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thesis entitled

A SEARCH FOR HOMOGENEOUS SUBGROUPS OF LEARNING DISABLED CHILDREN USING PSYCHOLOGICAL TESTS

presented by

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has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Counseling, Educational Psychology, and Special Education

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Date 5/4/84

A SEARCH FOR HOMOGENEOUS SUBGROUPS OF LEARNING DISABLED CHILDREN USING PSYCHOLOGICAL TESTS

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A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Counseling, Educational Psychology,
and Special Education

1984

ABSTRACT

A SEARCH FOR HOMOGENEOUS SUBGROUPS OF LEARNING DISABLED CHILDREN USING PSYCHOLOGICAL TESTS

By

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Four subgroups of learning disabled children were identified on the basis of a combination of WISC-R Verbal IQ-Performance IQ discrepancy and WRAT Reading, Spelling, and Arithmetic subtest scores. The subjects were identified from a group of school-identified learning disabled students who had received two psychological evaluations over a 2-to-4-year period. A retrospective study was conducted to determine if changes in WRAT scores at the second evaluation could be predicted on the basis of subgroup membership. The findings were not significant and raised questions regarding the potential for using these tests to identify homogeneous subgroups in the learning disabled population. WISC-R Verbal IQ, Performance IQ, and Full Scale IQ were all found to be quite stable for this population. An effort was made to relate the "ACID" profile to performance on the WRAT Reading subtest, but too few subjects actually exhibited this profile to make any such inferences. Finally, the subjects were grouped on the basis of special education placement to determine if the severity of the ability-achievement discrepancy was related to the type of special education placement.

Severity of the discrepancy appeared unrelated at the initial evaluation. At the re-evaluation, more severe discrepancies were found for the children placed in resource rooms and self-contained classrooms than for children placed in teacher consultant programs.

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CHAPTER I

SCOPE AND PURPOSE OF THE STUDY

Results of studies over the last 45 years indicate that there is a group of children who have unusual difficulty learning when exposed to traditional teaching methods, although they do not exhibit signs of common handicapping conditions such as sensory impairment or retardation (Johnson & Morasky, 1977; Kirk, 1972; Strauss & Lehtinen, 1942; Strauss & Werner, 1942). One such subgroup of underachievers is commonly described as having specific learning disabilities, and these children are being identified with increasing frequency as a result of mandatory special education.

The recognized characteristics that previously have been required for substantiating the diagnosis of a specific learning disability are: (1) an educationally significant discrepancy between measured functioning capacity and actual performance in a given achievement area and (2) a greater amount of scatter in measured learning abilities due to a difference in information-processing abilities (Farnham-Diggory, 1978; Johnson & Morasky, 1977; Owens, Adams, Forrest, Stolz, & Fisher, 1977).

The amount of scatter has not proved an effective diagnostic tool, however. The difficulty may lie in the heterogeneity of the group used to evaluate the scatter. Although learning disabled children as a group do not differ from other populations on the amount of scatter (Kaufman, 1979), some subgroups of learning disabled children may exhibit greater scatter in abilities than others.

In addition to the two generally accepted criteria for identifying a learning disability, various researchers have reported on other characteristics they associate with learning disabled children.

It has been mandated that the learning disabled child has average or above-average intelligence, adequate sensory acuity but is achieving much less than the child's age, intelligence, and educational background would predict (Gearhart, 1973). Valett (1969) wrote that learning disabled children have specific difficulty in acquiring and using information and skills needed for problem solving. Another aspect of learning disability has been described as integrity of emotional, motoric, sensory, and intellectual abilities with failure to achieve at an appropriate level (Johnson & Myklebust, 1967). Finally, Kirk (1972) wrote that the children display discrepancies in ability, have a specific problem not related to other primary handicapping conditions, and have behavioral deficits.

It should be noted that the above statements focus more on exclusion of certain characteristics than the presence of specific characteristics. Clarizio and McCoy (1983) suggested that learning disabled children exhibit secondary or associated difficulties in one or more of the following areas: visual-spatial skills, fine and gross motor skills, language skills, auditory discrimination, social and emotional skills, and, finally, in cognitive skills.

One problem in interpreting the literature is that there has been a proliferation of both theories and formulas for the process of diagnosis. Many researchers have used their own definition of learning disability in determining what constituted a learning disabled child. The authors of P.L. 94-142 attempted to remedy this in part by the establishment of both a single definition and guidelines for diagnosis:

> Those children who have a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which disorder may manifest itself in imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations. Such disorders include such conditions as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. Such term does not include children who have learning problems which are primarily the result of visual, hearing, or motor handicaps, or mental retardation, of emotional disturbance, or environmental, cultural, or economic disadvantage. (Section 5(b))

The Michigan Rule as stated in Public Act 451 includes the above statement but adds the following qualifiers:

> Rule 13. (2) The individualized educational planning committee may determine that a child has a specific learning disability if the child does not achieve commensurate with his or her age and ability levels in 1 or more of the areas listed in this subrule, when provided with learning experiences appropriate for the child's age and ability levels, and if the multidisciplinary evaluation team finds that a child has a severe discrepancy between achievement and intellectual ability in 1 or more of the following areas:
>
> (a) Oral expression.
> (b) Listening comprehension.
> (c) Written expression.
> (d) Basic reading skill.
> (e) Reading comprehension.
> (f) Mathematics calculation.
> (g) Mathematics reasoning.

(3) The individualized educational planning committee can not identify a child as having a specific learning disability if the severe discrepancy between ability and achievement is primarily the result of any of the following:

(a) A visual, hearing, or motor handicap.
(b) Mental retardation.
(c) Emotional disturbance.
(d) Environmental, cultural, or economic disadvantage.

As can be seen from the above definition and rules, the essential characteristic for diagnosis is the presence of a significant discrepancy between expected achievement and actual achievement. There continues to be much room for interpretation of the meaning of significant discrepancy, however.

Given the broad area of learning disabilities, this paper will focus on several areas in need of further investigation. These areas include identification of subgroups of learning disabled children, Wechsler Intelligence Scale for Children pattern analysis and its relationship to achievement test performance, and the consistency of test performance across evaluations.

The desire for consistency has led to numerous efforts to establish a characteristic profile on the subtests of the Wechsler Intelligence Scale for Children (WISC) and the Wechsler Intelligence Scale for Children-Revised (WISC-R) which would distinguish learning disabled children from other populations, and identify their characteristic strengths and weaknesses (Ackerman, Dykman, & Peters, 1976; Belmont & Birch, 1966; Clarizio & Bernard, 1981; Huelsman, 1970; Law, Box, & Moracco, 1980; Smith, Coleman, Dokecki, & Davis, 1977a). These studies have met with mixed results as either the profiles have fit normal children as well as the identified learning disabled children (Clarizio & Bernard, 1981), or it has not been possible to replicate those studies which do suggest a characteristic profile (Ryckman, 1981; Thompson, 1981; Vance & Singer, 1979). Thus, the studies are consistent in their failure to find a characteristic profile.

Several studies have suggested that while there may be no one characteristic profile, certain subtests seem to occur in an associated pattern of lower scores. These are the Arithmetic (A), Coding (C), and Digit Span (D) subtests which together are often referred to as the Freedom from Distractibility Factor (FDF) (Huelsman, 1970; Kaufman, 1975; Paal, Hesterly, & Wepfer, 1979). A related pattern, referred to as the ACID pattern as it includes the Information (I) subtest as well as the Arithmetic, Coding, and Digit Span subtests cited above, has also been described by several studies (Ackerman, Dykman, & Peters, 1976; Huelsman, 1970; Swartz, 1974).

There is some controversy regarding which tests actually constitute the FDF. Fisk and Rourke (1979) suggested that an AID pattern may be more common among learning disabled students, while Paal, Hesterly, and Wepfer (1979) reported that Information was not found to be low. Tabachnick (1979) indicated that low scores on Coding alone are significant in diagnosing the presence of a learning disability. Bernard (1978) found that his group of learning disabled subjects had their lowest performance on Arithmetic, Coding, and Information. These subtests were also the most powerful at discriminating between the learning disabled and the nonimpaired groups. Rourke (1981) suggested that the ACID profile may be useful in determining which learning disabled children are most likely to benefit from remedial reading programs.

Another recent development coming out of the many efforts to find a representative WISC or WISC-R pattern has been the recommendation that researchers give up on this search and turn to investigations of more homogeneous subgroups of learning disabled children in order to identify such groups, more clearly define the learning problems they face, and to begin developing appropriate educational programs for them (Denckla, 1973; Kaufman, 1981; McKinney, 1984; Rugel, 1974; Ryckman, 1981; Vance, Wallbrown, & Blaha, 1978). These authors believed that learning disabilities research has continued to focus on the characteristic profile concept beyond a profitable point.

Another problem encountered in interpreting the literature on learning disabilities is that researchers have tended to treat their subject population as though they all share a common problem (Cratty, 1974). A common approach has been to select children who have been identified as learning disabled by a school psychologist for research (Clarizio & Bernard, 1981; Koppitz, 1971; Paal, Hesterly, & Wepfer, 1979; Sattler & Ryan, 1981; Smith, 1978; Smith, Coleman, Dokecki, & Davis, 1977). In those cases where an effort has been made to differentiate among subgroups, the WISC/WISC-R Verbal Intelligence Quotient-Performance Intelligence Quotient discrepancy has been used for grouping the subjects (Clements & Peters, 1962; Paal, Hesterly, &

Wepfer, 1979; Rourke, Young, & Flewelling, 1971; Wells, 1970). Recent studies have indicated significant differences between the Verbal and Performance intelligence quotients are fairly common in normal students (Bortner, Hertzig, & Birch, 1972; Kaufman, 1976a; Vance & Singer, 1979), thus giving this comparison little diagnostic utility although it may be descriptively useful (Bernard, 1978; Veres, 1982).

The question of what happens to learning disabled children over the years has been explored in several longitudinal studies (Eaves & Crichton, 1975; Eaves, Kendall, & Crichton, 1974; Fox & Routh, 1983; Kaufman, 1981; Koppitz, 1971; Smith, 1978; Vance, Blixt, Ellis, & Debell, 1981; Werner & Smith, 1977; White, Alley, Deshler, Schumaker, Warner, & Clark, 1982; Levin, Zigmond, & Birch, 1983). These studies described the long-term effects in terms of academic achievement, emotional and social adjustment. All of the above indicate continuing problems in at least one of these areas.

One limitation of the Werner and Smith and the Eaves and Crichton studies is that they did not describe the continued problems in terms of standardized measures such as intelligence or achievement tests. Rather, they used reports of teachers, parents, and the students themselves.

The Koppitz study did report longitudinal data on the WISC and the WRAT. These data showed both gains and losses in Verbal IQ, Performance IQ, and Full Scale IQ with varying gains on the WRAT from age group to age group. Again, heterogeneous groups of learning disabled children were used, which may account for the inconsistent findings.

White, Alley, Deshler, Schumaker, Warner, and Clark (1982) compared a group of normal adults and learning disabled adults in terms of their adjustment on vocational, social, personal, community, medical, and educational variables. The learning disabled sample reported less satisfaction with their education, were less involved in social groups, and took more prescription medicine. The authors concluded that while the two groups were generally comparable, the lack of satisfaction of the LD sample needs further exploration.

Fox and Routh (1983) compared groups of normal readers and retarded readers in the first grade and again 3 years later. They found that children who lacked phonemic segmenting ability continued to exhibit significant difficulties in reading and were found to be dysphonetic spellers 3 years later. These subjects were compared on the Camp-Dolcort version of the Boder reading and spelling test.

Levin, Zigmond, and Birch (1983) followed up on 52 learning disabled students after 4 years. The greatest progress was made in the first year after identification as learning disabled. Mathematics showed much less growth than reading, as measured by the Peabody Individual Achievement Test.

Kaufman (1981) suggested that Verbal IQ scores may go down after time in learning disabled children. Smith (1978) retested a group of learning disabled children after 7 months on the WISC-R with the result of a four-point rise in Performance IQ while Verbal IQ remained unchanged. Vance, Blixt, Ellis, and Debell (1981) retested a group of children diagnosed as learning disabled and educable retarded after 2 years and reported that the Performance IQ went up two points and the Verbal IQ went down two points. These results indicate that no significant change was observed.

One point that the longitudinal studies have all agreed on is that children who are diagnosed as learning disabled appeared to have fairly persistent problems in academic areas, whether or not treatment is provided. In the Koppitz study, the children were assigned to learning disabled classrooms where they remained for 1 to 5 years. She found varying amounts of change, ranging from a few months to one grade level for those who remained in LD classrooms throughout the 5 years, recording 3 or 4 months gain for each year in the class. She suggested that the child's functioning at the time of admission has a direct bearing on how long the child will remain in special education. In the Werner and Smith study, the students did not receive any consistent form of treatment, although four-fifths had contact with at least one community agency. They reported that improvement was primarily related to early identification and continual emotional support to maintain self-esteem. Eaves and Crichton (1975) suggested that their population may represent a severely involved subject sample due to the procedure of selecting children who had been admitted to a diagnostic clinic, as compared to using a random selection procedure. Of the 39 subjects, half were placed in special education for a portion of their schooling, 11% received remedial help while being mainstreamed, 19% repeated a grade, and 21% were not receiving supportive services. The disabled readers in the Fox and Routh study were all held back 1 year, but no other mention is made of supportive services. Limitations associated with basic academic skills such as reading, coupled with poor ability to conceptualize, seem to lead to secondary problems in social and emotional areas (Koppitz, 1971; Werner & Smith, 1977). Once again, it is not clear what percentage or what subgroups of learning disabled children continued to have significant problems over time.

