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WISC CHARACTERISTICS AND DEVEREUX BEHAVIOR SCALE RATINGS FOR THIRD GRADE READING DISABLED CHILDREN IDENTIFIED BY THE YEARS BELOW, BOND AND TINKER, AND ERICKSON Z-SCORE METHODS

by

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MARJORIE J. MUZYCZKA. WISC Characteristics and Devereux Behavior Scale Ratings for Third Grade Reading Disabled Children Identified by the Years Below, Bond and Tinker, and Erickson Z-score Methods. (1974) Directed by: Marilyn T. Erickson. Pp. 91

The Wechsler Intelligence Scale for Children (WISC) and Spache Diagnostic Reading Scales were administered to one hundred and twenty third graders. Teachers responsible for reading instruction completed the Devereux Behavior Rating Scales for each child. Reading Disabled (RD) children were identified by three methods: 1) Years Below Grade Level, 2) Bond and Tinker Expectancy Formula, and 3) Z-score, employing Full Scale (FS) IQ, Performance Scale (PS) IQ, and Verbal Scale (VS) IQ as selection criteria. Ten percent of the population was selected as RD by each method. Control groups were formed for each RD group and matched on sex and WISC IQ scores.

PS - VS differences were found only for the Z-score children. They also had significantly higher IQ scores than RD children identified by either the Years Below or Bond and Tinker methods. Children identified by the Z-score method fell within the average to above average IQ range, while those identified by the Years Below and Bond and Tinker methods were in the below average to average range.

Very few differences in WISC subtest scores for the RD groups and their Controls were found when FS IQ score was used as the criterion. Only two subtests, Information and Vocabulary, discriminated the Years Below RD group from their Controls, while none of the subtests discriminated between either Bond and Tinker RD children and their Controls or

between Z-score RD children and their Controls. Half of the VS subtests discriminated between RD and Control children when WISC PS IQ score was used as the selection criterion. Z-score RD children scores significantly lower than their Controls on four (Information, Arithmetic, Vocabulary, and Digit Span) of the VS subtests while the Years Below group scored significantly lower on three (Information, Arithmetic, and Vocabulary) VS subtests and Bond and Tinker on two (Information, and Vocabulary) VS subtests. When VS IQ was the selection criterion, several of the PS subtests discriminated between RD and Control children with Z-score RD children scoring lower on the Block Design, Object Assembly and Coding subtests. The Bond and Tinker RD children scored significantly lower on the Object Assembly subtest, but no subtest differences were found in the comparisons between the Years Below RD children and their Controls. The results suggested that WISC subtest pattern may be a function of differences in verbal abilities since no characteristic subtest pattern emerged when FS IQ was the selection criterion.

Comparisons between RD and Control children on Devereux behavioral factors revealed that behavioral differences were a function of method of selection and the IQ score used as criterion. However, the Comprehension factor was found to discriminate between RD and Control children in eight out of nine group comparisons, suggesting that comprehension is a critical factor in reading skills. Other behavioral differences appeared to be highly related to verbal skills; that is, greater differences in VS IQ scores between RD and Control children were associated with a larger number of behavior problems.

The results suggest that RD children selected by the three methods vary considerably in their WISC subtest and behavior characteristics.

It is suggested that schools chose their methods of selection on the basis of specific remedial goals.

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INTRODUCTION

One of the critical variables in a child's school success is his ability to read. Estimates of the school population encountering significant difficulty in learning to read have ranged from 5 to 20 percent. Specific reading disability (RD) has been defined by Eisenberg (1966) as the inability "to learn with proper facility despite normal intelligence, intact senses, proper instruction and normal motivation (p. 360)." Although this definition is the most widely accepted to date, no general agreement exists as to the specific description, terminology, or etiology of reading problems (Carlson, 1973).

Etiology and Behavioral Description of Reading Disability

Historically, etiology of reading problems has been traced to some type of brain malfunction and various labels, mostly of medical origin have been applied to the problem. These labels have included: specific language disability, dyslexia, and specific reading disabilities. The label of specific dyslexia is still widely used.

Several early hypotheses related to the etiology of RD have been generated. Among them are speech abnormalities and mixed laterality of eyes, hands, and feet (Morgan, 1896), auditory and visual spatial discrimination (Bronner, 1917), and specific brain damage (Schimdt, 1918).

