithmetic,

Vocabulary, Comprehension, and Digit Span. Alternatively, the PIQ scale includes Picture Completion, Coding, Picture Arrangement, Block Design, Object Assembly, Symbol Search, and Mazes. The FSIQ is comprised of scores based on the total number of subtests. Furthermore, the WISC-III permits calculation of four factor-based index scores including VCI (Information, Similarities, Vocabulary, Comprehension), POI (Picture Completion, Picture Arrangement, Block Design, Object Assembly), FDI (Arithmetic, Digit Span), and PSI (Coding, Symbol Search).

Reliability. The reliability of the WISC-III (Wechsler, 1991) has been extensively researched. Split-half reliability coefficients were determined for all subtests except Coding and Symbol Search. For these two subtests stability coefficients were used as reliability estimates since measures of internal consistency are inappropriate for tests that rely on speed. Average reliability coefficients (ages 6-16), based on these two methods, are .84 for Information, .81 for Similarities, .78 for Arithmetic, .87 for Vocabulary, .77 for Comprehension, .85 for Digit Span, .77 for Picture Completion, .79 for Coding, .76 for Picture Arrangement, .87 for Block Design, .69 for Object Assembly, .76 for Symbol Search, .70 for Mazes, .95 for VIQ, .91 for PIQ, .96 for FSIQ, .94 for the VCI, .90 for the POI, .87 for the FDI, and .85 for the PSI.

A separate study of 353 children was conducted for the purpose of calculating test-retest reliabilities. The resulting average stability coefficients (ages 6-16) for the individual subtests, IQ scales, and factor-based scales were .85 for Information, .81 for Similarities, .74 for Arithmetic, .89 for Vocabulary, .73 for Comprehension, .73 for Digit Span, .81 for Picture Completion, .77 for Coding B, .64 for Picture Arrangement, .77 for Block Design, .66 for Object Assembly, .74 for Symbol Search B, .57 for Mazes, .94 for

VIQ, .87 for PIQ, .94 for FSIQ, .93 for the VCI, .87 for the POI, .82 for the FDI, and .84 for the PSI.

According to Wechsler (1991) interscorer agreement (ages 6-16) on all subtests excluding Similarities, Vocabulary, and Comprehension averaged in the high .90's. Average interscorer reliabilities (ages 6-16) for those subtests that require more judgment in scoring were .94 for Similarities, .92 for Vocabulary, .90 for Comprehension, and .92 for Mazes. Analysis of total subtest scores resulted in interscorer reliabilities of .98 for Similarities, .98 for Vocabulary, .97 for Comprehension, and .92 for Mazes.

Validity. Evidence supporting the validity of the WISC-III (Wechsler, 1991) is presented through a variety of empirical investigations. For example, the internal validity, as evidenced through intercorrelations of the subtests and scales, revealed that Verbal subtests generally correlate more highly with each other. As well, Performance subtests were found to correlate more highly with each other and not with the Verbal subtests. Wechsler (1991) points out that these findings support the convergent and discriminant validity of the WISC-III.

The convergent and discriminant validity are also reportedly demonstrated by high correlations between scales expected to correlate between the WISC-III (Wechsler, 1991) and the WISC-R (Wechsler, 1974). In one study of 206 children, between ages 6 and 16, correlations between subtest and IQ scores were found to be .80 for Information, .74 for Similarities, .67 for Arithmetic, .77 for Vocabulary, .67 for Comprehension, .71 for Digit Span, .57 for Picture Completion, .70 for Coding, .42 for Picture Arrangement, .76 for Block Design, .58 for Object Assembly, .53 for Mazes, .90 for VIQ, .81 for PIQ, and .89 for FSIQ.

Comparison of the WISC-III with other scales of intelligence resulted in similar correlation values. For example, correlations with the WAIS-R (Wechsler, 1981) ranged from .46 to .85 for subtests whereas correlations for VIQ, PIQ, and FSIQ were .90, .80, and .86 respectively. Correlation with the WPPSI-R (Wechsler, 1989) resulted in VIQ, PIQ and FSIQ correlations of .85, .73, and .85 respectively.

The WISC-III (Wechsler, 1991) has also been compared with other psychological measures such as achievement tests and neuropsychological tests in an effort to support the validity of the scale. For example, studies of special groups such as children in gifted programs, children with mental retardation, learning disabilities, attention-deficit/ hyperactivity disorder, severe conduct disorders, epilepsy, speech/language delays, and hearing impairments have been conducted. For the most part, the validity of this scale is based upon correlations estimates with the WISC-R (Wechsler, 1974) and the extensive empirical evidence that has been generated over the years in support of this instrument.

Statistical Analysis

Analysis of these data was carried out using the Statistical Package for the Social Sciences (SPSS). Statistical analysis consisted of descriptive statistics (e.g., mean, range, standard deviation) as a method for examining the profile of scores on the composite and factor scales as well as on individual subtests. In addition, statistical analysis focused on the between-group differences (FAS and ARND) for separate age groups (6-11 and 12-16) through the implementation of a statistical technique called analysis of variance. First, FSIQ scores were analyzed using a 2×2 ANOVA. Second, VIQ and PIQ scores were analyzed using a 2×2×2 MANOVA. Third, a 2×2×4 MANOVA was employed to examine differences on the VCI, POI, FDI, and PSI scores. The final stage of analysis

involved using a series of 2×2 ANOVA's to examine differences between the groups on individual subtest scores. This type of analysis for the subtest scores was carried out due to insufficient cell sizes that prevented the implementation of a MANOVA.

Chapter Four

Results

This chapter presents general findings, such as demographic characteristics, as well as the results of statistical analyses for comparisons made between the FAS and the ARND groups. Specifically, this section will examine: (1) research question 1, (2) research question 2, (3) research question 3.

Research Question 1

The first research question that will be addressed states: What are the characteristics of this Canadian sample of children and adolescents who suffer from FAS and ARND? Specifically, do they present with similar difficulties with academic achievement, experience poor adaptive functioning, problematic behaviors, mental health impairments, and family dysfunction as compared to research findings reported in the literature?

The gender breakdown for the 21 individuals diagnosed with FAS was 16 males (76.2%) and 5 females (23.8%). The education level for this group ranged from grade 1 to grade 10 with 52.3% of the subjects in grades 5 through 7. A total of 20 (95.2%) of the subjects were right hand dominant whereas only 1 (4.8%) was left handed. The mean age of this group was 11.6 years, which was somewhat higher but consistent with the mean age for the entire sample.

The ethnic composition of this group was primarily of Aboriginal status. Specifically, 18 (85.7%) of the 21 subjects were Aboriginal while the background of the remaining 3 (14.3%) was not reported. A total of 19 (90.5%) had a history of foster home placements at some point during their life while 2 (9.5%) had never been placed in

foster care. According to file information supplied through the Department of Child Welfare, all 21 of the subjects in this group had a temporary or permanent guardianship order in effect on one or more occasions since birth. In 2 (9.5%) of the cases the child remained in the care of a family member. According to the Department of Child Welfare, 7 (33.3%) children were adopted; however, 3 (42.8%) of these adoptions broke down while 4 (57.2%) remained intact. For those who were adopted, the age of the child at the point of adoption ranged from 3 days to 1080 days with a mean of 512 days. As of the date of assessment, 16 (76.2%) were residing in a foster home, 4 (19%) were living with their adoptive family, while only 1 (4.8%) individual was in the care of their biological mother.

