A Study of Cognitive Changes Over Time, as Reflected by the Wechsler Intelligence Scales, in a Learning Disabled Population

by

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B.A., Boston College, 1985

A THESIS SUBMITTED IN PARTIAL FULLFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

in the Department

of

Psychology

[redacted]

DEAN

DATE June 13, 1988

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ABSTRACT

Data from learning disabled subjects who had been given the WISC as children (mean age = 10 years) and the WAIS-R as adults (mean age = 25 years) were studied in an attempt to discover cognitive changes that may have occurred during the course of development.

Other longitudinal studies report variability in the development of the learning disabled population. For example, Spreen (1987) reported a less favorable future outcome (in terms of achievement and adjustment) for those learning disabled subjects with greater neurological impairment, while those without neurological impairment tended to have a more favorable outcome as adults. In contrast, Sarazin & Spreen (1986) found the neuropsychological test scores of the non-neurologically involved group to be the least stable over a 15 year interval, as compared to the scores of those with neurological deficits. Further, as a result of tracing cluster-analyzed subtypes of learning disabled subjects from childhood to adulthood, Spreen & Haaf (1986) found that many subjects were in different subtypes as adults. Changes occurred within the learning disabled population, as defined by neurological and cluster analyzed classifications.

In the present investigation, cognitive changes in subjects from both of these classification schemas were measured by differences between WISC and WAIS-R composite IQ scores, subtest scaled scores, and Verbal-Comprehension, Perceptual-Organization, and Freedom from Distractibility factor scores (as defined by Cohen, 1952, 1957, 1959; Kaufman, 1975; Parker, 1983).

In general, results suggest that subjects with no neurological impairment changed on the greatest number of Wechsler measures and showed the largest differences from childhood to adulthood. The results of the analyses involving the subtypes were ambiguous due to the small sample size, but they suggest that those with minimal impairment, as well as those with a reading disabilty or visuo-perceptual disorder, changed the most over a 15 year time period. In both classification schemas, scores tended to decline with time; the decline was in both the verbal and performance realms. Implications of these findings are discussed.

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Acknowledgements

I am grateful for the guidance given to me by all the members of my examining committee.

I extend a special note of thanks to Dr. Otfried Spreen for the patience and support he has given to me during my past two years at the University of Victoria.

I would also like to thank Dr. Michael Joschko, Dr. Brian Harvey, and Dr. Beverly Timmons for the time and consideration given in reviewing an earlier draft of this thesis.

Thanks also to Mary Sanseverino and Pat Konkin for their essential statistical help, and especially to Mike Doyle for his time and statistical expertise.

Finally, I would like to thank my family and friends, who have listened to me patiently and who have supported me unconditionally.

Dedication

To my parents, for always giving me the freedom to choose, for always selflessly supporting my choice, and especially for teaching me what's really important after all...

> "And what is as important as knowledge?" asked the mind.
>
> "Caring and seeing with the heart," answered the soul.

Flavia

I. INTRODUCTION

Areas of potential difficulty for the learning disabled population have been studied over time by many researchers in an attempt to understand the dynamics underlying the development of the learning disabled child and to assist in the planning and prediction of future development for the learning disabled adult (for a review, see Spreen, 1982). Spreen (1987) utilized a comprehensive battery of interviews and neuropsychological tests in a longitudinal study to discover how neurologically and non-neurologically impaired learning disabled children and adults are different from one another. Many of these differences have been reported previously (Denbigh, 1979; Hern, 1979, 1984; Peter & Spreen, 1979; Spreen, 1987), but the issue of cognitive change has not been addressed directly. The present investigation will focus on the cognitive changes that occur over a 15 year time period in the learning disabled, as reflected by differences between scaled scores on the subtests of the Wechsler Intelligence Scale for Children (WISC; Wechsler, 1949) and the corresponding scaled scores on the Wechsler Adult Intelligence Scale-Revised (WAIS-R; Wechsler, 1981).

Neuropsychological assessment depends heavily on the interpretation of various test scores, and the

Wechsler intelligence scales are very often an integral part of such an evaluation. It has been argued, however, that in practice the scores in and of themselves are of limited value; rather, it is the pattern of scores that proves most useful in understanding the clinical implications of the presenting disability (Lutey, 1977; Matarazzo, 1972; Rourke, Strang, & Fisk, 1986). Since the pattern of test scores is clinically important, it is possible that a study of the subtest scores of a learning disabled population on the WISC as compared to the WAIS-R may reveal significant differences in scores and patterns between the child and adult. Such information will add to the understanding of the dynamics underlying the development of intellectual capacities in the learning disabled, and perhaps it will suggest specific areas of continual or shifting deficits, towards which remediation should be directed.

To develop hypotheses related to cognitive changes over time in the learning disabled, as reflected by the Wechsler scales, a review of previous longitudinal studies is necessary, as is a review of the structure and stability of the Wechsler scales. In this way, previously discovered dynamics of the learning disabled may be used in conjunction with the known dynamics of the Wechsler tests in order to predict outcomes in the present investigation.

II. LITERATURE REVIEW

A. LONGITUDINAL STUDIES

The learning disabled population is not a single entity, but rather a population of individuals with many different types of difficulties, all of which result in attainment of a level of academic achievement below that expected for the person's age and intellectual development. The group as a whole has been studied extensively, as have the various subtypes within the larger learning disabled classification. Certain criteria have been used to define the learning disabled population more clearly, such as the extent of neurological impairment (Spreen, 1982). Few researchers, however, have conducted long-term investigations of the heterogeneous learning disabled population.

Koppitz (1971) conducted a five year follow-up study of 177 learning disabled children, 6-12 years of age (mean IQ=92), who had been referred to special public school classes for the educationally handicapped. Referral to the program came from teachers and/or parents, and acceptance was based on the presence of both a learning disability and the belief that the child would benefit from special class placement. She acknowledged that each child had multiple and complex difficulties, but she did not attempt to group the children according to their difficulties. Rather, she was interested in the outcome of the group as a whole. The general findings were: 1) 17% of the children were able to return to regular classes with fair success, 2) most progress was made by children with an IQ of at least 85, who had an achievement level no more than 2 years below their appropriate grade level, and who had supportive families, 3) at referral girls were usually more impaired than boys and younger children were more impaired than older children; fewer girls and younger children returned to regular classes, 4) while 45% of her sample was diagnosed by a neurologist or psychiatrist as having some kind of brain dysfunction, no significant relationship was found between any one medical or developmental factor and achievement at follow-up.

Follow-up studies which more specifically related neurological status to later abilities report variable results. For example, a reading disabled population studied by Gottesman, Belmont, and Kaminer (1975) showed no relationship between neurological signs and reading ability, either at admission or follow-up 3-5 years later. Ackerman, Dykman, and Peters (1977) similarly report no significant relationships between level of academic achievement and presence of neurological signs among learning disabled boys. In contrast, Silver and Hagin (1963) reported that dyslexic children with organic signs showed less improvement in reading than reading disabled children without such signs. A related finding was discovered by Kaste (1972) in a ten year follow-up study of 116 children (8-12 years of age at time of referral) showing some sign of cerebral dysfunction. She found that 85% of this group had more pronounced patterns associated with cerebral dysfunction at the time of follow-up. Such contradictory findings may be the result of methodological problems and the use of differently defined learning disabled groups. As a result, no firm conclusions about the relationship between neurological status and future outcome in a learning disabled population may be drawn from these studies.

The longitudinal studies carried out by Spreen (1987) clarified the issue. Children between the ages of 8 and 12 who had been assessed for learning problems at the University of Victoria Neuropsychology Clinic were divided into three groups according to the degree of neurological impairment, i.e. 1) definite impairment reflected by "hard" signs such as paresis or ataxia (labelled BD), 2) suggested impairment reflected by "soft" signs such as dyspraxia or nystagmus (labelled MBD), or 3) learning disability without clinically demonstrated neurological impairment (labelled LD). These terms were based on results of a neurological examination given at the time of referral, rather than on inferences from other sources. In this way, those children with hard signs, soft signs, and no signs could be contrasted with each other and with controls, and more definite conclusions than were previously possible could be drawn.

Subjects with an IQ less than 70, acquired brain damage during childhood, and/or primary emotional disturbances were excluded from the follow-up investigations. In addition, subjects who were untraceable or who had moved out of the Vancouver Island/Lower Mainland region were dropped from the study. A control group of 52 children matched for age, sex and socioeconomic status were selected from regional secondary schools; these students reportedly did not experience any learning difficulties, nor did they make exceptionally good progress. The study was divided into two phases. Eighty-four percent of the subjects originally assessed participated in Phase I, and 81% of the total sample (including controls) participated in Phase II.

Phase I consisted of interviewing 203 subjects and their parents on an average of nine years after the original assessment (mean age=19 years); questions referred to social, personal, and occupational adjustment. School records were also obtained. The results of this phase were reported in a number of studies:

1. Denbigh (1979) found that all three learning disabled groups evidenced a deficit in academic achievement, as well as a lower level of performance than the control group in all areas of study, including art and industrial education. They also had a poorer attitude towards school.

2. Hern (1979) found that in general, the probability of central nervous system disorders, birth and pregnancy problems, seizure activity, and behavior problems was greater in the learning disabled groups than in the control group.

3. Peter and Spreen (1979) found that all learning disabled groups reported a greater number of signs of personal maladjustment and more antisocial behaviour than the control group.

4. Spreen (1982) reported that subjects with an increasing degree of neurological impairment had more difficulty finding a permanent job and were paid lower wages.

In general, on a majority of outcome variables there was a significant difference between the learning disabled groups and the control group, and when differences within the learning disabled groups were found they were present in a linear fashion; i.e., the control group had the most favorable outcome, the learning disabled group without neurological impairment had a somewhat less favorable outcome, those with soft neurological signs fared worse than those with no signs, and those with hard neurological signs fared worst of all (Spreen, 1987). In all outcome areas, the presence of neurological impairment was related to poorer achievement and adjustment.

Phase II occurred on an average of 15 years after the original referral and involved most of the subjects from Phase I, as well as some subjects who had been assessed as children but who had refused to participate in Phase I. A total of 191 subjects, with a mean age of 24, were evaluated through a neurological examination, neuropsychological assessment, interview, and personality inventory. In general, a pattern similar to that resulting from Phase I was found; i.e., the presence of neurological signs in learning disabled children was related to poorer future outcome, as reflected in measures of academic achievement, intelligence, and personal, social, and occupational adjustment. Those with soft signs fared somewhat better than those with hard signs, but did not fare as well as those learning disabled without neurological signs.

Specifically with reference to the present topic, each of the three learning disabled groups obtained scores which were significantly different from each other on full scale IQ (FSIQ), verbal IQ (VIQ), and performance IQ (PIQ) as measured originally with the WISC and later with the WAIS-R. The typical pattern of decline in performance with the presence of greater neurological involvement was evidenced once again. Further, the three learning disabled groups obtained scores which were significantly different from each other on six of the WISC subtests (Similarities, Vocabulary, Picture Completion, Picture Arrangement, Object Assembly, and Coding) and on all of the WAIS-R subtests. An additional finding from Phase II was that neurological signs did not disappear with maturation, but rather tended to increase in frequency (Hern, 1984).

A further attempt to follow the maturation process was carried out by Spreen and Haaf (1986). Subtypes derived from the initial childhood assessment and those derived from the adult assessment were compared. Six childhood subtypes were defined: 1) specific reading disorder; 2) linguistic disorder; 3) specific arithmetic disorder; 4) minimally impaired; 5) severely impaired; 6) visuo-perceptual disorder. The authors report that the subtypes that were derived 15 years later "...generally tend(ed) to resemble some of the types found at middle childhood," (p. 177); the similar adult subtypes consisted of two severely impaired groups, two specific reading disabled groups, one arithmetic disorder group, and one "mixed general impairment" (p.177); the linguistic group was no longer present. It should be noted that a few additional measures were used in the adult subtyping procedure. The tracing of individual subjects from childhood to adulthood resulted in only "...a moderate degree of persistence" (p.170) (19 of 53 subjects were in similar subtypes at both ages). Since the linguistic group disappeared and 24 of 53 subjects changed subtypes, it is reasonable to assume that some changes in ability profiles occurred over time. It is the nature of these changes, as specifically reflected in Wechsler subtest scores, that is the subject of the present investigation.

It is interesting to note that Snow, Cohen, and Holliman (1985) actually subtyped 106 learning disabled children (mean age=10.4 years) on the basis of their WISC-R scores alone; they discovered two minimally impaired groups, two language disordered groups, an attention deficit group, and a generally impaired group. It is possible that shifts in subtype placement would also occur in this population, as happened in Spreen and Haaf's study. Changes in Wechsler scores over time may contribute to the shift in subtypes from childhood to adulthood. A brief review of what the Wechsler scales measure will aid the development of specific hypotheses regarding such changes.

B. THE STRUCTURE OF THE WECHSLER SCALES

The Wechsler scales are some of the most widely used measures of intelligence across all ages: the Wechsler Pre-school and Primary Scale of Intelligence (WPPSI) for ages 4.5-6 (Wechsler, 1967), the Wechsler Intelligence Scale for Children-Revised (WISC-R) for ages 6-16 (Wechsler, 1974; preceded by the original WISC, Wechsler, 1949), and the Wechsler Adult Intelligence Scale-Revised (WAIS-R) for ages 16 through adulthood (Wechsler, 1981; preceded by the Wechsler-Bellevue Scales and the WAIS, Wechsler, 1944, 1955). The latter two scales are composed of 11 subtests: Information, Vocabulary, Similarities, Comprehension, Arithmetic, Digit Span, Picture Arrangement, Picture Completion, Object Assembly, Block Design, Coding (WISC-R)/Digit Symbol(WAIS-R). On the WISC-R, Digit Span is optional, as is an additional subtest called Mazes. Numerous factor analytic studies have been performed on these scales in an attempt to discover the underlying structure of the tests, and thereby the underlying structure of intelligence, as defined by scores on a particular test.

The structure of intelligence has been debated for most of this century; Matarazzo (1972) provided a chronological review of this debate. Briefly, Matarazzo indicated that the early Spearman-Thorndike discussion of the existence of a unitary trait of intelligence (g) versus multiple specific abilities (s) gave way to the view that intelligence was a composite of a general g factor, some additional group factors, and also some specific factors reflected in highly specific test items and not in others.

Extensive factor analyses of the Wechsler-Bellevue I, WAIS, and WISC were carried out by Cohen (1952, 1957, 1959 respectively). His subjects were those from the original standardization samples, as well as various patient groups. He found that the subtests of these scales could be interpreted as four factors. First, Cohen identified Spearman's g factor -- all of the subtest to subtest correlation coefficients were positive and greater than zero indicating that each subtest measured something that they all had in common (with varying degrees of efficiency). Three additional factors were then identified: 1) Verbal-Comprehension, 2) Perceptual-Organization, and 3) Freedom from Distractibility or Memory. In normals, the Information, Comprehension, Vocabulary, and Similarities subtests loaded most highly on the Verbal-Comprehension factor;

the Object Assembly, Block Design, Picture Completion, and Picture Arrangement subtests loaded most highly on the Perceptual-Organization factor; the Digit Span and Arithmetic subtests loaded most highly on the Freedom from Distractibility factor. Cohen concluded that the four factor structure of intelligence as reflected by the Wechsler scales was similar from childhood through adulthood. In addition, he found that the factor structure of normals, psychoneurotics, acute schizophrenics, and brain damaged patients was similar. Matarazzo (1972) similarly concluded in his review of factor analyses of the Wechsler tests that all the scales reliably yielded across the age groups "... a robust first Verbal factor, ... a slightly less robust but quite strong Performance factor, ...and possibly a third factor (Memory/Freedom from Distractibility)," (pp. 273-274).

The Verbal-Comprehension and Perceptual-Organization factors have traditionally been interpreted as measures reflecting their respective cognitive components; the Freedom from Distractibility factor has been interpreted as a behavioural measure of distractibility, as well as a cognitive measure of sequencing ability, short-term memory, symbolic processing, and numerical ability (Kaufman, 1979).

The arrival of the revised Wechsler scales led to a new series of factor analyses to discover if they shared a factor structure similar to that of their predecessors. In general, the same results were found:

1. Kaufman (1975) factor analyzed the scores from the standardization sample of the WISC-R at 11 age levels between 6.5 and 16.5 years. He obtained results similar to those of Cohen (1959). He found a large general factor of intelligence, as well as the same three group factors of Verbal-Comprehension, Perceptual-Organization, and Freedom from Distractibility. The factors were comprised of the same subtests as in the Cohen study, except that Picture Arrangement did not have a high enough loading to be considered part of the Perceptual-Organization factor, suggesting that it measures something different from that which it measured in the original WISC. In addition, the Coding subtest was considered to be part of the Freedom from Distractibility factor.

2. Parker (1983) factor analyzed the scores from the standardization sample of the WAIS-R at nine age levels between 16 and 74 years, and once again found a factor of general intelligence, as well as Verbal-Comprehension, Perceptual-Organization, and Freedom from Distractibility factors. The subtests loading on these factors were once again similar to those in the Cohen study of the WAIS (1957), and the same as those found in

the Kaufman study of the WISC-R (1975). Picture Arrangement did not load highly on the Perceptual-Organization factor, again suggesting that it is measuring something different from what it previously measured on the WAIS.

Many approaches and variable conclusions have resulted from the numerous factor analytic studies of the Wechsler scales. However, general trends are present. In a review of the factor analytic studies of the WAIS-R, Leckliter, Matarazzo, and Silverstein (1986) state that most researchers preferred a two or three factor solution. Such interpretations are defined by subjective variables, described by Matarazzo (1972) as depending upon "...what you begin with (the particular tests you select), the representativeness (or bias) of your sample of subjects, and the bias from which you as an observer-factor analyst-theoretician approach your task..." (p.263). Hill, Reddon, and Jackson (1985) stated in another review of the factor analytic studies of the Wechsler scales, that a three factor solution seems to be the preferred number for clinical applications. Leckliter et al. and Hill et al. agree that it is the one factor solution that provides the most parsimonious model of the data, but it appears that a three factor solution is the most clinically useful. Matarazzo (1972) contended that the third factor may be the most important in special populations (alcoholic and brain injured). Other investigators contended that the Freedom from Distractibility factor and Perceptual-Organization factor reliably discriminated patients with Huntington's disease and their "at-risk" off-spring (Josiassen, Curry, Roemer, DeBease, & Mancall, 1982, cited in Leckliter et al., 1986). In general, Leckliter et al. and Hill et al. concluded that the three factor solution may provide the clinical investigator with a richer source of hypotheses when studying heterogeneous populations, such as the learning disabled.

Bannatyne (1971, 1974) proposed a recategorization of the WISC subtests based on his work with dyslexic children. His Conceptual category (Vocabulary, Similarities, Comprehension) is similar to the previously described Verbal-Comprehension factor; his Spatial category (Picture Completion, Block Design, Object Assembly) is similar to the previously described Perceptual-Organization factor; his Sequential category (Coding, Digit Span, and Arithmetic) is similar to the Freedom from Distractibility factor. He claimed that this recategorization was useful in distinguishing genetic dyslexics (those without known brain damage) from other types of reading disabled children. Genetic dyslexics had their highest scores on the Spatial category and lowest scores on the Sequential category.

Rugel's investigation (1974) of the factor structure of the WISC in two populations of disabled readers supports Bannatyne's recategorization system. Each population had a verbal and performance factor, however, the third factor was comprised of different subtests in each of the populations. In one population, Arithmetic, Digit Span and Coding loaded most highly on this factor, whereas in the other population, Digit Span did not load on this or any other factor. Since the structure of the third factor was different, these reading disabled individuals may have differed among themselves in ability levels assumed to be reflected by this factor, i.e. memory, sequencing ability, and distractibility. In addition, it was found that the g factor accounted for only 15-20% of the variance in these populations, whereas in normals it accounts for approximately 45% of the variance. Rugel suggested that each of the basic decoding, association, and encoding processes necessary for adequate performance on these tests are disrupted to a certain degree in a heterogeneous reading disabled population; thus, more subtest variance will be accounted for by individual differences in these processes, lowering the subtest intercorrelations, and thus the percent of variance accounted for by the g factor.