The present study was designed in two parts: Study I was designed to identify homogeneous groups of learning disabled children. Study II was designed to compare the subgroups identified in Study I: (1) to investigate whether particular combinations of skills and/or weaknesses change over time and (2) to determine whether profile analysis is useful for the prediction of future performance. The independent variable in the study was the combination of WISC-R Verbal IQ and Performance IQ scores and the Wide Range Achievement Test (WRAT) subtest scores. The dependent variables were changes in the WISC-R subtest and IQ scores and the WRAT subtest scores at the time of the 3-year reevaluation. A second independent variable was the presence or absence of the ACID profile with a dependent variable of the amount of change on the Reading Subtest of the WRAT. A third independent variable was the type of special education placement with a dependent variable of the severity of the ability-aptitude discrepancy.

Five research objectives of Study II were identified. The first objective of the research study was to determine if there are differences among homogeneous groups of learning disabled children on the amount of change observed over time on a standardized achievement test with each child serving as his own control.

A second objective was to determine if it is possible to predict the degree of change on the achievement subtests based on the initial pattern of WISC-R Verbal IQ-Performance IQ discrepancy and the initial WRAT subtest pattern. Identification of students who make minimal progress academically as compared to those who make significant progress was seen as an important first step in determining which students are at greater risk for continuing school failure.

A third objective was to determine if those students who exhibit the ACID profile differ in reading achievement over time as compared to those who do not exhibit the profile, regardless of the pattern analysis mentioned in the above objective. Again, the ability to predict which students are more likely to continue to be limited has implications for school programming. Two related questions are (1) whether the child who exhibits this pattern at the time of the initial evaluation continues to exhibit the same pattern at the time of later evaluations and (2) whether all four of these subtests are useful predictors of reading achievement. This knowledge would help educators to determine which learning disabled children have poor prognoses and are at the greatest risk for continued reading failure.

A fourth objective was to determine the stability of the learning disabled child's intelligence quotients. This was considered important as the IQ score is generally considered to be a measure of the child's basic ability against which one's level of achievement is compared in order to determine if a significant discrepancy exists. This information is used both to determine educational placement of learning disabled children and need for continuation in a special education program.

A fifth objective was to determine if the severity of the discrepancy between the child's ability and achievement was related to the type of classroom setting in which the child was placed. It seems logical that those children having the most severe discrepancy would be placed in a program with a greater amount of time spent in the special education placement than those with a less severe discrepancy; however, this has not been studied previously.

CHAPTER II

THEORY AND RESEARCH

This chapter focuses on the literature in the field of learning disabilities as it relates to the objectives of the present study. The chapter concludes with a critical summary of studies reviewed.

Review of the Research Literature

The review of the literature is divided into six sections. The first three sections focus on research on the major diagnostic strategies for identifying learning disabled children using the WISC and WISC-R as they relate to the objective of Study I. Those studies designed to investigate the presence of subtypes of learning disabled children are reviewed in the fourth section as they relate to the objective of Study I and the first two objectives of Study II. The last two sections are based on the third and fourth objectives of Study II. These studies were selected as they provide background and format for the present study.

Major Strategies Using the WISC-R for Diagnosis of Learning Disabilities

As has been described earlier, numerous studies have sought to clarify and specify the utility of the Wechsler Intelligence Scale for

Children (WISC) and the Wechsler Intelligence Scale for Children-Revised (WISC-R) for distinguishing normally achieving students from those with a learning disability. Three major strategies have been investigated for this purpose: (1) comparison of Verbal IQ and Performance IQ scores for the presence of a significant difference, (2) use of scatter analysis, and (3) profile analysis of the subtests.

Diagnostic Utility of the Verbal IQ-Performance IQ Discrepancy

The use of the Verbal IQ-Performance IQ discrepancy for diagnosing the presence of dysfunction has been popular since the publication of the WISC. The research in this area is confusing and contradictory. It has been commonly assumed that large differences are indicative of neurological dysfunction. Anderson, Kaufman, and Kaufman (1976) compared the average discrepancy found for a group of learning disabled children to that found for normal children. They reported that while differences were statistically significant, they were not meaningfully significant. The mean Verbal IQ-Performance IQ discrepancy for the learning disabled children was approximately three points greater than that of the normal children. Vance, Gaynor, and Coleman (1976) examined a group of 60 learning disabled children on the WISC-R. Analysis of the data using a test for differences between Verbal and Performance IQ scores was not significant. Vance et al. concluded that the Verbal-Performance IQ discrepancy is not useful as an index for the possible diagnosis of learning disabilities. Stevenson (1979) evaluated 55 children referred to a psychoeducational clinic. While she found a greater proportion of these children had significantly higher Verbal IQ scores than Performance, she noted that overall, more of the children had somewhat higher Performance IQ scores. She suggested that high Performance-low Verbal IQ scores are a valid clinical sign if one ignores the question of statistical significance. Paal, Hesterly, and Wepfer (1979) assessed 40 learning disabled children on the WISC-R, and their findings also supported the use of Verbal-Performance differences. Obviously, this continues to be a controversial question.

Diagnostic Utility of Subtest Scatter

Another theory holds that learning disabled children exhibit an unusual amount of scatter or irregular performance on the subtests of the WISC-R as compared to normal children (Clements, 1966). Kaufman (1976b) analyzed the test results of the 2,200 children used in the WISC-R standardization sample and found that the average difference between each child's highest and lowest scaled scores was seven points, with a standard deviation of two points. This indicated a much greater range of variability should be expected with all children than was previously thought.

Tabachnick (1979) compared a group of 105 learning disabled children with Kaufman's normative data. She found a greater amount of scatter for the learning disabled children in her sample. She reported that the range was comparable to Kaufman's data on the Verbal subtests as opposed to the range on the Performance subtests. Those subjects who were younger than 11 years old had greater scatter on the Verbal subtests than those 11 and older.

A similar study compared the scatter of 434 children referred to a reading clinic to the WISC-R standardization sample and replicated Kaufman's findings (Moore & Wielan, 1981). Tabachnick and Turbey (1981) reported that a comparison of 100 learning disabled children to Kaufman's data resulted in no significant differences. Ryckman (1981) suggested that while it is possible that greater scatter exists for learning disabled groups of children than normal groups, there is clearly considerable overlap. This suggests that the demonstration of greater scatter is of questionable value.

Search for a Characteristic WISC-R Profile

The third major approach to the diagnosis of learning disability has been the search for a characteristic WISC-R profile. Bannatyne (1971) regrouped the subtests into three factors labeled Conceptual, Spatial, and Sequencing. Using this method of reorganizing the subtests, he suggested that groups of learning disabled children score high on Spatial, lower on Conceptual, and lowest on Sequencing. He later revised this to four factors: Spatial, Verbal Conceptual, Sequencing, and Acquired Knowledge (1974). His theory about the order of factors was supported by Smith, Coleman, Dokecki, and Davis (1977b) in a study of 208 learning disabled children.

Vance and Singer (1979) attempted to replicate the Smith et al. study and found that 39% of their group met the Spatial>Conceptual> Sequential pattern. They reported that no unique or distinguishable pattern was evident and found that the use of WISC-R recategorization strategies is a weak method for diagnosis as there is such high individual variation within groups.

Thompson (1981) compared a sample of 64 learning disabled to 14 mentally retarded children and 51 children with psychological disorders. In his group, comparison of the learning disabled and mentally impaired children showed a pattern of Conceptual>Spatial>Sequential, while the children with psychological disorders showed the Spatial>Conceptual>Sequential pattern. Not only did this research fail to support Bannatyne's hypothesis of a unique profile for groups of learning disabled children, but in looking at the patterns for the individual children, Thompson found no significant difference in the frequency of this pattern among these three groups.

Law, Box, and Moracco (1980) also attempted to replicate the Smith study without success. They indicated that this may be due to the local nature of their sample and differences in the overall Verbal IQ-Performance IQ patterns exhibited by the subjects.

Clarizio and Bernard (1981) also attempted to determine if the three-factor grouping was present in the majority of learning disabled, and whether it was useful in discriminating them from other groups of handicapped and nonimpaired children. In a comparison of learning disabled, educable mentally impaired, emotionally impaired, otherwise impaired, and nonimpaired children, all of the groups with the exception of the educable mentally impaired children exhibited the Spatial>Conceptual>Sequencing pattern, again suggesting that Bannatyne's recategorization is not a valid procedure for diagnosis and placement. Again, these authors suggested that school-verified learning disabled children are too heterogeneous a group to expect one characteristic to be typical of all or even most of them.

Overall, it appears that the search for a characteristic profile has not been particularly successful in improving the process of diagnosis. While patterns and trends have been suggested, none have held up in terms of either describing individual children or discriminating learning disabled children from other handicapped populations or the nonhandicapped population. Several of these authors have suggested that while this type of approach may not provide valid discriminators for diagnostic purposes, it may be more useful in attempting to identify and describe homogeneous subgroups within the larger category of learning disabled (Clarizio & Bernard, 1981; Kaufman, 1981; Tabachnick, 1979; Ryckman, 1981).

Kaufman (1979) presented several conclusions in using group data such as above. First, the group data tell little about the specific individuals comprising the group, although they do provide us with information about the exceptionality in question. Second, group data can mask two or more subprofiles. Lutey (1977) identified three different subprofiles for reading disabled children based on her review of WISC studies. Kaufman also raised the point regarding significant scatter as mentioned earlier.

Subgroups of Learning Disabled Children

Subgroups Based on VIQ-PIQ Discrepancy

Several studies have identified subgroups of learning disabled children for a variety of purposes. Reed (1968) compared the reading achievement of 6-year-old children and 10-year-old children who were divided into three groups on the basis of Verbal-Performance IQ score discrepancies. Rank ordering for both age groups indicated that the high Verbal-low Performance groups achieved the highest reading score, while the Verbal-equal-to-Performance IQ group performed at the lowest level. The differences were not significant for the 6-year-old subjects. Doehring (1968) found similar results, as did Rourke (1976). These authors suggested that the variables which distinguish normal readers from retarded readers at younger ages are essentially the same as those which differentiate the two groups at later ages. Doehring indicated that visual motor skills may have relatively greater importance than verbal skills in learning to read at the younger ages.

Rourke and Telegedy (1971) divided 45 9-to-14-year-old boys into three groups on the basis of their WISC Verbal IQ-Performance IQ scores: high Performance-low Verbal, high Verbal-low Performance, and Verbal equal to Performance. The authors hypothesized that the Verbal IQ-Performance IQ discrepancies reflect the relative integrity of the cerebral hemispheres and sought to test this hypothesis by comparing their performance on a series of neuropsychological tests designed to test lateralization. They predicted that the high Performance-low Verbal group would perform at a higher level than the high Verbal-low

Performance group on psychomotor tests which involve complex visual-motor coordination regardless of the hand employed. This would be consistent with the view that these abilities are mediated by the right hemisphere. They also expected to see better left-hand performance by the high Performance-low Verbal group and the reverse for the high Verbal-low Performance group. The Verbal-equal-to-Performance group was expected to fall somewhere between the above two groups. The first hypothesis was supported. However, there was no significant difference between groups for right-hand or left-hand superiority. The authors concluded that these results suggest that groups of older children who exhibit varying Verbal IQ-Performance IQ discrepancies on the WISC also exhibit patterns of abilities and deficits which are consistent with theories on the relative specialization and intactness of the cerebral hemispheres. They also stated the Verbal IQ-Performance IQ relationship is likely to be more important for predicting reading disabilities than is general level of intelligence.

A similar study by Rourke, Young, and Flewelling (1971) identified three groups of learning disabled children in the same manner as the above study using 90 subjects. It was expected that the high Verbal-low Performance group would do better on those tests which involve verbal, language, and auditory-perceptual tests while the high Performance-low Verbal group would do better on those tasks involving visual perceptual skills. Again the Verbal-equal-to-Performance group was expected to perform at an intermediate level. These predictions were, in general, supported. These authors noted that an a posteriori comparison of the Reading, Spelling, and Arithmetic subtests of the WRAT indicated a striking difference between Reading and Spelling which were high and Arithmetic which was low for the high Verbal-low Performance group. These differences did not appear in the other two groups and suggest that the WRAT Arithmetic subtest involves something more than "verbal" ability. These results, in combination with the previous study described, further support the relationship of Verbal IQ-Performance IQ discrepancies to lateralization of cerebral functioning.

Rourke, Dietrich, and Young (1973) established three groups of learning disabled children in the same manner as above. In this study, the children were 5 to 8 years old, while in the above two studies, the children's ages ranged from 9 to 14 years old. This study was designed as a developmental extension of the above two studies and used the same measures as described above. A similar pattern as that demonstrated by the older group was observed on the verbal, auditory-perceptual, visual-perceptual, and problem-solving tasks. The performance on the motor and psychomotor tasks did not resemble that obtained for the older children. In comparison to the older group, there were few significant differences among groups in the present study. While the conclusion was made that these results do not support the view that Verbal-Performance discrepancies reflect the differential integrity of the cerebral hemispheres in younger children with learning disabilities, this study did suggest that patterns of strengths and weaknesses do persist through the two age groups. These results were in part attributed to a greater variability of performance of the younger children and the fact that other studies with similar student populations have found lower WISC reliability coefficients than do normal children.

Rie and Rie (1979) compared three groups of learning disabled children with average Full Scale IQ scores who were divided according to Verbal IQ-Performance IQ differences. The sample was composed of 56 6-to-10-year-old children. Reading deficits were assessed by computing grade equivalents and expected grade equivalents for each subject on the Iowa Test of Basic Skills. The groups were then compared using a two-way analysis of variance. The reading deficits were lowest for the high Verbal-low Performance group and greatest for the low Verbal-high Performance group. They found no differences based on age. These results were consistent with the findings of Rourke, Young, and Flewelling (1971) and suggested that general ability is not a factor in comparing these groups. This study also demonstrated that the disparity in Verbal-Performance patterns, as it affects reading skill, is observed in early to middle elementary-aged children as it is in older learning disabled students and randomly selected groups. Third, it suggested that even at early stages of reading in children with learning disabilities, disparity between Verbal IQ and Performance IQ, in favor of the Verbal IQ, is associated with a significantly less severe deficit than is a significant discrepancy in favor of the Performance IQ.