Among this group, there were no reported problems with substance abuse including the use of alcohol and illicit drugs. However, 9 (42.9%) individuals had a positive history of inappropriate sexual behaviors and activities while the remaining 12 (57.1%) reportedly had not engaged in sexually maladaptive behaviors. Furthermore, two (9.5%) had a positive history of suicidal behaviors while the background of the remaining 19 (90.5%) was unknown. A total of 8 (38.1%) subjects had a documented history of physical abuse and 6 (28.6%) were the victim of sexual abuse.

Among the 21 individuals in this group, only 3 (14.3%) of the biological mothers were known to have succumbed to premature death. Twelve (57.1%) were known to be alive while the whereabouts of 6 (28.6%) was unknown. Only 4 (19%) children reported contact with their biological mother. Alternatively, 8 (38.1%) of the biological fathers were known to be alive while the status of 13 (61.9%) was unknown. Three (14.3%) children acknowledged contact with their biological father.

Academically, a total of 20 (95.2%) out of the 21 subjects had a positive history of significant school related learning problems. Four (19%) apparently repeated at least one grade while the specific academic history of the remaining 17 (81%) was unknown. Fourteen (66.7%) were placed in modified educational programming at school due to ongoing difficulties with academic functioning. Furthermore, 10 (47.6%) had undergone a previous psychological assessment. While it is suspected that many or all of the remaining 11 (52.4%) individuals had undergone a previous psychological assessment, specific information to this effect was not disclosed. A total of 8 (38.1%) demonstrated some form of speech and language impairment and underwent speech language assessments and subsequent therapy.

Many of the children in this group presented with a previous diagnosis of a psychological disorder. Specifically, 14 (66.7%) had a diagnosis of attention-deficit/ hyperactivity disorder (ADHD), 1 (4.8%) had been diagnosed with depression, 2 (9.5%) suffered from a tic disorder or Tourette's disorder, 1 (4.8%) had a formal diagnosis of oppositional defiant disorder (ODD), while 1 (4.8%) had a positive diagnosis of conduct disorder. Furthermore, 1 (4.8%) individual suffered from schizophrenia. In terms of treatment, a total of 15 (71.4%) of the subjects had been prescribed medication by their attending physician due to ongoing behavioral and/or emotional problems. Overall, 19 (90.5%) individuals were described as demonstrating significant behavior problems within the home and at school.

A total of 62 subjects employed in this study were diagnosed with ARND, which is a substantially larger sample size as compared to the group of 21 subjects diagnosed with FAS. A total of 38 (61.3%) subjects in this group were male while the remaining 24

(38.7%) were female. The education level of this group was evenly distributed ranging from kindergarten through grade 11. Examination of handedness revealed 54 (87.1%) who were right hand dominant while the remaining 8 (12.9%) were left handed. The mean age of this group was 11 years.

The ethnic composition of this group consisted of 37 (59.7%) individuals of Aboriginal status, 4 (6.5%) subjects who were Caucasian, and 21 (33.9%) subjects of unknown ethnic background. The proportion of subjects who had been placed in foster care on at least one occasion was extremely high. Specifically, 60 (96.8%) subjects had a positive history of foster care while 2 (3.2%) had never been placed in care. In addition, all 62 of the subjects in this group, at one time or another, had been placed under a temporary or permanent guardianship order. Fifteen (24.2%) were adopted anywhere between 180 to 1260 days after birth. The mean age of adoption was 663 days. However, 6 (40%) of these aforementioned adoptions broke down and resulted in foster care placement as the adoptive parents were unable to deal with the behavioral difficulties exhibited by their child. As of the date of assessment, 6 (9.7%) individuals were residing with their biological mother, 44 (71%) were in foster care, 8 (12.9%) were living with their adoptive family, 3 (4.8%) were in the care of relatives, and 1 (1.6%) was residing with their biological father.

Examination of the incidence of reported substance use for this group revealed 13 (21%) who had a positive history of alcohol consumption and/or illegal drug use. Twenty-four (38.7%) reportedly demonstrated sexually inappropriate behaviors while 14 (22.6%) had attempted suicide on at least one occasion. Abuse was also problematic

among this group with 36 (58.1%) reportedly experiencing physical abuse while 29 (46.8%) were victims of sexual abuse.

Thirty-one (50%) of the biological mothers were known to be alive while 3 (4.8%) had died prematurely. Information regarding the status of the remaining 28 (45.2%) was not available. Furthermore, at least 19 (30.6%) of the subjects in this group continued to have contact with their biological mother. Alternatively, 10 (16.1%) biological fathers were reportedly alive although the status of the remaining 52 (83.9%) was unknown. Only 6 (9.7%) subjects reported contact with their biological father.

Academically, all of the subjects in this group had a positive history of significant school based learning problems. At least 9 (14.5%) were required to repeat a grade sometime during their schooling and 36 (58.1%) had a confirmed history of special education intervention. Thirty-eight (61.3%) subjects had been previously assessed by a psychologist and, although there was a lack of information regarding the remaining 24 (38.7%) subjects, it is highly suspected that many of them also underwent psychological testing. Speech and language difficulties were also observed among this group and at least 19 (30.6%) underwent a formal speech language assessment.

In terms of previous diagnoses of psychological disorders, at least 31 (50%) had been diagnosed with attention-deficit/hyperactivity disorder (ADHD), 18 (29%) with depression, 5 (8.1%) with oppositional defiant disorder (ODD), 6 (9.7%) with conduct disorder, 4 (6.5%) with a tic disorder or Tourette's disorder, 2 (3.2%) with an anxiety related disorder, 3 with schizophrenia (4.8%), 4 with post traumatic stress disorder (PTSD), 5 (8.1%) with attachment disorder, and 1 (1.6%) subject with bipolar disorder (1.6%). Thirty-two (51.6%) reported past and/or present use of medication as prescribed

by their attending physician to treat behavior and/or emotional problems. Furthermore, a total of 59 (95.2%) subjects were characterized as suffering from significant behavioral problems both within the home and at school. Examination of these results indicated that this sample of children and adolescents prenatally exposed to alcohol indeed suffer from a significant number of ongoing deficits consistent with the literature.

Research Question 2

The second research question states: What is the mean performance of children and adolescents diagnosed with FAS and ARND on the various composite, factor, and subtest scales of the WISC-III (Wechsler, 1991) based on Canadian standardization (Wechsler, 1996)? Is their performance as a group significantly below that expected given their chronological age? What are the strengths and weaknesses on the specific subtests among this population?

The results presented in Table 2, based on Canadian standardization (Wechsler, 1996) indicate the mean composite and factor scores for the ARND group are consistently higher as compared to the FAS group. The smallest discrepancy between these scores was 3.89 points on the PIQ scale while the largest difference was 6.84 points observed on the VIQ scale. The FSIQ scores for the FAS group ranged from 47 to 110 whereas the range of FSIQ scores for the ARND group ranged from 48 to 113. On the VIQ scale, scores for the FAS group ranged from 49 to 108 while the range for the ARND group was 45 to 114. The PIQ scores ranged from 53 to 113 for the FAS group and 57 to 116 for the ARND group. In terms of factor scores, the range for the VCI for the FAS group was 50 to 105 and for the ARND group the range was 50 to 114. The POI scores for the FAS group ranged from 54 to 119 whereas the range of scores for the

ARND group was 50 to 118. The FAS group range of scores on the FDI was 59 to 115 while the ARND group ranged from 50 to 109. Furthermore, the PSI range of scores for the FAS group was 53 to 114 and the ARND group ranged from 53 to 124.

