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The Learning Disability Index (LDI): An Analysis of its Utility in Discriminating Learning Disabilities

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THE LEARNING DISABILITY INDEX (LDI): AN ANALYSIS OF ITS
UTILITY IN DISCRIMINATING LEARNING DISABILITIES.

BY

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
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Abstract

201 WISC-R protocols from four differentially classified groups of 8-11 year old elementary school children were examined to assess the utility and validity of the LDI (Lawson & Inglis, 1984), as an assessment tool in identifying learning disabled (LD) children. Findings are discussed in terms of how the LDI discriminates among these differentially defined groups of children and its ability to correctly identify the LD population. Results show that the LDI has somewhat limited utility in these capacities, since it was not able to completely discriminate among all the groups, and correctly identified only a small portion of the (known) learning disabled sample.

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INTRODUCTION

Learning Disabilities: Concept and Definition

Over the years, with advances in education, concern for those who have been unable to learn in the prescribed (or expected) manner have prompted much speculation and investigation. Several major disciplines have contributed to the study of these learning problems and thus diverse definitional criteria have resulted. These diverse criteria sprung from the proliferation of equally diverse, and frequently contradictory etiological theories. This is the primary cause for the creation of much of the confusion that exists in the field of learning disabilities today (Bryan & Bryan, 1982., Haight, 1980., Vaughan & Hodges, 1973., Cruickshank, 1972., Bateman, 1965).

Prior to the 1960's, professionals who wanted to refer to the collection of disorders, later to become known as learning disabilities, used such terms as "minimal brain dysfunction/injury, psychoneurological learning disorders, dyslexia or perceptual handicap" (Hammil et al, 1987, p. 109). Many had theorized that learning disabilities were the result of specific unitary deficits or process

dysfunctions and each theorist put forth his or her own focus as the main, and more often, sole cause of the dysfunctions.

Learning disabilities have been cited as resulting from such dissimilar conditions as specific language disorders (Johnson & Myklebust, 1967., Kirk, 1962., Kirk & Kirk, 1971.), visual motor and visual perceptual problems (Kephart, 1968., Frostig & Maslow, 1973.), neural organizational pattern dysfunctions (Delcato, 1966.) and mixed cerebral dominance (Orton, 1937.). In fact, in a paper designed to clarify some of the various issues facing the field of learning disabilities, Cruickshank (1972) identified 43 terms used to describe essentially the same group of children. Vaughan and Hodges (1973) in their review article revealed some 38 existing definitions of learning disabilities.

Evidence tends to show that many of the various theories contain accurate elements, but, due to the proliferation of so many single factor models which focused only on one aspect of the overall disorder, resulting conceptualizations are inadequate and the field is in desperate need of integration and consolidation. Bateman (1965) contends that a problem in any one of the various areas might result in a learning disability and proposed that "the great diversity of research, terminology and remedial recommendations currently encompassed by the field

of learning disabilities could and should be integrated and related to each other" (Bateman, 1965, p.12).

Recently, Haight (1980) has pointed out that, "The idea that one approach would provide the cure and allow for teaching vast numbers of learning disabled children still continues in the minds of many people" (Haight, 1980, p.48). Haight (1980) also points out how the various unidimensional etiological theories and related remedial methods have served to confuse those who work with the learning disabled rather than serve any useful purpose. Moreover, Fletcher and Satz (1979), in a review of the research on learning disabilities, concluded that attempts to substantiate a unitary deficit hypothesis in the field have been a futile endeavor.

The term "Learning Disabilities" was originally suggested by Kirk (1962), who saw psycholinguistic deficiencies as the primary basis of the disorders and gave the following definition:

A learning disability refers to a retardation, disorder or delayed development in one or more of the processes of speech, language, reading, spelling, writing or arithmetic resulting from a possible cerebral dysfunction and not from mental retardation, sensory deprivation and/or emotional or behavioral disturbance. (Kirk, 1962, p. 263.)

Many (too numerous to mention in this small treatise), who came before Kirk and others who were contemporaneous with him (as Kirk himself acknowledged), contributed enormously to the concept of learning disabilities and the history of the formulation of the concept is well documented

(Hallahan & Cruickshank, 1973., Wiederholt, 1974., Bryan & Bryan, 1982). Wiederholt (1974) has even traced the beginnings of this field of interest back to Gall as early as 1808, but the formalization of the phenomenon, per se, is a more modern concern.

Kirk (1962) was most rigorous in formalizing and supporting the concept of learning disabilities and the association between learning difficulties and disorders of the Central Nervous System (CNS), which was also the primary focus of the field at that time. Although Kirk saw disorders of the CNS as related to learning difficulties, by rejecting the more popular terms of "Brain Damaged" or "Minimal Brain Dysfunctional" and adopting the term learning disabilities, he felt he would open the door not only to exploring other psychological and environmental aspects of the disorders, but also foster more positive efforts and hope around remediation.

The concept of an association between learning difficulties and disorders of the CNS had been based on the formulations of the earlier pioneering efforts of Paul Broca and Karl Wernicke. Broca was able to examine the brains of two of his patients who had lost their ability to speak (expressive aphasia) during their life time. Upon the inspection of their brains after death, Broca found that the brains of both these patients had atrophied in the frontal lobe section on the left side of the brain. Wernicke carried on Broca's work and was able to successfully show

that Broca's expressive aphasia was only one type of loss of speech from left hemisphere damage. He demonstrated another type of aphasia, called receptive aphasia, the inability to understand the speech of others. Localization theory, as this was called, did not go unchallenged. John Hughlings Jackson and his student Henry Head criticized localization theory and postulated that man's brain was not a collection of locales, each independent of the other, but parts of the brain were intimately linked and collaborative (Bryan & Bryan, 1982., Wiederholt, 1974).

Subsequently, Kurt Goldstein (1942), a German physician, elaborated on these ideas from work with World War I brain injured adults developing a composite of characteristics that depicted a connection between learning and brain injury. Goldstein's efforts were built upon the work of many who came before him including the founding fathers of the school of Gestalt psychology (Bryan & Bryan, 1982). Later, Strauss and Lehtinen (1947), Goldstein's students, applied these ideas with children's academic learning and provided a composite description of characteristics based upon physiological dysfunction, neurological signs and perceptual motor deficiencies.