Ackerman, Dykman, and Peters (1976) also found that the Sequential score was below average for a population of disabled readers. In particular, those with difficulties in arithmetic and reading scored highest on the Spatial and lowest on the Sequential categories; those with difficulties in arithmetic and spelling, but normal in reading, scored highest on the Conceptual and lowest on the Sequential categories.

McAllister (1981) similarly reported that 59% of a group of learning disabled children characterized by reading and arithmetic difficulties scored highest on the Spatial and lowest on the Sequential factors. The difference between the scores on these two factors was considered clinically meaningful in 99% of the children. In addition, four of the five arithmetic disabled subjects scored highest on the Conceptual and lowest on the Sequential factors, resulting in a clinically meaningful difference for most of the subjects. It appears that the three factor structure of the WISC is the most clinically useful when dealing with a learning disabled population.

In contrast, an additional factor was found by Baumeister and Bartlett (1962) when comparing 13-14 year old normal and retarded (IQ below 80) children on the WISC. Both groups had a general intelligence factor and a verbal factor. However, the performance factor was consistently weaker in the retarded group, and an additional factor, consisting of the Arithmetic, Picture Arrangement, and Coding subtests, appeared in this group. This addition has been called the "trace" factor and is thought to support the stimulus trace hypothesis of Ellis (1963, cited in Spreen, Tupper, Risser, Tuokko, & Edgell, 1984). This trace, a reverberating electrophysiological circuit in the brain, is triggered by a stimulus and is responsible for the laying down of memory; Ellis proposed that the trace would be shorter in duration and lower in intensity in the developmentally handicapped child, leading to deficits in learning and retention. The Coding, Picture Arrangement, and Arithmetic subtests require retention of new information, so perhaps it is this diminished ability in retarded individuals that has led to the appearance of an additional factor.

Blaha and Vance (1979) studied the factor structure of the WISC-R in a learning disabled population (mean age=10). They found the familiar structure of a general factor along with three group factors, called in this instance, Verbal-Comprehension, Spatial-Perceptual-Mechanical, and Freedom from Distractibility. The authors stated that these data, compared to that of a severely reading disabled population, resulted in a less complex structure, suggesting that the more severe a reading disability, the more the factor structure for that group will differ from the factor structure of normals. Naglieri (1981) also investigated the factor structure of the WISC-R in a learning disabled population and again found only the familiar Verbal-Comprehension, Perceptual-Organization, and Freedom from Distractibility factors.

It appears that the Wechsler tests can best be described by a general factor of intelligence, in addition to three factors, identified from this point on as Verbal-Comprehension, Perceptual-Organization, and Freedom from Distractibility. These factors were found in normal and learning disabled populations, although some differences were found in the composition of the structure in the more severely impaired groups. It is now necessary to investigate the stability of the subtests which comprise these factors. An investigation of the dynamics of the Wechsler tests will aid in the understanding of any changes over time that they may reflect, be they cognitive, or purely psychometric.

C. STABILITY OF WECHSLER SCORES

Stability of WISC IQ scores and subtest scaled scores were reported in two different studies. Quershi (1968) reported the stability of WISC composite IQ scores over a three month interval; 328 normal school children between the ages of 5 and 13 years were tested.

Median correlations were .79 for VIQ, .78 for PIQ, and .82 for FSIQ, thus reflecting relative stability of these measures over this time period. However, a significant practice effect was reported. Irwin (1966) reported WISC subtest scaled score stability over a one month time interval in a normal sample of 29 six year olds and 29 eleven year olds. Reliabilities in the six year old group ranged from a high of .76 for Information to a low of .41 for Comprehension; in the eleven year old group coefficients ranged from a high of.93 for Vocabulary to a low of.67 for Picture Arrangement. In general, WISC subtest scaled scores were relatively stable over a one month time period.

Wechsler (1974, 1981) reported the stability of the scaled scores obtained by a normative sample on the WISC-R and WAIS-R in their respective manuals. To assess the stability of the WISC-R scores, 303 children from six selected age groups in the standardization sample were retested after three to five weeks. The average stability coefficients of the subtest scaled scores across the six age groups ranged from .65 on Mazes to .88 on Information, and the coefficients for the VIQ, PIQ, and FSIQ were .93, .90, and .95, respectively. Similarly, 119 subjects from the WAIS-R standardization sample, representing the 25-34 and the 45-54 year age groups, were retested with the WAIS-R two to seven weeks after the initial testing. The subtest stability coefficients ranged from .67 on Object Assembly to .94 on Information, with coefficients of the composite IQ scores ranging from .89 on PIQ for 25-34 year group to .97 on the VIQ for the 45-54 year group. In addition, the WISC-R and WAIS-R were administered in a counterbalanced order to a normative sample of eighty 16 year olds; the interval between testings ranged from 1-6 weeks. The correlation coefficients for the subtest scaled scores ranged from .39 on Picture Arrangement to .86 on Vocabulary, while the coefficients for the VIQ, PIQ, and FSIQ were .89, .76, and .88, respectively. Wechsler reported that the differences in mean VIQ, PIQ, and FSIQ were only 0, 1, and 2 points, respectively, thus suggesting that the WAIS-R and WISC-R yield equivalent IQ scores for normal 16 year olds. However, the relatively low correlations of Picture Arrangement (.39) and Object Assembly (.47) signal the use of caution when interpreting differences between scores on the WISC-R and WAIS-R versions of these subtests. Practice effects resulting from the short test-retest interval were reported in all cases. Further investigations of the Wechsler scales involving a longer test-retest interval, as well as other populations, will provide a more complete background upon which to assess the stability of the Wechsler scales over time.

The stability of the composite IQ scores of the WISC over a four year period was reported by Gehman and Matyas (1956). Sixty normal children were given the WISC at a mean age of 11 years and again at a mean age of 15; test-retest correlations of .77 for VIQ, .74 for PIQ, and .77 for FSIQ suggest stability of these scores in a normal population (individual subtest correlations were not reported).

As part of a longitudinal study Yule, Gold, and Busch (1982) tested 85 normal children on the WPPSI at 5.5 years of age and later on the WISC-R at 16.5 years of age. The correlations between the VIQ, PIQ, FSIQ scores obtained at time 1 and time 2 were .82, .73, and .86, respectively. Where individual subtest correlations could be computed, they were found to be somewhat lower. However, only Picture Completion was below .50 (.43); the other six subtest correlations ranged from .50 on Comprehension to .69 on Vocabulary and Arithmetic. It can be concluded that the scaled scores of these two Wechsler scales appear to remain relatively stable in a normal population over an 11 year period.

Investigations of scaled score stability over time in other populations have led to different results, depending on the sample's level of intellectual functioning. Zimmerman, Covin, and Woo-Sam (1986) administered the WISC-R to a group of 13 year olds (n=90) referred for special education services; on an average of four years later the WAIS-R was administered. The correlations between the mean VIQ, PIQ, and FSIQ at time 1 and time 2 were all above .80, as previously reported for a normal sample by Wechsler (1981). WAIS-R IQ scores were 3-5 points higher than WISC-R scores (significant at the .01 level); while the scores remained stable, significant differences did appear, suggesting that changes occurred between time 1 and time 2. The differences became more apparent when the results were considered by WISC-R IQ levels. The differences between the two scales grew as the WISC-R FSIQ fell below 70: 1) for WISC-R FSIQ = 60-69, the WAIS-R FSIQ was 5.5 points greater than WISC-R, VIQ was 7.1 points greater, and PIQ was 3.1 points greater; 2) for WISC-R FSIQ = 50-59, the WAIS-R FSIQ was 12.3 points greater, VIQ was 15.9 points greater, and PIQ was 9.7 points greater; 3) for WISC-R FSIQ = 40-49, WAIS-R FSIQ was 18.0 points greater, VIQ was 18.0 points greater, and PIQ was 11 points greater. The averaged differences between the two scales became minimal as the WISC-R FSIQ rose from 70-100. This study suggests that the differences between scores on the WISC-R and WAIS-R are most marked at the lower ability levels, while as FSIQ's approach the average range, these scales are increasingly comparable, remaining relatively stable over a four year time period.

Similar results were found by Sattler, Polifka, Polifka, and Hilsen (1984). They compared WISC-R and WAIS-R scores of 30 students in classes for the learning disabled or mentally retarded, over a four year interval. At initial testing the mean age was 13.85 years, the mean WISC-R FSIQ was 81.13, mean VIQ was 81.00, and mean PIQ was 84.70. At follow-up, the mean age was 17.52 years, and the mean WAIS-R FSIQ was 82.70, mean VIQ was 81.13, and mean PIQ was 86.47. The scores were not significantly different from time 1 to time 2 and yielded correlations of .86 (FSIQ), .76 (VIQ), and .82 (PIQ). Thus, as FSIQ's approached average, the Wechsler scales provided comparable, stable measures of intelligence over time, as suggested by Zimmerman et al. (1986).

Support for the additional finding of Zimmerman et al. (1986), i.e. that as WISC-R FSIQ's decline below 70, differences between WISC-R and WAIS-R scores increase, comes from a study by Rubin, Goldman, and Rosenfeld (1985). Forty-one subjects between 12 and 15 years of age, gathered from a mentally retarded residential population, were tested with the WISC-R; the WAIS-R was administered an average of 3.2 years later. The differences between the WISC-R and WAIS-R FSIQ (means=55.83, 66.93, respectively), VIQ (means=58.80, 70.05), and PIQ (means=60.66, 65.54) were statistically significant, as were the correlations of .83, .79, and .82. Once again, while stability is reflected by high correlation coefficients, significant differences appeared on the two tests. In contrast, the subtest scaled scores showed only small differences, with only Arithmetic and Coding/Digit Symbol being significantly different on the two scales. The authors suggested that such results may have been due to the process of translating scaled scores into composite IQ scores.

It appears then, that when WISC-R FSIQ approaches the average range, VIQ, PIQ, and FSIQ scores obtained on the WISC-R are equivalent to scores obtained on the WAIS-R three to four years later, reflecting stability over time. As FSIQ declines below 70, the scores obtained on the two scales are no longer comparable, exhibiting an absence of stability over time.

The present investigation studies changes in scores on the WAIS-R relative to scores on the WISC (rather than the WISC-R), so a comparison of these two scales would be ideal; only one such study was found in the literature. Frauenheim & Heckerl (1983) compared WISC composite IQ scores of 11 dyslexics (mean age=10.6) with corresponding WAIS-R scores 17 years later (mean age=27); scores were essentially the same on the two measures (mean WISC VIQ=84, PIQ=105, FSIQ=94; mean WAIS-

R VIQ=85, PIQ=104, FSIQ=92).

In order to further substantiate the equivalence of WISC and WAIS-R scaled scores, a review of WISC/WISC-R comparisons may be helpful, since WISC-R/WAIS-R scores have been shown to be comparable in a population with FSIQ's in the borderline to average ranges. To summarize, if 1) WISC-R = WAIS-R and 2) WISC = WISC-R, then 3) WISC = WAIS-R.

Of particular interest to the present study is an investigation of WISC/WISC-R comparability in a learning disabled population, conducted by Fisk and Rourke (1987). Two hundred learning disabled subjects (mean age=9.6) were randomly assigned to either the WISC or the WISC-R condition. No significant differences between WISC and WISC-R VIQ, PIQ, or FSIQ appeared (mean WISC VIQ= 90.93, PIQ= 100.84, FSIQ= 95.18; mean WISC-R VIQ=89.96, PIQ= 99.69, FSIQ= 93.94), suggesting that summary IQ scores of these two tests are equivalent for a learning disabled population.

In contrast, Swerdlik (1977) reviewed 12 WISC/WISC-R comparison studies conducted with a wide variety of samples, including the Wechsler standardization sample, educable mentally retarded students, and deaf children. Many of the studies compared current WISC-R scores with WISC scores obtained 3-4 years earlier, but two studies administered both the WISC and WISC-R to subjects in a counterbalanced order with a test-retest interval not exceeding 67 days. In all instances WISC scaled scores for the three major indices were 5-8 points higher than the corresponding scores on the WISC-R.

In summary, previous findings suggest that WISC-R/WAIS-R IQ scores are equivalent in a population with an average level of intelligence, as are WISC/WISC-R scores in a learning disabled population with an average level of intelligence. So, a logical assumption leading from these comparisons is that WISC/WAIS-R scores should be equivalent in a learning disabled population with an average level of intelligence. Caution in interpreting such equivalence is necessary due to the conflicting studies which reported WISC IQ scores to be 5-8 points higher than WISC-R IQ scores. Further investigation of the subtest scaled scores which comprise these measures is necessary in order to assess their stability over time, which may or may not follow the same pattern as the composite IQ scores.

As mentioned previously, Rubin et al. (1985) reported little significant change in a mentally retarded population's WAIS-R subtest scaled scores, as compared to WISC-R subtest scaled scores obtained three years earlier. Arithmetic and Coding/Digit Symbol were the only scores showing a significant change (increase) over time. Correlations of the scaled scores ranged from

.58 on Information to .81 on Arithmetic, reflecting relative stability over a three year time period.

Other studies reported similar results. Smith (1978) conducted a study of the WISC-R subtests of 161 children in learning disabled classrooms over a seven month test-retest interval, in which he found the tests to remain relatively stable, with correlation coefficients ranging from .79 to .83. Kaste (1972) conducted a ten year follow-up study of children diagnosed with cerebral dysfunction in which she reported correlation coefficients of subtests ranging from .35 on Comprehension to .66 on Similarities (using the WISC and Wechsler-Bellevue II).

Sarazin and Spreen (1986) studied the stability of various neuropsychological tests over a 15 year time period in a learning disabled population, consisting of subjects with and without neurological impairment. They found that the VIQ and the PIQ from the WISC (at the mean age of 10 years) and the WAIS-R (at the mean age of 25 years) remained relatively stable, although WAIS-R scores were slightly lower. However, in looking at the individual subtest correlations between scores obtained at the initial assessment and those obtained at follow-up, it appeared that the non-neurologically involved (LD) group was the least stable (7 of the 11 subtests had correlations below .5, and when matched for IQ, 6 of

11 were below .5), while those with soft neurological signs (MBD) were somewhat more stable (3 correlations were below .5, when matched for IQ, 6 were below .5), and those with hard neurological signs (BD) were the most stable (1 correlation was below .5 and when matched for IQ, 3 were below .5). Therefore, even though the composite VIQ and PIQ remained relatively stable, changes occurred in the scaled scores of the subtests which comprise these measures, as suggested by the varying correlations. In addition, as seen previously, significant changes may also occur between scores that are reported as stable (Rubin et al., 1985; Zimmerman et al., 1986). The nature of these changes is of interest for the present study.

In summary, VIQ, PIQ, and FSIQ scores of a learning disabled population with FSIQ's greater than 70 remain relatively stable over time as measured by the Wechsler scales. Similar findings were reported for the subtest scaled scores in a mentally retarded population (Rubin et al., 1985), a group diagnosed with cerebral dysfunction (Kaste, 1972), and a learning disabled population over a seven month test-retest interval (Smith, 1978). However, Rubin et al. (1985) and Zimmerman et al. (1986) report significant differences between the VIQ, PIQ, and FSIQ scores as measured by the WISC-R and WAIS-R, even though these same measures result in significant correlations, suggesting stability. In addition, when a heterogeneous learning disabled population was subdivided according to the extent of neurological involvement and studied over a period of 15 years, the degree of subtest stability varied with the neurological diagnosis. So changes did occur in the learning disabled population; it is the nature of these changes within two different subgrouping schemas that is the subject of the present investigation.

III. HYPOTHESES

Three avenues of further investigation concerning cognitive changes in the learning disabled over time are suggested by the above research:

1. Sarazin and Spreen (1986) reported the relative stability of the VIQ and PIQ in a learning disabled population over a 15 year time period, stating that the BD group showed the highest stability, the MBD group showed moderate stability, and the non-neurologically impaired LD group showed the least stability, with WISC/WAIS-R correlations greater than .5 on only 4 of the 11 subtests. The varying levels of stability suggest that cognitive changes do occur in a learning disabled population over time.

Such varying levels of stability may be a consequence of different degrees of neurological impairment. The BD subjects have been so labelled on the basis of conclusive medical and/or clinical evidence of tissue damage and resulting behavioral decline (Gaddes, 1985). This impairment is likely to limit the possibilty of wide fluctuations in ability level; it is likely then, that the BD group's cognitive abilities will remain somewhat stable over time, as was reflected by the stable neuropsychological measures reported in the Sarazin and Spreen study. In contrast, soft signs are not as well defined as hard signs; they are only suggestive of "minimal brain damage". Thus, a greater possibilty for change exists for this group; such change was reflected in a lower level of stability on neuropsychological measures, as compared to the BD group, in the Sarazin and Spreen study. Those subjects exhibiting no neurological deficits have no known structural compromises, thus they have the greatest potential for change over time, as reflected by the lowest level of stability in the Sarazin and Spreen study.

In the present study, cognitive changes over time will be reflected in the analysis of difference scores between WISC and WAIS-R composite IQ scores and subtest scaled scores. In light of the preceding discussion, it is hypothesized that the LD group will have the most significant differences, thereby exibiting the most change from childhood to adulthood; the MBD group will have some significant differences, exhibiting somewhat less change; and the BD group will have few, if any, significant differences, exhibiting little change over 15 years. The changes in the scores will be analyzed within each group to see if significantly different patterns exist between the child and adult.

2. Spreen and Haaf (1986) report "...a moderate degree of persistence" (p.170) over a 15 year interval in

selected subtypes derived from a learning disabled population. To investigate why a greater degree of persistence is not present, the subjects in the various subtypes will be analyzed with respect to their Wechsler composite and scaled subtest scores only, to determine if significant differences exist on these measures among subtypes over time.

Both on the premise that neuropsychological tests measure brain function and on the basis of the neuropsychological profiles presented by Spreen and Haaf for each of the subtypes, it is assumed that the severely impaired subtype is the most neurologically compromised, while the minimally impaired subtype is relatively intact neurologically. Therefore, as in hypothesis 1, those subjects with few known deficits are assumed to have the greatest potential for change, while the impairments of the more severely involved subtypes serve as stabilizing factors, making wide fluctuations in ability level less likely for these groups.

It is hypothesized then that, the most significant differences, i.e. the most change, will be exhibited by the minimally impaired group; the least change will be exhibited by the severely impaired group; the remaining groups will show some degree of change. Again, the changes in scores will be analyzed to determine if significantly different patterns appear during childhood, as compared to adulthood.

3a. The most commonly reported factor structure of the the Wechsler scales is that of a general factor of intelligence, along with a Verbal-Comprehension factor, a Perceptual-Organization factor, and a Freedom from Distractibility factor (Cohen, 1952, 1957, 1959; Kaufman, 1975; Parker, 1983). It is hypothesized that this structure will be derived from both the WISC and the WAIS-R scores of a learning disabled population.

3b. Utilizing this factor structure, both the neurological classifications defined by Spreen (1978) and the statistical subtypes of Spreen and Haaf (1986) will be investigated to determine if any significant difference in factor scores occurs over time. Again, the most change is expected in the groups showing no neurological signs and minimal impairment, and the least change is expected in the neurologically impaired and most severely involved subtypes.

IV. METHODS

A. SUBJECTS

Subjects were drawn from the comprehensive longitudinal study carried out by Spreen (1987). These children were seen at the University of Victoria Neuropsychology Laboratory for learning problems between the ages of 8 and 12 and were followed up on the average of 15 years later. The following criteria were employed for subject selection: 1) VIQ or PIQ greater than 69; 2) no acquired brain damage during childhood; 3) no evidence of primary emotional disturbance at the time of referral; 4) complete WISC and WAIS-R test batteries (excluding Mazes).

Subjects were classified at the time of original assessment into one of three groups based on the results of a neurological examination conducted by one of two neurologists upon referral from a general practitioner. The three groups were: 1) those exhibiting "hard" signs of neurological impairment (e.g., paresis, ataxia), labelled as brain damaged (BD); 2) those exhibiting "soft" signs of neurological impairment (e.g., dyspraxia, nystagmus), labelled as having minimal brain dysfunction (MBD); 3) those with no signs of neurological impairment, labelled as learning disabled (LD).

In addition, data from subjects who had both previously been subtyped by Spreen and Haaf (1986) and who had complete Wechsler batteries at the time of initial assessment and follow-up, were gathered for further analyses.

Descriptive data for subjects used in each analysis will be presented in their respective results section.