Subgroups Based on Profile Analysis

Using a different approach, Vance, Wallbrown, and Blaha (1978) used profile analysis in an effort to identify representative profiles on the WISC-R. The subject population was made up of 128 reading disabled children between 7 and 12 years of age, having Full Scale IQs greater than 85. They were able to identify five representative profiles. Fourteen percent of the population exhibited the distractibility profile which was characterized by low scores on Digit Span and Arithmetic, somewhat higher scores on Information, relatively high scores on Similarities, Comprehension and Block Design, with average scores on the other subtests. The perceptual organization profile was found in 15% of the subjects. This group had low scores on Comprehension and Picture Arrangement. The language disability-automatic group was low on Digit Span and Comprehension and somewhat higher on Similarities, Picture Completion, and Coding. This comprised 21% of the subjects. Language disability-pervasive was characterized by extremely low scores on Similarities, moderately low Arithmetic and Digit Span, low Information, and high scores on Mazes and Block Design. This pattern appeared in 9% of the cases. The fifth pattern, behavioral comprehension and coding, exhibited very low scores on Coding, Picture Arrangement, and Comprehension, low scores on Mazes and Information, and higher scores on Similarities, Picture Completion, and Object Assembly. This was seen in 16% of the population. Approximately one-fourth of the subjects did not fit any of the above profiles. These subjects ranged from having relatively flat profiles to having a significant amount of variation. As a result, these authors recommended that caution be used when diagnosing children. They suggested these profiles have greater utility for developing remedial programs than for identification purposes.

In a second study using 104 of the subjects from above, Wallbrown, Vance, and Blaha (1979) reanalyzed the data and found that 75% of the subjects had profiles which clearly fit into one of the above-described ability patterns. Fourteen percent seemed to split evenly between ability patterns or showed minimal similarity. The other 24 subjects of the first study were eliminated from this one as their profiles were flat or showed minimal dispersion. They again suggested that these profiles are primarily useful for developing remedial hypotheses.

One portion of Stevenson's 1979 study of 55 children referred for educational evaluation analyzed the subtest patterns on the WISC-R in an effort to delineate probable learning process correlates. This analysis was based on Witkin's Verbal Comprehension, Analytic Field Approach, and Attention-Concentration Factors (Witkin, Dyk, Faterson, Goodenough, & Karp, 1962). In comparing the three factors, only the Attention-Concentration factor was found to be significantly lower. A comparison was also made across grade levels, and again a significant decrease was noted on the Attention-Concentration factor with increasing age.

Tabachnick and Turbey (1981) selected a group of 95 children ranging in age from 6 years 6 months to 16 years 10 months who had been diagnosed as learning disabled on the basis of difficulty in school, performance on psychodiagnostic tests, and judgment of experienced psychodiagnosticians. On the basis of these data, each child was assigned to one of nine categories describing the area of primary disability. Later, however, it appeared that some of the categories were too rare to be useful while others were difficult to distinguish between. As a result, the categories were reduced to the following three categories: (1) a category combining visual-motor and visual-perceptual disability (Visual) containing 66 of the subjects; (2) a category combining auditory-perceptual and receptive language disability (Audlang) containing 18 of the subjects; and (3) Memory, containing 18 children who showed all types of sequential memory difficulties. These groups were compared on three variables: (1) subtest scatter, (2) Bannatyne scores, and (3) subtest profiles. Of the first two variables, only the total range of scaled scores and the Verbal IQ-Performance IQ discrepancy were found to be significant. Greatest scatter was found for the visual group and least for the auditory language group. Classification efforts resulted in only 50% correct classifications. A separate profile analysis of the 11 subtests revealed no evidence of significant differences among the three groups. They concluded that WISC-R subtest scatter is not of diagnostic value in the discrimination of subtypes of learning disabled children, nor can the form of the learning disability be determined with recategorization into Bannatyne groups. Profile analysis was also thought to lack utility in designing treatment programs.

Subgroups Based on WRAT Subtest Scores

Rourke and Finlayson (1978) divided 45 9-to-14-year-old children with learning disabilities into three groups on the basis of their patterns of reading, spelling, and arithmetic as measured by the WRAT. The WISC IQ range was 86 to 114. The primary question being studied was whether children who exhibit varying patterns of academic abilities would exhibit unique, meaningful, and consistent patterns of verbal and visual-spatial behaviors. A related hypothesis was that if the above theory was supported, these findings might also shed some light on the nature of the brain-related abilities that are necessary for performance on reading, spelling, and arithmetic. It was predicted that children who had poor arithmetic performance with adequate reading and spelling skills would be relatively deficient in visual perceptual and visual spatial abilities. The three groups were: (1) relatively deficient in reading, spelling, and arithmetic; (2) relatively deficient in reading and spelling as compared to arithmetic; and (3) relatively deficient in arithmetic as compared to reading and spelling. The last two groups were actually somewhat matched on arithmetic. These groups were compared on the subtests of the WISC and several other neuropsychological tests designed to measure either verbal and auditory perceptual functioning or visual spatial and visual perceptual functioning. These hypotheses were supported. Groups 1 and 2 performed in a manner similar to that expected for groups of older children who exhibit a low Verbal-high Performance IQ pattern on the WISC, while Group 3 was comparable to those who exhibit a high

Verbal-low Performance pattern. Rourke and Finlayson emphasized that the differential patterns chosen for examination were far more salient with respect to the prediction of patterns of performance than were the levels of performance on the control variables. Again the finding that the younger group performed in a manner similar to the older group suggests a persistence of the pattern of strengths and weaknesses over time.

Rourke and Strang (1978) carried out a similar study in which 45 learning disabled children were divided into three groups in the same manner as above. However, this study proposed to examine inferences regarding differential hemispheric integrity by evaluating the patterns of performance on motor, psychomotor, and tactile-perceptual tasks for the three groups. This was considered important, as in the previous study, the two groups who had been equated for deficient arithmetic performance exhibited quite different performances on verbal and visual-spatial tasks although their levels of performance were quite similar. The conclusion was drawn that Group 3 displayed a marked deficiency relative to Groups 1 and 2 on some psychomotor and tactile perceptual skills. The authors also suggested that children with low arithmetic difficulty and high reading and spelling skills are probably not identified at as early an age as children with other types of learning disabilities. The relatively stronger reading and spelling abilities were thought to mask the arithmetic weakness. Also, a specific arithmetic impairment is often not attributed to brain-related deficiencies in the same manner as reading and spelling problems and is expected to improve with time rather than remediation.

Nolan, Hammeke, and Barkley (1983) attempted to determine whether subtypes of learning disabled children would exhibit unique neuropsychological profiles on the Luria-Nebraska Neuropsychological Battery as have been found in previous studies using other neuropsychological measures. Their 36 subjects ranged from 7 to 13 years old and had Full Scale WISC-R IQs of at least 80. Three groups of 12 subjects each were formed: a normal control group whose WRAT Reading, Spelling, and Arithmetic scores were $\geq$ the 40th percentile; a reading/spelling disabled group whose Reading and Spelling scores were $\leq$ the 20th percentile and Arithmetic score was $\geq$ the 40th percentile; and a math disabled group whose Arithmetic scores were $\leq$ the 20th percentile and Reading and Spelling were $\geq$ the 40th percentile. The study found only partial support for previous research. No Verbal IQ-Performance IQ discrepancies were found, nor was the math disabled group different from the normals when equated for IQ level and age. The reading/spelling disabled group was comparable to previous studies measuring impairments in linguistic functioning.

Subgroups Based on Multivariate Classification

Petrauskas and Rourke (1979) attempted to identify and describe subtypes of reading disabled children in terms of differential patterns of performance on a battery of neuropsychological measures including the WISC, using a multivariate classification procedure. Data from

160 subjects between the ages of 7 years 2 months and 8 years 11 months were collected. One hundred thirty-three were reading disabled, and 27 were normal readers. Using a Q factor analysis, this resulted in the identification of three subtypes of retarded readers. Type 1 contained the largest number of subjects (40). The characteristics considered significant here were clear evidence of disturbance in auditory-verbal memory and auditory-perceptual skills. They showed the greatest Verbal IQ-Performance IQ discrepancy in favor of Performance, and their WRAT Reading and Spelling scores were somewhat poorer than was their Arithmetic score. Type 2 contained 26 subjects and was characterized by minimal difference between Verbal and Performance IQ scores on the WISC; lowest subtest scores on Information, Arithmetic, Digit Span, and Coding; and uniformly poor performance on all three of the WRAT subtests. Type 3 contained 13 subjects who appeared to have a predominant deficit in conceptual flexibility, especially as it relates to linguistic coding. This group had a lower Verbal IQ than Performance IQ. They also were lowest on Arithmetic, Coding, Information, and Digit Span. WRAT performance was not reported for this group. Type 4 identified eight normal readers and was not produced reliably. Type 5 also had a lower reliability than the first two. This group was similar to Type 2 with the exception of the WRAT subtests. Reading and Spelling were lower than Arithmetic for these children. The authors stated that this study demonstrates that retarded readers are not a homogeneous group, and the profiles of these three groups suggest that these subjects had significant deficits in skills which have been

suggested by previous researchers to be "responsible" for reading retardation. They also suggested that this knowledge is important for developing remedial programs which fit the student rather than vice versa.

Fisk and Rourke (1979) used the Q factor analysis in an effort to identify subtypes of learning disabled children rather than strictly reading disabled. This study had 264 subjects between the ages of 9 and 14.9 years with Full Scale IQs between 86 and 114, and obtained centile scores < 30 on all three of the WRAT subtests. The subjects were divided into three age ranges (9-10 years, 11-12 years, 13-14 years) to determine (1) if subtypes would be observed at different age levels and (2) if some of the subtypes would be more evident at one age level than another. Subtype A was not described in terms of the WISC or the WRAT. This group was the strongest of the three subtypes on auditory-verbal and language-related tasks.

Subtype B exhibited poor auditory-verbal processing and psycholinguistic skills. This group had the largest Verbal IQ-Performance IQ discrepancy, and it was in favor of the Performance IQ. Type C appeared to be a subgroup of Type A and was distinguished by an unusually poor performance on fingertip number writing. Again, WISC and WRAT performance was not reported. This subtype did not emerge in the 9-to-10-year-old sample. Some general observations of this entire sample were reported. WISC Information, Arithmetic, and Digit Span were below average, while Coding was within one standard deviation of the mean, suggesting an AID pattern rather than an ACID pattern.

Picture Arrangement, Object Assembly, and Block Design were average to above average. No comments were made about patterns of performance on the subtests of the WRAT. They concluded that further research is needed in the area of longitudinal tracking of children of the various subtypes in order to determine if the data here actually do represent developmental trends. This, again, is expected to make it possible to evaluate specific approaches to academic remediation for learning disabled in a more reliable manner.

Lyon, Stewart, and Freedman (1982) identified five subgroups of learning disabled readers using multivariate analysis of variance and discriminant analysis on 10 neuropsychological measures. The subjects in this study were between 6 years 5 months and 9 years 9 months of age. The 75 learning disabled readers had a mean WISC-R Full Scale IQ score of 102.9, and the 42 normal readers had a mean Full Scale IQ score of 105.3. Of the 75 learning disabled readers, 11 could not be located consistently in any subgroup, so their scores were excluded from further analyses. The findings supported Fisk and Rourke's (1979) finding that similar subgroups can be found over a range of developmental levels.

Use of the ACID Profile as a Predictor of School Performance

A frequent finding in the WISC-R literature is that the Information, Arithmetic, Digit Span, and Coding scores are often relatively low (Ackerman, Dykman, & Peters, 1976; McManis, Figley, Richert, & Fabre, 1978; Robeck, 1971; Rugel, 1974). Kaufman (1981)

Table 2.1

Table 2.1.--Summary of studies investigating subtypes of learning disabled children.

	Subjects	N	Age	WISC: $\bar{X}$ FSIQ SD	FSIQ Range	1965 WRAT: R SD	A SD	S SD
Rourke & Telegedy (1971)	L.D.	49	9-14	HP-LV 98.9 (8.3) V = P 99.9 (10.6) HV-LP 97.0 (10.6)	85-115	N.R.[a]	N.R.	N.R.
Rourke, Young, & Flewelling (1971)	L.D.	90	9-14	HP-LV 96.3 (8.1) V=P 96.3 (10.1) HV-LP 94.3 (10.4)	79-119	17.3 (17.5)[b] 33.4 (28.3) 50.5 (32.3)	12.7 (13.1) 20.0 (20.4) 44.8 (32.9)	17.2 (11.6) 21.3 (15.8) 28.1 (21.6)
Rourke, Dietrich, & Young (1973)	L.D.	82	5-8	N.R.	79-120	N.R.	N.R.	N.R.
Vance, Wallbrown, & Blaha (1978)	R.D.	128	7-12	101.2 (12.6)	86-131	N.R.	N.R.	N.R.
Stevenson (1979)	L.D.	55	5y10m-17y3m	96.89[c] (N.R.)	78-116	N.R.	N.R.	N.R.
Rie & Rie (1979)	L.D.	56	6-10	HP-LV 99.3 (6.67) V = P 99.3 (9.29) HV-LP 94.8 (10.96)	80-116	N.R.	N.R.	N.R.
Tabachnik & Turbey (1981)	L.D.	95	6y6m-16y5m	101.0[c] (N.R.)	75-135	N.R.	N.R.	N.R.
Rourke, Yanni, MacDonald, & Young (1973)	L.D.	46	10-14	(1) 91.9 (9.4) (2) 91.2 (11.3) (3) 87.4 (9.2) (4) 90.3 (9.1)	80-120	29.1 (28.4) 44.9 (32.9) 15.1 (13.6) 25.6 (23.5)	17.1 (16.4) 32.3 (26.1) 9.0 (8.8) 19.7 (16.9)	12.2 (10.8) 19.3 (13.2) 11.1 (9.0) 16.5 (13.0)
Rourke & Finlayson (1978)	L.D.	45	9-14	(1) 97.73(7.52) (2) 99.20(7.31) (3) 95.00(5.74)	86-114	3.22(1.18) 2.34(.42) 8.47(1.90)	3.45(1.01)[d] 4.86(.70) 4.25(1.08)	2.97(1.05) 2.51(.39) 7.74(1.92)
Rourke & Strang (1978)	L.D.	45	9-14	N.R.	86-114	N.R.	N.R.	N.R.
Petrauskas & Rourke (1979)	R.D.	133	7y-8y11m	96.92(8.89)	80-120	13.24(6.18)	N.R.	N.R.
Fisk & Rourke (1979)	L.D.	264	9.0-14.9	Age 9-10 96.18(5.72) Age 11-12 96.37(7.56) Age 13-14 94.98(7.51)	86-114	12.30(7.05) 11.04(8.65) 10.89(8.80)	9.71(5.95) 7.02(5.56) 6.25(6.01)	16.61(6.59) 11.90(7.28) 10.45(7.26)
Nolan, Hammeke, & Barkley (1983)	L.D.	36	7-13	Normal 119.75(10.12)[c] Reading/Spelling 104.67(12.48) Math 106.92(13.19)	>80	76.25(10.84) 10.58(5.26) 61.25(12.32)	58.50(11.65) 50.17(8.05) 14.25(4.16)	71.75(11.82) 11.25(6.99) 54.00(10.91)
Lyon, Stewart, & Freedman (1982)	R.D.	75	6y5m-9y9m	102.90(12.60)	N.A.	N.A.	N.A.	N.A.