Work in the area of learning difficulties eventually culminated in the enactment of the Federal Learning Disabilities Act of 1969, Public Law 91-230, which was soon adopted by 49 states and endorsed by the Association for Children with Learning Disabilities (ACLD). This

legislation became the vehicle for special education funding by the federal government and provided the following definition:

Children with special learning disabilities exhibit a disorder in one or more of the basic psychological processes involved in understanding or in using spoken or written language. These may be manifested in disorders of listening, thinking, talking, reading, writing or arithmetic. They include conditions which have been referred to as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, developmental aphasia, etc (U. S. Office of Education, 1968, p. 34.).

Much has transpired since the enactment of P.L. 91-230. Rapid advances in the area have ensued since the modified description provided by the current 1977 federal guidelines under Public Law 94-142, (the Education for All Handicapped Children Act of 1975). Numerous positive effects have been realized through the definition and general goals of P.L. 94-142, particularly by way of financing educational programs for children with special education needs including the learning disabled, and programs for the training of the needed professionals. Nonetheless, interpretation of this P.L. 94-142 definition has caused much confusion which resulted in a series of problems that have affected theoretical and service delivery issues in the field of special education in general and learning disabilities in particular (Epps, Ysseldyke & Algozzine 1985., National Joint Committee on Learning Disabilities, 1981, 1987., Bryan & Bryan, 1982).

Much of the confusion around the federal law was created by the differential and vague criteria regarding how

learning disabilities was to be operationally defined and this lack of objective criteria for diagnosis, in turn, has hampered both service delivery and learning disability research.

The three major criteria set forth within the federal definition under P.L.94-142 are: (1) the discrepancy criterion, (2) the process deficit criterion and (3) the exclusion criterion. The discrepancy criterion requires that a child demonstrate a "severe" discrepancy between intellectual ability, as measured by an intelligence test such as the Wechsler Intelligence Scale for Children-Revised (WISC-R), and academic achievement as measured by an achievement test such as the Minnesota Achievement Test (MAT). The process deficit criterion demands that evidence exists which demonstrates that the child has a deficit in one or more of the primary psychological functions (auditory or visual perceptual, cognitive, motor response etc...). The exclusion criterion attempts to ensure that the child's learning problems are not the result of mental retardation, visual, hearing or motor handicaps, emotional disturbance or environmental, economic or socio/ cultural deprivation (Federal Register, 1977).

The causes for confusion become apparent if we look closely at how these criteria may fall prey to varied interpretations. Taking the discrepancy criterion for example, although the rules and regulations (Federal Register, 1977) stated that there must be a "severe"

discrepancy between achievement and intellectual ability, the regulation did not specify the amount of discrepancy that would meet the criteria for being "severe" and therefore this determination was left up to each individual state. This state of affairs of course, made for situations where a child could be classified as Learning Disabled (LD) in one state, while in another, he or she would not even be considered eligible for special education services. For example, some states operationalized "severe" discrepancy as being a nine month difference between grade level on achievement test and child's expected level according to IQ potential. Other states use a one year difference, or even more.

Moreover, as Keogh (1983,p.25) pointed out, a child may be put in the LD group for reasons such as " how much room there is in a program at the time, how tolerant is the regular class teacher of certain behaviors, who dominates the admissions committee, how aggressive is the parent? ". Further, a child who is just having general problems in learning, because of a temporary situation or for reasons other than being LD, and does not meet any of the other state classification criteria (i.e., criteria for Behaviorally Disordered (BD)), readily meets the exclusionary criterion and may be labelled LD just to get special education services.

In a recent study, Shepard, Smith and Vojir (1983) examined 800 Colorado students classified as learning

disabled and found that only 42.6% of the students met the criteria to be defined as learning disabled by either federal/state or the professional literature. The majority of the remaining 57.4% of children did have learning problems, but were incorrectly labelled learning disabled. Instead they showed characteristics of other difficulties such as mild mental retardation, emotional disturbances and low achievement due to language interference and other causes or handicaps.

Some suggest that the confusion created by the open ended federal definition may account for the recent (1985) 119% increase in reported LD cases along with the wide deviations in the number of reported LD cases from state to state (Epps, Ysseldyke, & Algozzine, 1985).

More recently steps have been taken by many professionals and professional organizations to clarify some of the confusion created by the federal definition. In a 1981 position paper of the National Joint Committee on Learning Disabilities (NJCLD), comprising six major organizations concerned with learning problems, several major problematic issues resulting from the federal definition were outlined. The first of these issues is also a major focus and concern of the present study and is as follows:

- "1. The current definition frequently has been misinterpreted. This has led many people to regard those with learning disabilities as a homogeneous group

of individuals. This conclusion is clearly erroneous. It has led to the belief that a standard approach to assessment and educational management exists for individuals with learning disabilities. The practices of identification, assessment and remediation were keyed to this interpretation of the definition with resulting confusion in these areas." (National Joint Committee on Learning Disabilities, 1987. p.107)

The NJCLD also pointed to other confounding issues with the definition, such as the failure of P.L.94-142 to acknowledge the developmental nature of learning disabilities. This critique emerges since the federal definition restricts itself to children rather than recognizing that learning disabilities also apply in early development and continue into adult life.

Another critique regards the implied etiology of the definition since it seems to restrict itself to suggesting that the basis of the disorder is due only to central nervous system dysfunction and fails "to appreciate the resultant interaction between the learner and the learning environments." (NJCLD, 1987 p.107). For example, there are many individuals with manifest central nervous system dysfunctions (i.e., Cerebral Palsy) who do not necessarily evidence learning disorders. There may also be a number of LD pupils in our school systems who have successfully adapted to academic demands and thus are not given that label.

The NJCLD also protests that the federal definition "lends itself to the misinterpretation that individuals with learning disabilities cannot be multi-handicapped or be from different cultural and linguistic backgrounds" (NJCLD, 1987. p. 107). Due to the above shortcomings, a new definition was proposed by the NJCLD. This definition falls more in line with what is presently being discerned from years of research on learning disabilities. It is as follows:

Learning disabilities is a generic term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical abilities. These disorders are intrinsic to the individual and presumed to be due to central nervous system dysfunction. Even though a learning disability may occur concomitantly with other handicapping conditions (e. g., sensory impairment, mental retardation, social and emotional disturbance), or environmental influences (e. g., cultural difference, insufficient/inappropriate instruction, psychogenic factors), it is not the direct result of those conditions or influences (Hammil et al, 1987 p.109).

As the NJCLD definition outlines, the group of children who show specific learning disabilities is a very heterogeneous one and are only homogeneous to the extent that they have problems in learning. According to LD specialists, the most prominent learning disability is reading disability. Nonetheless, even a reading disability is really symptomatic of many different kinds of underlying difficulties. Therefore there is no reason to expect that all reading disabled children will show the same pattern of scores.