B. PROCEDURE

At the time of initial referral the WISC was administered to subjects as part of a complete neuropsychological evaluation; at the time of follow-up the WAIS-R was administered. Scores from the 11 subtests resulted in a VIQ, PIQ, and a FSIQ. The VIQ is comprised of scores scaled for age from six subtests: 1) Information, 2) Similarities, 3) Vocabulary, 4) Comprehension, 5) Arithmetic, and 6) Digit Span. PIQ is generally comprised of scores from five subtests: 1) Picture Completion, 2) Picture Arrangement, 3) Block Design, 4) Object Assembly, and 5) Coding (WISC)/Digit Symbol (WAIS-R). The sixth subtest on the WISC Performance scale, Mazes, is optional and was not used in the present analysis since there is no such corresponding scale on the WAIS-R. The FSIQ is the composite score obtained from the total battery.

In addition to scores obtained on the 11 subtests, three factor scores were computed for each subject at both times of testing. The factors were based on previous factor analyses of the Wechsler scales (Cohen, 1952, 1957, 1959; Kaufman, 1975; Parker, 1983), and on a replication of these earlier findings resulting from a factor analysis of the present data (see Results section for details). The Verbal-Comprehension factor is comprised of scores on 1) Information, 2) Similarities, 3) Vocabulary, and 4) Comprehension. The Perceptual-Organization factor is comprised of scores on 1) Picture Completion, 2) Block Design, and 3) Object Assembly. The Freedom from Distractibility factor is comprised of scores on 1) Arithmetic, 2) Digit Span, and 3) Coding/Digit Symbol. Kaufman (1975) reported that the age to age consistency of the WISC-R factor solution permits the averaging of the scaled scores from the four Verbal-Comprehension tests, the three Perceptual-Organization tests, and the three Freedom from Distractibility tests in order to obtain factor scores for each subject. This age to age consistency was also found in analyses of the WISC (Cohen, 1959) and WAIS-R (Parker, 1983). For this reason, the scaled scores comprising each of these factors were averaged in order to obtain factor scores for each subject, at the time of initial assessment and follow-up.

Results of the analyses involving the composite IQ scores, the 11 subtest scaled scores, and the three factor scores obtained from the WISC and the WAIS-R follow.

V. RESULTS

All analyses utilized the Statistical Package for the Social Sciences (SPSS, 1983) programming system.

Results of the factor analyses will be presented first in order to establish the existence of the factors used as part of the subsequent investigations.

A. FACTOR ANALYSES OF WISC AND WAIS-R SCALED SCORES

Two separate factor analyses were conducted. First, the WISC subtest scaled scores of 96 learning disabled children (27 female, 69 male; mean age=10 years) with complete WISC batteries (excluding Mazes) were factor analyzed using the principal components method with a Varimax rotation. Then the WAIS-R subtest scaled scores of 137 learning disabled adults (36 females, 101 males; mean age=24.7 years) with complete WAIS-R batteries were factor analyzed using the same method. Both the analysis of the WISC and the analysis of the WAIS-R resulted in the derivation of a general factor, plus the three factors of Verbal-Comprehension (VC), Perceptual-Organization (PO), and Freedom from Distractibility (FFD).

The loadings of the first unrotated factor reflect the general "g" factor of intelligence proposed by Spearman (see Table 1). The Similarities and Vocabulary

TABLE 1

WISC and WAIS-R Subtest Loadings on Unrotated First Factor

UNROTATED FIRST FACTOR

SUBTEST	WISC	WAIS-R
Similarites	.83	.82
Vocabulary	.80	.83
Information	.74	.77
Picture Completion	.73	.73
Block Design	.72	.71
Picture Arrangement	.68	.76
Comprehension	.68	.80
Object Assembly	.66	.64
Digit Span	.62	.59
Arithmetic	.57	.75
Coding/Digit Symbol	.40	.53
% of Variance Accounted For	46.9%	52.9%

subtests were the best estimates of general intelligence in childhood and adulthood.

The subtests which loaded most highly on each of the rotated factors were: 1) VC: Information (.79 WISC/.87 WAIS-R), Comprehension (.73/.78), Vocabulary (.68/.88), and Similarities (.67/.75), as well as Arithmetic (.64/.56); 2) PO: Object Assembly (.87/.87), Picture Completion (.80/.71), Block Design (.71/.81), as well as Picture Arrangement (.52/.57); 3) FFD: Coding/Digit Symbol (.89/.84), Digit Span (.61/.60), as well as Arithmetic (.44/.56) (see Tables 2 and 3). The Arithmetic subtest loaded highly on the VC factor in this population, however it also had a relatively high loading on the FFD factor. Since Cohen (1952, 1957, 1959), Kaufman (1975), and Parker (1983) found Arithmetic to be part of the FFD factor throughout most of the age range, the present study will also consider it part of the FFD factor. Kaufman (1975) and Parker (1983) also excluded Picture Arrangement from the PO factor; since their extensive studies are being used as a foundation for the present work, the relatively lower Picture Arrangement loadings will be excluded from the PO factor in this study also.

In the analysis of the WISC data the three factors accounted for 68% of the total variance, with VC accounting for 27.2%, PO accounting for 25.8%, and FFD

TABLE 2

WISC Subtest Factor Loadings

SUBTEST	FACTOR* VC	PO	FFD
Information	.79	.25	.12
Comprehension	.73	.28	-.01
Vocabulary	.68	.48	.08
Similarities	.67	.50	.13
Arithmetic	.64	-.04	.44
Object Assembly	.13	.87	.07
Picture Completion	.21	.80	.21
Block Design	.35	.71	.06
Picture Arrangement	.30	.52	.41
Coding	-.04	.20	.89
Digit Span	.50	.10	.61
% of Variance Accounted For	27.2%	25.8%	15.0%

* Factors: VC = Verbal Comprehension
PO = Perceptual Organization
FFD = Freedom From Distractibility

TABLE 3

WAIS-R Subtest Factor Loadings

	FACTOR		
SUBTEST	VC	PO	FFD
Vocabulary	.88	.22	.20
Information	.87	.16	.16
Comprehension	.78	.29	.22
Similarities	.75	.35	.56
Arithmetic	.56	.20	.56
Object Assembly	.21	.87	.01
Block Design	.22	.81	.21
Picture Completion	.24	.71	.38
Picture Arrangement	.37	.57	.40
Digit Symbol	.13	.12	.84
Digit Span	.26	.25	.60
% of Variance Accounted For	30.8%	23.9%	19.5%

accounting for 15%. In the analysis of the WAIS-R data the three factors accounted for 74.2% of the total variance, with VC accounting for 30.8%, PO accounting for 23.9% and FFD accounting for 19.5%.

B. <u>NEUROLOGICALLY DEFINED LEARNING DISABLED CATEGORIES</u>

Data from subjects with complete WISC and WAIS-R batteries were gathered. Of the 96 subjects who had complete WISC batteries (used in the previously described factor analysis), 81 (24 females, 57 males) also had complete WAIS-R batteries. The mean age of subjects at the time of initial referral (time 1) was 9.9 years and the mean age at follow-up (time 2) was 24.4 years. They had attained an average of ten years of education. Subjects were classified into one of the three previously defined learning disabled groups (BD, MBD, LD), based on the results of a neurological examination administered at time 1 by one of two neurologists. Descriptive data for the three groups are presented in Table 4.

Difference scores were computed for each subject by subtracting the WISC subtest scaled score from the corresponding WAIS-R subtest scaled score (WAIS-R - WISC = difference score); thus, a negative difference indicated a lower score on the adult scale, while a positive difference indicated a lower score on the

TABLE 4

Descriptive Data for the Neurologically-Defined Groups

GROUP*	N	MALES	FEMALES	MEAN AGE AT REFERRAL	MEAN AGE AT FOLLOW-UP
BD	25	21	4	9.8	24.2
MBD	38	25	13	10.3	24.8
LD	18	11	7	9.5	24.2
TOTAL	81	57	24	9.9	24.4

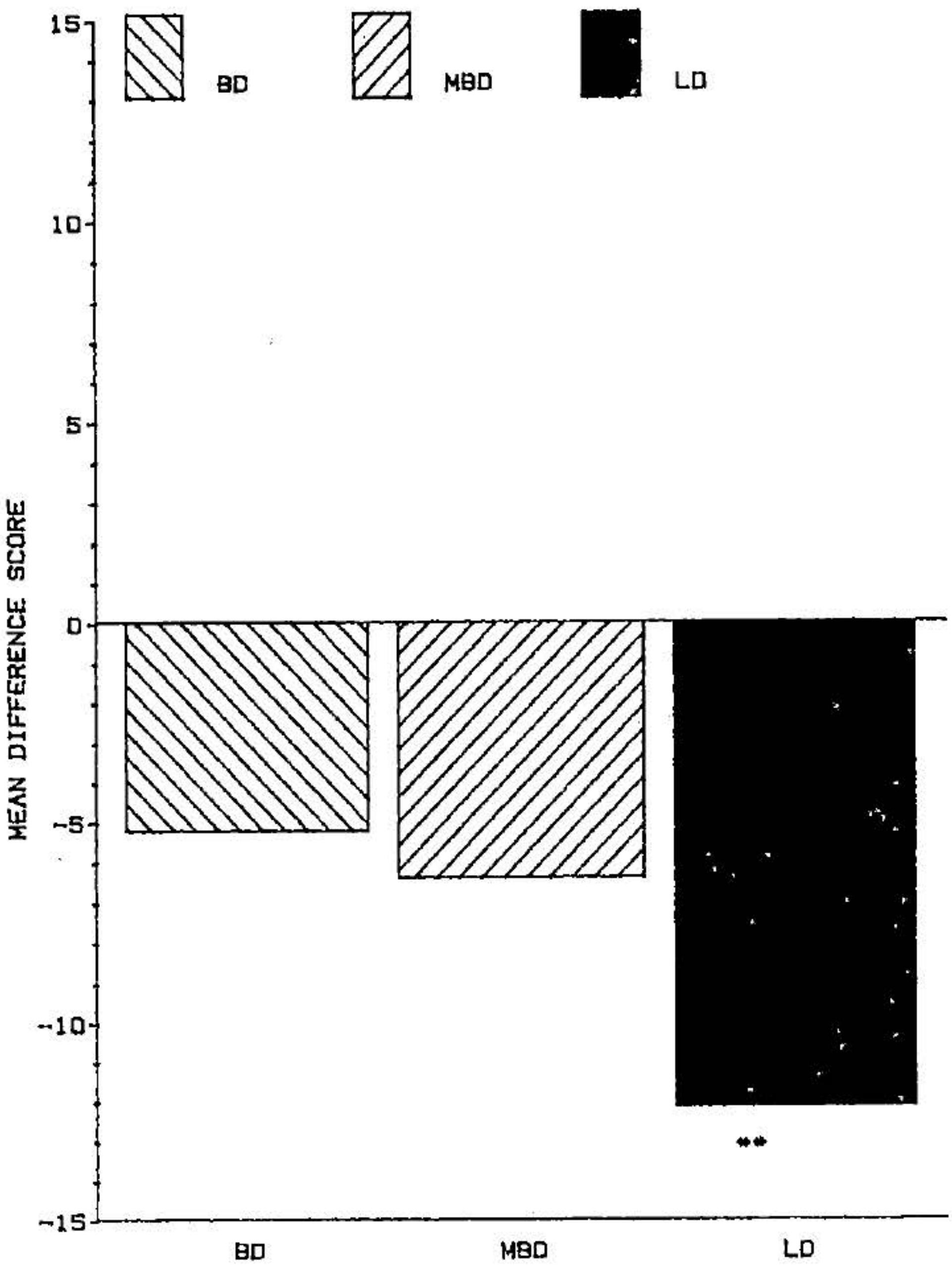
* 1) BD = evidence of hard neurological signs
2) MBD = evidence of soft neurological signs
3) LD = no evidence of neurological signs

children's scale. Differences between FSIQ, VIQ, PIQ, individual subtest scaled scores, and the VC, PO, and FFD factor scores were computed.

<u>1. Composite IQ Score Differences</u>: Initially, an Analysis of Variance (ANOVA) was performed on the difference scores resulting from the discrepancy between WISC and WAIS-R FSIQ scores in each of the three neurologically defined learning disabled categories. Thus, a 1x3 (one learning disabled factor with three classifications) ANOVA was performed. The mean differences between FSIQ's (DFIQ) were as follows: BD = -5.20, MBD = -6.37, LD = -12.11 (see Figure 1). These difference scores were significantly different from each other (p=.044). Contrasts were employed as part of the ANOVA program (Norusis, 1985) such that the LD group was compared to the BD and MBD groups combined, and the MBD group was compared to the BD and LD groups combined, and the BD group was compared to the MBD and LD groups combined. This analysis revealed that the LD DFIQ was significantly different from the DFIQ score of the BD and MBD groups (p=.013). In addition, a significant constant effect appeared (p=.000). The constant is a test of the grand mean; the null hypothesis tested is that the mean difference equals zero. Thus, the null hypothesis can be rejected: the difference between WISC

FIGURE 1.

MEAN DIFFERENCE BETWEEN WAIS-R AND WISC FSIQ SCORES*
IN EACH NEUROLOGICAL CLASSIFICATION



* SIGNIFICANTLY DIFFERENT FROM EACH OTHER (P=.044)
AND SIGNIFICANTLY DIFFERENT FROM ZERO (P=.000)
** SIGNIFICANTLY DIFFERENT FROM BD AND MBD DIFFERENCE SCORES (P=.013)

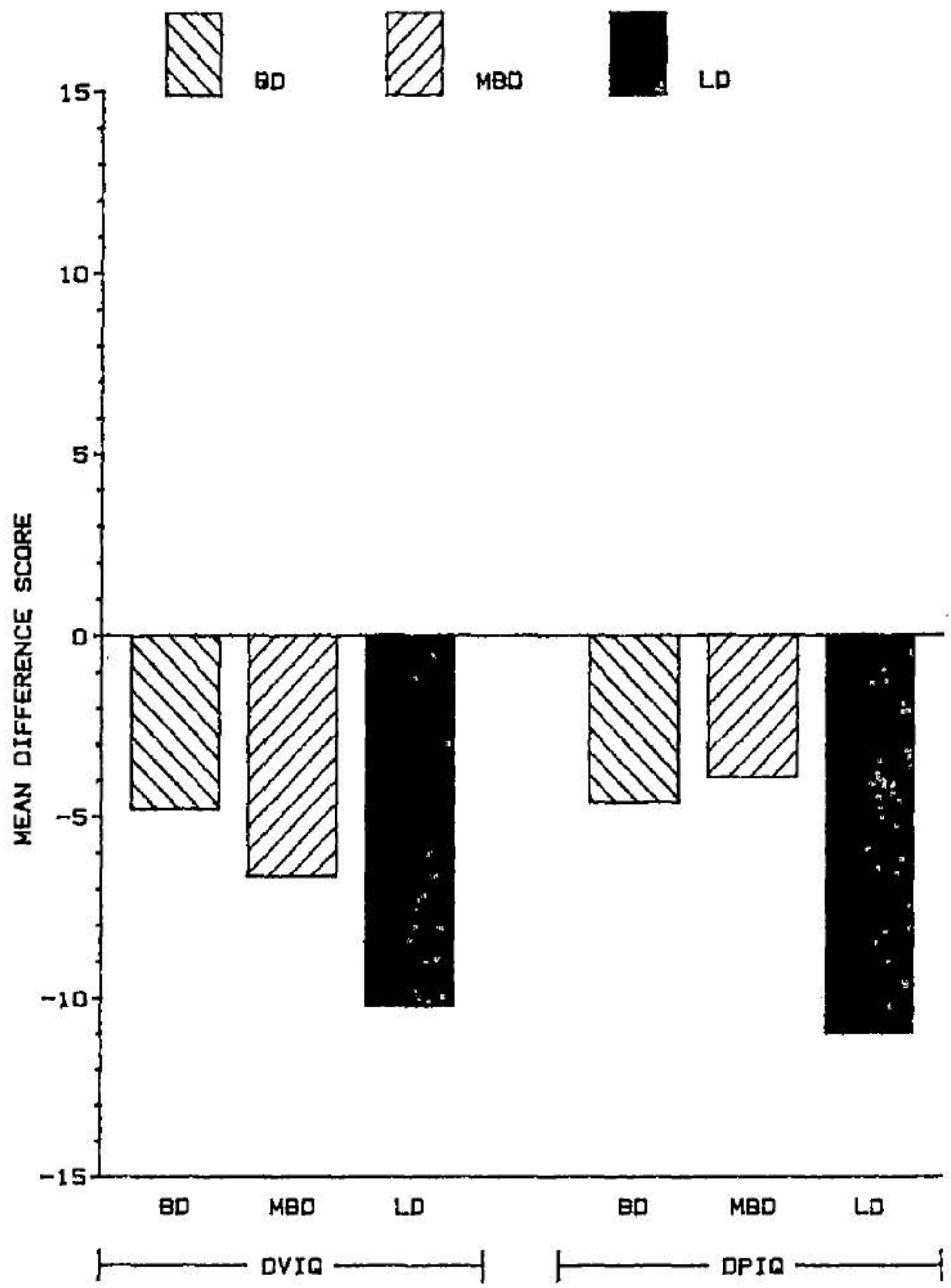
and WAIS-R FSIQ was significantly different from zero in all groups.

Due to this significance, it was statistically appropriate to analyze the differences between WISC and WAIS-R VIQ scores (DVIQ), and WISC and WAIS-R PIQ scores (DPIQ). A 1x3 Multivariate Analysis of Variance (MANOVA) of the DVIQ and DPIQ scores showed these difference scores not to be significantly different between the three groups (p=.156): 1) the mean DVIQ scores for the BD group = -4.80, MBD = -6.67, LD = -10.22, 2) the mean DPIQ scores for the BD group= -4.60, MBD =-3.92, LD = -11.00 (see Figure 2). However, once again the overall constant effect was significant (p=.000). Since the multivariate test of the constant was significant, it was appropriate to investigate the univariate tests, which were also significant; i.e., the DVIQ and DPIQ scores were significantly different from zero (p=.000).

In order to determine if this significance was due mainly to large differences in one group, and specifically since it was hypothesized that the non-neurologically impaired group would show the most change from time 1 to time 2, contrasts were added to the MANOVA program such that the difference scores of each group were compared separately with the difference scores of the other two groups combined. All analyses proved to be non-significant. It is of interest to note,

FIGURE 2.

MEAN DIFFERENCE BETWEEN WAIS-R AND WISC VIQ AND PIQ SCORES*
IN EACH NEUROLOGICAL CLASSIFICATION



* SIGNIFICANTLY DIFFERENT FROM ZERO (P=.000)

however, that an acceptable significance level was just barely missed (p=.056) when the LD group's DVIQ and DPIQ scores were compared to those of the BD and MBD groups together. Perhaps with a larger number of subjects significance would be found, suggesting that the LD group would be significantly different from the other two groups, as reflected by larger differences in their VIQ and PIQ scores from childhood to adulthood.

Briefly, these results indicate that the difference between WISC and WAIS-R FSIQ scores is significant among the groups, with the LD (non-neurologically involved) group showing the largest change over time. The difference between VIQ and PIQ scores do not differ significantly among the three learning disabled groups, however the difference scores are significantly different from zero, indicating that statistically significant changes did occur. In addition, this change was in a negative direction on all measures.

An attempt was made to assess the clinically significant changes that occurred in each of the three learning disabled groups; a difference of 15 points or greater in either direction on FSIQ, VIQ, and PIQ scores was considered clinically significant. When the neurological classifications were disregarded a greater number of the learning disabled population as a whole shifted by 15 points or more on the PIQ score (30.9%), as compared to VIQ (24.7%) and FSIQ (25.9%). However, the largest percentage of subjects showing this 15 point difference was consistently found in the non-neurologically involved population: 1) FSIQ: LD = 38.9%, MBD = 26.3%, BD =16%, 2) VIQ: LD = 33.3%, MBD = 23.7%, BD = 20%, 3) PIQ: LD = 38.9%, MBD = 28.9%, BD = 28% (see Figure 3). Once again, most of the change was in the negative direction; e.g., only one of the subjects in the non-neurologically involved group that changed by this specified amount showed a significant improvement.

In summary, a clinically significant change occurred in this learning disabled population, most frequently in those subjects who were non-neurologically impaired; change was found less frequently in the MBD group, and least frequently in the BD group.