[a]N.R. = Not reported.
[b]Percentile scores.
[c]Based on WISC-R.
[d]Grade equivalency scores.

noted that the factor he referred to as Fredom from Distractibility makes up three-fourths of the ACID profile. He did not find, in his factor analysis of the standardization data, that Information loaded with the other tests in the factor. In Huelsman's 1970 review of the WISC research on characteristic profiles, he found that 100% reported low Arithmetic, 95% reported low Coding, 80% reported low Information, and 60% reported low Digit Span, providing some support for this factor.

Partial ACID Profile Research Findings

Cullen, Boersma, and Chapman (1981) compared a group of learning disabled children to a group of normal children to (a) ascertain the utility of perceptual motor, verbal cognitive, and affective variables for discriminating between the two groups of "average" ability children and (b) to elaborate on the possible influence of affective variables on school learning for the two groups. They found that WISC-R Performance IQs were not significantly different for the two groups, but Verbal IQs were. The differences were largely due to lower learning disabled scores on the Information, Arithmetic, and Digit Span subtests. Coding was also lower, but not significantly. Wide Range Achievement Test (WRAT) scores were also lower on the three subtests, as were Student's Perception of Ability subtest scores. The Beery Test of Visual Motor Integration did not differ between the groups. These authors concluded that remedial procedures should focus on verbal-cognitive and affective dimensions of learning.

Vance, Gaynor, and Coleman (1976) analyzed the WISC-R subtest scores of 58 learning disabled children. Their data indicated that low subtest scores on Arithmetic, Coding, and Information were characteristic of this group. Bernard (1978) in a profile analysis of 197 school-verified learning disabled students also found the Arithmetic, Coding, Information pattern to distinguish the learning disabled students from the nonimpaired students.

Tabachnick (1979) suggested that low Coding may be significant but did not find the other three tests to be consistently low. Fisk and Rourke (1979) reported that an Arithmetic, Information, Digit Span pattern may be more commonly observed than the ACID pattern.

Huelsman (1970) and Ackerman, Dykman, and Peters (1976) both indicated that this profile is not representative of all children who exhibit learning disabilities, but if one or more of these tests is significantly depressed, the child is almost certain to have difficulty in the classroom.

Stability of WISC and WISC-R Scores for the Learning Disabled Population

Koppitz (1971) studied a group of 177 learning disabled public school children for 5 years. The children ranged in age from 6 to 12 years, and Full Scale IQ scores on the WISC ranged from below 79 to above 120. Of this sample, 42 returned to regular classes during the five years; 26 were referred for hospitalization; 38 either withdrew, transferred, or moved away; and 71 remained in the learning disabled program for the 5-year period. It appeared that a larger proportion of the younger children (6-8) and the oldest children (11-12) had dull normal or borderline intelligence at the beginning of the study. Koppitz concluded that the younger students often required long-term special education, and a minimal Full Scale IQ score of 85 at the time of diagnosis is needed if the child is to return to regular classes. The initial mean IQ was 98 for those children who eventually returned to regular classes, while mean IQ was 87 for those who remained in the LD program. Reading achievement as measured by the Wide Range Achievement Test was higher initially for the group who returned to regular education as well. The group who returned to regular classes spent an average of 3 years in special education.

It was found that the length of a pupil's stay in the learning disabled program before returning to regular education was related to his level of functioning but not to his age when entering the program. Those children who returned after 1 to 2 years were significantly brighter and had higher achievement on the WRAT Reading, Spelling, and Arithmetic subtests.

When comparing those who were in special education for 1 to 3 years to those who were in for 4 to 5 years before returning to regular education, Koppitz found stable IQ scores for both groups. Academic progress, however, showed an inverse relationship to the amount of time spent in special education. The children who remained for shorter times showed greater annual gains on the WRAT. The children who spent 1 year in the program gained 1.7 grade levels on the Reading subtest and 1.0 grade levels on the Spelling and Arithmetic subtests. The group who spent 2 years in the program made almost the same progress but over the 2-year period. The average yearly progress for the children who remained in the learning disabled program for 1 year was one grade level; for children who remained for 2 to 3 years, the gain was three-fourths of a year per school year; and for those who remained 4 to 5 years, the gain was one-half to one-third of a grade level per year. It was noted that the greatest average gain occurred in the first year and decreased with each year spent in special education from there on.

Full Scale, Verbal, and Performance IQ scores for the 71 children who remained in the learning disabled program throughout the study were quite stable. The initial means were: Verbal IQ--87, Performance IQ--89, and Full Scale IQ--87; five years later they were 87, 87, and 81, respectively. On the WRAT it appeared that the students fell behind 1 year over the 5-year period. The average gain for the group was 1.7 grade levels in Reading, 1.4 grade levels in Spelling, and 1.9 grade levels in Arithmetic.

In terms of age groups, the children in the 8-to-10-year-old range made the greatest gains. When the data were reanalyzed for each age group (6, 7, 8, 9,10, 11, and 12), it appeared that age was not related to the gains made. As a result, the children were redivided into groups on the basis of other characteristics.

Eighteen children were classified as dull and at the end of the study were established as moderately retarded. This group had an average Full Scale IQ of 77 initially and 72 after 5 years. They gained an average of 1.3 years on the WRAT subtests.

Nine children were described as dull children with good memory. Their average Full Scale IQ scores went from 81 to 80, and they showed a 3.6-year gain on the WRAT Reading and 2.2- and 2.5-year gains on the Spelling and Arithmetic. This was attributed to their strength in visual recognition and recall and lack of reasoning skills.

The third group was made up of 21 children having specific learning disabilities. Koppitz described them as experiencing "serious perceptual malfunction and severe memory deficits." Mean Full Scale IQ went from 91 to 90, and the group gained 1.0 grade levels in Reading and Spelling and 1.8 in Arithmetic. This group was described as quite heterogeneous in the types of difficulties exhibited.

The last group, emotional and behavior problems, was composed of 23 students. This group gained 2 points in mean IQ (94 to 96) and 2.4 grade levels in Reading, 2.1 in Spelling, and 2.2 in Arithmetic. The range of IQ scores was broader for this group, and again the problems observed were heterogeneous. When comparing changes in IQ scores for individual students, Koppitz reported that those children who showed the greatest gains were not fully cooperative at the time of the initial evaluation, so the results were not accurate. The children who exhibited a decrease were thought to have reached a plateau in mental development.

Koppitz concluded that children who can learn to read will learn to read even without motivation, but arithmetic requires more application and integration of skills, so children will not learn math without outside help. A second conclusion was that once a child was working up to ability, it was not possible to speed up the child's natural rate of progress through special strategies. Finally, she stated that repeating a grade is rarely helpful, as the learning disabled child requires a slower pace of learning and greater individual help than can be provided in a regular classroom.

Smith (1978) tested and retested a group of 161 learning disabled children from Nashville over a 7-month period. He reported that the mean Performance IQ was significantly higher than the Verbal IQ at both testings. Verbal IQ remained the same while Performance IQ rose by 4 points. This finding was statistically significant but was attributed, in part, to a practice effect. All of the Performance subtest scores rose, while the mean Vocabulary score decreased.

Vance, Blixt, Ellis, and Debell (1981) retested a sample of 75 learning disabled and educable mentally retarded children, ranging in age from 8 to 14 years, after 2 years. No significant differences were found in any of the three IQ scores.

Byrd, Buckhalt, and Byrd (1981) reviewed the WISC-R profiles of 385 children referred for academic difficulties and compared these on the basis of age. A decrease with age in the Acquired Knowledge factor was found for both the low-IQ and high-IQ groups, which was more marked for the low-IQ group. The subtests composing the Spatial Ability factor (Picture Completion, Block Design, and Object Assembly) were relatively high for the high-IQ group and showed little change with age, while the rankings were lower for the low-IQ group and showed a positive change with age. The older children did better on the speeded tests than the younger, with the exception of Coding which became lower. While the Coding decrease was inconsistent with the findings for the other speeded tests, it was consistent with previous findings of relative impairment in Coding performance by learning disabled children (Kaufman, 1979). The correlation between the subtest ranking of the youngest and oldest groups did not reach significance, but significant agreement was found for the 9-to-12-year-old group and the 13-to-16-year-old group regardless of high IQ or low IQ. These authors concluded that profile analysis must take age into account as the patterns may vary considerably within groups according to age.

Frauenheim and Heckerl (1984) completed a follow-up study on 11 males who had been identified as dyslexic in childhood. The mean age at diagnosis was 10 years 6 months and at follow up was 27 years. All of the subjects received special reading help in addition to regular education programming. The subjects were tested on the WISC at the time of the initial evaluation and the WAIS-R at the time of the present study. The IQ scores were remarkably stable given the time interval and the different forms of the test, with the largest change being a 2-point decrease on the Performance IQ. The range of IQ scores was also quite comparable.

Critical Summary of Previous Research and Implications for the Present Study

Many limitations exist in the above literature. The method used to determine expected grade level in the Rourke studies was based on the chronological age of the subjects and did not take intellectual ability into consideration. The method was not reported in the studies but was explained in correspondence with Dr. Rourke. This method assumes that all children at a particular age will be at the same level, although this is contradictory to common knowledge. Also, none of the studies listed in Table 2.1 indicated what method of determining expected achievement was used, nor did they report on the reliability of the ability-achievement discrepancy used.

Another problem is that the research does not quantify the severity of the learning disability, making it difficult to compare studies. The reader often must guess at the severity by the setting from which the subjects are drawn. The most common are public schools, private schools, or psychoeducational clinics.

The majority of the studies identifying subtypes of learning disabled children used the WISC rather than the more recently published WISC-R (Fisk & Rourke, 1979; Petrauskas & Rourke, 1979; Rourke, 1976; Rourke & Telegedy, 1971; Rourke, Young, & Flewelling, 1971; Rourke, Dietrich, & Young, 1973; Rourke & Finlayson, 1978; Rourke & Strang, 1978). As a result, the findings may not be generalizable to current diagnostic practices.

Only one of the longitudinal studies used the WISC and the WRAT as measures of the change over time of the subjects (Koppitz, 1971). The group was fairly heterogeneous with a number of children who were later determined to have disorders other than a specific learning disability. This study also compared groups rather than individuals and is somewhat dated. The other longitudinal studies described either employed a less commonly used test (Fox & Routh, 1983) or followed up using interviews rather than standardized testing (Werner & Smith, 1977; White, Alley, Deshler, Schumaker, Warner, & Clark, 1982). As a result, the outcomes were more descriptive of vocational, social, and emotional factors than academic or intellectual factors.

The majority of the research compared groups of children, rather than individuals, which may mask patterns more unique to individual children. While this information is helpful in describing the population, it cannot be used for the description of a specific child.

A fifth limitation is the emphasis on discovering the cause of the disability. This information is useful in identifying high-risk children, but little is known about the academic prognosis for individual children who are diagnosed as specifically learning disabled. Having identified these problems, the paper will now focus on the methodology including how these problems were controlled or reduced in this study.

CHAPTER III

METHOD

Rationale

Study I was designed to determine if subgroups of learning disabled children could be identified on the basis of the WISC-R and the WRAT. One goal of this study was to investigate whether there are differences between subgroups of learning disabled children relative to their general cognitive ability and academic achievement at the time of repeat evaluations. An effort was made to use methods for the identification of such differences which were similar to current diagnostic practices in the schools.

Methodological departures from the previous research studies were made. First, the subjects were identified on the basis of their performance on both the WISC-R and the WRAT, rather than their performance on one or the other. This approach is more consistent with the methods commonly employed for determining eligibility for special education services. Previous research has used one or the other test for identifying subgroups in conjunction with other less commonly used tests, such as the Halstead-Reitan Neuropsychological Test Battery. A second difference is that the majority of the earlier studies in this area selected subjects who were originally diagnosed on the basis of their performance on a neuropsychological test battery. It is unlikely that these tests will become the basis for diagnosis in the schools, so this study again attempted to use a process which is more applicable to the manner in which school psychologists actually operate.

The first goal of Study II was to determine if any of the subgroups showed greater improvement or deterioration in achievement test performance over time than others. This question was considered important for long-term special education programming. This study differs methodologically from previous studies in that each subject was compared to himself in addition to comparing group means. This change allowed the analysis of patterns of change within groups as well as across groups.