Other learning disabilities are associated with writing, spelling, and arithmetic skills. The five disabilities that best differentiate learning disabled from non-learning disabled children are disabilities in (1) reading comprehension, (2) attention, (3) auditory-visual coordination, (4) writing and (5) auditory speed of perception (Wissink, Kass, & Ferrell, 1975).

Recent evidence continues to show that students with learning disabilities could be differentiated from "normal" students along a wide array of deficits including linguistic, perceptual motor, attentional, cognitive and social - behavioral manifestations as well as basic academic skill deficiencies (Kavale & Nye, 1986).

Over the years, with advancement in computer technology, there have been numerous multivariate techniques or factor analytic studies (i.e., cluster analysis, and Q factor techniques involving correlations between subjects) that have been done with different learning disabled populations. Results have yielded mounting evidence that the "learning disabled" is indeed a heterogeneous category and many of these researchers and other experts in the field call for the abandonment of the search for one characteristic learning disabled profile or a single syndrome/unitary deficit theory of learning disabilities. They call instead for efforts aimed at empirical identification of homogeneous subtypes rather than in trying to come up with a global differentiation (Keogh, 1986.,

McKinney, 1984., Fisk & Rouke, 1983., Wilcox, 1982., Satz & Morris, 1981., Ryckman, 1981., Denkla, 1973).

The Wechsler Scales and The Learning Disabled (LD),
Behaviorally Disordered (BD) Distinction:

Since the publication of the Wechsler Intelligence Scale for Children (WISC) and the Wechsler Intelligence Scale for Children-Revised (WISC-R), (Wechsler, 1949, 1974), there has been a plethora of clinical/inferential propositions, factor analytic studies and other research conducted on the instrument. These efforts also included the development of certain intra-test scatter indices and patterns that may assist in identifying children with particular learning and cognitive difficulties.

Efforts in this area have spanned three or more decades and aside from their use in intelligence testing and learning disabilities, work on and with the Wechsler scales has been very broad based. The WISC and WISC-R have been used in many dissimilar and varied areas including searches for sub-cultural variations (Levinson, 1960., Holland, 1960., Fitch, 1966.), with the blind (Tillman, 1967.), the hearing impaired and deaf (Brill, 1962.), with speech disorders (Goodstein, 1961.), other miscellaneous handicaps such as low birth weight (Bell, Taylor & Dockrell, 1965.), in identifying characteristics of specific physical disorders such as familial dysautonomia, an inherited

disease with nervous system etiology (Sak, Smith & Dancis, 1967.), delinquency (Wechsler, 1944., Wechsler & Jaros, 1965., Dean, 1977.), emotional disturbance (Jacobson, 1967., Woody, 1968., Zimmerman & Lambert, 1961.), schizophrenia (Wechsler and Jaros, 1965., Kissel, 1966.), various identified organic disorders (Rowley, 1961., Hopkins, 1964.) and as neurological indicators (Burgemeister, 1962.). For more extensive reviews and discussions see Zimmerman and Woo Sam (1972) and Sattler (1982).

The WISC-R is an individually administered test of general intelligence consisting of twelve subtests that are divided into two scales, Verbal and Performance (nonverbal). Two of the subtests (Digit Span & Mazes) are not used in the computation of the Full Scale IQ and are considered supplementary, although they have proved important when looking at the learning disabled population (Kaufman, 1979., Sattler, 1982., Rourke & Strang, 1983). The six subtests from the Verbal scale are Information, Similarities, Arithmetic, Vocabulary, Comprehension and Digit Span. The six subtests from the Performance (nonverbal) scale are Picture Completion, Picture Arrangement, Block Design, Object Assembly, Coding and Mazes.

Statistical studies to date provide some support for the construct validity of its verbal/nonverbal scales (Kaufman, 1981). Nonetheless, the fact that the test itself has statistical support for the WISC-R's division into verbal/nonverbal dimensions does not imply that the same is

true of the large heterogeneous population of people we label learning disabled. Other recategorizations have emerged due to research on and with the WISC and WISC-R scales.

One of the first recategorizations of the WISC was the result of a factor analytic study done by Witkin et al (1962). Witkin and his associates uncovered three factors that had statistical significance. Factor I was a Verbal Comprehension factor consisting of Vocabulary, Information, and Similarities. The second factor was an Attention/Concentration factor consisting of Digit Span, Arithmetic and Coding. The third factor, the Analytic Field Approach consisted of Picture Completion, Block Design and Object Assembly. But Witkin et al were not focused on learning disabilities; they were pursuing other lines of research concerning psychological differentiation.

One early index that was focused on discriminating learning disability was derived from the consistent finding, on the WISC and later on the WISC-R, of the so called ACID profile - low scores in Arithmetic, Coding, Information, and Digit Span - documented by Heulsman (1970) with disabled readers and later among diverse groups of learning disabled children (Ackerman, Dykman & Peters, 1976., Kaufman, 1979).

Another system for identifying the learning disabled was presented by Bannatyne (1971, 1974). Bannatyne proposed that the subtests of the WISC be recategorized into Spatial Ability (Picture Completion; Block Design and Object

Assembly), Conceptual Ability (Comprehension; Similarities and Vocabulary), Sequential Ability (Digit Span; Arithmetic and Coding) and Acquired Knowledge (Information; Arithmetic and Vocabulary) categories, rather than the Verbal/Performance (nonverbal) categories used by Wechsler. He posited that learning disabled children (especially reading disabled) will show the following pattern of scores : Spatial > Conceptual > Sequential.

Many clinicians today use the WISC-R as a basis for hypotheses about the individual student's deficit area or cognitive style, and as an indicator of the direction further assessment and remediation should take. However, research results regarding its specific use in differentiating between LD and other special education groups by any one index or pattern of scores, remains varied, inconclusive and somewhat contradictory. (Sattler, 1982., Kaufman, 1981).

Nonetheless, the WISC-R continues to be a vital tool with the LD population, particularly around outlining areas of deficit and in differentiating subtypes. Recently, McKinney (1984) in a major review article on research attempting to differentiate learning disability subtypes, lists seven major published empirical studies, numerous clinical inferential indices, and differential neuropsychological predictors, most all of which employed the use of the WISC-R along with other measures in discriminating learning disabilities. In addition, there

were also studies using behavioral dimensions. All studies supported the contention that the children we call learning disabled are a heterogeneous entity that can be divided into several subtypes regarding their particular characteristics. Only two subtypes showed a primary verbal/ nonverbal deficit.