2. Subtest Scaled Score Differences: Difference scores were computed for each of the subtests, excluding Mazes. The mean difference scores are presented in Table 5.

A 1x3 MANOVA was executed with the difference scores serving as the 11 dependent variables. The multivariate test of the difference scores showed them not to be significantly different from each other across groups (p=.149). While the univariate tests cannot be interpreted due to the non-significance of the multivariate test, it is interesting to note the

FIGURE 3.

PERCENTAGE OF EACH NEUROLOGICALLY-DEFINED GROUP CHANGING BY AT LEAST 15 POINTS ON VIQ, PIQ, AND FSIQ SCORES FROM CHILDHOOD TO ADULTHOOD

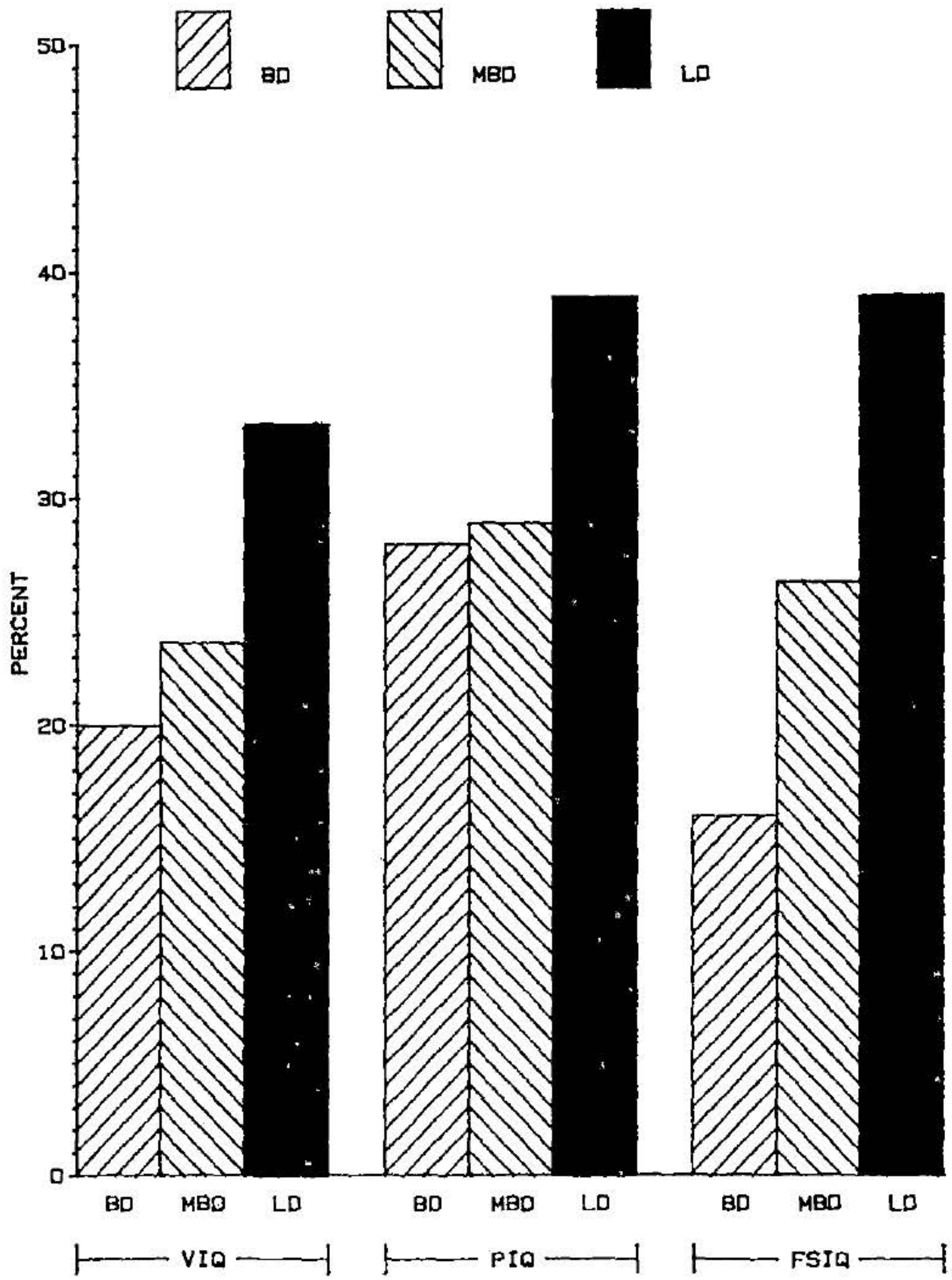


TABLE 5
Mean Subtest Difference Scores (WAIS-R - WISC) by Neurological Group

	GROUP			
SUBTEST	BD	MBD	LD	TOTAL SAMPLE
Information*	-1.40**	-.66	-2.28**	-1.25
Comprehension*	-.80	-.95	-.50	-.80
Arithmetic	.44	-.50	-1.17	-.36
Similarities*	-1.80**	-2.21**	-2.06**	-2.05
Vocabulary*	-1.76**	-2.05**	-3.67**+	-2.32
Digit Span*	-.48	-.37	-.72	-.48
Picture Completion*	-1.48**	-.98	-1.06	-1.15
Picture Arrangement	.32	.61	-2.00**+	-.06
Block Design*	-1.28**	-.32	-.83	-.73
Object Assembly*	-1.28**	-.95	-1.72**	-1.22
Coding/Digit Symbol*	-.52	-.42	-2.11**+	-.83

* Overall significantly different from zero ($p < .03$)
** Univariate tests show to be significantly different from zero in specified group ($p < .02$)
\+ Significantly different from the scores of the other two groups ($p < .05$)

significant differences on Vocabulary (p=.030), Picture Arrangement (p=.005), and Coding/Digit Symbol (p=.016). In addition, the constant effect once again proved to be highly significant (p=.000), thus the difference scores were significantly different from zero. In particular, differences on the following subtests were significantly different from zero: Information (p=.001), Comprehension (p=.022), Similarities (p=.000), Vocabulary (p=.000), Digit Span (p=.027), Picture Completion (p=.016), Block Design (p=.027), Object Assembly (p=.006), and Coding/Digit Symbol (p=.000). Only the differences in Picture Arrangement and Arithmetic were non-significant.

Since it was hypothesized that the LD group would show the most change, analyses of the constant effect were done in each group independently to determine which group showed significant differences from zero on which subtests. The results indicate that six of the LD group's difference scores were significantly different from zero: 1) Information (p=.005), 2) Similarities (p=.011), 3) Vocabulary (p=.000), 4) Picture Arrangement (p=.001), 5) Object Assembly (p=.047), and 6) Coding/Digit Symbol (p=.006). Two of the MBD group's difference scores were significantly different from zero: 1) Similarities (p=.000), and 2) Vocabulary (p=.000). Six of the BD group's difference scores were significantly different from zero: 1) Information (p=.003), 2) Similarities (p=.005), 3) Vocabulary (p=.000), 4) Picture Completion (p=.010), 5) Block Design (p=.011), and 6) Object Assembly (p=.039). Statistically significant change occurred in all three groups on Similarities and Vocabulary, and it appears that the LD and BD groups changed on an equivalent number of subtests, thus refuting the hypothesis that the LD group would show the most change, i.e. change on the greatest number of subtests.

In order to explore further the hypothesis that the LD group would show the most change, i.e. in this instance the largest difference score, contrasts were added to the MANOVA program to compare each group independently with the other two. The LD group's difference scores were significantly different from the combined difference scores of the BD and MBD groups (p=.038); specifically, significant differences appeared on Vocabulary (p=.012), Picture Arrangement (p=.002), and Coding/Digit Symbol (p=.019). The BD group's differences were not significantly different from the other two groups' scores (p=.379), nor were the differences of the MBD group significant (p=.339).

It appears that the subtest difference scores of the three learning disabled groups are significantly different from zero, with statistically significant differences on Similarities and Vocabulary in all three.

It also appears that the Vocabulary, Picture Arrangement, and Coding/Digit Symbol difference scores of the non-neurologically impaired group were significantly different from those of the other two groups. It is important to note that changes were in a negative direction on all subtests for the LD group, ten subtests for the MBD group, and nine subtests for the BD group.

Once again, the clinically significant changes that occurred in each of the three learning disabled groups were assessed; a difference of at least ± 3 points was considered clinically significant. Overall, 40% or more of the learning disabled group as a whole (i.e. when neurological classifications were disregarded) showed a three point or greater change on six subtests: 1) Similarities, 2) Object Assembly, 3) Vocabulary, 4) Picture Completion, 5) Comprehension, and 6) Picture Arrangement; 77% of these changes were in the negative direction. Forty percent or more of the non-neurologically involved group showed this amount of change on seven subtests: 1) Vocabulary, 2) Information, 3) Object Assembly, 4) Coding/Digit Symbol, 5) Comprehension, 6) Similarities, and 7) Picture Arrangement; 86% of these changes were in the negative direction. Forty percent or more of the MBD group showed a three point or greater change on five subtests: 1)

Similarities, 2) Picture Completion, 3) Object Assembly, 4) Vocabulary, and 5) Comprehension; 77% of these changes were in the negative direction. Forty percent or more of the BD group showed a three point or greater change on four subtests: 1) Similarities, 2) Picture Arrangement, 3) Object Assembly, and 4) Arithmetic; 63% of these changes were in the negative direction. (See Table 6.)

In summary, a clinically significant change occurred on the Wechsler scales in a large percentage of the learning disabled population as a whole. The non-neurologically involved group exhibited this change on the greatest number of subtests. The MBD group changed on fewer subtests, and the BD group changed on the fewest subtests. Most of the change was in the negative direction.

<u>3. VC, PO, and FFD Factor Score Differences</u>: In the analyses involving the VC, PO, and FFD factors, the Picture Arrangement and Mazes subtests were excluded, resulting in data from 84 subjects (24 female, 60 male) with a mean age of 10 years at time 1 and a mean age of 24.5 years at time 2. As mentioned previously, the three factor scores of each subject were determined by computing the mean scaled score of the subtests which comprise that factor, i.e. 1) the VC factor score is the

TABLE 6

Subtests with Differences of at least ± 3 points in 40% or more of each Neurological Group

BD (n=25):	Similarites (50%)
	Picture Arrangement (44%)
	Object Assembly (44%)
	Arithmetic (40%)
MBD (n=38):	Similarities (57.9%)
	Picture Completion (50%)
	Object Assembly (47.4%)
	Vocabulary (44.7%)
	Comprehension (40%)
LD (n=18):	Vocabulary (72.2%)
	Information (66.7%)
	Object Assembly (55.6%)
	Coding/Digit Symbol (55.6%)
	Comprehension (50%)
	Similarities (50%)
	Picture Arrangement (44.4%)
TOTAL SAMPLE (n=81):	Similarities (49.4%)
	Object Assembly (48.1%)
	Vocabulary (45.7%)
	Picture Completion (43.2%)
	Comprehension (40.7%)
	Picture Arrangement (40.7%)

mean of the Information, Comprehension, Vocabulary, and Similarities scaled scores, 2) the PO factor score is the mean of the Object Assembly, Picture Completion, and Block Design scaled scores, and 3) the FFD factor score is the mean of the Coding/Digit Symbol, Digit Span, and Arithmetic scaled scores.

Factor scores were computed at time 1 and time 2. A difference score was then computed, subtracting the time 1 factor score from the time 2 factor score (WAIS-R-WISC), as in the previous analyses. Thus, each subject had a VC difference score (DVC), a PO difference score (DPO), and a FFD difference score (DFFD). The mean difference scores are presented in Table 7.

A 1x3 MANOVA with the three factor difference scores serving as dependent variables was executed. The multivariate test of the difference scores was not significant ($p=.249$), indicating that the three groups were not significantly different from each other on these measures. Once again however, the multivariate constant effect was significant ($p=.000$), as were all three univariate tests ($p=.000$), indicating that the factor difference scores were significantly different from zero.

An analysis of the constant effect was done in each group independently in order to determine on which factors each of the learning disabled groups exhibited

TABLE 7

Mean Factor Difference Scores (WAIS-R - WISC) by Neurological Group

	GROUP			
FACTOR	BD	MBD	LD	TOTAL SAMPLE
VC	-1.44	-1.46	-2.13	-1.60
PO	-1.35	-.86	-1.20	-1.08
FFD	-.20*	-.47	-1.33	-.57

* only score not significantly different from zero (p=.618)

this significant difference. Results indicate that the BD group's DVC and DPO scores were significantly different from zero (p=.000, .001, respectively), while the MBD and LD groups' DVC (p=.000, .000), DPO (p=.012, .033), and DFFD (p=.023, .004) were all significantly different from zero.

To determine if one group's difference scores were significantly different from the others, each group's difference scores were compared to the other two group's scores combined. No overall significance was found, although when the difference scores of the LD group were compared to the scores from the other two groups, the univariate test of the DFFD was found to be significant (p=.018).

The VC, PO, and FFD factor scores at time 1 do not differ significantly from these same scores at time 2 among the three learning disabled groups; however, the difference scores are significantly different from zero, once again indicating that statistically significant changes did occur. Again, all changes are in a negative direction, reflecting a decline in scores from childhood to adulthood.

Clinically significant changes were assessed. A difference score of ± 3 points or more was considered clinically significant due to measurement in scaled score units (i.e. each factor score is an average of the subtest scaled scores which comprise it, therefore it is expressed in units comparable to individual subtest scores). More of the learning disabled group as a whole exhibited this change on the VC factor (26.2%), as compared to the PO factor (20.2%) and FFD factor (11.9%). More of the non-neurologically involved group showed this change on the VC factor (44.4%), as compared to the MBD (21.9%) and BD (20%) groups. Fewer subjects changed on the other two factors: 1) PO: BD = 20%, MBD = 21.9%, LD = 16.7%, 2) FFD: BD = 12%, MBD = 7.3%, LD = 22.2%. (See Figure 4.)

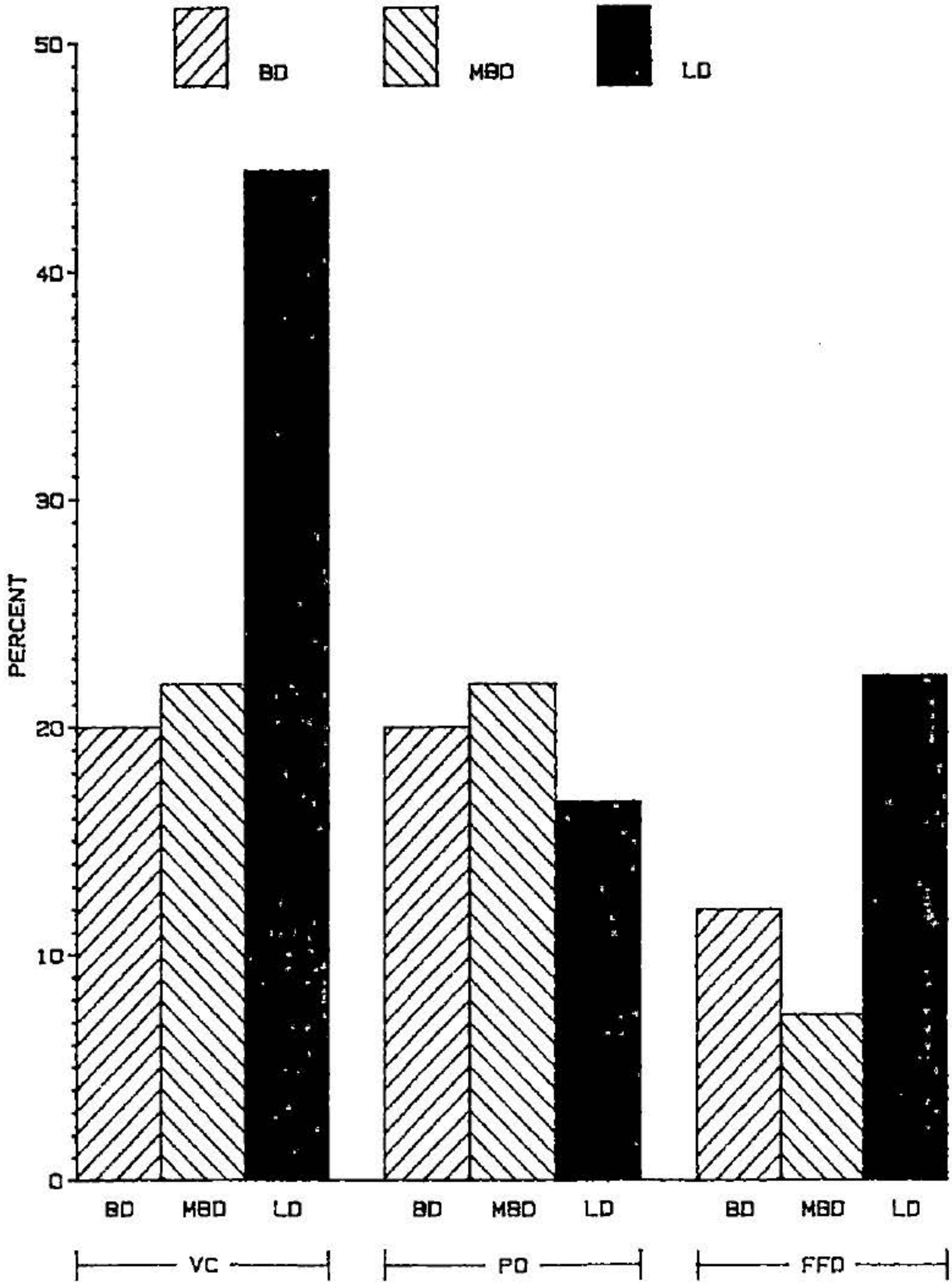
Clinically significant change on the factor scores did occur in some of the learning disabled population. The most marked change occurred on the VC factor in the non-neurologically involved subjects.

C. LEARNING DISABLED SUBTYPES DEFINED BY SPREEN AND HAAF (1986)

Of the 63 subjects previously subtyped by Spreen and Haaf (1986), 35 (12 female, 23 male) were found to have complete WISC and WAIS-R batteries; the mean age at time of initial referral was 10.4 years and the mean age at follow-up was 24.7 years. Subjects were classified into one of six subtypes resulting from a cluster analysis of their scores at time 1 on Sentence Repetition (Spreen and Benton, 1977), Right-Left

FIGURE 4.