Prior research with adults suggesting that minimal brain damage might be the cause of reading disability prompted Strauss and Lehtinen (1948) to postulate that reading disabled children suffered diffuse brain damage during the perinatal period which could not be detected by conventional neurological examinations based on hard signs. They devised an examination

based on minor neurological signs which was theoretically connected to the hypothesized neural deficit. Cognitive and perceptual tests were used to diagnose brain injury if soft neurological signs were not found. Cognitive and perceptual tests indicating conceptual and perceptual difficulties in such tasks as differentiating figure from ground and classifying objects into groups were taken as evidence of brain damage. Included in Strauss and Lehtinen's conceptualization of the disorder was an absence of an adequate approach to new words, and the presence of faulty recognition of familiar words, confusion of similar words and letters, phrases, and sentences, omissions and an overall careless attitude toward the content of material read. Strauss and Lehtinen also associated behavioral disturbances in the classroom situation such as distractibility, hyperactivity, and disinhibition with the brain disorder.

The labels "brain injury" and "minimal brain dysfunction" were substituted by the term "learning disabilities", in the 1960's. Learning disabled children were described as having average or above average intelligence yet manifesting difficulty with specific academic skills, abstract concepts such as time and space, perceptual deficits in one or more of the sensory channels, coordination deficits (including balance, manual dexterity and left-right orientation), abnormal motor activity (including both hyper- and hypoactivity), emotional lability, short attention span and/or distractibility, impulsivity, and "soft" neurological signs. (Clements and Peters, 1962; Clements, 1969)

The problem of reading has been regarded as being a special case of learning disability. A checklist, specifically developed to diagnose RD was developed by Spraings (1969). The list included behaviors identified by Clements as well as: poor ability to relate letter and sound, visual

hyperactivity; topographical disturbance; sequencing difficulties; and poor spontaneous and creative writing. Norman and Darley (1959) have extended the behavioral description of inferior readers to include: tenseness, hypersensitivity, apathy, withdrawal, anxiety, disorganization and resistance.

Johnson and Myklebust (1967) have further extended behavioral identification of RD children to include memory impairments (which may include deficits in span as well as immediate and delayed recall), and poor body image in terms of drawing the human figure. Bond and Tinker (1973) have devised a list of behavioral symptoms associated with RD which become evident in a classroom situation. These include shyness or retiring behavior, inability to concentrate, habitual nail-biting, a tendency to stutter, and a lack of self confidence manifested as discouragement, irritability and aggressive compensatory behavior.

In summary, a characteristic pattern of distractibility, perseveration and hyperactivity appears to describe learning disabled children, and more specifically for the RD child, the following patterns have been identified: (a) perceptual problems such as time and space orientation, (b) coordination problems such as fine motor skills and left-right orientation, (c) difficulties with abstract concepts such as associating meaning with representational materials, (d) visual and auditory memory problems and (e) emotional problems often arising from a low frustration tolerance.

Specification of behaviors associated with reading difficulty should be incorporated into a diagnostic device for the identification of the RD child, but to date no such measure has been developed. The Devereux Scale (Spivack and Swift, 1967) developed to evaluate classroom behavior, may prove to be a useful device for the behavioral assessment of RD children. Investigation of the Devereux Scale is one of the purposes of this research.

On a non-behavioral level, the specific characteristics of children identified as RD in the research literature have been varied, probably because of the differences in sampling procedures and the techniques used in identification. These sampling procedures and techniques are briefly discussed below.

The samples from which RD children have been drawn have included clinic and teacher referrals as well as whole school grades. Teacher or clinic referral has been the most commonly used method for identifying RD children in the research literature. Access to standardized test data and their interpretation by teachers and clinicians have varied among teachers and clinicians from one study to another. The lack of consistent objective criteria has been further complicated by the possibility that the referral may have also been dependent on behaviors which were not directly involved in the child's reading status; that is, teachers may have been more likely to identify a child as RD when the child also presented a behavior problem, such as talking out in class. Clinic referrals have also likely suffered from biases in that the characteristics of patient samples have varied according to the type of clinic (public or private), its location, and the professional affiliations of the clinic personnel. Clinic and teacher referrals are probably the weakest sampling method because the criteria used to refer these children are often unspecified or vary greatly among teachers and clinicians. School populations have represented a more adequate population from which to select RD children because the potential biases mentioned above have been minimized.

In general, two types of objective techniques for identifying RD children have been used in research studies: 1) the Years Below Grade Level model, and 2) two discrepancy models: Bond and Tinker Expectancy

Formula and Z-score discrepancy. In the Years Below model, the child's reading achievement is ascertained through the use of standardized tests and then compared with the child's actual grade placement or his appropriate grade placement based on his chronological age. An arbitrary cut-off score is then determined by the investigator, and all children whose test scores fall below this level are labeled as RD. The Years Below method, while less expensive in terms of test administration time and materials, may identify children as RD who might be better classified as "slow learners"; that is, some children perform poorly on all measures of ability and achievement and having only an achievement measure permits inclusion of children who, with further testing, would exhibit a slow rate of development in all areas of functioning. The Years Below method has the implicit assumption that all children should learn these academic skills at the same rate; children, in fact, learn these skills at various rates, the best predictions of which are IQ scores.