Today the Wechsler scales remain the most widely used of the individual intelligence testing measures and are regarded as a stable and reliable assessment instrument in measuring children's intelligence. The WISC-R also continues to be a clear choice, along with a comprehensive battery of other measures, in the identification of learning problems (Sattler, 1982., Kaufman, 1981).

Relevant to the present study is the fact that, in addition to its use with LD, the WISC and WISC-R have also been used extensively in research around differentiating behavioral disorders or emotional disturbance. Some of the work was based in part on Wechsler's (1944 p.155) observation that "the most outstanding single feature of the adolescent psychopath's test pattern is his systematic high performance score as compared to his verbal test score...". The exceptions were female psychopaths.

However, research findings concerning what a verbal/nonverbal discrepancy means remain inconclusive and often contradictory. Many suggest that the verbal/nonverbal dichotomy is not a practical diagnostic index for discriminating learning disabled children from other

children. Especially given the fact that research continues to show that other special education groups as well as normal children show similar patterns (Kaufman, 1979, 1981, 1976a, 1976b).

As Zimmerman and Woo-Sam (1973) concluded, from their exhaustive review of the published research on the WISC, "The question is not whether VIQ-PIQ differences are significant, but rather what such differences signify. The situation is analogous to elevation in body temperature. Fever is clearly an abnormal condition. However, fever per se cannot be regarded as diagnostic of any specific disease since it is associated with any number of disease conditions." (Zimmerman & Woo-Sam, 1973. p.9).

More recently others have substantiated this conclusion both in studies exploring patterns of emotional disturbance and learning disabilities on the WISC-R. For example, in the case of indications for emotional disturbance on the WISC-R, Dean (1977), in a well controlled study involving 41 adolescent males referred as a result of conduct disorders, found that, "in general a group analysis showed a depression of verbal functions and satisfactory reliability.", but patterns of scatter only were "useful in the diagnosis of a generalized state of emotional disturbance." (Dean, 1977, p.486).

In the case of what verbal/nonverbal differences on the WISC-R signify, many are aligned with the conclusion that it does show an "abnormal condition". Overall results of

empirical investigations have been inconsistent regarding whether one WISC-R profile was able to differentiate the learning disabled from other groups such as the behaviorally disordered (Matarrazo, 1972., Sattler, 1974., Zimmerman & Woo-Sam, 1973).

Research suggests that a number of WISC-R profiles may exist for the learning disabled. Other profiles that have been suggestive of learning disability are patterns of intra subtest scatter and discrepancies among the different subtests that make up the two scales (Sattler, 1982., Kaufman, 1979).

The Lawson and Inglis studies and the LDI

In 1984, Lawson and Inglis proposed a Learning Disability Index (LDI), that is based on a verbal nonverbal pattern of WISC-R scaled subtest scores, which they postulated as being able to indicate the possibility of a learning disability. The authors used factor score coefficients derived from an unrotated principal components analysis of the normative data from the WISC-R. The pertinent factor, Factor II, is a bipolar factor which may be interpreted as describing a verbal/nonverbal continuum of test material.

This index (LDI) was based on the authors' review of 17 studies, of published WISC and WISC-R data of variously diagnosed learning disabled (LD) children (N=2040) (Lawson &

Inglis, 1985). The authors reported that comparing these scores with those of Wechsler's (1974) normative data, revealed that the amount of deficit shown by the LD children on any particular subtest to be closely matched, proportionally, to the degree of verbal and/or nonverbal content as expressed by the Factor II score coefficient of that subtest. In addition, they reported that Wechsler's categorization of the WISC and the WISC-R subtests into the Verbal and Performance scales coincided well with the factor structure of their LD sample, except for the fact that the Coding subtest seems to be closer, in the factorial sense, to the verbal items.

The Lawson and Inglis (1984, 1985) statistical analysis from which they developed the LDI appears sound and scholarly. Nonetheless, contrary to what has been reported in the literature and more in line with the federal/state classification, it supports the underlying assumption that the learning disabled are one homogeneous group and could be all successfully differentiated along one dimension, a verbal/nonverbal continuum of subtest scatter as captured by the LDI. Further, much like the federal law under P.L.94-142, the authors provide a broad definition of learning disabilities as borrowed from Gaskins (1982), "any child who has great difficulty in meeting academic standards at school" (Lawson and Inglis, 1985, p. 35) and admit that their studies are limited in part by the fact that they use broadly defined groups of LD from many (17) different

studies. This of course, in light of the prior discussions, is a major shortcoming of the Lawson and Inglis (1984) studies.

The LDI is derived from eleven of the twelve WISC-R subtests scaled scores, excluding mazes. This index is normally distributed with a mean of zero and a standard deviation of 301 in the normative WISC-R data. Values for the LDI are positive when there is a verbal deficit, and negative where there is a nonverbal deficit. The LDI is converted to a Z-score for predicting the probability of the profile being from a child with a learning disability.

(A worksheet for calculating a child's LDI and a probability table are presented in APPENDIX I).

An LDI which exceeds the 90th percentile (1.64) or lies below the 10th percentile (-1.64) is considered to be statistically abnormal and indicates an individual who is learning disabled. Children below the 10th percentile (negative LDI) are seen as a " special subgroup of the learning disabled " but instead of a deficit in verbal ability they show a significant deficit in nonverbal abilities (Lawson & Inglis, 1984,P.519). However, the authors failed to comment on, or reference, this " special subgroup " in their later research and failed to say why this finding does not necessitate a hypothesis of heterogeneity. Nonetheless, they did recommend that the LDI be interpreted in light of the historical and clinical

context presented by each individual case but did not go on to elaborate on what exactly this meant.

In later research, Tittmore, Lawson and Inglis (1985) conducted a follow up validation study of the LDI using 1550 LD and Mentally Retarded (MR) children (ages 7 - 11) referred to a Canadian school board psychology services because of education difficulties. They found that the learning disabled and mentally retarded groups had mean scores on this index that were reliably different from the expected scores of the normative population (Wechsler's 1974 national sample), which revealed a verbal deficit in their test performances. In addition sex differences on this index appeared in both the normal and abnormal groups. That is, boys showed a relative superiority on nonverbal tasks, whereas conversely, girls showed a superiority on verbal tasks.

Later, Inglis and Lawson (1985) also reported a cross - cultural validation study of the LDI using previously collected data from 64 learning disabled Mexican-American and 46 Papago children. Their results revealed clear differences between the mean LDI scores of these children when compared to the normative group.