Previous studies have reported that students exhibiting lower scores on the Arithmetic, Coding, Information, and Digit Span subtests are likely to demonstrate difficulty in school. Rourke (1981) suggested that this profile may distinguish learning disabled readers who improve from those who continue to exhibit a severe reading problem. This study attempted to answer Rourke's question with respect to performance on the Reading subtest on the WRAT.

This study assessed changes in Verbal, Performance, and Full Scale IQ scores over time. It is presently unclear whether the performance of individual learning disabled children on intelligence tests remains stable or if this fluctuates over time. This question has a strong bearing on the recertification process for special education services and potential placement changes. Again, each child was compared to himself for a measure of individual change.

Finally, this study addressed the question of how the severity of the discrepancy relates to the type of educational placement. While it previously seemed logical to place learning disabled children into different types of educational settings according to ability-achievement discrepancy, there is no empirical evidence that it is actually the case.

Hypotheses and Research Questions

	WRAT		
WISC-R	Reading and Spelling > Arithmetic +15	Reading and Spelling +15 < Arithmetic	Reading = Arithmetic = Spelling
Verbal IQ > Performance IQ +9	A	B	C
Verbal IQ Within 10 Points of Performance IQ	D	E	F
Verbal IQ +9 < Performance IQ	G	H	I

Figure 3.1.--Subgrouping of learning disabled children.

The following research hypotheses were tested in Study I:

1. Homogeneous subgroups of learning disabled children can be identified utilizing a combination of the WISC-R VIQ-PIQ discrepancy and WRAT Reading, Arithmetic, and Spelling subtest patterns.

2. The subgroups will not differ significantly on the WISC-R FSIQ scores at the time of the initial evaluation.

The following research hypotheses were tested in Study II:

Hypothesis 1 deals with the first objective of Study II, namely, to determine if differences exist among homogeneous groups of learning disabled students on the amount of change observed over time on standardized tests.

1. Significant differences will be found among the subgroups of learning disabled children on the measured change in the subtest scores of the WISC-R and the WRAT at the time of re-evaluation.

Hypotheses 2 through 5 deal with the second objective of Study II, namely, is it possible to predict the degree of change on the WRAT subtests based on the initial pattern of WISC-R Verbal IQ-Performance IQ discrepancy and the initial WRAT subtest pattern.

2. The children in cells A, B, and C will show greater improvement on the WRAT Reading and Spelling subtests at the time of re-evaluation than the children in cells D through I.

3. The children in cell D will show less improvement on the Reading and Spelling subtests than those in A, B, and C but greater improvement than the children in cells E through I.

4. The children in cell H will show greater improvement at the time of re-evaluation on the WRAT Arithmetic subtest than the children in the other eight groups.

5. The children in cell F will show less improvement on the WRAT subtests than the children in the other cells.

Hypothesis 6 deals with the third objective, namely, to determine if those children who exhibit the ACID profile differ in reading achievement over time as compared to those who do not, regardless of the subgroups.

6. Those children having Arithmetic, Coding, Information, and Digit Span as their lowest WISC-R subtest scores will show significantly less improvement on the WRAT Reading subtest at the time of re-evaluation than those children not exhibiting this pattern.

Hypotheses 7 through 9 deal with the fourth objective of the study, namely, to determine the stability of the learning disabled child's intelligence quotients.

7. Verbal intelligence scores will show a significant decrease at the time of re-evaluation.

8. Performance IQ will not show a significant change at the time of re-evaluation.

9. Full Scale intelligence scores will show a significant decrease at the time of re-evaluation.

Hypothesis 10 deals with the fifth objective of Study II, namely, to determine if the severity of the achievement-ability discrepancy is related to the type of special education classroom placement.

10. The severity of the discrepancy between ability and achievement is not related in a consistent manner to the type of educational placement.

Definitions

Specific learning disability. The Michigan Rule defines specific learning disability as follows:

> Rule 13. (1) "Specific learning disability" means a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations. The term includes such conditions as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia and developmental aphasia. The term does not include children who have learning problems which are primarily the result of visual, hearing, or motor handicaps, of mental retardation, of emotional disturbance, or of environmental, cultural, or economic disadvantage.

(2) The individualized educational planning committee may determine that a child has a specific learning disability if the child does not achieve commensurate with his or her age and ability levels in one or more of the areas listed in this subrule, when provided with learning experiences appropriate for the child's age and ability levels, and if the multidisciplinary evaluation team finds that a child has a severe discrepancy between achievement and intellectual ability in one or more of the following areas:
(a) Oral expression.
(b) Listening comprehension.
(c) Written expression.
(d) Basic reading skill.
(e) Reading comprehension.
(f) Mathematics calculation.
(g) Mathematics reasoning.

(3) The individualized educational planning committee may not identify a child as having a specific learning disability if the severe discrepancy between ability and achievement is primarily the result of any of the following:
(a) A visual, hearing or motor handicap.
(b) Mental retardation.
(c) Emotional disturbance.
(d) Environmental, cultural, or economic disadvantage.

Expected achievement. The expected achievement will be stated in the form of a *z* score rather than a grade equivalency score in order to provide comparability to the measured achievement. The expected achievement will be computed using the formula

$$Z_x = \frac{(X_i - \bar{X})}{\sigma_x}$$

where X_i is the WISC-R Full Scale IQ score.

Measured achievement. The measured achievement will be stated as a *z* score. The score will be computed for each WRAT subtest using the formula

$$Z_y = \frac{(Y_i - \bar{Y})}{\sigma_y}$$

where Y_i is the WRAT subtest score.

Significant discrepancy. The discrepancy or difference score will be computed using the following formula:

$$Z_D = \frac{|Z_x - Z_y|}{\sqrt{(1-r_{xx}) + (1-r_{yy})}}$$

Since the reliabilities of the WISC-R and the WRAT subtests fall between .90 and .95, a minimum difference of .66 standard deviations between the two scores is necessary to be certain that a significant discrepancy exists (Reynolds, 1981).

Subjects

The learning disabled population included all children referred to the Holton, Holland, Lowell, and Ottawa Area Intermediate School Districts between 1974 and 1981 who were subsequently diagnosed as having a specific learning disability as described by Michigan Public Act 451, Rule 13. This diagnosis was based on the findings of the multidisciplinary evaluation team of the above school districts with the psychological testing having been administered by an approved school psychologist. One hundred ninety-six children who met the following subject criteria were identified out of the above population:

1. Ages at initial evaluation ranging from 7 years 6 months to 13 years 6 months.

2. Initial diagnosis using the WISC-R and WRAT.

3. Re-evaluation on the WISC-R and WRAT 2 to 4 years later.

4. Full Scale IQ scores falling between 70 and 115, as children who fall outside of the "normal" range may differ markedly for reasons other than a specific learning disability, and this investigation is

meant to apply to average children rather than those who are being considered for special education placement for either giftedness or retardation.

5. English as a primary language.

6. No primary diagnosis of emotional impairment and/or the subject had not been referred to a psychiatrist for evaluation.

7. Regular school attendance since the beginning of kindergarten.

8. No physical deficits in the areas of vision or hearing.

The subjects were divided into three groups on the basis of their performance on the initial administration of the WISC-R as follows:

1. Verbal IQ score and Performance IQ score within 10 points of each other.

2. Verbal IQ score at least 10 points higher than the Performance IQ score.

3. Performance IQ score at least 10 points higher than the Verbal IQ score.

These differences were selected in order to be able to make comparisons to the subgroups identified in earlier studies by Rourke and others even though differences of at least 10 points are not considered diagnostically significant.

Each of these groups was further divided into three subgroups based on their performance on the initial administration of the WRAT as follows:

1. Reading, Spelling, and Arithmetic standard scores at least 1 standard deviation below the expected grade placement.

2. Reading and Spelling standard scores at least 12 points below Arithmetic.

3. Arithmetic standard score below Reading and Spelling by at least 12 points.

Again, the differences were selected in order to make comparisons to the subgroups identified in earlier studies.

The subjects included 161 males and 35 females. The higher proportion of males (82%) is consistent with the research on sex-related differences in diagnosis of learning disability, which indicates that in almost any sample of learning disabled children, 80 percent are likely to be male (Farnham-Diggory, 1978).

Instruments

Two standardized assessment instruments were used to evaluate the change in the students in the study.

The Wechsler Intelligence Scale for Children-Revised

The Wechsler Intelligence Scale for Children-Revised (WISC-R) was administered to all children in the study. The WISC-R was designed to evaluate general intellectual ability as well as specific strengths and weaknesses in verbal and visuoperceptual performance in children through the ages of 6 years 0 months to 16 years 11 months.

The standardization of the WISC-R was based on a national sample stratified on the variables of age, sex, race, geographic region, and occupation of the head of the household. The total sample comprised 2,200 cases (Wechsler, 1974, p. 17). The average split-half reliability coefficient is r = .94 for Verbal IQ, r = .90 for Performance IQ, and r = .96 for Full Scale IQ (corrected by the Spearman-Brown formula and computed using Fisher's z transformation). The average corrected stability coefficient of the Verbal IQ score is r_{12} = .92 (computed using Fisher's z transformation). The test and retest were given 3 to 5 weeks apart. Reliability of the information subtest ranged from r = .80 at age 7.5 to .90 at age 15. Coding ranged from .63 at 7.5 years to .80 at 15.5 years, with an average reliability score of .72. Arithmetic's lowest reliability score falls at age 8.5, with an r = .69, and the highest reliability of r = .81 is obtained at ages 11.5 and 13.5. On Digit Span, the reliabilities ranged from r = .71 at age 10.5 to .84 at age 7.5. Reliability coefficients were not available for all ages on the Coding and Digit Span subtests. The reliabilities reported above were clearly acceptable for the purposes of the research.

A group of 303 children from six age groups in the WISC-R standardization sample were retested after a 1-month interval to assess the stability of the WISC-R. The Full Scale IQ score changed about 7 IQ points, the Verbal IQ 4 IQ points, and the Performance IQ about 10 IQ points. All changes were increases. These results suggest a definite practice effect, especially on the Performance Scale. Stability coefficients were .95 for FSIQ, .93 for VIQ, and .90 for PIQ (Wechsler, 1974).

One hundred eighteen children in four age groups participated in the study of the validity of the WISC-R. Each child was administered the Stanford-Binet Intelligence Scale Form L-M (SBIS, L-M) within 9.5 months of the WISC-R. The average correlation between the SBIS, L-M and the Verbal IQ was .71, Performance IQ was .60, and the Full Scale IQ was .73.

The Wide Range Achievement Test

The second standardization research instrument selected for the study was the Wide Range Achievement Test (WRAT) (Jastak & Jastak, 1976). This test was designed to assess reading, spelling, and arithmetic performance.

There are two levels of this test: Level 1 for students younger than 12, and Level 2 for those 12 and over. Each level was standardized on at least 150 males and 150 females at each of 19 age levels, resulting in a population of 5,868 persons at Level 1 and 5,933 at Level 2. Norms were not stratified on the basis of any specific criterion.

Split-half reliability coefficients are reported for each subtest by grade level. All exceed .90 (Jastak & Jastak, 1978). Validity data are not reported; however, content validity is assumed (Salvia & Ysseldyke, 1978). A revision of this test was published in 1978. Breen and Prasse (1982) compared the 1976 and 1978 forms and reported that they were equivalent if standard scores were used for the comparison.

Procedures

The directors of special education in Kent and Ottawa Counties were contacted by telephone to request permission to review their files of those students who had been or were presently enrolled in a special education program. Four of the six directors contacted agreed to participate in the study, and they selected files which met the researcher's requirements, from which the data were collected. Data were gathered on sex, birth date, dates of evaluation, WISC-R scores, WRAT scores, and type of special education placement. The districts represented rural and small urban communities in Western Michigan. Two (one urban and one suburban) school districts refused to participate. As a result, no children from a major urban community were included. The participating communities were composed primarily of middle- and lower-income Caucasian families. The largest minority group was composed of Mexican-Americans.

Analysis of the Data

Study I, Hypothesis 1 was tested by determining the number of subjects having WISC-R and WRAT test patterns which meet the requirements of the cells. Hypothesis 2 was tested using a one-way ANOVA to compare the cell FSIQ means.

Study II, Hypotheses 1, 2, and 3 were not testable due to insufficient cell sizes of cells A, B, C, D, and G. Hypotheses 4 and 5 were tested using separate analyses of covariance using estimated true scores for each WRAT subtest to demonstrate the differential change among cells E, F, H, and I.

Hypothesis 6 was tested using a one-way ANOVA of an index of response to compare the change in WRAT Reading scores of the two groups. In addition, a distribution of the various combinations of the above tests found as the lowest subtests was tabulated.

Hypotheses 7, 8, and 9 were tested using correlated *t*-tests. The educational significance was evaluated according to the number of subjects who change categories, as outlined in the WISC-R manual.

Hypothesis 10 was tested by dividing the subjects into groups based on their initial placement into self-contained, resource room, or teacher consultant programs. The discrepancies for each subject were computed by transforming the WRAT subtest scores and WISC-R Full Scale IQ scores into *z* scores for comparability. The difference between each WRAT subtest standard score and the Full Scale IQ score was computed using the comparison between *z* scores described earlier. Three one-way ANOVAs were computed to test for significant differences among the three groups' discrepancies between FSIQ and each WRAT subtest.

Limitations and Assumptions of the Study

The study assumes that only one population of learning disabled children exists, namely, those children who have been identified and placed. It is possible, however, that these children may represent a small portion of a much larger population of learning disabled children. For example, although the referral rate of males for specialized services is much higher, Lambert and Sandoval (1980) found an equivalent rate of incidence for underachievement of males and females in an unreferred sample. If it is true that ability-achievement discrepancies are evenly distributed across males and females, then a large number of learning disabled females are not being identified.