Table 2

Means and Standard Deviations for Composite and Factor Scale Scores for the FAS and ARND Groups Based on Canadian Standardization

	FAS		ARND	
Scale	M	SD	M	SD
FSIQ	75.19	15.98	80.87	13.55
VIQ	73.90	15.61	80.74	14.60
PIQ	81.04	16.97	84.93	13.46
VCI	74.76	15.42	81.19	14.83
POI	82.80	17.70	87.20	14.45
FDI	76.71	15.00	82.91	13.94
PSI	81.57	18.36	87.00	15.17

Table 3 divides the sample of individuals diagnosed with FAS into the lower (47.6%) and upper (52.4%) age ranges. With the exception of the PSI, the 12-16 age group consistently outperformed the 6-11 age group on all of the composite and factor scores. The smallest discrepancy between the two groups was 0.58 points on the VIQ scale. Alternatively, the largest difference score, in favor of the 12-16 age group, was

4.60 points on the POI. The discrepancy score on the PSI was 5.98 points in favor of the 6-11 age group.

The FSIQ scores for the 6-11 age group ranged from 56 to 96 whereas the range of FSIQ scores for the 12-16 age group ranged from 47 to 110. On the VIQ scale, scores for the 6-11 age group ranged from 52 to 97 while the range for the 12-16 age group was 49 to 108. The PIQ scores ranged from 64 to 97 for the 6-11 age group and from 53 to 113 for the 12-16 age group. In terms of factor scores, the range for the VCI for the 6-11 age group was 55 to 94 and for the 12-16 age group the range was 50 to 105. The POI scores for the 6-11 age group ranged from 55 to 96 whereas the range of scores for the 12-16 age group was 54 to 119. The 6-11 age group range of scores on the FDI was 62 to 98 while the 12-16 age group ranged from 59 to 115. Furthermore, the PSI range of scores for the 6-11 age group was 60 to 114 and the 12-16 age group ranged from 53 to 108.

Table 3

Means and Standard Deviations for Composite and Factor Scale Scores for the FAS Group Ages 6-11 and 12-16

	6-11		12-16	
Scale	M	SD	M	SD
FSIQ	74.20	11.54	76.09	19.72
VIQ	73.60	13.72	74.18	17.82
PIQ	79.10	9.84	82.81	21.94
VCI	74.00	11.66	75.45	18.76
POI	80.40	12.68	85.00	21.70
FDI	76.30	12.90	77.09	17.32
PSI	84.70	19.75	78.72	17.44

Table 4 presents the results of the ARND group subdivided into lower (51.6%) and upper (48.4%) age groups. Again, with the exception of the PSI score, the mean scores for the ARND group on each of the composite and factor scores was higher for the 12-16 age group as compared to the 6-11 age group. The smallest difference score was 1.13 points on the FDI in favor of the 12-16 age group. Again, in favor of the ARND group, the largest discrepancy was 6.60 points on the VCI . The difference on the PSI, in favor of the 6-11 age group, was 1.29 points.

The FSIQ scores for the 6-11 age group ranged from 48 to 113 whereas the range of FSIQ scores for the 12-16 age group ranged from 65 to 109. On the VIQ scale, scores

for the 6-11 age group ranged from 45 to 114 while the range for the 12-16 age group was 63 to 114. The PIQ scores ranged from 57 to 111 for the 6-11 age group and 57 to 116 for the 12-16 age group. In terms of factor scores, the range for the VCI for the 6-11 age group was 50 to 114 and for the 12-16 age group the range was 60 to 114. The POI scores for the 6-11 age group ranged from 54 to 113 whereas the range of scores for the 12-16 age group was 50 to 118. The 6-11 age group range of scores on the FDI was 50 to 106 while the 12-16 age group ranged from 67 to 109. Furthermore, the PSI range of scores for the 6-11 age group was 53 to 124 and the 12-16 age group ranged from 60 to 117.

Table 4

Means and Standard Deviations for Composite and Factor Scale Scores for the ARND Group Ages 6-11 and 12-16

	6-11		12-16	
Scale	M	SD	M	SD
FSIQ	78.53	14.33	83.36	12.41
VIQ	78.03	15.64	83.63	13.04
PIQ	83.15	13.69	86.83	13.17
VCI	78.00	14.88	84.60	14.24
POI	84.15	13.47	90.46	14.96
FDI	82.37	16.68	83.50	10.53
PSI	87.62	15.73	86.33	14.79

Table 5 examines the mean differences between the FAS group and the ARND group for each of the 12 subtests utilized in this study. The ARND group performed consistently higher on 11 out of the 12 subtests. The mean score for the FAS group on the Picture Completion subtest was slightly higher than the ARND group at 0.13 points. The smallest discrepancy was 0.11 points observed on the Object Assembly subtest in favor of the ARND group. Alternatively, the largest discrepancy, also in favor of the ARND group, was a difference of 1.71 on the Symbol Search subtest.

Table 5

Means and Standard Deviations for Subtest Scores for the FAS and ARND Groups

	FAS		ARND	
Subtest	M	SD	M	SD
Information	5.76	3.68	7.16	3.16
Similarities	5.80	3.48	7.16	3.51
Arithmetic	5.61	3.16	6.80	3.00
Vocabulary	5.42	3.31	6.25	3.23
Comprehension	4.76	2.91	6.01	3.35
Digit Span	6.52	2.69	7.37	2.51
Picture Completion	7.95	3.78	7.82	3.10
Coding	6.38	3.38	6.82	3.38
Picture Arrangement	6.23	2.93	7.70	2.93
Block Design	6.42	3.70	8.03	3.13
Object Assembly	7.90	3.41	8.01	3.29
Symbol Search	6.61	4.11	8.32	3.24

Table 6 provides the mean subtest scores for the FAS group for ages 6-11 and 12-16. The Information, Similarities, Digit Span, Picture Completion, Picture Arrangement, and Block Design subtest means are higher for the 12-16 age group as compared to the 6-11 age group. The remaining subtests, including Arithmetic, Vocabulary, Comprehension, Coding, Object Assembly, and Symbol Search evidenced higher means

for the 6-11 age group than the 12-16 age group. The smallest difference between means on the Comprehension subtest was 0.14 points in favor of the FAS group. The largest discrepancy, in favor of the ARND group, was 1.79 for the Picture Arrangement subtest.

Table 6

Means and Standard Deviations for Subtest Scores for the FAS Group Ages 6-11 and 12-16

	6-11		12-16	
Subtest	M	SD	M	SD
Information	5.60	2.75	5.90	4.50
Similarities	5.10	3.24	6.45	3.72
Arithmetic	5.90	3.51	5.36	2.97
Vocabulary	5.50	3.27	5.36	3.50
Comprehension	5.00	2.66	4.54	3.23
Digit Span	6.10	1.72	6.90	3.38
Picture Completion	7.50	2.83	8.36	4.58
Coding	6.70	3.40	6.09	3.50
Picture Arrangement	5.30	2.31	7.09	3.26
Block Design	6.30	2.98	6.54	4.41
Object Assembly	8.10	3.57	7.72	3.43
Symbol Search	7.40	4.59	5.90	3.70

Table 7 summarizes and compares the means of the ARND group for ages 6-11 years and 12-16 years. Nine of the 12 subtest mean scores were higher for the 12-16 age group than the 6-11 age group. Only the Arithmetic, Coding, and Block Design subtest mean scores were higher for the 6-11 age group. The smallest subtest mean discrepancy was 0.14 points on the Arithmetic subtest with the higher score belonging to the FAS group. Alternatively, the most notable difference was 2.57 points on the Picture Arrangement subtest in favor of the ARND group.