In another more recent longitudinal study, (Tittmore, Lawson and Inglis, 1987), data involving 1371 children referred to a school board psychological service because of educational difficulties, revealed that abnormal LDI's do not appear in children referred for learning problems before

the age of about 8 years. Data also showed that the mean LDI scores for the referred children were reliably different from the scores of the normative population. The authors also found that the emergence of elevated LDIs after age 8 was caused not only by a decrease in scores on the verbal items, but also by an actual increase in their scores on nonverbal tests. The authors hypothesize that the decline in scores on the more verbal subtests may indicate a cumulative deficit in abilities related to academic achievement. In addition, the accelerated development of nonverbal ability is seen as compensatory development of the more unaffected functions in a damaged organism.

Statement of the Problem

There are two major shortcomings with the Lawson and Inglis research and the Learning Disability Index (LDI). First, the authors claim that they can differentiate LD by means of a single index, the LDI, which captures the pattern of verbal/nonverbal discrepancy they claim to be indicative of the heterogeneous LD population. This finding runs contrary to what has been discerned in the literature from numerous research studies. It stands to reason, as outlined by these studies, that given the heterogeneity of the LD population, no one index will be able to consistently predict LD. Furthermore a verbal/nonverbal deficit on the

WISC-R has been found to be only a general indication of an "abnormal condition" (with neurological correlates) rather than specifically diagnostic of the LD population.

Secondly, very limited research has been done on the Learning Disability Index (LDI) since its publication by Lawson and Inglis in 1984. Of the three studies that were published to date (all written or coauthored by those writers), outlined above, two were done with similar groups of Canadian school children with broadly defined learning difficulties (Tittmore, Lawson & Inglis, 1985, 1987). The other was a cross cultural validation study using another researcher's data (Inglis & Lawson, 1985). This was similar to what the authors had done in the original development of the index when they used data from seventeen (17) different studies and compared it with Wechsler's normative sample (Lawson & Inglis, 1984, 1985).

The present investigation was not a replication of the Lawson and Inglis study. It was however, designed to test the utility of the index particularly when pitted against the contrary findings in the field. For an instrument such as the LDI to be considered clinically useful and stand up to scientific scrutiny, given the findings already presented, it must be able to discriminate the specific group (LD) it purports to identify, from the rest of the special education population, particularly the Behaviorally Disordered (BD) group.

In light of the above discussions, distinguishing across categories of special populations not only makes practical sense, but also holds particular implications for research and delivery of services (i.e., diagnostic, educational or training programs). Furthermore, it seems to make little sense to compare a LD sample with only the WISC-R normative sample or with the mentally retarded (MR) as Lawson and Inglis did in developing their index. It makes much more practical sense to see if the LDI can discriminate across different categories of special education groups, particularly in light of what has just been discussed about the insufficiency of a verbal deficit on the WISC-R in identifying the entire learning disabled population.

The present study explored: (A) How well the LDI was able to discriminate among four groups of elementary school children (ages 8-11) who were referred for psychological assessment. It further examined: (B) How well the LDI correctly predicted the classifications of these children. Three of the groups were identified as needing special education services : (1.) The Learning Disabled; (2.) The Behaviorally Disordered; and (3.) The Mentally Retarded. The fourth group, Normals, consisted of children referred for testing but not found to be in need of special education services.

The definitions of the Rhode Island Board of Regents, under the guidelines of the federal handicapped Services Act; P.L. 94-142, for the three defined groups of children

in this study may be found in Appendix II (although the actual sample had to meet more stringent criteria).

Given what has been discerned in the literature and in the Lawson and Inglis studies. It was therefore predicted that: (1) The LDI would be able to differentiate the LD from the normals and MRs but would be unable to discriminate the LD from the BD group.

(2) The LDI would be unable to correctly identify children classified as being LD or not LD.

(3) In accordance with findings by Tittmore, Lawson & Inglis (1987), the LDI should show sex differences for all the groups. That is, males as a group should generally show more of a verbal deficit than females and therefore have higher LDI scores.

METHOD

Subjects

The data consisted of 201 previously administered WISC-R protocols drawn from a larger pool of protocols of elementary school children from two rural schools, two suburban schools, and an urban psychological consulting agency. The scores on the WISC-R were then used to compute the LDI's of all individuals in each group and the data analyzed to see if the expected significant differences or patterns emerged.

A search of the records of children referred for special education assessment from each of the schools and the psychological consulting agency was done in order to identify students, with available WISC-R protocols, who were appropriate for the study, that is, those who met the criteria outlined below.

Subjects were 3 groups of differentially diagnosed children classified (under State Regulation, mandated by PL 94-142) as 90 Learning Disabled (LD), 58 Behaviorally Disordered (BD), and 12 Mentally Retarded (MR), in addition to, a fourth group of 41 Normals (children who after testing were found not to be in need of special education services).

All students in the LD group were identified as having a specific learning disability such as reading, writing, math, or spelling. They also met the criteria for one of two operational definitions under P.L.94-142, discrepancy criterion (discrepancy of one year +) or process deficit criterion. Subjects who met the exclusionary criterion were not included. In a further effort to obtain a more homogeneous sample, care was taken in eliminating those students who carried dual or multiple classifications such as, LD/BD or MR/LD/BD.

The BD group was primarily diagnosed as Conduct Disorders. The MR group was from the Mild or Educable MR category. Further, only children in the age bracket 8 to 11 years old were included in the sample. This was mainly due to trying to relate these findings to evidence from the

longitudinal study by Tittmore et al (1987) which showed LDI patterns emerging only after eight years of age in most children.

The sample was predominantly white and of varying socio-economic status. As a matter of convenience in obtaining protocols and in an attempt to control for examiner effects and thus generate more scoring consistency, only protocols administered by one school psychologist for each school system was used. Protocols from the consulting agency were administered by three different psychologists.

This study was a sample survey comparison study and statistical results were computed using BMDP and SAS standard computer program packages available through the University of Rhode Island's Computer Center. The Chi square analysis was hand calculated.

A table of the means and standard deviations of the WISC-R subtests scores for males and females of each of the groups is presented in Appendix III.

RESULTS

The first analysis was conducted to examine whether the LDI was able to differentiate groups of LD children from others and to explore the possibility of a statistically significant difference between the groups of males when compared to females. The Fmax test for homogeneity of variance was done and found to exceed critical limits. This violation of homogeneity was found to be caused by both the

more within group homogeneity (i.e., smaller SD) and the disproportionately small number of subjects found in the MR group (N=12) as compared to the others. The MR group was therefore dropped from the first portion of the statistical analyses.