The subjects consisted of a sample of special education students in small urban and rural school districts who were identified by school psychologists as learning disabled and placed in special education by Educational Planning and Placement Committees. The process involved in identifying these children was not examined in this study. An assumption was made, therefore, that all subjects were appropriately classified. By this it is meant that it is expected that the psychologists diagnosed the children according to federal guidelines, Public Law 94-142, and Michigan P.A. 451, and that the Educational Planning and Placement Committees similarly followed the law in placing the children in their programs. Ysseldyke, Algozzine, Shinn, and McGue (1979) compared a sample of school-identified learning disabled children to a sample of nonlabeled children with similar levels of underachievement. These researchers found that an average of 96% of the scores were within a common range. In comparing the characteristics of these children with the federal definition, they reported that as many as 40% may be misclassified. Shepard, Smith, and Vojir (1983) also reported a high rate of misclassification.

Another limitation of the study is based on the use of difference scores. Two types of difference scores are used in this study, gain scores and discrepancy scores. A problem related to the use of gain

scores and to the use of a nonrandom sample is that of regression to the mean or statistical regression. The difficulty in evaluating change in groups who are selected on the basis of poor or extreme test performance is that it is statistically predictable that, on a retest, the average score will have a strong probability of being higher than the average score on the first test. This result is not related to any genuine effect of any treatment but rather is the result of the imperfect correlation between the first and second testings. The less perfect the correlation between the two tests, the greater the regression to the mean will be. This does not mean that an individual will necessarily change toward the mean but, simply, that our best guess is that the direction of any change will be toward the mean. In other words, the farther a score is from the population mean, whether it is extremely high or low, the greater the likelihood that the retest score will be closer to the mean than the first score. Measurement theory assumes that a more deviant score contains a greater proportion of measurement error than a less deviant score. Since error is assumed to be random, it is likely that the measurement error will be less at the time of the retest. A common flaw in research studies which use extreme groups and gain scores is interpretation of the data without acknowledging the issue or effects of regression to the mean (Campbell & Stanley, 1963). As mentioned earlier, the present study includes the use of gain scores on the WISC-R and the WRAT. The results of these analyses must be interpreted quite cautiously, given the problem of regression to the mean.

Gain scores are considered the least reliable of difference scores. Porter (1973) suggested that a cautious interpretation of the results can supply useful evaluation information. When the correlation between the two measures is reasonably high, it tends to reduce the reliability of the gain score. However, if the correlation between the two measures is low, the question of validity, or whether the two tests are measuring the same thing, is raised. Mehrens and Lehman (1975) reported that they may be reliable enough for making decisions about groups.

Discrepancy scores are also less reliable as they are affected by the reliabilities and the intercorrelation of both tests used to compute the discrepancy score. As a result, discrepancy scores must also be interpreted quite cautiously. Discrepancy scores were used in this study as the federal and state definitions of learning disability include the criterion of a "severe discrepancy between achievement and intellectual ability." As Shepard, Smith and Vojir (1983) pointed out, the definition of learning disability is vague and provides equivocal guidelines for educational diagnosis.

Since the sample was not randomly selected, generalization of the results is limited. Beyond meeting the dual criteria of age (7 to 13 years) and identification as learning disabled, subjects were included in the study only if they had two complete WISC-R and WRAT protocols 2 to 4 years apart and if the director of special education in that district agreed to participate in the study.

Subgroups in the present study were established using inferential classification. As a result, the findings pertain only to other research studies using a similar approach and not to those studies which have established subgroups on the basis of multivariate classification procedures, such as Q-factor analysis and hierarchical cluster analysis.

The WISC-R and WRAT were not administered during the study. Rather, the data were taken from case records in retrospective review. Therefore, inaccuracies of test information due to errors in administration and scoring could not be controlled.

CHAPTER IV

RESULTS

The primary focus of this research was to determine the potential for using commonly used psychological tests for establishing homogeneous subgroups of learning disabled children and predicting their performance on academic achievement tests on the basis of group membership.

In the first part of this chapter, the findings which relate to establishing subgroup membership are examined. Of major importance to the questions addressed is the frequency and ease with which learning disabled students can be described in terms of subgroups membership. While it may be of theoretical benefit to look at homogeneous subgroups, the practical significance is limited if identification is not easily achieved using standard measurement procedures. Also, if the proportion of learning disabled students who fit the subtypes is low, the practical value is again reduced.

Following the analysis of particular WISC-R and WRAT combinations for establishing the presence of homogeneous subgroups, a more specific exploration of the data occurs. This is to determine whether subgroup membership provides any basis for meaningful predictions of academic achievement as measured by the WRAT on later evaluations.

In the next section, the frequency of the ACID pattern is described and the utility of using this pattern for prediction of reading performance is examined. The frequencies of related patterns are also reported and compared to previous research.

The fourth section addresses the questions related to stability of WISC-R IQ scores in learning disabled children. Comparisons to other studies of stability of IQ in special education and regular education students are made. The educational significance is evaluated in terms of the number of children who change intellectual classification categories as outlined in the WISC-R manual.

The last section of this chapter compares the three types of special education placement in terms of the severity of the ability-achievement discrepancy. The discrepancies for the WISC-R and each WRAT subtest are evaluated to determine if severity of discrepancy is related to type of special education placement.

Study One

Analysis of Subgroup Membership Based on WISC-R and WRAT Scores

> Hypothesis 1. Homogeneous subgroups of learning disabled children can be identified utilizing a combination of the WISC-R VIQ-PIQ discrepancy and WRAT Reading, Arithmetic, and Spelling subtest patterns.

As discussed in a previous chapter, researchers have established subgroups on the basis of WISC Verbal IQ-Performance IQ discrepancies or WRAT subtest patterns. Group membership in this study was based on a combination of Verbal IQ-Performance IQ discrepancies and WRAT subtest patterns. Of the 196 subjects, 26 had VIQ > PIQ +9, 87 had a difference of less than 10 points, and 83 had VIQ < PIQ +9. When subgroup membership required one standard deviation between the standard scores on the WRAT subtests in addition to the VIQ-PIQ discrepancy, only 32 (16%) of the 196 subjects fit into a specific subgroup. When the requirement was lowered from a difference of 15 standard score points to 12 standard score points, 33 more subjects were placed in the subgroups. Table 4.1 shows the frequency of subgroup membership with the 15- and 12-point differences.

Table 4.1.--Subgroup membership with 15- and 12-point standard score differences.

WISC-R	Reading & Spelling > Arithmetic + 15 (12)[a]	Reading & Spelling + 15 (12) < Arithmetic	Reading = Spelling = Arithmetic
VIQ > (P+9)	A 0 (1)	B 1 (2)	C 1 (1)
No significant difference	D 1 (4)	E 5 (12)	F 7 (14)
VIQ < (P+9)	G 2 (2)	H 6 (11)	I 9 (18)

[a]( ) refers to total _N_ identified using the 12-point difference.

Of significance is the finding that using the stricter classification procedure, only 16% of the learning disabled population could be placed in a subgroup and that even when the requirements were reduced, only 33% fit into the categories. This finding suggests that (1) it may not be possible to identify homogeneous subgroups which will include the majority of learning disabled students, (2) subgroups may only be established using a multivariate approach rather than commonly used test scores, or (3) the approach used in this study and others (Rourke & Finlayson, 1978; Rourke & Strang, 1978; Petrauskas & Rourke, 1979; Fisk & Rourke, 1979; Lyon, Stewart, & Freedman, 1982) may define subgroup membership too narrowly to include most students.

The finding that it was not possible to fill the categories where lower arithmetic performance and/or lower visual perceptual problem solving skills were criteria implies that children with problems in the above areas are less likely to be identified as learning disabled. Although the federal and state definitions include a broad range of skills as possible disability areas, the multidisciplinary team's focus may have remained on verbal skills and reading performance as the most commonly identified problem area. In fact, only 26 of the 196 subjects met the requirement of VIQ > PIQ +9. Due to low numbers of subjects in cells A, B, C, D, and G, these groups were not included in later data analyses.

> Hypothesis 2. The subgroups will not differ significantly on the WISC-R FSIQ scores at the time of the initial evaluation.

A one-way ANOVA was performed on the mean Full Scale IQ scores of cells E, F, H, and I to determine if these groups were comparable at the time of the initial evaluation. Hypothesis 2 was not supported ($F = 3.462$, $df = 3$, $p < .023$), indicating an initial difference among the cells. As can be seen in Table 4.2, cells E (V = P, R&S < A) and

H (V < P, R& S < A) were noticeably lower than cells F (V = P, R = S = A) and I (V < P, R = S = A). The first two cells have in common relatively weaker verbal skills on the WRAT, while the latter two cells have relatively equal academic skills, although all achievement scores are depressed. This finding may be related to the fact that all of the instructions include a large verbal component. The results should be interpreted cautiously, however, as the cells' Ns are very small. The initial difference is also likely to have a bearing on the interpretation of the predictive hypotheses.

Table 4.2.--$\bar{X}$ cell FSIQ scores and standard deviations by WRAT grouping.

		RS < A[a]		R = S = A
V = P	E	89.58 (5.70)	F	96.00 (8.30)
V < P	H	90.45 (10.71)	I	97.89 (7.81)

[a]R = Reading
S = Spelling
A = Arithmetic

Study Two

Hypothesis 1. Significant differences will be found among the subgroups of learning disabled children on the measured change in the subtest scores of the WISC-R and the WRAT at the time of re-evaluation.

Hypothesis 2. The children in cells A, B, and C will show greater improvement on the WRAT Reading and Spelling subtests at the time of re-evaluation than the children in cells D through I.

> Hypothesis 3. The children in cell D will show less improvement on the Reading and Spelling subtests than those in A, B, and C but greater improvement than the children in cells E through I.

Hypotheses 1 through 3 were not tested due to the failure to fill cells A, B, C, D, and G and the small sizes of the other four cells.

> Hypothesis 4. The children in cell H will show greater improvement at the time of re-evaluation on the WRAT Arithmetic subtest than the children in the other eight groups.

Hypothesis 4 was not supported and, in fact, cell H (VIQ < PIQ, R & S < A) was the lowest of all four cells on the Arithmetic retest. The analysis of covariance produced a significant interaction between the WRAT profile and the Verbal IQ-Performance IQ discrepancy (F = 4.302, df = 1,50, p = .043) for the WRAT Arithmetic subtest. (See Table 4.3.) The interaction was graphed using the adjusted cell means of the WRAT Arithmetic subtest from the second evaluation (Figure 4.1).

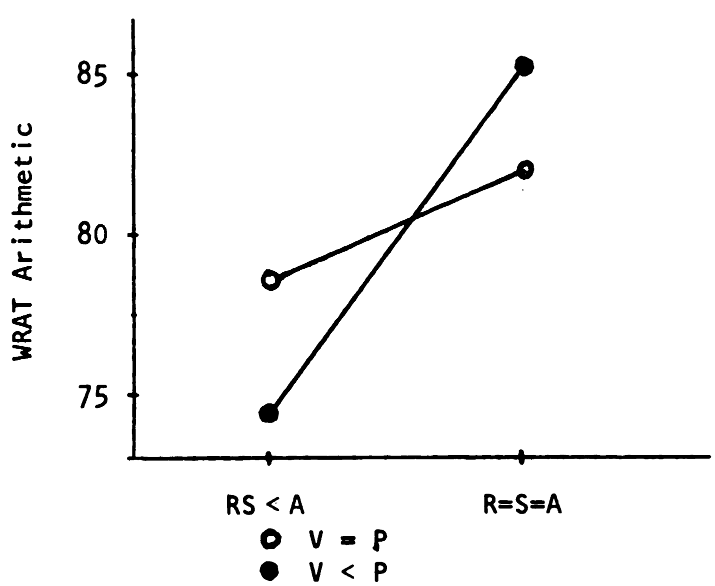

Figure 4.1.--Interaction between WRAT profile and VIQ-PIQ discrepancy.

Table 4.3.--Cell X WRAT Arithmetic analysis of covariance using estimated true scores.

Source of Variation	Sum of Squares	df	Mean Square	F	Sig. of F
Within cells	2681.07	50	53.62		
Regression	1935.94	1	1935.94	36.10	0
Constant	127.35	1	127.35	2.38	.130
RSA	565.88	1	565.88	10.55	.002
IQ	1.44	1	1.44	.03	.871
RSA X IQ	230.72	1	230.72	4.30	.043

The pattern of the interaction (RS < A) < (R = S = A) is consistent with the pattern of FSIQ scores at the time of the initial evaluation. In looking at the means for each cell from both evaluations, cell H had a decrease of 11.36 standard score points, which was the largest change of all four groups. (See Table 4.4.) The interactions and the decrease in Arithmetic raise the question of the role of verbal skills in Arithmetic, as it would be expected that cell H should be weakest in verbal skills. Although the WRAT Arithmetic subtest is a purely computational test, teaching methods are typically verbal.

<u>Hypothesis 5</u>. The children in cell F will show less improvement on the WRAT subtests than the children in the other cells.

Hypothesis 5 was not supported. The analysis of covariance using estimated true scores for the Reading subtest produced an $F = 1.20$, $df = 1,50$, $p = .29$, and the analysis for the Spelling subtest resulted in $F = .14$, $df = 1,50$, $p = .706$. The analysis for the Arithmetic subtest was reported earlier in Table 4.3. In comparing the cell means, cell F

Table 4.4.--Cell means and standard deviations on the two administrations of the WRAT.