PERCENTAGE OF EACH NEUROLOGICALLY-DEFINED GROUP CHANGING BY AT LEAST 3 POINTS ON VC, PO, AND FFD FACTOR SCORES FROM CHILDHOOD TO ADULTHOOD



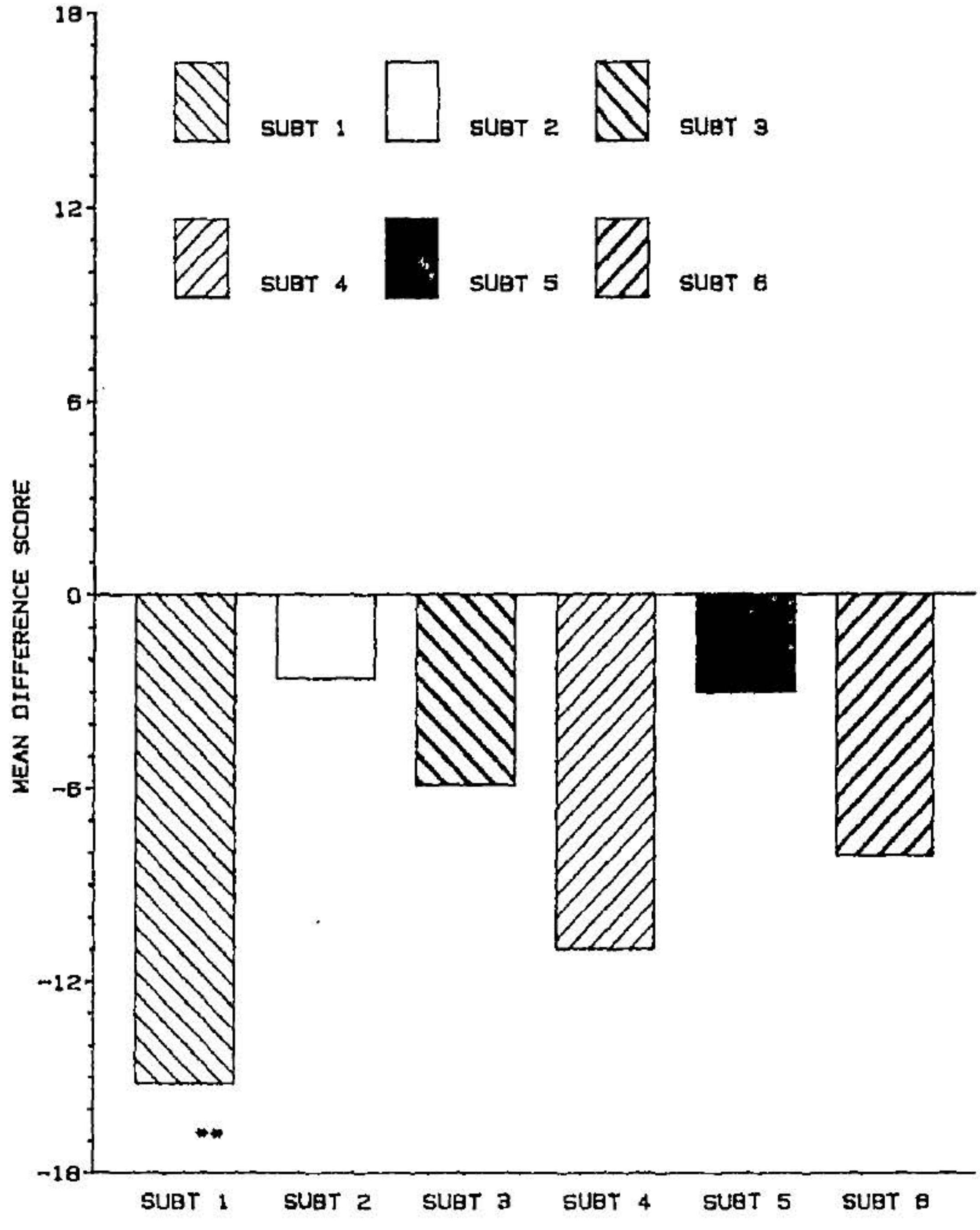
Orientation (Benton, 1959), the Wide Range Achievement Test (Jastek & Jastek, 1978), and the Similarities, Vocabulary, Block Design and Coding subtests of the WISC. As previously mentioned, the six subtypes are: 1) specific reading disorder (n=5), 2) linguistic disorder (n=5), 3) specific arithmetic disorder (n=8), 4) minimally impaired (n=4), 5) severly impaired (n=3), and 6) visuo-perceptual disorder (n=10). The data were analyzed in the same way as the data from the neurologically defined subgroups; i.e., difference scores were computed for the composite IQ scores, subtest scaled scores, and factor scores.

1. Composite IQ Score Differences: Initially, a 1x6 ANOVA was performed on the difference scores resulting from the discrepancy between WISC and WAIS-R FSIQ scores. The mean difference scores were as follows: 1) -15.20, 2) -2.60, 3) -5.86, 4) -11.00, 5) -3.00, and 6) -8.10 (see Figure 5). These difference scores were not significantly different from each other (p=.130), but they were significantly different from zero (p=.000). When the DFIQ score of each subtype was compared with the DFIQ scores of the other five subtypes combined, the score of subtype 1 was significantly different from the others (p=.022).

Next a 1x6 MANOVA was performed on the DVIQ and

FIGURE 5.

MEAN DIFFERENCE BETWEEN WAIS-R AND WISC FSIQ SCORES* IN EACH SUBTYPE



* SIGNIFICANTLY DIFFERENT FROM ZERO (P=.000)

** SIGNIFICANTLY DIFFERENT FROM DIFFERENCE SCORES OF OTHER SUBTYPES (P=.022)

DPIQ scores. The DVIQ scores were: 1) -12.20, 2) -2.40, 3) -3.13, 4) -13.75, 5) -4.67, and 6) -8.00. The DPIQ scores were : 1) -13.80, 2) -1.20, 3) -4.88, 4) -7.25, 5) -3.67, and 6) -3.90 (see Figure 6). These scores were not significantly different among the subtypes (p=.389), although subtypes 1 and 4 have the largest differences. The difference scores were significantly different from zero (p=.000). The univariate tests of the constant effect were also significant for both the DVIQ (p=.000) and DPIQ (p=.008).

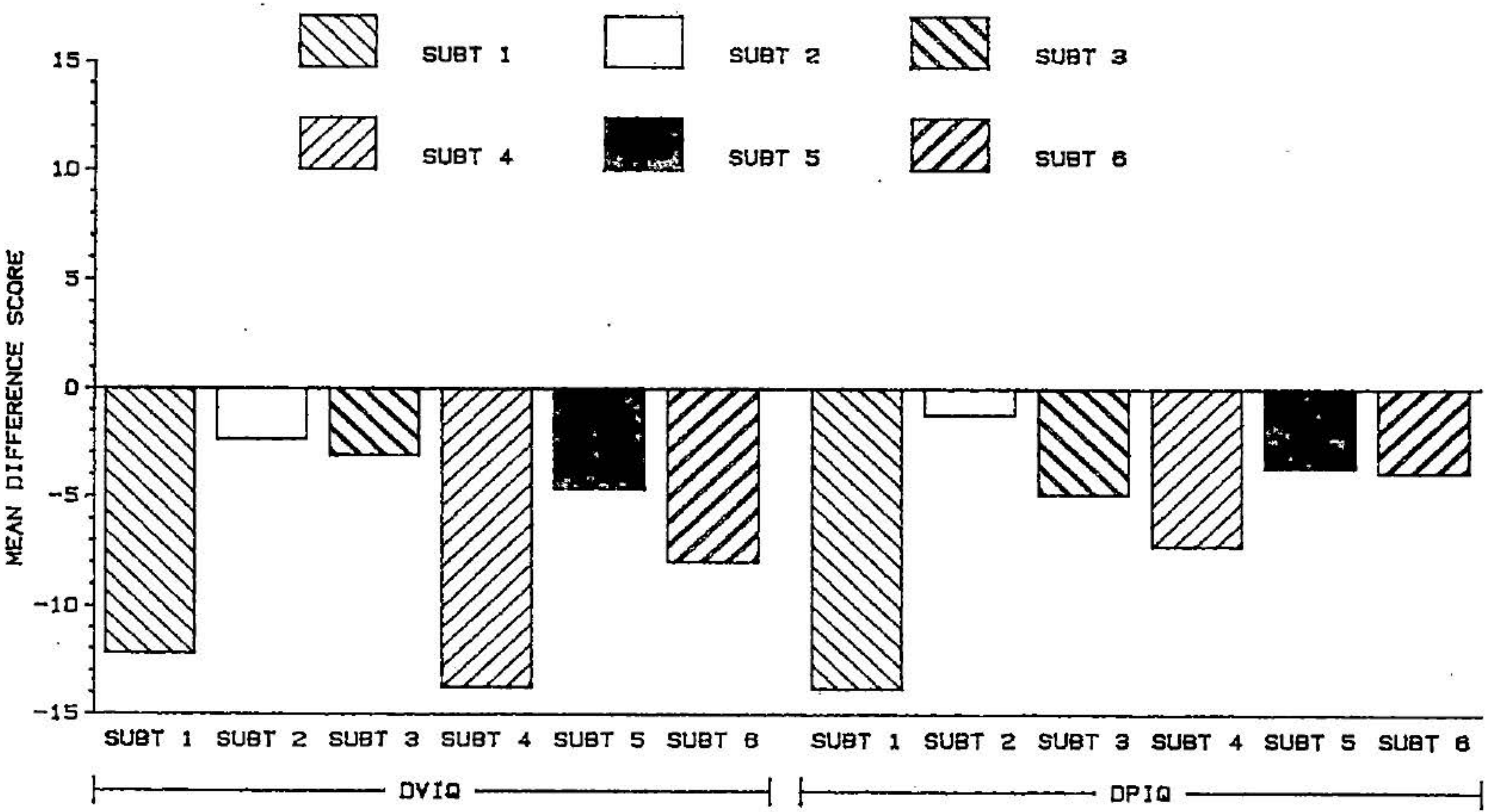
The constant effect was then analyzed in each subtype independently to discover which subtypes' DVIQ and DPIQ scores were significantly different from zero. The multivariate tests showed significance only in the difference scores of subtypes 1 (p=.003) and 6 (p=.019); further, the univariate tests show only the DVIQ scores to be significant from zero in both of these subtypes (1: p=.025, 6: p=.007).

Contrasts were utilized to compare each subtype independently with the rest, in order to determine if there were significantly large differences between scores at time 1 and time 2 in any one subtype, as specifically hypothesized to occur in the minimally impaired group. All analyses proved to be non-significant.

The DFIQ, DVIQ and DPIQ scores were not

FIGURE 6.

MEAN DIFFERENCE BETWEEN WAIS-R AND WISC VIQ AND PIQ SCORES* IN EACH SUBTYPE



* SIGNIFICANTLY DIFFERENT FROM ZERO (P=.000)

significantly different among the subtypes, but they were significantly different from zero; therefore, changes occurred from time 1 to time 2.

The clinical meaningfulness of this change was assessed by determining the percentage of each subtype that changed by ± 15 points or more on FSIQ, VIQ, and PIQ. As a whole, only 22.9% of this learning disabled population differed by at least 15 points on FSIQ, only 20% differed on VIQ by this amount, and only 28.6% differed on PIQ by this amount. In contrast, 80% of subtype 1 and 50% of subtype 4 had a minimum FSIQ difference of ±15 points. Further, 40% of subtype 1 and 50% of subtype 4 had a clinically significant DVIQ score; 40% of subtype 1, 50% of subtype 4, and 40% of subtype 6 had a clinically significant DPIQ score. Such differences did not appear at all in subtypes 2 and 3, with a smaller percentage (33.3%) of subtype 5 showing a significant difference on VIQ and PIQ (see Table 8). Again, most of the change was in the negative direction.

It appears that the most clinically significant changes in composite IQ scores occurred in subtypes 1 and 4, i.e. in those subjects defined as being specifically reading disabled and minimally impaired.

<u>2. Subtest Scaled Score Differences:</u> Difference scores were computed for each of the subtests excluding Mazes.

TABLE 8

Percentage of each Subtype Changing by 15 points or more on Composite IQ Scores

SUBTYPE	VIQ	PIQ	FSIQ
1 (n=5)	40%	40%	80%
2 (n=5)	0	0	0
3 (n=8)	0	12.5%	0
4 (n=4)	50%	50%	50%
5 (n=3)	33.3%	33.3%	0
6 (n=10)	20%	40%	22.9%
Total Sample (n=35)	20%	28.6%	22.9%

The mean difference scores are presented in Table 9.

A 1x6 MANOVA of these difference scores showed them to be not significantly different among the six subtypes (p=.707), although they were significantly different from zero (p=.012). Specifically, significant univariate tests of the constant effect appeared in the difference scores of Information (p=.002), Similarites (p=.005), Vocabulary (p=.000), and Object Assembly (p=.034).

An attempt was made to analyze each subtype independently to discover which subtypes showed a significant difference from zero on which subtests. However, due to the small number of subjects in each subtype, multivariate tests of the 11 dependent variables was not possible. The following results of the univariate tests should therefore be viewed with caution. Subtype 1's Vocabulary difference score was significantly different from zero (p=.019). Subtype 4's Arithmetic (p=.022) and Picture Completion (p=.030) difference scores were significantly different from zero. Subtype 6's Information (p=.027) and Similarities (p=.013) difference scores were significantly different from zero.

In order to determine if one subtype's difference scores were significantly different from those of the other subtypes, contrasts were employed such that each subtype was compared independently with the rest. All

TABLE 9

Mean Subtest Difference Scores (WAIS-R - WISC) by Subtype

SUBTYPE

SUBTEST+	1	2	3	4	5	6	TOTAL SAMPLE
INF*	-2.00	.20	-1.25	-2.00	-2.00	-2.00	-1.51
SIM*	-3.20	-.60	.13	-2.25	-.67	-2.30	-1.49
ARI	-.20	-.20	.13	-3.75	.00	-.20	-.51
VOC*	-4.60	-1.60	-.75	-3.50	-2.67	-1.60	-2.14
COM	-.20	-1.00	-1.50	-.75	-1.67	-.30	-.83
DSP	-1.80	-.20	-.38	-.75	-.67	.80	-.29
PCM	-1.40	1.00	-.50	-2.50	1.33	-1.90	-.89
PAR	-2.20	.20	-.38	.25	-1.33	-.50	-.60
BLD	-1.20	-1.20	-.25	-1.00	.00	-1.00	-.80
OBA*	-3.20	.60	-2.00	.25	-2.67	-3.00	-1.11
COD	-1.40	.00	-.75	-1.25	.67	-.40	-.57

* Difference scores are significantly different from zero ($p < .04$)

+ Subtests:

INF = Information
SIM = Similarities
ARI = Arithmetic
VOC = Vocabualry
COM = Comprehension
DSP = Digit Span
PCM = Picture Completion
PAR = Picture Arrangement
BLD = Block Design
OBA = Object Assembly
COD = Coding/Digit Symbol

multivariate analyses proved to be non-significant. It is interesting to note, however, that significant univariate tests appeared on subtype 1's Vocabulary difference score (p=.049) and subtype 4's Arithmetic difference score (p=.003) when compared with the difference scores of the other subtypes.

It appears that the difference scores of the six subtypes are not significantly different from each other, but the difference scores on the Information, Similarities, Vocabulary, and Object Assembly subtests were significantly different from zero. The individual analyses revealed significant changes in specific subtypes, but these results must be viewed with caution, due to the small sample size.

An investigation of the clinical significance of these changes revealed that 40% or more of the subtyped population as a whole changed by at least ± 3 points on six subtests: 1) Comprehension (51.4%), 2) Similarities (51.4%), 3) Information (42.9%), 4) Picture Completion (42.9%), 5) Object Assembly (42.9%), and 6) Picture Arrangement (40%). This amount of change was shown by 40% or more of subtype 1 on eight subtests, subtype 2 on four subtests, subtype 3 on two subtests, subtype 4 on seven subtests, subtype 5 on four subtests, and subtype 6 on seven subtests (see Table 10 for details). It appears that subtypes 1, 4, and 6 show the most

TABLE 10

Percentage of Each Subtype with Subtest Difference Scores of at Least ± 3 Points

	SUBTYPE*						
SUBTEST	1	2	3	4	5	6	TOTAL SAMPLE
INF	40%	20%	37.5%	50%	33.3%	60%	42.9%
SIM	80%	60%	50%	50%	0	50%	51.4%
ARI	20%	0	12.5%	75%	33.3%	20%	22.9%
VOC	80%	20%	25%	50%	33.3%	30%	37.1%
COM	40%	60%	25%	75%	100%	50%	51.4%
DSP	40%	40%	0	25%	0	40%	25.7%
PCM	60%	20%	12.5%	50%	66.7%	60%	42.9%
PAR	60%	0	37.5%	50%	33.3%	50%	40%
BLD	20%	40%	0	0	66.7%	10%	17.1%
OBA	80%	20%	25%	25%	66.7%	50%	42.9%
COD	20%	0	50%	25%	0	20%	22.9%

* Subtype Sample Size:

1) n = 5
2) n = 5
3) n = 8
4) n = 4
5) n = 3
6) n = 10

clinically significant change, with most changes going in the negative direction.

3. VC, PO, and FFD Factor Score Differences: The three previously defined factor scores were obtained for each of the 35 subjects. The mean difference scores are presented in Table 11.

A 1x6 MANOVA of the factor scores showed them to be not significantly different among the six subtypes (p=.604). However, the constant effect was significant (p=.000); specifically, the difference scores of the VC (p=.000), PO (p=.020), and FFD (p=.022) factors were significant.

All multivariate tests resulting from the analysis of the constant effect of each subtype independently proved to be non-significant; however, significant univariate tests appeared on the DVC score of subtype 1 (p=.017) and subtype 6 (p=.012)

All multivariate tests which utilized contrasts to compare each subtype with the others proved to be non-significant. However, the DFFD score of subtype 4 was found to be significant in the univariate analysis (p=.028).

In general, due to the small number of subjects, subtypes cannot be distinguished from each other according to difference scores on the VC, PO, and FFD

TABLE 11

Mean Factor Difference Scores (WAIS-R - WISC) by Subtype

	FACTOR DIFFERENCE SCORES+		
SUBTYPE	DVC*	DPO*	DFFD*
1	-2.50	-1.93	-1.13
2	-.75	.13	-.13
3	-.84	-.92	.33
4	- 2.13	-1.08	-1.92
5	-1.75	-.44	.00
6	-1.55	-1.07	.07
Total Sample	-1.49	-.93	-.46

* Significantly different from zero (p < .03)

+ DVC = Difference in Verbal-Comprehension Factor Score
  DPO = Difference in Perceptual-Organization Factor Score
  DFFD = Difference in Freedom from Distractibility Factor Score

factors. However, statistically significant change did occur, as reflected by the significant constant effect.

Clinically significant change of at least ±3 points was exhibited by ony 17.1% of the subtyped population as a whole on the DVC and DPO scores, and by only 5.7% on the DFFD score. Table 12 shows the percentage of each subtype showing this difference on each factor score. Only subtype 4 has a substantial number of subjects (50%) exhibiting this large a difference, and this is only on the DVC score. Again, any changes that did occur were in the negative direction.

D. ANALYSIS OF INTER-SUBTEST CORRELATIONS

Pearson Product Moment correlations were computed for all subtests at time 1 and at time 2 in each of the three neurologically defined classes and in each of the six cluster analyzed subtypes. Using Fisher's r to z transformation (Garret, 1958), correlations that were expected to be the most different from time 1 to time 2 (i.e., correlations between the subtest score with the biggest difference and the subtest score with the smallest difference) were shown to be not significantly different from time 1 to time 2 ($p > .05$ in all cases). Thus, it was assumed that differences between correlations of subtests showing less change would also be non-significant.

TABLE 12

Percentage of Each Subtype Changing by ± 3 Points on Factor Scores

	FACTOR		
SUBTYPE	VC	PO	FFD
1 (n=5)	20%	20%	20%
2 (n=5)	20%	0	0
3 (n=8)	0	12.5%	0
4 (n=4)	50%	25%	25%
5 (n=3)	33.3%	33.3%	0
6 (n=10)	10%	20%	0
Total Sample (n=35)	17.1%	17.1%	5.7%

E. Post-Hoc Analyses

1. Analyses of the FSIQ, VIQ, and PIQ of the subjects in each classification were done in order to investigate the independence of groups on these measures at time 1 and time 2.

An ANOVA of the FSIQ in the three neurologically defined learning disabled groups showed the groups to be significantly different from each other on this measure at time 1 (p=.041), but not at time 2 (p=.321). A MANOVA of the VIQ and PIQ scores showed that the PIQ score was significantly different among the groups at both times (p=.007, p=.048), but the VIQ score was not (p=.340, p=.872). The non-neurologically involved group had consistently higher scores, while the group with soft signs had somewhat lower scores, and the group with hard signs had the lowest scores (see Table 13).

An ANOVA of the FSIQ in the cluster analyzed subtypes showed the subtypes to be significantly different from each other on this measure at both times (p=.000, p=.000). Significance among subtypes at both times was also found on VIQ (p=.000, p=.000) and PIQ (p=.002, p=.003) scores. Subtypes 1, 4, and 6 had the highest scores on these measures (see Table 14).