Means and standard deviations of LDI scores for each of the groups by gender are presented in Table 1.

Table 1.

ZLDI Means and Standard Deviations (N=201)

		<u>X</u>	<u>SD</u>
LD	M(N=57)	.872	1.05
	F(N=33)	.302	1.05
	M+F(N=90)	.663	1.08

BD	M(N=42)	.580	.97
	F(N=18)	.633	.91
	M+F(N=58)	.595	.95

MR	M(N= 7)	.247	.54
	F(N= 5)	.616	.52
	M+F(N=12)	.401	.54

Normals	M(N=27)	.206	.94
	F(N=14)	.002	.81
	M+F(N=41)	.136	.89

A two-way ANOVA (sex by group) was then performed on the data from the three remaining groups. Results did not show a statistically significant difference between the LDI means for females as compared to males. However, LD boys ($X=.872$) did have noticeably higher LDI means than did LD girls ($X=.302$). There was also no statistically significant main effect for sex by group interactions. However, there was a statistically significant main effect for group ($w=.0318$) at $p < .05$. Gender was therefore eliminated as a factor.

A one-way ANOVA was then done in a post hoc exploration of the differences among the mean LDI scores for the three groups. Results showed a main effect for group ($w=.0186$) statistically significant at $p < .05$.

The ANOVA Summary Table is presented in Table 2.

Table 2.

ANOVA Summary Table of ZLDI Means for Three Groups
(excluding MR). (N=189)

Source	SS	df	MS	F	w
Mean	36.85	1	36.85	36.65	
Group	8.18	2	4.09	4.07*	.0186
Error	187.008	186	1.005		

* $p < .05$

A Neuman-Keuls follow up test of pairwise comparison of the LDI means was then done. Results revealed that the LDI was not able to differentiate among all three groups in the sample, as predicted, although statistically significant differences were obtained between the LD group when compared to the normal group. There were no differences between the LDI means of the LD and BD groups. In addition, the LDI mean for the BD group was also significantly different from that of the normals. A summary table for the Neuman-Keuls is provided in Table 3.

Table 3.

<u>Neuman-Keuls Test of Means</u>				
<u>.136</u>	<u>.595</u>	<u>.663</u>	/	<u>critical</u>
_____	.459*	.527*	/	.440
	_____	.068	/	.368
		_____	/	

*p < .05

The second portion of the statistical analysis examined how well the LDI's classification of LD coincided with the state's classification under P.L.94-142. A Chi Square analysis of the LDI versus state classification of the sample was carried out with all groups (including MR). Results did not yield a significant effect chi square (3.35,

df 1, did not exceed 3.84 at $p < .05$ level), showing that no significant relationship existed between the LDI predictions and state classification. Table 4 presents the results of the chi square analysis.

Table 4

Chi Square Summary Table (N=201)

State/School Classification

	LD	NOT LD
LD	17 / 12.54	11 / 15.46
LDI		
Not LD	73 / 77.46	100 / 95.54

Chi Square observed = 3.35, df 1, not sig. $p < .05$.

(Observed frequencies for each cell are given above the diagonals whereas expected frequencies are given below the diagonals).

Overall, the results do not offer support for the use of the LDI in correctly identifying LD children. Of the 90 subjects classified as being LD by this study, only 17 (18.9%) were identified as LD by the LDI index. The 73 (81.1%) remaining LD subjects were falsely identified as not being LD. Of the 111 subjects classified as not LD by this study, 11 were said to be LD by the LDI. Of these 11, 9 were from the BD group while 2 were from the group of

Normals. None of the MR protocols were identified as LD by the LDI index.

There was an overall agreement between the two indices that 58.2 % (117) of the subjects were correctly identified, LD 8.5% (17) and not LD 49.7% (100), by both systems. The remaining 41.8% (84 subjects), consisted of 36.3% (73) false negatives, that is, children who the LDI said were not LD when in fact they were, and (5.5%) false positives, children who the LDI said were LD when in fact they were not. These results show, that as an index, the LDI is too specific and not very sensitive, and as such, fails to identify a large subset of children who are truly LD (81.1% of LD sample).

Three individuals had negative LDIs which met the criteria for the "special subgroup" (Lawson & Inglis, 1984). Interestingly, only one was from the LD group, whereas the other two were the only two protocols from the group of Normals identified as being LD by the LDI.

DISCUSSION

In the present study, as expected from previous findings in the research, the LDI did not completely discriminate among all the groups. Although, as reported in the research by Lawson & Inglis (1984), the LDI was able to

differentiate the LD from the Normal group. As predicted, it was unable to differentiate the BD group from the LD group. What the data did say was that the LDI scores of both the LD and BD groups were similar to each other but were different from the scores of the Normal group. It also showed that the scores of the MR group were so different from all the others (due to higher homogeneity within the MR group as compared with the others) that they were statistically incompatible.

Turning to the question of whether the LDI is a good predictor of learning disabilities. Results of this investigation suggest, that the LDI may have limited utility in this regard since it seems to be only identifying a subset of the learning disabled population, those whose deficit or deficits are manifest at the extremes of a global verbal/nonverbal continuum. The fact that the LDI identified only 18.9% of the LD sample as being LD makes the categorization too specific and puts it at risk for misidentifying, as it did, a large portion of the LD population, some 81.1%. This of course implies that the use of the LDI will result in many thousands of children going unrecognized and unserved by our education system.

The fact that the present study found no main effect for gender does not give statistical support to the findings by Lawson and Inglis (1985) and Tittamore, Lawson and Inglis (1987) who reported noticeable differences between LDI means of learning disabled boys and learning disabled girls.

However it is possible that my study did not have a large enough sample to show an effect. Nonetheless, the LDI scores for boys in the LD group were generally higher than girls as was also true for the normals and the MRs as well (see Table 1). In the BD group, the order was reversed (as was the case with Wechsler's (1944) female "sociopaths"), with BD girls obtaining slightly higher LDI scores than BD boys. Nonetheless, the number values for both BD males and females were very close and are considered about the same statistically. The fact that girls have lower LDI scores than their male counterparts seems logically predictable since girls are encouraged by traditional sociological roles to be more verbal, whereas, boys are more action (nonverbally) oriented. However, the fact that BD girls are less verbal than their male counterparts seems harder to reconcile with sociological gender role learning.