Table 7

Means and Standard Deviations for Subtest Scores for the ARND Group Ages 6-11 and 12-16

	6-11		12-16	
Subtest	M	SD	M	SD
Information	6.96	2.97	7.36	3.39
Similarities	5.96	3.79	8.43	2.69
Arithmetic	6.87	3.35	6.73	2.62
Vocabulary	5.56	2.99	7.00	3.36
Comprehension	5.81	3.56	6.23	3.15
Digit Span	7.03	3.05	7.73	1.74
Picture Completion	7.25	3.15	8.43	2.99
Coding	7.37	3.51	6.23	3.18
Picture Arrangement	6.46	2.47	9.03	2.84
Block Design	8.12	3.07	7.93	3.24
Object Assembly	7.75	3.78	8.30	2.70
Symbol Search	7.84	3.58	8.83	2.80

Table 8 provides a look at the performance of the FAS and ARND groups based on U.S. Standardization (Wechsler, 1991). These results in Table 8 are consistently higher as compared to the figures presented in Table 2, which are based upon Canadian Standardization. However, the trend of higher performance for the ARND group as

compared to the FAS group is consistent. The largest discrepancy between the scores in Table 8 was 6.29 points on the VCI whereas the smallest discrepancy of 3.96 points was observed on the PIQ scale.

The FSIQ scores for the FAS group ranged from 50 to 110 whereas the range of FSIQ scores for the ARND group ranged from 50 to 116. On the VIQ scale, scores for the FAS group ranged from 50 to 107 while the range for the ARND group was 46 to 114. The PIQ scores ranged from 58 to 112 for the FAS group and 59 to 119 for the ARND group. In terms of factor scores, the range for the VCI for the FAS group was 50 to 104 and for the ARND group the range was 50 to 114. The POI scores for the FAS group ranged from 59 to 119 whereas the range of scores for the ARND group was 54 to 120. The FAS group range of scores on the FDI was 61 to 115 while the ARND group ranged from 50 to 109. Furthermore, the PSI range of scores for the FAS group was 58 to 117 and the ARND group ranged from 54 to 124.

Table 8

Means and Standard Deviations for Composite and Factor Scale Scores for the FAS and ARND Groups Based on U.S. Standardization

	FAS		ARND	
Scale	M	SD	M	SD
FSIQ	78.76	16.26	84.53	13.42
VIQ	75.95	15.38	82.20	14.53
PIQ	85.57	16.55	89.53	13.16
VCI	76.80	15.81	83.09	14.93
POI	87.09	17.67	91.83	14.26
FDI	79.61	14.79	84.93	13.09
PSI	86.14	18.71	91.09	14.45

In accordance with Kaufman's (1994) seven stages of WISC-III interpretation, current results indicate that the mean global intellectual (FSIQ) functioning for the FAS group fell within the mid Borderline range (5^{th} percentile), which is significantly lower than the mean for the normative sample. Global intellectual functioning for the FAS group when divided into lower and upper age ranges remained within the Borderline range at the 4^{th} and 5^{th} percentile respectively. Alternatively, the global intellectual (FSIQ) functioning for the ARND group fell at the low end of the Low Average (9^{th} percentile) range. Again, these results are significantly lower as compared to the normative sample. The lower age range for the ARND group achieved a mean FSIQ

within the Borderline (8th percentile) range whereas the upper age group had a mean FSIQ within the Low Average (13th percentile) range.

With regard to the second step of profile interpretation, examination of the VIQ and PIQ intellectual abilities for both the FAS and ARND groups indicated that the discrepancies were not statistically significant for either group. This conclusion also held true upon examination of the lower and upper age ranges for both the FAS and ARND groups.

Thirdly, comparison of the VCI and FDI factor scores as well as the POI and PSI factor scores for both groups indicated a very consistent profile. In other words, there were no statistically significant discrepancies between these scores which, according to Kaufman (1994), indicates the VIQ and PIQ scores represent an accurate estimate of each groups respective intellectual functioning. Again, these observations held true for lower and upper age ranges for both groups of alcohol exposed children and adolescents.

The fourth level of interpretation involves determining if the discrepancy between VIQ and PIQ is abnormally large. However, the answer to this question has already been addressed as there was no statistically significant discrepancy between the VIQ and PIQ composite scores.

With regard to step five, which focuses on the interpretative nature of the profile of scores, the overall mean score on the performance scale for both groups is higher as compared to the mean verbal scale score. As a result, it appears that the performance based skills for both groups of alcohol exposed children and adolescents is a relative strength as compared to mean performance on the verbal tasks. This profile of scores remained consistent for the lower and upper age ranges of FAS and ARND groups.

In terms of subtest strengths and weaknesses, a normative comparison for the FAS group indicates that all mean subtest scores are significantly lower than expected with the exception of Picture Completion and Object Assembly. The mean performance for each of these two subtests was also lower than the mean in the standardization sample, however, the discrepancy was not statistically significant. This pattern of results held true for the lower and upper age range for both the FAS and ARND groups. Alternatively, for the ARND group, comparison of the mean subtests scores with the standardization sample resulted in statistically lower performance on all subtests except Picture Completion, Picture Arrangement, Block Design, Object Assembly, and Symbol Search. Again, the mean scores on these 5 subtests were lower than expected as compared to the normative sample, however, the discrepancy was not statistically significant. For the lower age range, all subtest scores were significantly lower than the standardization sample with the exception of Block Design, Object Assembly, and Symbol Search. These latter three subtests were lower than the mean subtest score for the standardization sample but this discrepancy was not statistically significant. As for the upper age range, all of the mean subtest scores were lower than the mean subtest score for the standardization sample and the scores on Information, Arithmetic, Vocabulary, Comprehension, and Coding proved to be statistically significant.

The final stage involves evaluating the overall profile of scores to provide further insight regarding observed strengths and weaknesses and to support possible diagnoses, remediation strategies, and educational planning. In this case, from a more global perspective, it is apparent that the children and adolescents in this sample suffer from more difficulties with verbal skills, which would suggest that they may also experience

increased difficulties with academic achievement. With regard to subtest scores, there appeared to be a pattern of low scores on the Comprehension subtests for both the FAS and ARND groups. The same holds true for the 6-11 and 12-16 FAS age groups as well as the 12-16 ARND age group suggesting difficulties with social knowledge and judgment. There did not appear to be a consistent trend for an elevated subtest score.

Research Question 3

The third research question states: Do children and adolescents diagnosed with FAS and ARND demonstrate significantly different performance on the composite (VIQ, PIQ, FSIQ), factor (VCI, POI, FDI, PSI), and individual subtest scores on the WISC-III (Wechsler, 1991)? Is there a level of performance characteristic of FAS and ARND populations?

Null Hypothesis (H_{01}): Children and adolescents diagnosed with FAS and ARND will not demonstrate statistically significant differences on composite, factor, and subtest scores as measured by the WISC-III (Wechsler, 1991).

The means obtained from the FAS and ARND groups on the various composite and factor scales as well as individual subtests were compared statistically through the implementation of a series of ANOVA's and MANOVA's. Homogeneity of variance for the FAS and ARND groups on PIQ, the Freedom from Distractibility Index, and the Digit Span subtest was not achieved. However, according to Glass and Hopkins (1996), ANOVA is robust to violations of both normality and homogeneity of variance. The scores on each of the composite and factor scales were normally distributed. However, a number of the subtests demonstrated a mildly skewed distribution of scores including Information, Similarities, Arithmetic, Vocabulary, Comprehension, Picture Completion,

Coding, and Symbol Search. The remaining subtests demonstrated a normal distribution of scores. Overall, despite these subtle inconsistencies, the statistical analyses that were carried out on these data are considered valid.

Table 9 shows the results of a 2×2 ANOVA that was carried out for FSIQ and revealed no statistically significant differences between the two alcohol exposed groups.