2. WISC-R IQ scores were predicted from WISC IQ scores, using the equation developed by Schwarting (1976): WISC-

TABLE 13

Mean Composite IQ Scores at Time 1 and Time 2 in Each Neurologically-Defined Group

IQ SCORE+	BD	GROUP MBD	LD	TOTAL SAMPLE
FSIQ 1*	90.40	96.58	102.94	96.09
VIQ 1	93.32	95.79	99.67	95.58
PIQ 1*	89.88	97.90	105.72	97.60
FSIQ 2	85.20	90.21	90.83	88.80
VIQ 2	87.52	89.13	89.44	88.70
PIQ 2*	85.28	93.97	94.72	91.46

* Significantly different among groups ($p < .05$)

+ FSIQ 1 = WISC Full Scale IQ
  VIQ 1 = WISC Verbal IQ
  PIQ 1 = WISC Performance IQ

  FSIQ 2 = WAIS-R Full Scale IQ
  VIQ 2 = WAIS-R Verbal IQ
  PIQ 2 = WAIS-R Performance IQ

TABLE 14

Mean Composite IQ Scores at Time 1 and Time 2 in Each Subtype

	SUBTYPE					
IQ SCORE	1	2	3	4	5	6
FSIQ 1*	110.20	88.20	84.75	108.50	71.00	102.90
VIQ 1*	104.00	86.20	84.75	107.25	73.33	104.90
PIQ 1*	115.20	92.20	87.38	108.50	74.33	100.10
FSIQ 2*	95.00	85.60	78.88	97.50	68.00	94.80
VIQ 2*	91.80	83.80	81.63	93.50	68.70	96.90
PIQ 2*	101.40	91.00	82.50	101.25	70.67	96.20

TOTAL SAMPLE
FSIQ 1 = 95.60
VIQ 1 = 95.06
PIQ 1 = 96.97
FSIQ 2 = 87.89
VIQ 2 = 88.00
PIQ 2 = 91.46

* Significantly different among groups ($p < .003$)

R VIQ = .91 x (WISC VIQ) + 5, WISC-R PIQ = .77 x (WISC PIQ) + 17.75, WISC-R FSIQ = .91 x (WISC FSIQ) + 2.72. Differences between WAIS-R and predicted WISC-R FSIQ, VIQ, and PIQ scores were then computed. The mean differences are presented in Table 15. The LD group exhibited the largest difference on all measures.

An ANOVA of the estimated DFIQ score showed that the groups were not significantly different from each other on this measure ($p=.07$), nor were the DFIQ scores significantly different from zero ($p=.06$). However, when contrasts were employed the LD group's DFIQ was found to be significantly different from the scores of the other two groups ($p=.022$). No other comparisons were significant.

A MANOVA of the estimated DVIQ and DPIQ scores showed that the groups were not significantly different from each other on these measures ($p=.218$), but the DVIQ score was significantly different from zero ($p=.001$).

Clinically significant change of $\pm$ 15 points on these measures was exhibited by a larger percentage of the LD group, as compared to the BD and MBD groups: 1) VIQ: LD=33.3%, MBD=5.3%, BD=4%; 2) PIQ: LD=22.2%, MBD=7.9%, BD=16%; 3) FSIQ: LD=16.7%, MBD=5.3%, BD=4%.

TABLE 15

Mean Difference between WAIS-R and Estimated WISC-R VIQ, PIQ, and FSIQ Scores in Each Neurologically-Defined Group

GROUP	EST. DVIQ*	EST. DPIQ	EST. DFIQ
BD	-1.49	-1.68	.22
MBD	-3.04	.85	-.40
LD	-6.25	-4.43	-5.57**

* Significantly different from zero (p=.001)
** Significantly different from the scores of the other two groups (p=.022)

VI. DISCUSSION

In general, the present findings indicate that significant changes do occur in a learning disabled population over a 15 year time period, as reflected by differences between WISC and WAIS-R scaled scores. The multivariate tests of significance suggest that both classification schemas, i.e the neurological categories and the cluster analyzed subtypes, reflect this change. Initial statistics suggest that the change is not significantly different among the groups within each schema. Further analyses, however, suggest that the changes that occurred in the non-neurologically involved group, and the minimally impaired and specifically reading disabled subtypes, were distinct from the changes that occurred in the other groupings.

A. DISTINCTIONS OF THE NON-NEUROLOGICALLY INVOLVED GROUP/HYPOTHESIS 1:

1) Of the BD, MBD, and LD groups, the LD (non-neurologically involved) group showed the largest difference between childhood and adulthood on most measures (excluding the Comprehension, Similarities, Picture Completion, Block Design and PO difference scores).

2) Difference scores of the LD group were shown to be

significantly larger from the difference scores of the MBD and BD groups; specifically, the differences in FSIQ, Vocabulary, Picture Arrangement, and Coding/Digit Symbol were significant. The LD group's difference scores for VIQ and PIQ just barely missed significance when compared to these scores in the MBD and BD groups.

3) A large percentage of the LD group consistently showed a clinically significant change over time (as defined by ± 15 point shift in composite IQ scores or ±3 point shift in subtest scaled scores and factor scores); fewer of the MBD group showed this change and even fewer of the BD group showed this change. Across groups, most of the difference scores indicate a decline in performance from childhood to adulthood, relative to peers.

4) Further findings showed that the difference scores of six subtests in the LD group were significantly different from zero (Information, Similarities, Vocabulary, Picture Arrangement, Object Assembly, and Coding/Digit Symbol), as were the difference scores of six subtests in the BD group (Information, Similarities, Vocabulary, Picture Completion, Block Design, and Object Asssembly). The MBD group only had two difference scores that were significantly different from zero (Similarities and Vocabulary). VIQ and PIQ difference scores were significantly different from zero in all

three groups, as were the differences in VC and PO; the difference in the FFD factor score was significant from zero in the LD and MBD groups, but not the BD group.

5) Clinically, all three groups had a substantial number of subjects (40% or more) that declined on the Similarities and Object Assembly scaled scores. The other changes that occurred in each of the groups were in both the verbal and performance realms. When factor scores were investigated, only a substantial number of the LD group changed on the VC factor (44.4%). Therefore, it appears that diffuse changes occurred in all aspects of the underlying structure of intelligence, as measured by the Wechsler scales.

In summary, it appears that the group with no neurological signs as children (LD) is indeed the least stable of the three classifications, as suggested by Sarazin and Spreen (1986), and is showing the most change from childhood to adultoood, as hypothesized in the present investigation. The group with soft signs as children (MBD) showed less change than the group with no signs, while the group with hard signs as children (BD) showed more statistically significant change than expected (significantly different from zero on six subtests); however, in clinical terms the BD group showed little change in capacity from childhood to adulthood, as reflected by relatively similar WISC and

WAIS-R scores.

The findings of Hern (1984) offer a possible explanation for these results. She found that neurological signs do not disappear with maturation, but rather they tend to increase in frequency; at follow-up 11.8% of the group originally categorized as showing no neurological involvement showed some evidence of hard signs, and 72.5% showed some evidence of soft signs. It is possible that the LD group's apparent decline in relative cognitive ability from childhood to adulthood is due to an increase in the appearance of neurological deficits in adulthood that were not present at the time of the original assessment. In contrast, soft signs persisted into adulthood in 84.8% of the MBD group, and 23.9% exhibited hard signs as adults; also, hard signs persisted into adulthood in 93.5% of the BD group, and 54.8% exhibited soft signs as well. It appears that those with neurological signs as children are less likely to evidence change in their cognitive abilities as they grow up, while those with no neurological signs as children tend to decline in ability, relative to their peers, as time passes. Such findings contradict any suggestions that learning disabilites are due to a maturational lag of the development of the nervous system and that the learning disabled child will catch up. It is more likely that their abilities will remain limited; in fact, if these children are not monitored carefully and given special help, their abilities may decline relative to age expected performance levels. Such a finding suggests that these children should be provided with intervention services as early as possible and that they be followed closely throughout their childhood years.

B. DISTINCTIONS OF THE SUBTYPED POPULATION/HYPOTHESIS 2:

Results from the analysis of the subtyped population should be viewed with caution due to the small sample size. In general, results indicate that as a whole, the scaled scores of the subtyped population changed, but these changes were not significantly different between the subtypes. Multivariate analyses by subtype of the subtest scaled scores were inappropriate due to the small number of subjects in each subtype and large number of variables, and the individual multivariate tests of the factor score differences were non-significant; therefore, the univariate analyses of subtest and factor differences are reported for exploratory purposes only. These analyses revealed the following:

1) Subtype 1's FSIQ and Vocabulary difference scores, and subtype 4's Arithmetic and FFD difference scores were significantly different from the scores of the

other subtypes.

2) Investigating the subtypes independently revealed subtypes 1, 4, and 6 to be the only subtypes with difference scores significantly different from zero: a) subtype 1's scores changed significantly on the VIQ score, the VC factor score, and the Vocabulary subtest; b) subtype 4's scores changed significantly on the Arithmetic and Picture Completion subtests; c) subtype 6's scores changed significantly on the VIQ score, the VC factor score, and the Information and Similarities subtests.

4) Clinically significant change consistently occurred in a substantial number of subjects (defined as 40% or more) in subtypes 1, 4, and 6: a) subtype 1 changed by a clinically significant amount on FSIQ, VIQ, PIQ, and eight subtests; b) subtype 4 changed on FSIQ, VIQ, PIQ, and seven subtests; c) subtype 6 changed on PIQ and seven subtests. The other subtypes showed little clinically significant change. Again most of the differences indicate a decline in scaled scores from childhood to adulthood.

The hypothesis put forth in this investigation, i.e. that the minimally impaired subtype would show the most change over time, is supported to some extent. However, equivalent changes occurred in the specifically reading disabled and visuo-perceptual disordered subtypes; therefore, it cannot be said that the minimally impaired showed the most change. All three subtypes, in fact, changed to some degree over 15 years as reflected by variability in their Wechsler scaled scores from childhood to adulthood.

Spreen and Haaf (1986) found most of the subjects in subtypes 1 and 6 to remain in similar subtypes as adults, thus the reading and visuo-perceptual problems persisted; in contrast, the minimally impaired subjects tended to disperse among the minimally impaired, arithmetic, and reading disorder adult subtypes. Since a large battery of tests was used in the subtyping procedure, it is possible that the variability in Wechsler scores was not pronounced enough to cause placement in another grouping for subtypes 1 and 6, while subtype 4's Wechsler differences may have had an influence on their reclassification, in conjunction with changes on the other measures. This reclassification of the minimally impaired group suggests that they are indeed the least stable of the subtypes.

Conversely, Spreen and Haaf found the subjects of the linguistic subtype (subtype 2) to be more severely impaired as adults, while the present investigation revealed little change in their Wechsler scores. In this case, the impairment on the other measures of the cluster analysis battery may be quite pronounced, causing the shift to a more severely impaired subtype. In the present analysis, subtypes 3 and 5, those with a specific arithmetic disorder and a severe impairment, showed little change over time; Spreen and Haaf also found these subjects to remain in similar subtypes as adults, thus their difficulties appear to have persisted. These results suggest that improvement from childhood to adulthood is generally not in evidence in a learning disabled population.

C. DERIVATION OF THREE FACTORS/HYPOTHESIS 3:

As outlined in the beginning of the results section, the familiar VC, PO, and FFD factor structure was derived from the WISC and WAIS-R data, suggesting that the structure of intelligence, as measured by the Wechsler scales, is similar in children and adults. Further support for this stability comes from the similar WISC and WAIS-R subtest scaled score correlations. Differences appeared on individual subtests, but the overall pattern of performance was similar in learning disabled children and adults.

Differences on the three factor scores over time in each of the two classification schemas were discussed in each of their respective sections. To summarize, significant change occurred on these measures, but neither the three neurologically defined groups, nor the six subtypes were significantly different from each other on the factor score differences. In general, there was a decline in scores from childhood to adulthood.

A more detailed analysis revealed that the BD group's FFD score was the only score not showing a significant change over time, thus indicating that attentional capacities for this group remain relatively constant.

In general, clinically significant change was exhibited in each factor by a small percentage of each group. However, 44.4% of the LD group showed a significant change on the VC factor. Perhaps verbal skills are somewhat more compromised over time than other abilities in this group.

The subtypes could not be distinguished from each other on these measures due to the small sample size.

D. GENERAL DISCUSSION:

In the present investigation the WISC and WAIS-R scaled scores were considered to be comparable. This assumption was based on a combination of previously discussed findings: 1) Wechsler (1981) reported that in normal 16 year olds the differences between WISC-R and WAIS-R VIQ, PIQ, and FSIQ scores were only 0, 1, and 2 points, respectively; 2) Sattler et al (1984) and Zimmerman et al (1986) found that as WISC-R FSIQ's approached the average range, WISC-R and WAIS-R VIQ, PIQ, and FSIQ scores provided comparable, stable measures of intelligence over time; and 3) Fisk and Rourke (1987) found that WISC and WISC-R VIQ, PIQ, and FSIQ scores were comparable in a learning disabled population. So, if 1) WISC-R = WAIS-R and 2) WISC = WISC-R, then 3) WISC = WAIS-R. Thus, a logical assumption leading from these comparisons is that WISC and WAIS-R scores should be comparable in a learning disabled population with a FSIQ approaching the average range. In addition, Frauenheim and Heckerl (1983) found WISC and WAIS-R IQ scores to be comparable in a dyslexic sample.

Sarazin and Spreen (1986) suggested that the reductions they found in WISC/WAIS-R FSIQ, VIQ, and PIQ scores of a learning disabled population over a 15 year time period possibly reflected "a genuine minor reduction in intellectual abilities, but is more likely the result of administering the newly revised adult intelligence scale (WAIS-R) with the newly standardized norms" (p.198). Since WISC and WAIS-R scores appear to be comparable in a learning disabled population, however, it is suggested that the decline in scores found in the present investigation do indeed reflect compromised intellectual abilities. This decline over time was most evident in the non-neurologically involved group. The post-hoc analyses also showed that the childhood FSIQ scores were significantly different from each other among the three learning disabled groups, with the non-neurological group having the highest score; in contrast, the adult FSIQ scores were no longer significantly different among groups -- the LD group's score had declined so that the LD and MBD groups had very similar scores as adults (which were higher than the scores of the BD group). Thus, support is given to the suggestion that the differences evidenced over time represent a real decline in cognitive ability for the LD group, relative to their peers.

However, other studies report that the WISC yields IQ scores that are 5-8 points higher than scores on the WISC-R (Swerdlik, 1977). If the WISC-R is comparable to the WAIS-R, then the differences between WAIS-R and WISC IQ scores may be overestimated by 5-8 points. To account for this possible discrepancy, WISC-R IQ scores were estimated from WISC IQ scores using the equation derived by Schwarting (1976). Differences between WAIS-R and estimated WISC-R FSIQ, VIQ and PIQ scores were then computed. The BD and MBD groups showed little difference between the adult and childhood measures; however, the LD group exhibited the largest difference on all indices, with the FSIQ difference score being significantly larger than the difference scores of the other two groups. In addition, a larger percentage of the LD group, as compared to the MBD and BD groups, changed by a clinically significant amount ($\pm$ 15 points) on these measures, with the largest number of subjects showing this change on the VIQ score. The difference scores were once again negative, indicating a decline in cognitive ability from childhood to adulthood (relative to peers) in the non-neurologically involved (LD) group.

As mentioned earlier, this relative decline in ability is parallelled by an increase in the appearance of neurological signs during adulthood (Hern, 1984). This inverse relationship suggests that a dysfunction at the level ofthe cerebral hemispheres may be contributing to the relatively compromised situation of the learning disabled adult. In general, a greater ability to engage in abstract thought is needed to do well on the WAIS-R, as compared to the WISC or WISC-R. A child of 10 may do well on the WISC or WISC-R even though they may take a concrete approach to problem solving; they are not yet expected to have developed the more complex abstract approach. However, a 25 year old who has not developed skills of abstraction will do less well on the WAIS-R as compared to his/her peers. It is possible that the neurological deficits which become apparent in adulthood, somehow impede the later stages of cognitive development, thereby impeding the proper development of abstract thought processes. It is suggested therefore, that perhaps the group with no neurological signs as children did more poorly on the WAIS-R, as compared to the WISC, because the abstract skills needed to do well on the WAIS-R were not properly developed.

More subjects who were not involved neurologically as children showed a clinically significant decline on the VC factor score and the estimated VIQ score, suggesting decline in the verbal domain for this group; however, in all other analyses significant changes occurred in both the verbal and performance areas. Thus, it is difficult to suggest a specific area of focus for future remediation strategies with the learning disabled. Each child has a pattern of strengths and weaknesses and it is this pattern which should guide the development of individualized intervention programs. This study does suggest that learning disabled children, especially those with no neurological involvement at an early age, be carefully followed; in this way, any appearance of neurological signs and/or cognitive difficulties may be discovered at the earliest possible age, thus providing the greatest potential for successful remediation strategies.

Future research comparing changes in WAIS-R scaled scores with respect to the currently used WISC-R is needed to further substantiate the claim that cognitive decline occurs in a learning disabled population over time. A more comprehensive study with a larger subtype sample is needed to assess any changes that may occur within these groups. Further, a comparison of the learning disabled's performance as children and as adults on a larger battery of tests may offer greater insight into the dynamics of cognitive development in this population.

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APPENDICES

Abbreviations Used in Raw Data Listings:

ID: Subject Identification Number

SEX: 0 = Female
1 = Male

CAT: Neurological Category
1 = presence of hard signs (BD)
2 = presence of soft signs (MBD)
3 = no signs (LD)

SUBT: Subtype
1 = specific reading disorder
2 = linguistic disorder
3 = specific arithmetic disorder
4 = minimally impaired
5 = severely impaired
6 = visuo-perceptual disorder

Missing Data = * or -1

INF: WISC Information Scaled Score
COM: WISC Comprehension Scaled Score
ARI: WISC Arithmetic Scaled Score
SIM: WISC Similarities Scaled Score
VOC: WISC Vocabulary Scaled Score
DSP: WISC Digit Span Scaled Score
PCM: WISC Picture Completion Scaled Score
PAR: WISC Picture Arrangement Scaled Score
BLD: WISC Block Design Scaled Score
OBA: WISC Object Assembly Scaled Score
COD: WISC Coding Scaled Score
MAZ: WISC Mazes Scaled Score
VIQ: WISC Verbal IQ Score
PIQ: WISC Performance IQ Score
FIQ: WISC Full Scale IQ Score

AINF: WAIS-R Information Scaled Score
ACOM: WAIS-R Comprehension Scaled Score
AARI: WAIS-R Arithmetic Scaled Score
ASIM: WAIS-R Similarities Scaled Score
AVOC: WAIS-R Vocabulary Scaled Score
ADSP: WAIS-R Digit Span Scaled Score
APCM: WAIS-R Picture Completion Scaled Score
APAR: WAIS-R Picture Arrangement Scaled Score
ABLD: WAIS-R Block Design Scaled Score
AOBA: WAIS-R Object Assembly Scaled Score

ADSY: WAIS-R Digit Symbol Scaled Score
AVIQ: WAIS-R Verbal IQ Score
APIQ: WAIS-R Performance IQ Score
AFIQ: WAIS-R Full Scale IQ Score

VC1: WISC Verbal-Comprehension Factor Score
PO1: WISC Perceptual-Organization Factor Score
FFD1: WISC Freedom From Distractibility Factor Score

VC2: WAIS-R Verbal-Comprehension Factor Score
PO2: WAIS-R Perceptual-Organization Score
FFD2: WAIS-R Freedom From Distractibility Factor Score

DVC: Verbal-Comprehension Difference Score
DPO: Perceptual-Organization Difference Score
DFFD: Freedom From Distractibilty Difference Score