	WRAT 1						WRAT 2					
	R		S		A		R		S		A	
	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
Cell E N = 12	74.58	(6.67)	71.17	(8.66)	90.58	(6.64)	72.00	(6.10)	72.42	(5.18)	83.17	(7.98)
Cell F N = 14	76.09	(5.87)	73.57	(8.42)	78.64	(8.81)	78.93	(9.46)	72.09	(7.25)	77.57	(11.20)
Cell H N = 11	74.21	(6.61)	74.82	(6.62)	88.18	(7.63)	75.27	(7.88)	74.64	(7.88)	76.82	(8.17)
Cell I N = 18	75.33	(7.49)	73.72	(7.84)	78.89	(8.54)	77.78	(9.74)	74.06	(7.46)	81.61	(9.76)
Total N = 55	75.04	(6.64)	73.35	(7.83)	83.24	(9.50)	76.31	(8.79)	73.46	(6.98)	79.96	(9.60)

(V = P, R = S = A) exhibited the largest improvement on WRAT Reading, second largest improvement on the Spelling subtest, and the smallest change of any cell on the Arithmetic subtest. On the Arithmetic subtest, cell I (V < P, R = S = A) gained and cells E (V = P, R & S < A) and H (V < P, R = S = A) lost; so here, too, cell F is actually in a stronger position in relation to the other cells. This finding may be explained by cell F's initially higher FSIQ score. Cell F had the second highest mean FSIQ, suggesting that these subjects may have been in a better position initially for acquisition of new learning than the subjects in cells E and H. In fact, cells E and H showed the greatest decreases on both Reading and Arithmetic, which is consistent with the FSIQ patterns.

Cell E showed the lowest correlation between the first and second administrations of the WRAT, while the other three groups were more similar to each other. To explain this, three additional two-way ANOVAs were computed to determine if age or test-retest interval might be affecting these correlations. None of these analyses was significant statistically (Age 1: $F = .50$, $df = 3,51$, $p = .683$; Age 2: $F = .87$, $df = 3,51$, $p = .461$; Test-Retest Interval: $F = 1.55$, $df = 3,51$, $p = .214$), nor is any pattern evident in looking at the actual numbers to explain this finding. The lower reliability may be related to the particular combination of strengths and weaknesses these subjects exhibit. Lack of homogeneity of the sample may be a problem. However, no clear explanation is available at this point. (See Table 4.5.)

Table 4.5.--Correlation between WRAT 1 and WRAT 2.

	Reading	Spelling	Arithmetic
Cell E	.500	.045	.333
Cell F	.604	.675	.696
Cell H	.711	.603	.634
Cell I	.652	.551	.742

Analysis of the Frequency of the ACID Test and Related Patterns

> Hypothesis 6. Those children having Arithmetic, Coding, Information, and Digit Span as their lowest WISC-R subtest scores will show significantly less improvement on the WRAT Reading subtest at the time of re-evaluation than those children not exhibiting this pattern.

The aim related to the ACID test was to determine if the presence or absence of this pattern had predictive value regarding performance in Reading. It was hypothesized that children who exhibit this pattern are less likely to improve on the WRAT Reading subtest at the time of re-evaluation. Only 11 (6%) of the 196 subjects exhibited a pattern of lower scores on the Arithmetic, Coding, Information, and Digit Span subtests at the initial evaluation. A one-way ANOVA using index of response was calculated to test this hypothesis. The hypothesis was not supported ($F = .913$, $df = 1,194$, $p = .341$). The result is not surprising given the large difference in the number of subjects in the two groups. Even if the results had suggested a difference between these two groups, the findings would require a cautious interpretation as a group of 11 subjects is much more affected by one extreme score than a group of 185 subjects.

A frequency count of the related patterns was completed, as much controversy exists regarding both the significance of this pattern and whether all four tests are needed. Table 4.6 provides a summary of these data.

Table 4.6.--Frequency of ACID pattern and related patterns.

	ACID	ACI	AID	ACD	CID	AC	AI	AD	CI	CD	ID
No. of subjects	11	6	14	17	7	4	6	6	6	7	12
% of total group	6%	3%	7%	9%	4%	2%	3%	3%	3%	4%	6%

None of these patterns accounts for more than 9% of this population, and together they only describe 50% of the subjects. Kaufman's (1979) Freedom From Disability Factor (Arithmetic, Coding, and Digit Span) was the most frequent pattern found in this group. Digit Span was the most frequently low subtest, followed by Information, Coding, and Arithmetic, in that order.

Analysis of Stability of WISC-R Scores

Hypothesis 7. Verbal intelligence scores will show a significant decrease at the time of re-evaluation.

This hypothesis was tested using a one-way correlated *t*-test which was not significant in a comparison of the total group across the two evaluations. Correlated *t*-tests were also calculated for the three groups based on VIQ-PIQ discrepancy. The Verbal > Performance group and Verbal = Performance group showed significant decreases in VIQ (t = 3.13, df = 25, p < .005), while the Verbal < Performance group showed a significant gain (t = -3.113, df = 82, p < .05). Verbal IQ decreased 4.38 points in the Verbal > Performance group and 2.034 points in the Verbal = Performance group. Verbal IQ rose 2.21 points for the Verbal < Performance group. Hypothesis 7 was not accepted for the total group but was not rejected for the Verbal > Performance group and the Verbal = Performance group. The average standard error of measurement (S_{em}) for the Verbal IQ score is 3.60. The changes reported here for the Verbal = Performance group and the Verbal < Performance group fall within this range of error. However, the Verbal > Performance group shows a greater change than would be expected on this basis. The means and standard deviations for each group are reported in Table 4.7.

> *Hypothesis 8*. Performance IQ will not show a significant change at the time of re-evaluation.

Hypothesis 8 was supported for the total group, the Verbal = Performance group, and the Verbal < Performance group. In contrast to expectations, the Verbal > Performance group had a significant gain in Performance IQ (t = -3.058, df = 25, p < .01). The Verbal > Performance group's Performance IQ rose by 4.19 points. The Performance IQ has an average S_{em} of 4.66. Thus, though the change reported here is statistically significant, it is not educationally significant as it falls within the confidence interval established with the S_{em}. The change may be due to the effect of regression to the mean

Table 4.7.--IQ score means and standard deviations on the two administrations of the WISC-R.

	WISC-R 1			WISC-R 2		
	VIQ	PIQ	FSIQ	VIQ	PIQ	FSIQ
	$\overline{X}$ SD	$\overline{X}$ SD	$\overline{X}$ SD	$\overline{X}$ SD	$\overline{X}$ SD	$\overline{X}$ SD
V > P N = 26	95.31(11.33)	81.62(9.02)	87.62(10.38)	90.81(12.15)	85.88(10.14)	87.42(10.85)
V = P N = 87	87.97(8.63)	89.97(8.13)	87.78(8.44)	85.79(10.69)	90.74(11.62)	86.69(10.94)
V < P N = 83	81.92(9.63)	100.15(10.48)	89.66(9.68)	84.10(10.11)	99.94(11.24)	90.70(9.44)
Total N = 196	86.38(10.42)	93.17(11.35)	88.56(9.25)	85.74(10.81)	93.99(12.43)	88.57(10.42)

or to a practice effect, though a practice effect is unlikely given the 2-4 year interval between evaluations.

Hypothesis 9. Full Scale intelligence scores will show a significant decrease at the time of re-evaluation.

No significant differences were found for any of the groups. Table 4.8 lists the *t*-test results, as well as the mean difference scores by group. As can be seen from the table, although several of the *t*-tests show significant statistical differences, the mean differences are actually quite small and would not be considered educationally significant.

Table 4.8.--Correlated *t*-tests and mean differences of IQ scores.

		Verbal IQ	Performance IQ	Full Scale IQ
Total		t = 1.038	t = -1.258	t = - .221
N = 196	$\bar{X}_D$	.55	- .78	- .097
V > P +9		t = 3.13**	t = -3.058**	t = 0.00
N = 26	$\bar{X}_D$	4.38	-4.19	.00
V = P		t = 2.575*	t = - .889	t = 1.134
N = 87	$\bar{X}_D$	2.034	- .885	.770
V < P +9		t = -3.113**	t = .220	t = -1.594
N = 83	$\bar{X}_D$	-2.21	.205	-1.036

*p < .01.

**p < .005.

In an effort to assess the effects of statistical regression on the findings for Hypotheses 7, 8, and 9, the subjects were regrouped on the basis of the Verbal-Performance IQ discrepancy at the time of the second evaluation and the correlated t-tests for the new subject groupings. If regression to the mean accounts for the observed changes in IQ scores, the changes should be in the reverse direction of the changes reported for the initial groupings. The results are reported in Table 4.9.

Table 4.9.--Correlated t-tests and mean differences of IQ scores based on the regrouping of the subjects.

		Verbal IQ	Performance IQ	Full Scale IQ
V > P		t = .474	t = -1.750*	t = - .337
N = 16	$\overline{X}_D$	1.813	-3.750	-1.813
V = P		t = - .243	t = -1.26	t = - .418
N = 88	$\overline{X}_D$	- .490	-1.034	- .280
V < P		t = -2.239**	t = 4.076****	t = 2.430***
N = 92	$\overline{X}_D$	-1.500	3.587	1.489

*p < .05.

**p < .025.

***p < .01.

****p < .001.

The direction of the change for the Verbal > Performance regrouping was in the same direction for all three IQ scores as the change observed for the original grouping. The Verbal = Performance regrouping changed in the opposite direction on the Verbal IQ and Full

Scale IQ scores as compared to the original grouping and in the same direction on the Performance IQ score. The Verbal < Performance regrouping changed in the opposite direction on the Full Scale IQ score but not the Verbal or Performance IQ scores. These findings suggest that regression toward the mean is a possible explanation for the differences noted for the Verbal = Performance group on the Verbal and Full Scale IQ scores as well as the Verbal < Performance group on the Full Scale IQ score. While the findings do not support the expectancy of regression toward the mean for all of the groupings, the findings also do not clarify any other basis for the observed change.

To investigate more fully the possible impact of IQ score changes, a further analysis was carried out. Each intellectual classification category (Borderline, Dull Normal, Mildly Impaired, Bright) on the WISC-R has a 10-point range, other than the Normal category which has a 20-point range. Seventy-two subjects changed categories. No subject changed by more than one category.

Only three of the subjects showed a change in IQ score of 10 points or more, suggesting that the majority of those who showed a category change were near the lower or upper limit of the first category they were placed in. Table 4.10 shows the changes in more detail. The mean interval between evaluations was 36 months, with a mean age of 10 years at the first evaluation and 13 years at the second. These results suggest that, in general, all three IQ scores are stable for the learning disabled population.

Table 4.10.--Changes in IQ category at re-evaluation by VIQ-PIQ discrepancy groups.

N	Borderline to Dull Normal	Dull Normal to Normal	Normal to Bright	Bright to Normal	Normal to Dull Normal	Dull Normal to Borderline	Borderline to Mildly Impaired
V > P	2	2	0	1	2	3	0
V = P	3	9	2	2	9	9	2
V < P	7	7	1	0	9	2	0
Total	12	18	3	3	20	14	2

Pearson product-moment correlations were computed to further evaluate the test-retest reliability of the VIQ, PIQ, and FSIQ scores across the two evaluations. The measure of stability ranged from a low of *r* = .64 for the Verbal = Performance group for both Verbal and Performance IQs to a high of *r* = .84 for the FSIQ of the Verbal > Performance group. The reliability coefficients for all groups are reported in Table 4.11. Salvia and Ysseldyke (1978) recommended that tests have reliability coefficients of at least .9 before making placement decisions and of at least .8 before making screening decisions. They do not state what kind of reliability they are referring to. Although only two of the coefficients for FSIQ meet the .8 criterion, the interval used in this study is considerably longer than that used in the majority of evaluations of test stability. Given the mean test-retest interval of 36 months, the Wechsler IQ scores do appear to be stable for the learning disabled population.

Table 4.11.--Test-retest reliability coefficients for the WISC-R IQ scales.

	VIQ	PIQ	FSIQ
V > P	*r* = .82	*r* = .74	*r* = .84
V = P	*r* = .64	*r* = .64	*r* = .73
V < P	*r* = .78	*r* = .69	*r* = .80
Total	*r* = .73	*r* = .74	*r* = .77

Relationship of Special Education and Ability-Achievement Discrepancy

> Hypothesis 10. The severity of the discrepancy between ability and achievement is not related in a consistent manner to the type of educational placement.

At the time of the initial evaluation, 42 students were placed in teacher consultant programs, 106 were in resource rooms, and 13 were in self-contained classrooms. Thirty-five students were either diagnosed as learning disabled but continued in regular education, or were in placements for which there was no available information. The discrepancies were computed between the FSIQ and each WRAT subtest for both evaluations. Analyses of variance were then calculated for each discrepancy, comparing teacher consultant, resource room, and self-contained placements. None of the ANOVAs was significant for the first evaluation. (See Table 4.12.) This finding supports the suggestion that the factors which are used to determine the least restrictive environment have little relationship to the degree of academic disability.

ANOVAs were computed for the same three groups using the discrepancies found at the time of the second evaluation. (See Table 4.13.) Again, none of the statistical tests reached significance, indicating that the students in the three placements were comparable in terms of academic disability.

A third set of ANOVAs was calculated using the type of placement at the second evaluation as the basis for the groups. (See Table 4.14.) This comparison was considered important, as the composition of the three groups changed. At the time of the second evaluation, only

Table 4.12.--Means, standard deviations, and ANOVAs for initial special education placement based on the WISC-R-WRAT discrepancy scores at the initial evaluation.

	Teacher Consultant (N = 42)		Resource Room (N = 106)		Self-Contained Room (N = 13)		ANOVA		
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	F	df	p
Reading Discrepancy	3.13	(2.8)[a]	3.12	(2.1)	4.07	(2.3)	1.020	2,158	.362
Spelling Discrepancy	2.93	(2.3)	3.24	(2.2)	3.66	(2.1)	.608	2,158	.546
Arithmetic Discrepancy	1.76	(1.4)	1.91	(1.5)	1.48	(0.8)	.585	2,158	.558

[a]Reported in z-score units.

Table 4.13.--Means, standard deviations, and ANOVAs for initial special education placement based on the WISC-R-WRAT discrepancy scores at the re-evaluation.