Table 9

Two-Way Analyses of Variance for Diagnosis × Age for Full Scale Intellectual Functioning

Source	df	SS	MS	F	Power
Diagnosis	1	527.30	527.30	2.61	.359
Age	1	177.08	177.08	.878	.152
Diagnosis × Age	1	33.93	33.93	.168	.069
Residual	79	15929.44	201.63		

As demonstrated in Table 10, a 2×2×2 MANOVA was conducted to examine the differences between the groups on the VIQ and PIQ scales. Again, no statistically significant differences were observed.

Table 10

Multivariate and Univariate Analyses of Variance F Ratios for Diagnosis × Age for Verbal and Performance Intellectual Functioning

		ANOVA	
	MANOVA	VIQ	PIQ
Variable	F (2, 78)	F (1, 79)	F (1, 79)
Diagnosis	1.73	3.42	1.21
Age	.517	.680	1.02
Diagnosis × Age	.445	.448	.000

Note. Multivariate F ratios were generated from Wilks' Lambda. MANOVA = multivariate analysis of variance; ANOVA = univariate analysis of variance.

Furthermore, a 2×2×4 MANOVA was also conducted to examine the four factor scales (VCI, POI, FDI, PSI). As demonstrated in Table 11, no statistically significant differences were observed.

Table 11

Multivariate and Univariate Analyses of Variance F Ratios for Diagnosis × Age for Factor Scores

		ANOVA			
	MANOVA	VCI	POI	FDI	PSI
Variable	F (4, 76)	F (1, 79)	F (1, 79)	F (1, 79)	F (1, 79)
Diagnosis	.976	3.05	1.43	2.94	1.66
Age	1.10	1.14	2.01	.069	.793
Diagnosis × Age	.206	.468	.049	.002	.329

Note. Multivariate F ratios were generated from Wilks' Lambda. MANOVA = multivariate analysis of variance; ANOVA = univariate analysis of variance.

In addition, a series of 2×2 ANOVA's were carried out to determine if there were any significant differences in subtest scores between the FAS and ARND groups. This form of analysis was employed as the cell sizes were not large enough to permit the implementation of a MANOVA. Results of each of these analyses were not statistically significant. A total of 12 ANOVA tables were constructed based on the results of statistical comparisons made between the two groups for the subtest scores and are located in the Appendix.

Therefore, given the results of these statistical analyses, the null hypothesis was not rejected. Overall, there were no statistically significant differences between the FAS and ARND groups on composite, factor, and subtest scores.

Chapter Five

Discussion

This study investigated the intellectual functioning among children and adolescents diagnosed with FAS and ARND. The design of this investigation was very descriptive and practical in nature and attempted to address many of the methodological shortcomings of previous research in this area. For example, many studies cited in the literature make generalizations based on small sample sizes, avoid direct comparisons between FAS and ARND groups, and report the results of measures of intellectual functioning in a very convoluted manner. In particular, this present study employed a relatively large sample size, clearly defined diagnostic criteria for FAS and ARND based on the widely recognized classification system advocated by the Institute of Medicine (IOM et al., 1996), a largely Aboriginal sample, use of an up to date and well recognized single measure of intellectual functioning based on Canadian Standardization, analysis of age as a potential variable, and an extensive examination of demographic variables and general characteristics as a means to provide a contextual milieu. The goal of this study was to provide a detailed analysis of how children and adolescents perform on the WISC-III for the ultimate benefit of clinicians who work with this population.

This chapter will discuss the results of the present study. First, the three research questions proposed in chapter one will be addressed. Secondly, implications for clinical use will be examined followed by identification and discussion of the limitations of this investigation. Fourthly, suggestions for further research will be proposed based on recent trends in the literature as well as the findings from this current investigation. Lastly, conclusions will be drawn from the results of this present study.

Research Question 1

What are the characteristics of this Canadian sample of children and adolescents who suffer from FAS and ARND? Specifically, do they present with similar difficulties with academic achievement, experience poor adaptive functioning, problematic behaviors, mental health impairments, and family dysfunction as compared to research findings reported in the literature?

The demographic and social characteristics of this sample provides the contextual milieu for interpretation of results as well as important information to aide the efforts of community based agencies focused on the provision of services for this population as well as reducing the incidence of FAS and ARND. In all cases, the children and adolescents involved in this study were referred through the Department of Social Services and the known ethnic composition of this sample was largely of Aboriginal origin. Although Aboriginals are not the only segment of society that are affected by FAS and ARND, the results of this study indicate that the majority of those who are coming to the attention of the Department of Social Services are of Aboriginal origin.

One quarter of those involved in the study were adopted, however, almost fifty-percent of these adoptions broke down. A large portion of individuals involved in the study demonstrated significant problems associated with inappropriate sexual behavior, school related learning problems as well as speech and language related difficulties. Over fifty percent reportedly were the victims of physical abuse and just over forty percent were subject to sexual abuse. Suicidal behaviors as well as significant mental health and behavioral problems were also reported. Surprisingly, only a small percentage of the sample reportedly engaged in substance use including alcohol and illegal drugs.

As well, only a small percentage of biological mothers reportedly succumbed to an early death. These results are in contrast to previous findings that a high percentage of biological mothers of FAS and FAE children die prematurely (IOM et al., 1996). Not surprisingly, only a very small portion of the children and adolescents had any contact with their biological mother and father. Overall, the problems faced by the children and adolescents in this investigation were numerous and very significant. Dysfunctional family interactions combined with problematic behavioral concerns related to prenatal alcohol exposure places many of these individuals at risk for future, ongoing problems.

Research Question 2

What is the mean performance of children and adolescents diagnosed with FAS and ARND on the various composite, factor, and subtest scales of the WISC-III (Wechsler, 1991) based on Canadian standardization (Wechsler, 1996)? Is their performance as a group significantly below that expected given their chronological age? What are the strengths and weaknesses on the specific subtests among this population?

Results of this present study are consistent with previous findings of higher mean FSIQ among individuals diagnosed with ARND versus those diagnosed with FAS (Kerns et al., 1997; Kopera-Frye & Zelinski, 1995; LaDue et al., 1992; Mattson et al., 1997). In addition, there was also a pattern of higher intellectual functioning on the PIQ scale as compared to the VIQ scale for both the FAS and ARND groups However, these current results are in direct contrast to the findings of higher VIQ functioning as compared to PIQ functioning as reported by Thomas et al. (1998). Examination of the factor scores indicated that the mean VCI score was lower as compared to the mean POI score for both

the FAS and ARND groups. These findings are not surprising since the VCI is comprised of the same subtests as the VIQ scale with the exception of Arithmetic. Alternatively, the composition of the POI is identical to the PIQ scale in all respects except for the inclusion of Coding. With respect to the remaining factor scores, for both the FAS and ARND groups, there was a pattern of higher mean scores on the PSI versus the FDI.

Comparison of FSIQ for the FAS and ARND groups by age (6-11 and 12-16) revealed a consistent pattern of higher scores for those diagnosed with ARND versus FAS. Further examination of these data for the FAS and ARND groups by age (6-11 and 12-16) resulted in a similar trend for lower VIQ functioning versus PIQ functioning. Again, there was a notable discrepancy for both FAS and ARND lower and upper age groups, similar to that observed between the VIQ and PIQ scales, between the VCI and POI in favor of the latter. Higher scores were also noted for the FAS and ARND lower and upper age groups on the PSI as compared to the FDI. However, the 6-11 year FAS and ARND groups performed considerably higher on the PSI compared to the 12-16 year FAS and ARND groups. Each of the remaining composite and factor scores were higher for the FAS and ARND 12-16 age group. Therefore, based on these results, it appears as though younger children prenatally exposed to alcohol perform better on speeded tasks as compared to adolescents who suffer from prenatal exposure to alcohol.