APPENDIX A: Raw data used in the WISC Factor Analysis

ID	SEX	AGE	INF	COM	ARI	SIM	VOC	DSP	PCM	PAR	BLD	OBA	COD	MAZ	CAT
7	1	8	14	12	9	13	13	9	13	12	11	9	11	-1	1
19	1	9	5	9	5	4	6	3	2	4	7	5	2	7	1
23	1	10	9	8	5	4	8	6	12	9	12	9	4	-1	1
24	1	10	10	9	4	4	8	6	9	11	5	5	5	4	1
30	1	10	13	6	9	6	9	14	9	5	7	2	8	-1	1
33	1	10	5	6	8	11	6	8	11	13	10	11	5	-1	1
34	1	10	11	7	10	10	10	6	9	7	7	6	5	-1	1
37	1	11	9	7	9	10	13	6	11	2	5	2	5	-1	2
38	1	11	15	17	13	15	10	10	12	9	14	13	8	-1	2
44	1	12	11	17	10	15	13	9	12	11	10	15	5	13	2
45	1	12	14	8	13	11	9	12	7	10	9	5	7	-1	1
47	1	12	5	6	10	4	4	5	8	5	7	6	8	6	1
73	0	9	9	11	2	9	13	10	11	9	11	11	8	7	1
79	0	11	9	10	10	10	12	9	18	6	12	11	9	-1	1
82	0	12	7	12	5	12	11	7	5	11	7	4	8	-1	2
102	1	8	6	12	10	6	10	7	12	12	9	11	10	12	2
103	1	8	10	11	12	11	13	8	12	12	11	8	13	-1	2
105	1	8	9	13	11	14	18	13	17	18	12	13	10	-1	2
110	1	10	14	12	14	16	14	9	15	19	10	12	10	-1	3
121	1	9	14	14	9	16	18	14	17	12	14	12	10	-1	1
122	1	9	7	7	2	6	6	5	13	6	9	12	6	-1	1
124	1	10	7	10	4	13	9	5	5	6	8	11	4	-1	2
125	1	10	4	4	4	3	6	6	8	7	7	9	11	-1	2
127	1	10	10	9	7	14	13	8	13	7	9	16	8	-1	1
132	1	10	8	10	6	8	6	5	12	11	8	9	8	-1	1
136	1	10	7	11	8	11	11	6	10	10	11	9	9	-1	2
137	1	10	9	12	11	14	12	9	11	10	10	8	9	-1	2
138	1	10	15	20	11	12	14	9	11	8	10	9	11	12	1
142	1	10	12	12	12	12	11	6	11	13	12	13	11	-1	3
144	1	10	11	9	10	12	14	12	12	10	14	10	5	-1	2
147	1	11	9	11	12	13	10	12	11	14	10	8	6	-1	2
151	1	11	11	13	7	15	14	15	17	15	13	13	11	-1	3
154	1	12	15	16	11	17	10	10	17	10	13	15	8	-1	1
155	1	12	12	12	12	15	13	12	14	10	10	13	8	9	3
174	0	8	7	13	10	9	10	9	10	10	7	3	10	7	2
176	0	8	7	8	9	7	6	9	6	11	11	11	8	-1	2
177	0	9	9	11	13	11	8	13	6	7	6	6	11	5	2
178	0	9	4	3	5	5	7	7	7	4	9	5	10	-1	1
181	0	9	9	13	13	9	8	10	13	7	11	11	11	-1	2
182	0	9	9	6	7	13	11	6	10	11	7	10	8	-1	2
183	0	10	10	7	13	14	12	11	14	13	14	13	14	-1	2
184	0	10	10	7	8	15	10	16	10	9	7	11	12	11	2
187	0	10	7	8	4	6	8	8	10	11	7	9	14	-1	3
193	0	11	9	12	6	15	14	14	17	10	20	14	7	17	2
194	0	11	6	8	4	12	5	9	9	10	6	10	12	-1	2
196	0	11	7	10	7	6	8	8	8	10	6	9	6	11	2
199	0	12	9	6	6	13	10	5	13	10	7	12	9	-1	3
204	0	13	7	10	6	6	8	5	9	4	6	5	13	-1	2
215	1	8	6	7	5	8	3	4	15	5	7	10	6	-1	2
217	1	8	18	14	11	20	17	12	14	12	10	13	12	11	3
218	1	8	8	12	11	12	9	8	15	14	9	10	5	9	3

APPENDIX A: (continued)

ID	SEX	AGE	INF	COM	ARI	SIM	VOC	DSP	PCM	PAR	BLD	OBA	COD	MAZ	CAT
223	1	9	11	12	8	10	13	12	11	10	7	13	10	13	2
224	1	9	14	7	7	11	6	8	11	7	11	15	9	-1	2
228	1	9	8	6	6	10	11	6	14	11	8	15	12	-1	3
236	1	11	13	10	13	15	14	12	11	15	13	13	13	-1	3
238	1	11	11	9	11	12	13	8	13	12	11	12	6	-1	3
244	1	13	9	18	10	15	16	10	18	10	15	14	8	-1	2
259	0	8	8	7	10	15	10	10	15	11	9	12	11	-1	3
260	0	9	7	13	7	15	12	5	14	15	11	10	10	-1	3
261	0	9	11	9	10	15	14	12	15	8	14	16	11	-1	3
262	0	9	4	6	12	8	11	6	2	6	9	5	9	-1	3
264	0	10	11	12	12	13	14	10	10	14	9	8	12	-1	3
269	0	12	8	8	7	7	9	5	2	10	2	9	4	4	2
1869	1	10	14	17	7	14	17	6	11	7	13	10	4	-1	1
1870	1	10	11	11	5	7	12	12	15	14	11	9	12	12	3
1877	1	9	12	10	7	16	15	8	12	8	10	9	8	-1	2
1887	1	8	4	2	4	6	6	4	9	7	11	9	5	13	1
1890	1	7	9	12	8	7	10	5	8	9	12	6	7	-1	3
1891	1	13	8	11	13	13	11	8	18	12	12	14	10	-1	1
1897	1	10	10	16	8	13	11	8	10	14	12	14	9	-1	2
1900	1	10	13	15	11	10	11	6	9	9	7	6	4	-1	1
1903	1	10	10	8	6	14	13	4	14	15	12	13	11	-1	3
1979	0	8	10	6	8	13	13	11	8	8	10	8	10	-1	1
1991	1	8	7	8	10	6	7	7	11	8	8	8	6	-1	2
2043	0	8	8	5	7	5	7	10	10	11	7	8	14	8	3
2079	1	12	6	5	7	11	10	5	12	8	12	9	5	-1	2
2082	1	9	5	5	6	7	5	11	3	6	6	3	6	-1	1
2099	1	10	4	6	5	8	11	5	5	7	10	7	4	6	1
2100	1	9	4	6	5	10	6	5	5	6	10	7	3	-1	1
2479	1	7	9	16	10	15	15	9	14	12	13	10	11	-1	2
2480	1	10	11	10	5	6	13	8	10	9	6	9	7	7	3
2481	1	10	4	8	5	9	8	6	9	8	6	10	5	-1	1
2482	1	11	17	9	7	16	17	8	10	14	10	11	4	-1	2
2490	0	11	6	10	8	9	8	9	7	7	9	10	8	-1	2
2495	1	8	5	9	6	11	15	7	16	14	11	14	11	-1	2
2499	1	10	11	13	4	13	11	6	11	5	11	11	7	-1	2
2505	1	13	12	11	10	13	11	7	16	14	12	15	9	-1	2
2527	1	10	5	9	4	4	9	8	8	10	6	8	9	6	3
2541	1	10	8	5	7	6	8	6	8	5	10	10	9	-1	1
2544	1	11	15	15	11	12	16	10	17	14	16	16	13	-1	3
2549	0	8	4	3	6	5	7	3	8	5	6	10	5	6	1
2557	1	11	11	10	7	9	15	5	19	11	12	15	4	-1	2
2559	1	13	6	10	9	9	10	10	9	12	9	10	8	-1	2
2565	1	11	13	8	11	13	13	11	13	15	14	13	11	-1	3
6023	1	11	6	3	9	5	4	4	9	6	7	5	8	-1	2
6024	1	10	5	9	7	5	5	5	12	6	8	3	12	-1	2

NUMBER OF CASES READ = 96 NUMBER OF CASES LISTED = 96

APPENDIX B: Raw data used in the WAIS-R Factor Analysis

ID	SEX	AINF	ADSP	AVOC	AARI	ACOM	ASIM	APCM	APAR	ABLD	AOBA	ADSY	CAT
7	1	11	9	11	15	13	11	11	11	12	8	18	1
8	1	5	8	5	6	7	7	9	9	6	5	6	2
12	1	5	9	5	4	7	2	9	7	9	9	4	1
13	1	6	3	7	8	8	7	6	7	9	9	6	1
14	1	6	6	8	6	8	7	6	9	6	7	4	1
19	1	1	1	1	3	3	3	3	4	4	1	2	1
20	1	8	9	9	11	9	10	10	13	10	8	5	1
24	1	8	5	8	6	7	7	7	6	7	3	6	1
27	1	1	4	2	4	4	3	8	6	6	10	6	1
30	1	9	16	8	10	8	8	10	7	5	3	7	1
33	1	3	7	4	5	4	5	11	7	12	13	5	1
34	1	12	9	12	7	10	10	8	8	7	5	6	1
37	1	10	4	9	7	8	6	6	8	9	6	6	2
38	1	15	16	13	11	15	14	14	11	14	16	6	2
40	1	5	4	5	3	6	5	5	6	7	7	5	1
42	1	9	6	9	7	9	6	10	11	5	5	8	2
43	1	10	8	8	11	8	10	6	5	6	4	4	1
44	1	12	10	10	7	15	12	12	12	9	10	7	2
45	1	9	13	8	14	9	8	9	6	7	9	7	1
70	0	9	8	7	7	8	10	6	10	6	10	9	1
75	0	6	2	5	5	7	7	7	8	8	9	5	1
76	0	9	6	10	8	11	10	8	8	7	6	11	1
79	0	8	10	12	11	13	10	14	11	10	12	12	1
82	0	9	4	10	7	10	7	10	11	6	3	9	2
100	1	9	5	7	7	9	5	9	7	8	11	8	2
102	1	9	7	8	8	11	6	10	12	10	10	11	2
110	1	12	8	8	11	10	11	14	15	13	13	7	3
116	1	8	6	8	7	14	8	9	11	10	10	5	2
118	1	5	8	5	4	6	5	3	5	8	7	4	1
121	1	14	10	13	11	10	6	12	13	12	10	9	1
122	1	7	4	8	4	7	7	10	7	10	10	5	1
124	1	6	2	4	7	6	3	8	8	5	10	5	2
125	1	5	6	5	5	3	5	5	6	6	7	6	2
127	1	12	3	11	5	7	9	6	11	6	10	8	1
130	1	8	12	7	11	7	5	11	12	6	8	10	2
131	1	4	5	3	4	5	2	7	7	6	5	5	2
135	1	9	9	9	7	11	7	14	8	9	8	5	1
137	1	7	4	9	7	14	9	14	11	9	10	8	2
138	1	12	10	12	15	10	11	14	12	11	6	6	1
141	1	8	13	7	11	4	8	6	7	10	6	8	2
144	1	7	9	11	9	10	9	12	12	14	7	6	2
145	1	9	7	10	6	10	9	11	11	9	9	8	2
147	1	6	13	9	12	9	13	14	10	11	12	7	2
148	1	6	7	10	11	10	6	9	11	10	7	9	1
149	1	7	8	9	12	8	8	3	7	5	3	6	1
150	1	10	8	7	6	9	8	4	6	7	8	5	2
153	1	8	8	8	9	9	5	11	11	9	9	6	1
154	1	12	9	10	12	10	11	12	12	11	10	7	1
156	1	10	4	10	5	12	6	5	7	5	6	3	1
174	0	6	11	10	7	8	8	9	15	6	9	8	2
175	0	6	6	5	6	5	6	5	7	7	3	5	1

APPENDIX B: (continued)

ID	SEX	AINF	ADSP	AVOC	AARI	ACOM	ASIM	APCM	APAR	ABLD	AOBA	ADSY	CAT
176	0	5	8	5	7	6	5	11	7	9	8	7	2
178	0	5	5	5	6	6	6	5	7	4	7	5	1
181	0	9	9	8	7	11	13	8	8	7	8	11	2
182	0	10	7	12	14	15	15	9	17	13	10	11	2
183	0	10	11	10	11	13	15	11	15	14	12	16	2
184	0	5	15	6	7	9	6	12	12	11	9	10	2
185	0	9	12	8	8	12	9	11	11	10	5	10	1
187	0	5	9	6	6	5	3	6	8	7	7	12	3
188	0	8	8	5	5	5	10	12	13	5	9	8	2
193	0	10	12	13	8	14	11	14	17	15	14	9	2
194	0	6	8	7	6	6	9	9	6	11	11	12	2
196	0	6	8	6	5	5	6	9	8	8	8	11	2
197	0	7	6	7	11	7	8	6	7	5	3	9	1
199	0	6	8	8	7	8	7	10	7	6	9	7	3
204	0	9	3	10	6	8	6	9	8	5	4	10	2
212	1	14	8	10	7	14	9	10	12	6	6	6	3
214	1	13	8	16	10	11	14	12	11	9	11	6	3
215	1	6	4	6	5	7	6	10	12	8	9	5	2
217	1	11	8	13	9	14	13	14	12	11	15	8	3
218	1	6	6	5	6	9	6	17	13	7	6	9	3
224	1	7	8	9	7	9	9	11	9	9	7	6	2
225	1	6	8	8	7	8	8	9	12	8	7	6	2
228	1	8	8	8	5	5	9	9	9	12	6	6	3
231	1	7	6	8	9	11	11	14	11	12	10	5	3
233	1	9	9	10	7	14	9	14	13	13	11	8	2
238	1	10	10	13	12	14	13	11	12	12	12	8	3
243	1	5	6	6	7	6	4	11	11	14	10	6	3
244	1	11	8	10	10	14	12	11	8	14	12	6	2
259	0	9	11	12	11	11	13	11	11	8	9	11	3
261	0	7	11	7	6	8	10	11	9	12	11	10	3
262	0	9	9	7	7	7	8	7	6	9	8	6	3
264	0	8	6	9	6	9	9	8	7	8	9	8	3
266	0	7	6	7	4	11	9	8	8	10	9	10	3
269	0	8	7	7	6	5	7	8	6	6	8	4	2
1869	1	15	10	16	11	15	14	10	12	14	14	6	1
1870	1	6	10	8	10	10	9	17	11	10	12	8	3
1877	1	10	8	10	9	7	9	12	8	8	6	6	2
1884	1	8	10	12	11	12	13	12	9	14	11	6	2
1887	1	2	2	5	7	6	5	6	7	10	6	7	1
1889	0	5	7	5	7	6	5	8	4	9	10	3	1
1890	1	6	6	6	6	6	7	10	7	6	7	6	3
1891	1	8	10	8	9	9	13	12	11	14	14	6	1
1897	1	8	10	6	7	9	7	12	12	11	10	8	2
1900	1	10	10	12	10	14	8	11	7	3	8	5	1
1979	0	5	7	7	10	9	10	8	11	9	5	9	1
1983	1	9	10	5	11	3	8	14	11	19	13	8	1
1991	1	8	6	5	6	6	3	9	7	7	5	6	2
1992	1	3	6	6	6	6	5	12	12	12	10	7	2
2004	1	2	6	5	4	6	4	6	11	8	4	6	1
2030	1	6	6	6	8	6	7	9	8	7	5	6	1
2043	0	3	6	5	6	9	5	9	6	7	7	10	3

APPENDIX B: (continued)

ID	SEX	AINF	ADSP	AVOC	AARI	ACOM	ASIM	APCM	APAR	ABLD	AOBA	ADSY	CAT
2077	1	8	9	8	9	10	7	10	7	7	6	10	1
2079	1	8	8	8	7	9	8	14	9	10	12	6	2
2082	1	4	4	4	3	4	5	3	4	3	3	3	1
2099	1	5	6	6	4	7	7	4	6	7	5	3	1
2100	1	6	6	6	5	6	5	6	9	5	8	4	1
2103	1	7	4	6	8	7	6	10	9	9	7	6	1
2479	1	11	7	10	6	14	8	8	8	9	10	8	2
2480	1	6	8	6	4	10	6	10	8	6	6	7	3
2481	1	4	5	6	8	6	6	10	7	8	6	4	1
2482	1	10	7	10	8	9	13	11	13	8	7	5	2
2486	1	9	6	8	5	11	9	9	9	12	7	6	3
2490	0	6	10	6	7	7	4	9	9	7	9	8	2
2495	1	6	6	6	8	8	12	8	10	9	9	6	2
2499	1	6	8	7	6	9	6	6	7	9	6	6	2
2505	1	8	7	9	12	12	10	11	11	13	12	8	2
2508	0	3	4	4	3	4	3	6	6	3	5	5	1
2511	0	2	5	4	5	5	5	5	6	6	7	6	1
2517	1	4	6	5	6	7	8	11	11	9	9	5	2
2519	1	5	7	5	7	6	5	8	8	8	10	5	2
2520	1	12	6	9	13	18	14	12	13	13	9	11	1
2527	1	8	6	5	6	7	8	10	10	6	8	6	3
2541	1	6	6	5	7	5	6	6	6	5	5	5	1
2542	1	11	6	8	11	8	10	9	11	11	7	8	2
2544	1	10	9	10	8	8	10	10	11	9	10	5	3
2549	0	1	2	2	3	2	4	4	1	5	4	2	1
2557	1	9	6	8	6	7	9	10	12	11	13	6	2
2559	1	8	5	8	9	10	13	11	11	12	12	9	2
2565	1	10	6	9	11	12	10	14	12	11	7	12	3
2591	0	10	8	11	9	9	9	10	12	14	14	8	3
2595	1	4	9	4	4	4	4	7	9	5	6	5	2
6003	1	9	6	10	7	11	9	8	8	7	9	5	2
6008	1	5	8	8	7	9	5	6	9	7	7	6	2
6023	1	8	3	5	7	7	8	9	8	7	7	8	2
6024	1	4	6	5	6	3	5	6	7	6	6	6	2
6034	1	5	6	5	6	7	5	6	8	7	6	5	2