Some of the latest research efforts continue to reaffirm the heterogeneity of the learning disabled population in terms of characteristics, specific deficits and remediation needs. Many WISC-R patterns are being discerned for the LD. Most recently, Holcomb et al (1987), applied a multivariate profile analysis or clustering technique to the WISC-R scores of a heterogeneous group of children (N=119) who had been identified by their school systems as learning disabled. Six types of WISC-R profiles were empirically derived. Verbal/nonverbal discrepancies were present only in two of their six subtypes (these may

indeed be similar to those suggested by the Lawson and Inglis index but further research is needed to explore this factor). In a cross validation procedure, a second group of LD was successfully classified (93% were correctly typed into the six WISC-R subtypes generated from the initial sample). The heterogeneity of LD population described in this research is also validated by the fact that subtypes which fitted more clinical/inferential profiles such as the ACID were also found (Holcomb et al,1987).

The present study concurs with most of the other literature and shows that children belonging to the heterogeneous group we call the learning disabled, cannot all be identified on only a verbal/nonverbal unidimensional continuum of WISC-R subtest scores as is the case with the claims of the LDI. In fact as evidence already discussed shows, a verbal/nonverbal difference on the WISC-R seems to be a general indication of an "abnormal condition" (with implied neurological correlates) and is not of itself indicative of a learning disability, particularly since children with emotional disorders (BD) and others also show similar profiles.

Further, the WISC-R's subtests measure many other variables or factors than just a general verbal/nonverbal dimension. Lawson et al (1984) may indeed be tapping one subtype of the learning disabled, or rather, two subtypes, since the authors themselves point out that there was a "special subgroup" who scored in the negative direction

(below the 10th percentile) and showed a nonverbal impairment, who are also considered to be learning disabled.

As noted, three subjects in this study, who had scores in the negative direction met the LDI criteria, but curiously enough only one came from the LD group, while the other two were from the group classified as Normal. In this regard the LDI may be of some very limited utility, since it may be picking up this 'special subgroup' apparently being missed by the state.

The utility of being able to discriminate the mentally retarded from LD with the use of the LDI seems particularly questionable. For one, the group of children classified as MR have to meet more stringent specific criteria than the others. In fact, the IQs among all other groups, including BD and LD, can vary from the Superior range to the Low average range (Satz & Morris, 1981., Schiff et al, 1981., Kaufman, 1979). On the other hand, children in the MR group have to obtain a WISC-R score below a Full Scale IQ of 70. Maybe there are also a number of the mentally retarded who could be seen as learning disabled but mental retardation is itself judged on the ability to learn, therefore, the attempt appears redundant.

Furthermore, since the WISC-R's scaled scores of someone who performs in the MR range are very depressed, showing deficits in all verbal and nonverbal areas, it seems questionable that there would be enough variation in the scores as to reflect statistically significant

verbal/nonverbal differences, in an extreme enough range, in order for them to be classified as LD by the LDI. The MR group from this study with its small Standard Deviation is a prime example. It therefore does not seem surprising that none of the MR group in this study were identified as being LD by the LDI.

Moreover, the fact that the WISC-R is such a verbally loaded test raises the question of whether it is the most appropriate measure with suspected mental retardates. In fact, one of the reasons for there being such a small number of MR protocols available for this research was the fact that both the agency and the schools considered the Stanford Binet, or other measures, as more appropriate with the mentally retarded. Moreover, the Stanford Binet, although it has changed much since it was first developed in 1905, was originally intended for separating the "mentally retarded from normal children" in the Public schools of Paris, France and is still favored over the Wechsler for this purpose today (Sattler, 1974 p. 99). Another reason for such a small MR sample, may be that many mentally retarded children are typically enrolled in more specialized (mostly private) programs.

Limitations of This Study

It is questionable as to how much the results of this study could be generalized to other population groups, given that different states use slightly different criteria for

identifying the learning disabled, and since there are wide fluctuations in the percentage of children reported to be LD by different states.

The findings of this study, although they provide strong evidence and arguments, should be interpreted cautiously given the fact that the population from which the sample was drawn, although representative of the Rhode Island population (rural, suburban and urban) are not representative of the general U.S. or North American population. Southern Rhode Island school children and the Rhode Island Elementary School population as a whole do not appear to be quite typical of the general U. S. population. In fact, examination of the prevalence of LD according to States (U. S. Office of Special Education, 1984), shows the Rhode Island population of LD to be the largest reported, 63% of children ages 3 to 21 identified as handicapped were considered LD. Although California, 55%; New Hampshire, 58% and Texas, 52% showed comparable percentages. Whereas, in contrast, only 26% of handicapped children in Alabama were classified as LD, essentially similar to those reports in Indiana, 27%; Kentucky, 27%; and South Carolina, 29%.

Moreover, given the results of this study and other findings obtained from other sources of the scientific literature, if the LDI is to be used with any confidence by clinicians and educators (especially in the United States), more research needs to be done with larger and more representative groups of the learning disabled and other

special education populations. For example, different elementary school children from different states and varied school systems need to be assessed.

Another limitation of this study is that sample selection took place under restrictions regarding availability of subjects, but on the other hand, some consistency was gained by the fact that protocols from each school system were completed by only one psychologist in that system. Also more restrictive criteria were imposed on the actual population pool used, to assure purer LD, BD or MR samples. It can also be argued that the pool from whence the sample was drawn did not include students with learning disability characteristics who had been able to achieve well enough academically, thus going undetected.

Summary and Future Directions

Children who have difficulty learning present complex diagnostic and assessment problems. Since the WISC-R is widely used in assessing the LD population, the more that profiles for different homogeneous LD subtypes can be systematized and understood, the easier it is to translate test results into consistent educational action.

Given the heterogeneity of the LD population, the fact that single factor models of learning disabilities focus upon only one aspect of the overall disorder, resulting

conceptualizations such as the verbal/nonverbal model of the LDI, appear inadequate. In fact, as discussed above, learning disability seems to be a term describing a variety of syndromes with different severities and etiologies rather than a homogeneous disorder that can be neatly placed on a verbal/nonverbal unidimensional continuum.

The findings of this study adds strong support to the conclusion that a verbal/nonverbal deficiency on the WISC-R is more indicative of a generalized "abnormal condition" rather than a specific indication of a learning disability per se. Particularly since this profile is also reflected in protocols of other groups. Results therefore do not suggest using this index (LDI) in the way the proponents intended, that is, as a way of differentiating the individual learning disabled student from others (MR or normative sample). Even a more limited use such as identifying specific subtypes of the LD population, who show severe verbal or nonverbal deficits, seems contra indicated. Particularly given the fact that better ways of determining verbal/nonverbal deficiencies among children already exist with well validated and reliable instruments such as the Wechsler scales. In light of this, the LDI appears to be merely reproducing, rather inefficiently, a small subset of what can readily be discerned with the use of the Wechsler scales.