In terms of subtest scores, the ARND group performed consistently higher than the FAS group on all subtests with the exception of Picture Completion. For the FAS group, the lowest mean subtest score was on Comprehension whereas the highest mean score was on Picture Completion. Alternatively, the lowest mean subtest score for the

ARND group was also for Comprehension whereas the highest mean score was evidenced on the Symbol Search subtest.

Examination of the mean subtest scores for the FAS group by age (6-11 and 12-16) revealed that the lower age group performed better on 6 of the subtests as compared to the upper age group. Specifically, the age group comprised of 6-11 year olds outperformed the age group made up of 12-16 year olds on the Arithmetic, Vocabulary, Comprehension, Coding, Object Assembly, and Symbol Search subtests. Alternatively, the 12-16 year old FAS group performed better on the Information, Similarities, Digit Span, Picture Completion, Picture Arrangement, and Block Design subtests as compared to the 6-11 year olds. The highest subtest score for the 6-11 age group was on the Object Assembly subtest whereas the lowest score for this age group was on the Comprehension subtest. As for the 12-16 year olds, this group evidenced the lowest score on the Comprehension subtest while the highest subtest score for this group was on the Picture Completion subtest.

The dispersal of subtest scores for the ARND group by age (6-11 and 12-16) was more heavily weighted in favor of the 12-16 year old age group. Specifically, the upper age group outperformed the lower age group on the Information, Similarities, Vocabulary, Comprehension, Digit Span, Picture Completion, Picture Arrangement, Object Assembly, and Symbol Search subtests. The 6-11 age group demonstrated higher scores on the remaining three subtests, including Arithmetic, Coding, and Block Design, as compared to the upper age group. The Lowest mean subtest score for the 6-11 age group was on the Vocabulary subtest whereas the highest mean subtest score was on Block Design. With respect to the upper age group, two subtests were equally low

including Comprehension and Coding while the highest mean subtest score was on Picture Arrangement.

Overall, the group diagnosed with FAS demonstrated consistently lower composite and factor scores than the group of children and adolescents diagnosed with ARND. Almost all of the composite and factor scores for the FAS group fell within the mid to high 70's with the exception of the PIQ scale and the POI, which fell in the low 80's. On the other hand, all of the composite and factor scores for the ARND group fell within the 80's. There was considerably more variability when the composite and factor scores were broken down by age for the FAS group as both the 6-11 and 12-16 age groups demonstrated composite and factor scores in the 70's and 80's. Alternatively, for the ARND group, the 12-16 age group demonstrated scores consistently in the 80's while the 6-11 age group achieved scores in the 70's and 80's. These latter observations are more consistent with the overall performance of the FAS versus ARND groups. As for the subtest scores, there was a consistent trend for lower scores on the Comprehension subtest for the FAS and ARND groups as well as the FAS 6-11 and 12-16 groups and the ARND 12-16 age group. There was no distinct pattern for high scores on the subtests for any of the groups.

It is difficult to make comparisons with previous studies carried out in this area as the format used to report intellectual functioning among this population varies considerably from one study to another. For example, a number of studies do not report the FSIQ and, instead, present their results in the form of a range (e.g., Iosub, Fuchs, Bingol, & Gromisch, 1981; Steinhausen et al., 1993; Steinhausen, & Spohr, 1998). As well, many do not statistically compare the performance of two or more groups, such as

FAS versus ARND (e.g., Shaywitz et al., 1980; Iosub et al., 1981; Steinhausen et al., 1993; Kerns et al., 1997).

Nevertheless, despite these inconsistencies, a number of comparisons with studies reporting FSIQ for FAS and ARND or FAE groups are worthy to note. The overall pattern of low FSIQ for the FAS versus the ARND group for this present study is consistent with a number of previous studies cited in the literature; however, the performance of the FAS group for this current study does not appear to be as low as expected given previous findings. In particular, Conry (1990) demonstrated a discrepancy between FAS and FAE groups with the FAS group performing much lower than the FAE group. More specifically, Conry reported a mean FSIQ score of 60.1 for the FAS group and 86 for the FAE group. Streissguth et al. (1991) also compared FAS and FAE groups and reported a mean FSIQ score of 66 for the FAS group and 73 for the FAE group. As well, Streissguth et al. (1991) reported a similar discrepancy with a mean FSIQ score for the FAS group of 66 (test 1) and 66.7 (test 2) compared to a mean FSIQ score for the FAE group of 79.5(test 1) and 82.2 (test 2). Streissguth and Dehaene (1993) demonstrated a very large discrepancy between FAS, FAE, and PEA groups. They noted a FSIQ score of 69.6 for the FAS group, 93 for the FAE group, and 91.7 for the PEA group. Kopera-Frye and Zelinski (1995) reported a FSIQ score of 79.1 for a group of FAS children and 93.9 for a sample of FAE children. Finally, Mattson et al. (1997) reported a mean FSIQ score of 74.4 for a sample of FAS children and a score of 83.6 for a group of children prenatally exposed to alcohol.

Each of these previous studies employed at least two, and in some cases (e.g., Streissguth, & Dehaene, 1993; Streissguth et al., 1991) more than two, measures of

intellectual functioning. It is interesting to note the similarity of findings between this current study and the Mattson et al. (1997) study. In particular, both studies examined children and adolescents and, although Mattson et al. also employed the use of the WPPSI-R, the WISC-R was the primary instrument used as a measure of intellectual functioning. Thus, it appears as though the studies that employ several different measures (e.g., Conry, 1990; Streissguth et al., 1991; Streissguth, Herman, & Smith, 1978a; Streissguth, Herman, & Smith, 1978b), and particularly those that utilize measures other than the Wechsler Scales, tend to result in lower FSIQ's for FAS groups as well as considerable variability for comparison groups with a known history of prenatal alcohol exposure.

There are also some studies that focus on Full Scale intellectual functioning solely for individuals diagnosed with FAS. Carney and Chermak (1991) reported a mean FSIQ score of 79 for a group of 10 children diagnosed with FAS. As well, Thomas et al. (1998) reported a mean FSIQ score of 74.3 for a group of 15 children and adolescents diagnosed with FAS. In both of these studies, the WISC-R was employed as the primary measure of intellectual functioning. As well, Thomas, et. al. also employed the WISC-III. Overall, results of this present investigation are more consistent with these studies as compared to those that utilize a broad range of measurement instruments.

Alternatively, there are also a number of studies that report higher than expected FSIQ functioning among individuals with a positive history of prenatal exposure to alcohol. For instance, Shaywitz et al. (1980) reported a FSIQ of 98.2 for a group of PEA individuals; however, this sample was selected for their high performance and, therefore, the results are somewhat misleading. However, Aronson et al. (1985) reported a mean

FSIQ score of 95 for 21 FAS individuals; however, there was no indication as to the nature of the sampling procedure employed. In 1990, Streissguth et al. reported a FSIQ score of 107.6 for a sample of 482 individuals diagnosed with PEA. Again, these results are somewhat misleading as the sample was not broken down into specific diagnoses. Instead, it appears they grouped all FAS and FAE individuals together and termed them the PEA group. Lastly, Kerns et al. (1997) reported on two groups of eight FAS individuals with a mean FSIQ score of 97.1 and 75 respectively. These results, yet again, are rather misleading as they divided the entire sample into the higher performing and lower performing groups.