	Teacher Consultant (N = 42)		Resource Room (N = 106)		Self-Contained Room (N = 13)		ANOVA		
	X	SD	X	SD	X	SD	F	df	p
Reading Discrepancy	4.24	(5.9)[a]	3.58	(6.9)	3.98	(2.8)	.165	2,158	.848
Spelling Discrepancy	3.55	(2.8)	3.63	(2.3)	4.55	(3.0)	.886	2,158	.414
Arithmetic Discrepancy	2.42	(2.0)	2.55	(1.7)	2.65	(1.84)	.116	2,158	.890

[a]Reported in z-score units.

Table 4.14.--Means, standard deviations, and ANOVAs on the WISC-R-WRAT discrepancy for placement at the re-evaluation.

	Teacher Consultant (N = 42)		Resource Room (N = 106)		Self-Contained Room (N = 13)		ANOVA		
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	F	df	p
Reading Discrepancy	4.18	(8.2)	3.93	(6.4)	4.49	(3.8)	.036	2,150	.965
Spelling Discrepancy	2.01	(1.7)	4.04	(2.4)	5.81	(2.7)	9.167	2,150	.0002
Arithmetic Discrepancy	1.44	(1.2)	2.83	(1.8)	2.93	(1.7)	5.739	2,150	.004

20 students were in teacher consultant programs, 125 were in resource rooms, and 8 were in self-contained classrooms. Forty-three students fell into other categories. This set of comparisons produced significant findings for the Spelling discrepancy and the Arithmetic discrepancy. The students in the teacher consultant group appeared to have a smaller discrepancy on the WRAT Spelling subtest than the other two groups ($F = 9.167$, $df = 2,150$, $p < .0002$). The same was true for the WRAT Arithmetic subtest ($F = 5.73$, $df = 2,150$, $p < .002$). The three groups exhibited similar discrepancies for the WRAT Reading subtest. The Holton and Lowell school districts do not have self-contained classrooms, so some children from these communities may qualify for a self-contained room but be placed in a resource room.

CHAPTER V

DISCUSSION

Overview

In this chapter the findings related to homogeneous subgroups, the ACID test, stability of IQ scores for learning disabled children, and the relationship of the ability-achievement discrepancy to special education placement are examined more closely in terms of their value for practitioners and researchers. Recommendations for future research and clinical practice are made for each area discussed.

Utility of Subgroups of Learning Disabled Children

Although some researchers remain optimistic about the search for subtypes of learning disabled children (Fisk & Rourke, 1979; Lyon, Stewart, & Freedman, 1982; Nolan, Hammeke, & Barkley, 1983; Petrauskas & Rourke, 1979; Rourke & Finlayson, 1978; Rourke & Strang, 1978), the findings in this study raise questions regarding the usefulness of establishing homogeneous subgroups of learning disabled children. The subgroups in this study were established using a clinical inferential approach, so the results reported here can only be compared to other studies using a similar approach. Little comparison will be possible to those studies using a multivariate approach. The approach used in this study attempted to duplicate the diagnostic strategies of practicing school psychologists unlike the studies mentioned above, which used either more extensive psychological testing than is commonly used in schools, or which used complicated statistical methods, also not used in the schools.

In looking over the data used in this study, it did appear that subgroups other than those postulated may exist. However, the net result would have been 10 to 12 subgroups of three to five subjects in each. The finding that only 28% of this group could easily be placed in a subgroup suggests several possibilities. First, it may be that the subgroups were too narrowly defined to allow inclusion of a majority of the subjects. The problem in other learning disabled research, however, has been that categories have been too broad and thus have not allowed for clear description and prediction based on those categories. The difficulty, then, is how to establish the subgroup criterion narrowly enough to allow for description and broadly enough to include more of the children. One approach could be to relate the diagnostic categories to remedial strategies to allow for the possibility of prescriptive teaching. Behavioral subgroups may be more promising approach than intelligence-achievement test defined groups. McKinney (1984), for example, utilized a behavioral classification method to identify four subgroups of learning disabled children, suggesting another practical approach to further clarifying the characteristics of this population.

Second, if learning disabled children cannot be easily placed in a subcategory by practitioners in the field using the practitioner's methods, it seems unlikely that many of the research findings will be used in actual practice. It would seem that the ultimate goal of research related to subgroup identification would be to improve educational placement and planning for this group of children, yet the methods used for placement are so esoteric that such a generalization is not credible. McKinney (1984) noted that certain statistical classification procedures (Q-factor analysis and hierarchical cluster analysis) are designed to group individuals into clusters. They do not guarantee that the clusters are meaningful, nor do they have prognostic value. He also raised questions about the utility of multivariate methods if the groupings cannot be related to different developmental outcomes.

A third issue raised by this study has to do with the reality of the homogeneous subgroups of learning disabled children. Do they really exist, or are we simply following a hopeful dream as in the research on characteristic WISC-R profiles, scatter analysis, and poorly established cerebral dominance? In looking over the research cited in Chapter II, it was noted that all of the University of Windsor studies used very large subject pools from which to draw relatively small sample sizes for the actual studies. The range was 82 subjects from a pool of 350 (Rourke, Dietrich, & Young, 1973) to 264 subjects from a pool of 2,500 (Fisk & Rourke, 1979). The latter (264) was the largest subject sample used by Rourke and his coresearchers. Several of the studies used <u>N</u>s of 45 to 50 (Rourke & Telegedy, 1971; Rourke, Yanni, MacDonald, & Young, 1973; Rourke & Finlayson, 1978; Rourke &

Strang, 1978). The small sample sizes used suggest that these subgroups may not be representative of a majority of learning disabled subject pools either, adding support to the question of the existence of homogeneous subgroups into which the majority of learning disabled children can be classified. Again, behavioral subgrouping may provide another means of exploring this issue.

Related to this is the possibility that the subgroups in previous research were somewhat artificially established. Very few children with a stronger Verbal IQ or with stronger Reading and Spelling scores are diagnosed as learning disabled. In general, the literature (Farnham-Diggory, 1978; Huelsman, 1970; Ackerman, Peters, & Dyckman, 1976; Anderson, Kaufman, & Kaufman, 1976; Smith, Coleman, Dokecki, & Davis, 1977a) has shown a far greater proportion of children having higher Performance IQ. Yet most of the earlier studies did have the Verbal IQ greater than Performance group. It was not possible to find such a group in this study. Nolan, Hammeke, & Barkley (1983) also had difficulty establishing a Verbal > Performance group.

The final possibility is that those who are making the diagnosis of learning disability are not adhering to the definition such that children with other problems are being categorized as learning disabled. The federal definition has often been criticized as too general (Farnham-Diggory, 1978; Oakland & Goldwater, 1979; Shepard, Smith, & Vojir, 1983). Shepard et al. (1983) analyzed a group of 800 children identified as learning disabled and found that "true" learning disabled children comprised only 43% of this group. She suggested that "the label applied for the purpose of providing services cannot be assumed valid." If the label cannot be assumed valid, the possibility of defining subgroups is severely hampered. McKinney (1984) stated that most of the research on learning disability subtypes has been confined to reading disability. Thus, it is reasonable to assume that learning disabled samples defined by the federal guidelines would be more heterogeneous than the samples in previous studies.

Recommendations for Future Research

Recommendations for future research in definition of homogeneous subgroups are: (1) to establish how accurately the federal and state guidelines are being used, as inaccurate diagnosis will continue to confound any findings; and (2) to attempt to define the subgroups such that they can be identified by practitioners in diagnostic settings within the school districts. McKinney (1984) has provided another possible route in his work with behavioral subgroups. He has also suggested that future studies test the utility of alternative interventions for learning disabled children by using trait x treatment paradigms.

Predictions Based on Subgroup Membership

The results provided little support for the concept of predicting future performance of Reading, Spelling, and Arithmetic achievement as measured by the WRAT based on subgroup membership. The findings were limited by all of the questions raised in the previous section and imply that further research here should be delayed until such time that more representative and consistent subgroups can be defined.

Use of the ACID Test as a Predictor of School Performance

The use of the ACID test as a determinant of a subgroup of learning disabled children found little support in this study. As a result of the small number of subjects who fell into this group, it was not possible to make any meaningful prediction of reading problems. The fact that earlier studies (Kaufman, 1979; Cullen, Boersman, & Chapman, 1981; Vance, Gaynor, & Coleman, 1976; Bernard, 1978; Tabachnick, 1979; Fisk & Rourke, 1979) have also not been able to find this pattern with any regularity suggests that the base rates for this particular profile may be quite low.

Recommendations for Future Research

The low base rates may limit the diagnostic utility of the ACID test. The prescriptive validity was also tested in this study with little support. At this point, the construct of the ACID profile has no demonstrated utility for either diagnosis or prescription. Future research might focus on matching those learning disabled children who do exhibit the ACID profile to learning disabled children who do not, in order to further evaluate the question of differences in responsivity to remedial reading programs.

Stability of WISC-R IQ Scores for Learning Disabled Children

The evaluation of the Verbal, Performance, and Full Scale IQ scores indicated that these scores are quite stable for learning disabled children. The hypothesis that Verbal IQ would decrease over time was not supported. The mean change for all three IQ scores was less than one point over a 3-year period. Statistically significant changes were noted for the subgroups based on VIQ-PIQ discrepancies. However, these were not educationally meaningful changes as the largest changes represented a four-point decrease in Verbal IQ and a four-point gain in Performance IQ for the Verbal IQ > Performance IQ group. These changes fall within or close to the expected range given the S_{em} for these tests. None of the Full Scale IQ difference scores were statistically significant, and the Verbal and Performance IQ changes tended to be in a direction which would reduce the size of the discrepancy. Further analyses to determine what proportion of this effect was due to regression to the mean did not indicate that regression to the mean was a large factor in the observed change. The regression effect is always a problem in studies such as this, where the subjects are chosen on the basis of poor performance on a test and are not randomly assigned to groups. The lack of support for regression is somewhat surprising. The finding of stability is consistent with previous research using shorter test-retest intervals in both learning disabled and normal children (Wechsler, 1974; Tuma & Applebaum, 1980; Vance, Blixt, Ellis, & DeBell, 1981; Smith, 1978). The majority of subjects remained in the same intellectual category (124 or 63%). A lesser number of subjects changed IQ categories (72 or 37%), and none of the changes was over more than one intellectual category.

Sattler (1982) reported that IQs obtained after the age of 5 or 6 tend to remain fairly stable although individuals may show great fluctuation. Children with high IQs tend to show greater variability than children with low IQs. McCall (1977) found that IQs obtained by the age of 5 years correlated highly with adult IQs (.50 and higher). The correlations between IQ scores in this study were greater than the above, suggesting that the stability of learning disabled children's WISC-R IQ scores is no less stable than that of normal children.

The finding of stable IQ scores for the learning disabled population was reassuring in a number of areas. First, the stability indicates that the test commonly used to estimate ability can be relied upon to give consistent results. If the finding had been of unreliability, a question would have been raised about the use of this test for making periodic assessments and evaluations. The practice effect reported in other studies appears to decrease with the longer interval, suggesting less of a problem in making erroneous decisions at the time of re-evaluation. Second, learning disabled children do not appear to be falling progressively further behind their non-learning-disabled peers on the measure of general ability. Kaufman (1981) suggested that Verbal IQ might decrease as learning disabled children would have progressively more difficulty on Bannatyne's Acquired Knowledge Factor.

His question was not addressed directly in this study, but the consistency in test performance would not lend credence to his hypothesis.

Recommendations

Kaufman's hypothesis does raise an interesting question for future research in this area. Are Bannatyne's factors also stable, or does the performance on individual subtests vary considerably over time? Future research might focus on the stability of the various factors of the WISC-R for both normal and learning disabled populations.

Relationship of Special Education Placement and Ability-Achievement Discrepancy

No significant differences were found in the ability-achievement discrepancy of students placed in teacher consultant, resource room, or self-contained programs at the time of the initial placement. The lack of differences suggests that the multidisciplinary education teams are using criteria other than those spelled out in PL 94-142 for making placement decisions. According to this law, the severity of the ability-achievement discrepancy is to be used for both diagnosis and determining the least restrictive environment for each child. Other researchers have also suggested that placement decisions have little to do with the actual data collected on the children. Ysseldyke and Algozzine (1983) found that placement decisions are more closely related to naturally occurring student characteristics. Ysseldyke (1983) reviewed the literature on the team decision-making process and came to the conclusions that the process is inconsistent and that the teams function largely to endorse teacher-identified problems. He reported that although many data are collected on students, their bearing on eligibility and placement is largely ignored by the team.

Analysis of the discrepancies as they related to the type of placement at the time of the re-evaluation indicated differences among the groups for Spelling and Arithmetic skills, but not Reading. Students in teacher consultant programs appeared to have less severe discrepancies than those in resource rooms or self-contained programs. The finding of significant differences for two academic areas suggests that the ability-achievement discrepancy may be used as a more essential factor in determining the placement of older students than of younger students. The lack of specific academic skills may be more disturbing in older children, who have less time in which to acquire them than younger children. Another hypothesis is that teachers may focus more on teaching reading as a basic skill than on arithmetic or spelling, so that the reading discrepancy changes less. A third hypothesis has to do with the nature of the WRAT Reading subtest, which is essentially a test of single-word recognition and pronunciation. While these students may all continue to be able to sound out words equally well, greater variation might be found using a test of reading comprehension. Finally, some of the school districts from which these subjects were drawn did not have self-contained rooms for learning disabled students, so it may be that the resource room groups contain students who would be placed in self-contained rooms if one had been available.

Recommendations for Future Research

Future research in this area might focus on further clarification of the different placement strategies for older versus younger learning disabled students. Second, the discrepancy in reading may be more meaningful if it is evaluated using a test of comprehension rather than word recognition. A study using such a test might show a discrepancy at the older age group which the WRAT is not designed to test.

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