NUMBER OF CASES READ = 137 NUMBER OF CASES LISTED = 137

APPENDIX C: Raw data used in the analyses of Wechsler scaled scores

ID	CAT	SUBT	INF	COM	ARI	SIM	VOC	DSP	PCM	PAR	BLD	OBA	COD	MAZ	VIQ	PIQ	FIQ	AINF	ADSP	AVOC	AARI	ACOM	ASIM	APCM	APAR	ABLD	AOBA	ADSY	AVIQ	APIQ	AFIQ
7	1	•	14	12	9	13	13	9	13	12	11	9	11	-1	110	108	110	11	9	11	15	13	11	11	11	12	8	18	112	114	114
19	1	5	5	9	5	4	6	3	2	4	7	5	2	7	71	62	64	1	1	1	3	3	3	3	4	4	1	2	56	56	54
24	1	3	10	9	4	4	8	6	9	11	5	5	5	4	80	75	76	8	5	8	6	7	7	7	6	7	3	6	80	74	76
30	1	3	13	6	9	6	9	14	9	5	7	2	8	-1	97	74	85	9	16	8	10	8	8	10	7	5	3	7	96	77	86
33	1	•	5	6	8	11	6	8	11	13	10	11	5	-1	84	100	91	3	7	4	5	4	5	11	7	12	13	5	72	94	78
34	1	6	11	7	10	10	10	6	9	7	7	6	5	-1	94	78	85	12	9	12	7	10	10	8	8	7	5	6	97	79	88
37	2	•	9	7	9	10	13	6	11	2	5	2	5	-1	94	65	78	10	4	9	7	8	6	6	8	9	6	6	83	80	80
38	2	•	15	17	13	15	10	10	12	9	14	13	8	-1	121	108	117	15	16	13	11	15	14	14	11	14	16	6	125	116	125
44	2	•	11	17	10	15	13	9	12	11	10	15	5	13	116	107	113	12	10	10	7	15	12	12	12	9	10	7	103	99	101
45	1	6	14	8	13	11	9	12	7	10	9	5	7	-1	108	83	96	9	13	8	14	9	8	9	6	7	9	7	99	84	92
79	1	6	9	10	10	10	12	9	18	6	12	11	9	-1	100	108	104	8	10	12	11	13	10	14	11	10	12	12	101	113	106
82	2	•	7	12	5	12	11	7	5	11	7	4	8	-1	94	79	85	9	4	10	7	10	7	10	11	6	3	9	86	85	84
102	2	•	6	12	10	6	10	7	12	12	9	11	10	12	91	107	99	9	7	8	8	11	6	10	12	10	10	11	89	102	94
110	3	•	14	12	14	16	14	9	15	19	10	12	10	-1	121	122	124	12	8	8	11	10	11	14	15	13	13	7	97	118	105
121	1	•	14	14	9	16	18	14	17	12	14	12	10	-1	126	121	126	14	10	13	11	10	6	12	13	12	10	9	105	108	106
122	1	2	7	7	2	6	6	5	13	6	9	12	6	-1	72	94	81	7	4	8	4	7	7	10	7	10	10	5	79	86	80
124	2	•	7	10	4	13	9	5	5	6	8	11	4	-1	87	78	81	6	2	4	7	6	3	8	8	5	10	5	71	81	74
125	2	•	4	4	4	3	6	6	8	7	7	9	11	-1	66	89	75	5	6	5	5	3	5	5	6	6	7	6	71	75	72
127	1	•	10	9	7	14	13	8	13	7	9	16	8	-1	101	104	103	12	3	11	5	7	9	6	11	6	10	8	86	88	85
137	2	1	9	12	11	14	12	9	11	10	10	8	9	-1	108	97	103	7	4	9	7	14	9	14	11	9	10	8	88	102	93
138	1	•	15	20	11	12	14	9	11	8	10	9	11	12	123	101	114	12	10	12	15	10	11	14	12	11	6	6	108	98	103
144	2	•	11	9	10	12	14	12	12	10	14	10	5	-1	109	101	106	7	9	11	9	10	9	12	12	14	7	6	95	98	97
147	2	6	9	11	12	13	10	12	11	14	10	8	6	-1	108	99	104	6	13	9	12	9	13	14	10	11	12	7	99	105	101
154	1	6	15	16	11	17	10	10	17	10	13	15	8	-1	120	118	121	12	9	10	12	10	11	12	12	11	10	7	101	102	101
174	2	4	7	13	10	9	10	9	10	10	7	3	10	7	97	85	91	6	11	10	7	8	8	9	15	6	9	8	90	92	90
176	2	•	7	8	9	7	6	9	6	11	11	11	8	-1	85	96	89	5	8	5	7	6	5	11	7	9	8	7	78	86	79
178	1	•	4	3	5	5	7	7	7	4	9	5	10	-1	70	79	72	5	5	5	6	6	6	5	7	4	7	5	75	70	73
181	2	•	9	13	13	9	8	10	13	7	11	11	11	-1	103	104	104	9	9	8	7	11	13	8	8	7	8	11	94	89	91
182	2	•	9	6	7	13	11	6	10	11	7	10	8	-1	91	94	92	10	7	12	14	15	15	9	17	13	10	11	111	114	114
183	2	4	10	7	13	14	12	11	14	13	14	13	14	-1	108	125	117	10	11	10	11	13	15	11	15	14	12	16	108	128	119
184	2	•	10	7	8	15	10	16	10	9	7	11	12	11	106	100	104	5	15	6	7	9	6	12	12	11	9	10	87	105	93
187	3	3	7	8	4	6	8	8	10	11	7	9	14	-1	80	101	89	5	9	6	6	5	3	6	8	7	7	12	75	87	77
193	2	•	9	12	6	15	14	14	17	10	20	14	7	17	110	129	121	10	12	13	8	14	11	14	17	15	14	9	105	130	118
194	2	•	6	8	4	12	5	9	9	10	6	10	12	-1	81	96	87	6	8	7	6	6	9	9	6	11	11	12	81	98	86
196	2	3	7	10	7	6	8	8	8	10	6	9	6	11	85	89	85	6	8	6	5	5	6	9	8	8	8	11	77	92	80
199	3	6	9	6	6	13	10	5	13	10	7	12	9	-1	89	101	94	6	8	8	7	8	7	10	7	6	9	7	83	85	82
204	2	3	7	10	6	6	8	5	9	4	6	5	13	-1	81	82	80	9	3	10	6	8	6	9	8	5	4	10	81	81	71
215	2	•	6	7	5	8	3	4	15	5	7	10	6	-1	72	90	79	6	4	6	5	7	6	10	12	8	9	5	76	88	79
217	3	•	18	14	11	20	17	12	14	12	10	13	12	11	134	114	127	11	8	13	9	14	13	14	12	11	15	8	110	114	113
218	3	•	8	12	11	12	9	8	15	14	9	10	5	9	100	104	102	6	6	5	6	9	6	17	13	7	6	9	79	100	86
224	2	3	14	7	7	11	6	8	11	7	11	15	9	-1	91	104	97	7	8	9	7	9	9	11	9	9	7	6	88	89	86
228	3	•	8	6	6	10	11	6	14	11	8	15	12	-1	86	114	99	8	8	8	5	5	9	9	9	12	6	6	83	86	83
238	3	•	11	9	11	12	13	8	13	12	11	12	6	-1	104	106	105	10	10	13	12	14	13	11	12	12	12	8	110	106	108
244	2	6	9	18	10	15	16	10	18	10	15	14	8	-1	119	121	122	11	8	10	10	14	12	11	8	14	12	6	102	101	101
259	3	•	8	7	10	15	10	10	15	11	9	12	11	-1	100	111	106	9	11	12	11	11	13	11	11	8	9	11	109	97	104
261	3	4	11	9	10	15	14	12	15	8	14	16	11	-1	111	120	117	7	11	7	6	8	10	11	9	12	11	10	89	102	94
262	3	•	4	6	12	8	11	6	2	6	9	5	9	-1	86	74	80	9	9	7	7	7	8	7	6	9	8	6	90	91	89
264	3	4	11	12	12	13	14	10	10	14	9	8	12	-1	113	104	109	8	6	9	6	9	9	8	7	8	9	8	87	83	87
269	2	5	8	8	7	7	9	5	2	10	2	9	4	4	84	67	73	8	7	7	6	5	7	8	6	6	8	4	79	77	77

APPENDIX C: (continued)

ID	CAT	SUBT	INF	COM	ARI	SIM	VOC	DSP	PCM	PAR	BLD	OBA	COD	MAZ	VIQ	PIQ	FIQ	AINF	ADSP	AVOC	AARI	ACOM	ASIM	APCM	APAR	ABLD	AOBA	ADSY	AVIQ	APIQ	AFIQ
1869	1	•	14	17	7	14	17	6	11	7	13	10	4	-1	116	93	106	15	10	16	11	15	14	10	12	14	14	6	126	108	121
1870	3	•	11	11	5	7	12	12	15	14	11	9	12	12	97	115	107	6	10	8	10	10	9	17	11	10	12	8	93	111	100
1877	2	•	12	10	7	16	15	8	12	8	10	9	8	-1	109	96	103	10	8	10	9	7	9	12	8	8	6	6	93	83	87
1887	1	5	4	2	4	6	6	4	9	7	11	9	5	13	65	94	76	2	2	5	7	6	5	6	7	10	6	7	71	79	73
1890	3	2	9	12	8	7	10	5	8	9	12	6	7	-1	91	89	89	6	6	6	6	6	7	10	7	6	7	6	79	79	77
1891	1	6	8	11	13	13	11	8	18	12	12	14	10	-1	104	122	114	8	10	8	9	9	13	12	11	14	14	6	94	110	100
1897	2	1	10	16	8	13	11	8	10	14	12	14	9	-1	106	113	110	8	10	6	7	9	7	12	12	11	10	8	87	102	92
1900	1	6	13	15	11	10	11	6	9	9	7	6	4	-1	106	79	93	10	10	12	10	14	8	11	7	3	8	5	105	97	91
1979	1	6	10	6	8	13	13	11	8	8	10	8	10	-1	101	92	96	5	7	7	10	9	10	8	11	9	5	9	88	86	86
1991	2	3	7	8	10	6	7	7	11	8	8	8	6	-1	85	87	85	8	6	5	6	6	3	9	7	7	5	6	76	77	75
2043	3	•	8	5	7	5	7	10	10	11	7	8	14	8	81	97	88	3	6	5	6	9	5	9	6	7	7	10	76	82	77
2079	2	2	6	5	7	11	10	5	12	8	12	9	5	-1	84	94	88	8	8	8	7	9	8	14	9	10	12	6	88	98	91
2082	1	•	5	5	6	7	5	11	3	6	6	3	6	-1	82	64	71	4	4	4	3	4	5	3	4	3	3	3	68	58	62
2099	1	•	4	6	5	8	11	5	5	7	10	7	4	6	79	76	75	5	6	6	4	7	7	4	6	7	5	3	77	67	72
2100	1	•	4	6	5	10	6	5	5	6	10	7	3	-1	75	74	72	6	6	6	5	6	5	6	9	5	8	4	76	75	75
2479	2	•	9	16	10	15	15	9	14	12	13	10	11	-1	115	114	116	11	7	10	6	14	8	8	8	9	10	8	102	90	98
2480	3	•	11	10	5	6	13	8	10	9	6	9	7	7	92	86	88	6	8	6	4	10	6	10	8	6	6	7	80	80	79
2481	1	•	4	8	5	9	8	6	9	8	6	10	5	-1	79	83	79	4	5	6	8	6	6	10	7	8	6	4	77	78	76
2482	2	•	17	9	7	16	17	8	10	14	10	11	4	-1	115	99	108	10	7	10	8	9	13	11	13	8	7	5	97	88	93
2490	2	2	6	10	8	9	8	9	7	7	9	10	8	-1	90	87	88	6	10	6	7	7	4	9	9	7	9	8	80	86	82
2495	2	1	5	9	6	11	15	7	16	14	11	14	11	-1	92	122	107	6	6	6	8	8	12	8	10	9	9	6	91	89	89
2499	2	•	11	13	4	13	11	6	11	5	11	11	7	-1	97	93	95	6	8	7	6	9	6	6	7	9	6	6	82	77	78
2505	2	1	12	11	10	13	11	7	16	14	12	15	9	-1	104	122	114	8	7	9	12	12	10	11	11	13	12	8	95	106	99
2527	3	3	5	9	4	4	9	8	8	10	6	8	9	6	79	87	81	8	6	5	6	7	8	10	10	6	8	6	80	83	80
2541	1	•	8	5	7	6	8	6	8	5	10	10	9	-1	79	89	82	6	6	5	7	5	6	6	6	5	5	5	79	71	74
2544	3	•	15	15	11	12	16	10	17	14	16	16	13	-1	120	136	131	10	9	10	8	8	10	10	11	9	10	5	92	93	92
2549	1	•	4	3	6	5	7	3	8	5	6	10	5	6	66	76	68	1	2	2	3	2	4	4	1	5	4	2	60	60	58
2557	2	•	11	10	7	9	15	5	19	11	12	15	4	-1	97	115	107	9	6	8	6	7	9	10	12	11	13	6	85	100	90
2559	2	2	6	10	9	9	10	10	9	12	9	10	8	-1	94	97	95	8	5	8	9	10	13	11	11	12	12	9	93	106	98
2565	3	1	13	8	11	13	13	11	13	15	14	13	11	-1	110	122	117	10	6	9	11	12	10	14	12	11	7	12	98	108	102
6023	2	•	6	3	9	5	4	4	9	6	7	5	8	-1	70	79	72	8	3	5	7	7	8	9	8	7	7	8	79	82	79
6024	2	•	5	9	7	5	5	5	12	6	8	3	12	-1	75	90	80	4	6	5	6	3	5	6	7	6	6	6	72	74	72

NUMBER OF CASES READ = 81 NUMBER OF CASES LISTED = 81

APPENDIX D: Raw data used in the analyses of Wechsler factor scores

ID	CAT	SUBT	VC1	PO1	FFD1	VC2	PO2	FFD2	DVC	DPO	DFFD
7	1	.	13.00	11.00	9.67	11.50	10.33	14.00	-1.50	-.67	4.33
19	1	5	6.00	4.67	3.33	2.00	2.67	2.00	-4.00	-2.00	-1.33
24	1	3	7.75	6.33	5.00	7.50	5.67	5.67	-.25	-.67	.67
30	1	3	8.50	6.00	10.33	8.25	6.00	11.00	-.25	.00	.67
33	1	.	7.00	10.67	7.00	4.00	12.00	5.67	-3.00	1.33	-1.33
34	1	6	9.50	7.33	7.00	11.00	6.67	7.33	1.50	-.67	.33
37	2	.	9.75	6.00	6.67	8.25	7.00	5.67	-1.50	1.00	-1.00
38	2	.	14.25	13.00	10.33	14.25	14.67	11.00	.00	1.67	.67
44	2	.	14.00	12.33	8.00	12.25	10.33	8.00	-1.75	-2.00	.00
45	1	6	10.50	7.00	10.67	8.50	8.33	11.33	-2.00	1.33	.67
79	1	6	10.25	13.67	9.33	10.75	12.00	11.00	.50	-1.67	1.67
82	2	.	10.50	5.33	6.67	9.00	6.33	6.67	-1.50	1.00	.00
102	2	.	8.50	10.67	9.00	8.50	10.00	8.67	.00	-.67	-.33
110	3	.	14.00	12.33	11.00	10.25	13.33	8.67	-3.75	1.00	-2.33
121	1	.	15.50	14.33	11.00	10.75	11.33	10.00	-4.75	-3.00	-1.00
122	1	2	6.50	11.33	4.33	7.25	10.00	4.33	.75	-1.33	.00
124	2	.	9.75	8.00	4.33	4.75	7.67	4.67	-5.00	-.33	.33
125	2	.	4.25	8.00	7.00	4.50	6.00	5.67	.25	-2.00	-1.33
127	1	.	11.50	12.67	7.67	9.75	7.33	5.33	-1.75	-5.33	-2.33
137	2	1	11.75	9.67	9.67	9.75	11.00	6.33	-2.00	1.33	-3.33
138	1	.	15.25	10.00	10.33	11.25	10.33	10.33	-4.00	.33	.00
141	2	.	9.25	8.67	11.67	6.75	7.33	10.67	-2.50	-1.33	-1.00
144	2	.	11.50	12.00	9.00	9.25	11.00	8.00	-2.25	-1.00	-1.00
147	2	6	10.75	9.67	10.00	9.25	12.33	10.67	-1.50	2.67	.67
154	1	6	14.50	15.00	9.67	10.75	11.00	9.33	-3.75	-4.00	-.33
174	2	4	9.75	6.67	9.67	8.00	8.00	8.67	-1.75	1.33	-1.00
176	2	.	7.00	9.33	8.67	5.25	9.33	7.33	-1.75	.00	-1.33
178	1	.	4.75	7.00	7.33	5.50	5.33	5.33	.75	-1.67	-2.00
181	2	.	9.75	11.67	11.33	10.25	7.67	9.00	.50	-4.00	-2.33
182	2	.	9.75	9.00	7.00	13.00	10.67	10.67	3.25	1.67	3.67
183	2	4	10.75	13.67	12.67	12.00	12.33	12.67	1.25	-1.33	.00
184	2	.	10.50	9.33	12.00	6.50	10.67	10.67	-4.00	1.33	-1.33
187	3	3	7.25	8.67	8.67	4.75	6.67	9.00	-2.50	-2.00	.33
193	2	.	12.50	17.00	9.00	12.00	14.33	9.67	-.50	-2.67	.67
194	2	.	7.75	8.33	8.33	7.00	10.33	8.67	-.75	2.00	.33
196	2	3	7.75	7.67	7.00	5.75	8.33	8.00	-2.00	.67	1.00
199	3	6	9.50	10.67	6.67	7.25	8.33	7.33	-2.25	-2.33	.67
204	2	3	7.75	6.67	8.00	8.25	6.00	6.33	.50	-.67	-1.67
215	2	.	6.00	10.67	5.00	6.25	9.00	4.67	.25	-1.67	-.33
217	3	.	17.25	12.33	11.67	12.75	13.33	8.33	-4.50	1.00	-3.33
218	3	.	10.25	11.33	8.00	6.50	10.00	7.00	-3.75	-1.33	-1.00
224	2	3	9.50	12.33	8.00	8.50	9.00	7.00	-1.00	-3.33	-1.00
228	3	.	8.75	12.33	8.00	7.50	9.00	6.33	-1.25	-3.33	-1.67
238	3	.	11.25	12.00	8.33	12.50	11.67	10.00	1.25	-.33	1.67
244	2	6	14.50	15.67	9.33	11.75	12.33	8.00	-2.75	-3.33	-1.33
259	3	.	10.00	12.00	10.33	11.25	9.33	11.00	1.25	-2.67	.67
261	3	4	12.25	15.00	11.00	8.00	11.33	9.00	-4.25	-3.67	-2.00
262	3	.	7.25	5.33	9.00	7.75	8.00	7.33	.50	2.67	-1.67
264	3	4	12.50	9.00	11.33	8.75	8.33	6.67	-3.75	-.67	-4.67
269	2	5	8.00	4.33	5.33	6.75	7.33	5.67	-1.25	3.00	.33
1869	1	.	15.50	11.33	5.67	15.00	12.67	9.00	-.50	1.33	3.33

APPENDIX D: (continued)

ID	CAT	SUBT	VC1	PO1	FFD1	VC2	PO2	FFD2	DVC	DPO	DFFD
1870	3	.	10.25	11.67	9.67	8.25	13.00	9.33	-2.00	1.33	-.33
1877	2	.	13.25	10.33	7.67	9.00	8.67	7.67	-4.25	-1.67	.00
1887	1	5	4.50	9.67	4.33	4.50	7.33	5.33	.00	-2.33	1.00
1890	3	2	9.50	8.67	6.67	6.25	7.67	6.00	-3.25	-1.00	-.67
1891	1	6	10.75	14.67	10.33	9.50	13.33	8.33	-1.25	-1.33	-2.00
1897	2	1	12.50	12.00	8.33	7.50	11.00	8.33	-5.00	-1.00	.00
1900	1	6	12.25	7.33	7.00	11.00	7.33	8.33	-1.25	.00	1.33
1979	1	6	10.50	8.67	9.67	7.75	7.33	8.67	-2.75	-1.33	-1.00
1991	2	3	7.00	9.00	7.67	5.50	7.00	6.00	-1.50	-2.00	-1.67
2043	3	.	6.25	8.33	10.33	5.50	7.67	7.33	-.75	-.67	-3.00
2079	2	2	8.00	11.00	5.67	8.25	12.00	7.00	.25	1.00	1.33
2082	1	.	5.50	4.00	7.67	4.25	3.00	3.33	-1.25	-1.00	-4.33
2099	1	.	7.25	7.33	4.67	6.25	5.33	4.33	-1.00	-2.00	-.33
2100	1	.	6.50	7.33	4.33	5.75	6.33	5.00	-.75	-1.00	.67
2479	2	.	13.75	12.33	10.00	10.75	9.00	7.00	-3.00	-3.33	-3.00
2480	3	.	10.00	8.33	6.67	7.00	7.33	6.33	-3.00	-1.00	-.33
2481	1	.	7.25	8.33	5.33	5.50	8.00	5.67	-1.75	-.33	.33
2482	2	.	14.75	10.33	6.33	10.50	8.67	6.67	-4.25	-1.67	.33
2490	2	2	8.25	8.67	8.33	5.75	8.33	8.33	-2.50	-.33	.00
2495	2	1	10.00	13.67	8.00	8.00	8.67	6.67	-2.00	-5.00	-1.33
2499	2	.	12.00	11.00	5.67	7.00	7.00	6.67	-5.00	-4.00	1.00
2505	2	1	11.75	14.33	8.67	9.75	12.00	9.00	-2.00	-2.33	.33
2517	2	.	6.25	12.00	7.33	6.00	9.67	5.67	-.25	-2.33	-1.67
2527	3	3	6.75	7.33	7.00	7.00	8.00	6.00	.25	.67	-1.00
2541	1	.	6.75	9.33	7.33	5.50	5.33	6.00	-1.25	-4.00	-1.33
2544	3	.	14.50	16.33	11.33	9.50	9.67	7.33	-5.00	-6.67	-4.00
2549	1	.	4.75	8.00	4.67	2.25	4.33	2.33	-2.50	-3.67	-2.33
2557	2	.	11.25	15.33	5.33	8.25	11.33	6.00	-3.00	-4.00	.67
2559	2	2	8.75	9.33	9.00	9.75	11.67	7.67	1.00	2.33	-1.33
2565	3	1	11.75	13.33	11.00	10.25	10.67	9.67	-1.50	-2.67	-1.33
2595	2	.	5.50	9.33	6.33	4.00	6.00	6.00	-1.50	-3.33	-.33
6023	2	.	4.50	7.00	7.00	7.00	7.67	6.00	2.50	.67	-1.00
6024	2	.	6.00	7.67	8.00	4.25	6.00	6.00	-1.75	-1.67	-2.00

NUMBER OF CASES READ = 84 NUMBER OF CASES LISTED = 84

VITA

Surname: McQuaid **Given Names:** Monica Mary

Place of Birth: Queens, N.Y. **Date of Birth:** 25 January 1963

Educational Institutions Attended:

BOSTON COLLEGE, Boston, Massachusetts	1981 to 1985
UNIVERSITY OF VICTORIA, Victoria, B.C.	1986 to 1988

Degrees Awarded:

Bachelor of Arts	1985	Boston College
Master of Arts	1988	University of Victoria

Honors and Awards:

Phi Beta Kappa induction	1984
Alpha Sigma Nu induction	1984
Boston College Scholarship	1981 to 1985
University of Victoria Fellowship	1986 to 1988
IODE Scholarship for Women	1987/1988