Three studies cited in the literature report patterns of subtest scores (Mattson et al., 1997; Shaywitz et al., 1980; Streissguth et al., 1990). However, as previously noted with respect to composite and factor scores, comparisons between current results and previous findings are difficult at best. For example, Shaywitz et al. (1980) observed elevated scores on a number of subtests including Similarities, Comprehension, Object Assembly, and Block Design. Alternatively, low scores were reported on Coding, Arithmetic, Digit Span, and Information subtests. The problem arises due to the fact that these generalizations are based upon the WPPSI, WISC, and the WAIS. The results of a study completed by Streissguth et al., (1990) are more straightforward as low scores were reported on the Arithmetic and Digit Span subtests based upon results obtained from the WISC-R. Finally, Mattson et al. (1997) reported no statistically significant differences between the FAS and PEA groups on the Similarities, Vocabulary, Digit Span subtests. Results from this present study, based upon WISC-III subtests scores for the FAS and ARND groups, indicate that both the FAS and ARND groups performed lowest on the

Comprehension subtest. The highest score for the FAS group was evidenced on the Picture Completion subtest while the ARND group performed best on Symbol Search.

In summary, there are a number of studies in the literature that focus on intellectual functioning among individual who suffer from prenatal exposure to alcohol. As previously observed, there appear to be some trends based on observed scores. More specifically, several studies employed multiple measures of intellectual functioning and the overall pattern of results points to lower FSIQ for these studies as compared to the present study. Those studies that primarily examined children and adolescents using only one or two measures of intellectual functioning tended to report results that are more consistent with the results of this current study. In particular, this finding was more pronounced for those studies that specifically used the Wechsler scales. Furthermore, there are a number of studies that report much higher intellectual functioning scores, however, these particular investigations, for the most part, were biased in their methodology and used intellectual functioning as a selection technique.

In terms of subtest scores, current findings are not consistent with the very limited number of previous investigations; however, consistently lower scores were observed on the Comprehension subtest. Overall, the results appear to demonstrate that descriptions of intellectual functioning are more consistent between studies that employ the same or similar tests of IQ. Therefore, generalizations made in the past regarding trends in IQ functioning are somewhat misleading as it appears biased methodologies, small sample sizes, and broad age ranges resulting in the use of various testing instruments has skewed the results in both directions. Based on these current findings, which are supported by previous studies that were carried out in a similar fashion, it appears FAS individuals

demonstrate a mean IQ in the mid 70's while those suffering from ARND have a somewhat higher mean performance in the low 80's.

Research Question 3

Do children and adolescents diagnosed with FAS and ARND demonstrate significantly different performance on the composite (VIQ, PIQ, FSIQ), factor (VCI, POI, FDI, PSI), and individual subtest scores on the WISC-III (Wechsler, 1991)? Is there a level of performance characteristic of FAS and ARND populations?

Null Hypothesis (H_{01}): Children and adolescents diagnosed with FAS and ARND will not demonstrate statistically significant differences on composite, factor, and subtest scores as measured by the WISC-III (Wechsler, 1991).

Analysis of these data did not result in statistically significant discrepancies between the FAS and ARND groups on the composite, factor, and subtest scores. Based on clinical observations, these results are not surprising. However, these results are not entirely commensurate with the findings of Mattson et al. (1997). Specifically, Mattson and colleagues found that comparison of a sample of 34 children diagnosed with FAS versus 13 children, referred to as the PEA group, resulted in a statistically significant difference between FSIQ scores. However, statistical comparison of the FAS and PEA groups on the VIQ and PIQ scales did not result in a statistically significant discrepancy. Furthermore, comparison of the WPPSI-R subtest scores between the two alcohol exposed groups did not result in statistically significant findings. However, Mattson et al. also compared the subtest performance of the two groups on the WISC-R (Wechsler, 1974) and found they differed significantly on all subtests except Similarities, Vocabulary, and Digit Span. Given the results of this current study, the null hypothesis

was not rejected and it was concluded that there were no statistically significant differences on measures of intellectual functioning on the WISC-III (Wechsler, 1991) among children and adolescents diagnosed with FAS and ARND.

Limitations of the Study

There are several areas worth considering that limit the interpretation of this study. First, the sample size of those diagnosed with FAS was much smaller as compared to the ARND sample. As a result, a larger sample size of children and adolescents in the FAS group would have been desirable. Although the current sample size and distribution of scores was sufficient for the purposes of statistical analyses, increasing the number of participants would have provided a stronger foundation for interpretation of the results.

Secondly, given the retrospective nature of this investigation, it was not possible to examine aspects of cognitive functioning as measured by other psychological tests often administered to children and adolescents experiencing learning and behavioral difficulties. A prospective study would have allowed for a more systematic analysis of numerous aspects of cognitive functioning.

Third, the demographic data employed in this study was not complete in all cases and, therefore, resulted in a somewhat disjointed account of the problems incurred by these children and adolescents. Ideally, detailed information regarding each area of inquiry for all individuals would have provided a more concise appraisal as well as more confidence in making generalizations based upon the current sample.

Fourthly, this is by no means a random sample and, therefore, the results are limited in their generalizability. However, given the problems associated with

identifying this population, it would be extremely difficult to acquire an unbiased data set.

Clinical Implications

Given the results of this investigation, there is considerable evidence indicating that children and adolescents prenatally exposed to alcohol suffer from numerous longstanding problems. From a clinical perspective, it is imperative that practitioners be cognizant of the social, emotional, behavioral, and mental health difficulties, in addition to the cognitive deficits, incurred by this population. Expectations must be adjusted accordingly to accommodate the strengths and weaknesses of children and adolescents diagnosed with FAS or ARND as they frequently vary considerably. For example, many of the individuals examined in this study demonstrated considerable difficulty with academic based learning tasks, behavior, and social and emotional problems that invariably interfere with performance within a school based environment. Therefore, many children with FAS and ARND require specialized programming focused on their specific abilities. Furthermore, increased resources must be devoted to dealing with the social and emotional turmoil that these children experience. Counselling, social skills and life skills training and, most importantly, a supportive, safe and stable living environment must be provided for these children. Meeting the basic needs of these children through manipulation and modification of their environment will provide them with the best chance of performing up to their potential and improving the quality of their life.

Suggestions for Future Research

Current results add to already existing data regarding the intellectual performance of alcohol exposed children and adolescents. The results of this present investigation are generally consistent with previous studies citing higher performance by those diagnosed with ARND versus individuals diagnosed with the most severe form of prenatal exposure to alcohol, namely FAS. However, it does not appear the results of intellectual functioning provide all of the answers to the many questions clinicians and researchers have regarding this population. For instance, why do those individuals diagnosed with FAS or ARND, who fall within the Average range intellectually, continue to experience ongoing problems with adaptive functioning and decision making? Alternatively, why do adolescents who seemingly have few difficulties on a measure of intellectual functioning repeatedly engage in unusual behaviors? Answers to these questions require highly comprehensive investigations as a means to understand the global difficulties that these children and adolescents are experiencing.

Based on the literature review for this current investigation, there appears to be a definite trend in research on humans toward the use of more complex psychological tests to document the cognitive and behavioral difficulties incurred by this population. However, to date, these more complex studies are extremely limited in number. Beginning in the early 1970's, most, if not all of the cognitive investigations on FAS, were single case studies or studies that involved a very small sample size. As well, many of these early studies were focused on describing and defining the characteristics often associated with this debilitating condition. As society became more aware of the problem, and as knowledge accumulated, researchers and clinicians had increased access

and resources to study larger groups of individuals with FAS and FAE. Therefore, in the late 1970's and throughout the 1980's and 1990's, research focused on the cognitive deficits among this population employed larger and larger sample sizes. Most of the studies focused on intellectual functioning (Mattson & Riley, 1998) as well as other related areas of cognitive functioning that were observed to be problematic for this population such as speech and language difficulties (e.g., Church & Kaltenbach, 1997). However, researchers have been, and continue to be, limited by the relative lack of individuals identified as prenatally exposed to alcohol. Diagnostic strategies and criteria continue to evolve and there still appears to be considerable discrepancy regarding the manner in which individuals are diagnosed. A review of the diagnostic criteria and proposed diagnostic classification system by the IOM et al. (1996) has proven invaluable as it now provides researchers and clinicians with a more concrete basis for diagnosis.