If future studies of this type were to be conducted on the LDI it would certainly be in the experimenter's better

interest to secure a larger sampling of the special education population. A larger sample of the mentally retarded population also needs to be secured to make the groups more equal in size, thus possibly making them more amenable to statistical analysis. Unfortunately, as is seen by the strong arguments and efforts of this study, this seems an impractical task to complete without an increase in compromises due to confounds that would be invariably introduced by such a process.

In addition, one may also want to use a fifth group, or second sample of normals taken from children who were never referred for testing. In the case of this study including such a group would have presented too many extraneous variables (i.e., getting permission to test this population, having the same examiners who tested the others available etc...) and would not be particularly useful, since, this type of youngster has little or no chance of ever being classified LD specifically because they are never referred.

APPENDIX I

WORKSHEET FOR CALCULATING LEARNING DISABILITY INDEX (LDI)
LAWSON AND INGLIS (1984) FACTORIAL MODEL (N = 2200)

Subtests Scaled Scores (SS) X Weight(W) = WSS

1. Information	---	-14
2. Similarities	---	-05
3. Arithmetic	---	-33
4. Vocabulary	---	-15
5. Comprehension	---	-04
6. Digit Span	---	-47
7. Picture Completion	---	37
8. Picture Arrangement	---	27
9. Block Design	---	26
10. Object Assembly	---	45
11. Coding	---	-25

Sum(SS) = _____

Sum(WSS) = _____

$$\text{LDI} = \text{Sum}(\text{SS} \times \text{W}) + 0.7 \times \text{Sum}(\text{SS})$$

$$= \text{_____} + 0.7 \times \text{_____}$$

$$= \text{_____}$$

$$Z_{\text{LDI}} = \text{LDI} / 301$$

$$= \text{_____}$$

FROM NORMAL CURVE TABLE
PROBABILITY OF SCORING IN THE LDI GROUP

z = 2.57 = 99% Probability	1.43 = 85%
z = 1.96 = 95% Probability	1.27 = 80%
z = 1.64 = 90% Probability	1.15 = 75%

APPENDIX II

The definitions of the Rhode Island Board of Regents, under the Handicapped Services Act, Public Law 94-142, for the three defined groups of children are as follows:

1.) The Learning Disabled: A child who has a disorder in one or more of the basic psychological processes 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 do mathematical calculation. The term learning disability includes such conditions as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia and developmental aphasia. It 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 Behaviorally Disordered: A child who exhibits a significant and observable disorder to a marked degree over an extended period of time (as determined by the evaluation process) in one or more of the following:

(A.) Extreme difficulty in learning which cannot be explained by intellectual, sensory, neurophysiological, or general health factors; nor can it be attributed to ethnic or cultural differences;

(B.) Consistent inability in establishing or maintaining satisfactory interpersonal relationships with peers and/or teachers;

(C.) Constant and pronounced inappropriate or immature types of behavior or feelings under normal conditions;

(D.) General pervasive mood of unhappiness or depression to a marked degree and over a significant length of time;

(E.) Psychosomatic complaints related to personal, social or school problems;

The above definition should include but not be limited to disorders which are referred to as: autism, schizophrenia, neurosis, psychosis, emotional handicap and emotional disturbance.

APPENDIX II cont'd

3.) The Mentally Retarded: A child who functions at a significantly subaverage general intellectual level while concurrently manifesting deficits in adaptive behavior during the development period, and who at the time of evaluations, obtains a score on an individually administered test in accordance with the following table of intelligence quotients:

<u>LEVELS</u>	<u>Wechsler Scale</u> (Standard Deviation-15)
MILD	69-55
MODERATE	54-40
SEVERE	39-25 (Extrapolated)
PROFOUND	24 and below (Extrapolated)

APPENDIX III

Means and Standard Deviations of WISC-R Subtests Scaled
Scores (Mazes excluded) Males (N=133)

Males

WISC-R Subtests	(LD) (N=57)		(BD) (N=42)		(MR) (N=7)		(NOR) (N=27)	
	X	SD	X	SD	X	SD	X	SD
I	8.8	3.1	10.4	3.2	4.2	1.6	12.1	2.6
S	10.6	3.6	11.6	4.1	3.2	2.0	13.5	4.2
A	8.1	2.6	9.3	2.9	3.4	1.3	12.1	2.6
V	9.5	3.2	10.8	3.2	4.2	1.7	12.2	3.0
C	10.4	3.1	10.9	3.0	5.0	1.4	12.6	3.0
DSP	8.2	3.2	8.7	2.7	3.3	2.9	10.8	3.6
PC	11.1	2.7	10.5	3.1	3.6	1.8	11.6	2.9
PA	10.4	2.6	10.8	2.7	4.2	1.5	11.7	2.1
BD	9.9	3.1	10.7	3.1	4.7	2.4	12.3	2.5
OA	10.3	2.6	11.2	2.9	5.0	2.1	11.7	2.4
Cd	8.5	2.9	9.9	3.3	5.0	2.0	10.8	2.5

Means and Standard Deviations of WISC-R Subtests Scaled
Scores (Mazes excluded) Females (N=68)

Females

WISC-R Subtests	(LD) (N=33)		(BD) (N=16)		(MR) (N=5)		(NOR) (N=14)	
	X	SD	X	SD	X	SD	X	SD
I	8.8	2.8	10.7	3.1	3.2	1.1	10.9	3.0
S	10.6	2.5	11.7	3.5	2.2	0.8	12.3	3.7
A	8.2	2.1	9.0	2.5	2.2	0.4	10.2	2.9
V	9.5	3.0	11.1	2.2	3.8	0.8	11.5	3.0
C	10.3	2.7	11.8	3.1	4.4	1.1	11.6	2.8
DSP	8.4	2.9	9.6	2.5	1.6	1.7	9.9	2.9
PC	9.9	2.6	11.9	2.2	3.8	2.1	11.3	2.4
PA	11.1	2.8	12.1	2.4	4.4	2.6	11.0	3.5
BD	8.9	2.3	10.6	3.5	4.2	2.3	10.0	3.0
OA	9.1	3.0	11.4	2.4	4.6	1.8	10.0	2.3
Cd	10.5	3.0	11.2	3.3	5.6	1.1	10.9	3.4

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