Within the past two to three years a number of studies have surfaced that focus on more complex neuropsychological measures aimed at identifying and quantifying the central nervous system deficits and poor higher cognitive abilities often demonstrated by this population (e.g., Mattson et al., 1999; Olsen, Feldman, Streissguth, Sampson, & Bookstein, 1998). As well, research over the past several years has very slowly focused on employing standardized measures of behavioral and mental health functioning among individuals diagnosed with FAS and ARND. However, given the nature of the difficulties experienced by individuals suffering from the effects of prenatal exposure to alcohol, considerably more research must focus on the adaptive, behavioral, mental health, and higher cognitive functioning of this population.

Conclusions

The underlying impetus for this study was based upon the seemingly variable presentations of intellectual functioning among children and adolescents presenting with FAS and ARND. Although this population generally presents with considerable intellectual difficulties, review of the literature provided very limited results in determining general patterns of intellectual functioning on current measures of intellectual functioning such as the WISC-III. This study was conducted in an effort to expand current knowledge regarding the performance of children and adolescents prenatally exposed to alcohol. As a result of these findings, there is a definite need for the provision of increased services for children, adolescents, and adults who suffer from the effects of prenatal exposure to alcohol.

The children and adolescents examined in this investigation clearly suffered from considerable problems including family dysfunction, learning deficits, behavioral difficulties, poor adaptive functioning, cognitive deficits, as well as physical, emotional, and sexual abuse. Given these ongoing problems, it is not surprising that most succumb to the secondary disabilities commonly associated with prenatal exposure to alcohol.

Despite global patterns of intellectual functioning among children and adolescents diagnosed with FAS and ARND, there appears to be considerable variability in performance. Given the results of this study, and in light of previous research cited in the literature, it appears that children and adolescents with FAS, who are assessed using one of the Wechsler scales, tend to perform in the 70's on the measure of FSIQ. Alternatively, children and adolescents diagnosed with FAE or ARND tend to perform in the 80's on FSIQ. Consistent with the literature, individuals who suffer from the effects

of prenatal exposure to alcohol consistently perform better on the PIQ scale versus the VIQ scale.

There do not appear to be any notable trends in the literature regarding individual subtest performance patterns; however, results from this present study reflect a pattern of poor performance on the Comprehension subtest. Specifically, the Comprehension subtest is a measure of practical social knowledge and judgment. Therefore, in light of more current studies (e.g., Mattson et al., 1999) that demonstrate problematic higher order problem solving and poorly developed decision making skills among children and adolescents exposed to alcohol in utero, it is not surprising the individuals in this current study performed poorly on this particular subtest. There were no distinctive elevated patterns of performance on any of the subtests.

Although no statistically significant differences were observed between the FAS and ARND groups, based on the results of this investigation, there is clear evidence to suggest that children and adolescents prenatally exposed to alcohol suffer from far greater problems than just lower intellectual functioning. In conclusion, it appears as though examination of individual subtest scores provides limited insight regarding the cognitive strengths and weaknesses incurred by children and adolescents diagnosed with FAS and ARND. However, global measures, such as composite and factor scores, appear very useful in the overall delineation of intellectual functioning among this population. In summary, there is considerable need for more research in this area to facilitate further understanding of the cognitive strengths and weaknesses of children and adolescents prenatally exposed to alcohol.

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Appendix

Table 12

Two-Way Analyses of Variance for Diagnosis × Age for Information

Source	df	SS	MS	F	Power
Diagnosis	1	31.26	31.26	2.80	.380
Age	1	1.95	1.95	.175	.070
Diagnosis × Age	1	3.08	3.08	.003	.050
Residual	79	881.24	11.15		

Table 13

Two-Way Analyses of Variance for Diagnosis × Age For Similarities

Source	df	SS	MS	F	Power
Diagnosis	1	31.73	31.73	2.81	.381
Age	1	57.09	57.08	5.05	.603
Diagnosis × Age	1	4.82	4.82	.427	.099
Residual	79	891.96	11.29		

Table 14

Two-Way Analyses of Variance for Diagnosis × Age for Arithmetic

Source	df	SS	MS	F	Power
Diagnosis	1	21.51	21.51	2.27	.319
Age	1	1.79	1.79	.190	.071
Diagnosis × Age	1	.610	.610	.064	.057
Residual	79	748.81	9.47		

Table 15

Two-Way Analyses of Variance for Diagnosis × Age for Vocabulary

Source	df	SS	MS	F	Power
Diagnosis	1	11.29	11.29	1.08	.177
Age	1	6.62	6.62	.635	.123
Diagnosis × Age	1	9.69	9.69	.928	.159
Residual	79	824.92	10.44		

Table 16

Two-Way Analyses of Variance for Diagnosis × Age for Comprehension

Source	df	SS	MS	F	Power
Diagnosis	1	24.47	24.47	2.26	.318
Age	1	4.44	4.44	.000	.050
Diagnosis × Age	1	2.99	2.99	.278	.082
Residual	79	852.96	10.79		

Table 17

Two-Way Analyses of Variance for Diagnosis × Age for Digit Span

Source	df	SS	MS	F	Power
Diagnosis	1	12.06	12.06	1.83	.268
Age	1	8.93	8.93	1.36	.211
Diagnosis × Age	1	4.48	4.48	.007	.051
Residual	79	518.64	6.56		

Table 18

Two-Way Analyses of Variance for Diagnosis × Age for Picture Completion

Source	df	SS	MS	F	Power
Diagnosis	1	.127	.127	.012	.051
Age	1	16.40	16.40	1.52	.230
Diagnosis × Age	1	.400	.400	.037	.054
Residual	79	850.41	10.76		

Table 19

Two-Way Analyses of Variance for Diagnosis × Age for Coding

Source	df	SS	MS	F	Power
Diagnosis	1	2.61	2.61	.229	.076
Age	1	11.99	11.99	1.04	.173
Diagnosis × Age	1	1.11	1.11	.097	.061
Residual	79	903.87	11.44		

Table 20

Two-Way Analyses of Variance for Diagnosis × Age for Picture Arrangement

Source	df	SS	MS	F	Power
Diagnosis	1	37.88	37.88	5.16	.612
Age	1	74.25	74.25	10.11	.881
Diagnosis × Age	1	2.34	2.34	.319	.086
Residual	79	579.94	7.34		

Table 21

Two-Way Analyses of Variance for Diagnosis × Age for Block Design

Source	df	SS	MS	F	Power
Diagnosis	1	40.40	40.40	3.65	.471
Age	1	1.13	1.13	.001	.050
Diagnosis × Age	1	.748	.748	.068	.058
Residual	79	874.19	11.06		

Table 22

Two-Way Analyses of Variance for Diagnosis × Age for Object Assembly

Source	df	SS	MS	F	Power
Diagnosis	1	.194	.194	.017	.052
Age	1	.123	.123	.011	.051
Diagnosis × Age	1	3.33	3.33	.296	.084
Residual	79	889.38	11.25		

Table 23

Two-Way Analyses of Variance for Diagnosis × Age for Symbol Search

Source	df	SS	MS	F	Power
Diagnosis	1	44.39	44.39	3.67	.474
Age	1	.984	.984	.081	.059
Diagnosis × Age	1	24.08	24.08	1.99	.287
Residual	79	953.69	12.07		