The discrepancy model is a second objective technique for identifying RD children. The discrepancy model assumes that the child's rate of learning to read should be commensurate with rate of overall intellectual development as measured by IQ tests. Disability is diagnosed on the basis of a discrepancy between actual reading achievement and expected reading achievement which is computed on the basis of overall intellectual functioning. Bond and Clymer (Bond and Tinker, 1973) have developed the formula /(years in school X IQ/100) + 1.0*/ for computing the expected reading level.

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*The 1.0 is added because the child starts school at grade 1.0 and after a year in school, the average child is at grade 2.0 or just entering the second grade.

The Erickson (1974) Z-score discrepancy formula is another discrepancy method which may be used for identifying RD children. This method measures the discrepancy between standardized Z-scores for intelligence and reading achievement tests. Individual intelligence and achievement test scores are converted to Z-scores using the group mean and standard deviation. The negative discrepancies between IQ and reading achievement Z-scores are rank ordered and those children whose scores fall in the lower 10 percent of the distribution are diagnosed as reading disabled.

For school samples in which IQ and achievement scores approximate the national standardization norms for the particular testing instruments, both discrepancy methods would probably identify the same children as RD. The Bond and Clymer method identifies children as RD on the basis of national norm criteria, while the Z-score method identifies RD children in the context of the community norms, thus acknowledging that particular schools may not contain children whose characteristics reflect the national norms.

Of the many standardized tests available, studies which investigate the variables related to RD have most often used the IQ scores and subtests of the Wechsler Intelligence Scale for Children (WISC) as dependent variables. Investigators have attempted to determine whether RD children have unique WISC subtest patterns. However, the results of these studies have not been consistent with one another. Some studies have found RD children to have particular WISC profiles, while others have not. This inconsistency may have been due in part to differences in subject samples and methods used for identification.

Relatively few researchers have used the Years Below or discrepancy model with whole school grade samples, and no studies comparing the available methods have been published. Behavioral and standardized test characteristics of RD children will not be reviewed in the context of the sampling procedures and methods used for identification.

Years Below Grade Level Method for Identifying RD Children

Clinic Sample. Various investigators (Neville, 1961; Kallos, Grabow, and Guarino, 1961; Coleman and Rasof, 1963; Hunter and Johnson, 1971; and Ackerman, Peters, and Dykman, 1971) have used the Years Below method for identifying RD children. The investigators matched RD children with controls on the basis of sex, age, grade, race, IQ and SES. The age of their subjects ranged from 7 through 16 years. All of the investigators, with the exception of Coleman and Rasof (1963), limited their samples to children with IQs which fell in the normal range.

With the exception of Coleman and Rasof (1963), the results indicated that RD children scored significantly lower on the Verbal Subtests than on the Performance subtests with a characteristic pattern of low scores on the Information, Arithmetic, Digit Span and Coding subtests. Coleman and Rasof included children whose IQs fell below the normal range in their total sample and found overall low scores on both the Verbal and Performance subtests. However, when they regrouped their sample and considered only those children whose IQ scores fell in the normal range, their results agreed with those of the other investigators.

WISC Performance subtest score results indicated no agreement among the investigators as to a characteristic subtest pattern for RD children. Significantly high scores on the Block Design subtest were reported by Neville (1961), Kallos et al. (1961), and Coleman and Rasof (1963).

Neville (1961) viewed his results in terms of Cohen's Factor Analysis of the WISC which yields five separate factors; i.e., Verbal Comprehension I, Perceptual Organization, Freedom from Distractability, Verbal Comprehension II, and Quasi Specific factors. Neville concluded that low scores seem to be related to scholastic types of tasks and limited ability to concentrate, while the high scores (Picture Arrangement and Block Design) were relatively removed from formal types of learning.

Kallos, Grabow and Guarino (1961), although they did not find their Verbal IQ scores to be significantly lower than their Performance IQ scores, did find the characteristic pattern of low Information, Arithmetic, and Coding subtest scores and a high score for Block Design. Kallos et al. compared their data with that reported earlier by Altus (1956) rather than against standardization norms; however, Altus selected subjects with WISC IQ scores of 80 or more, while Kallos et al. limited their IQ range to 90 - 109. Kallos, et al. found their results to be in agreement with those reported earlier by Altus.

Coleman and Rasof (1963) included a much wider range (70 - 136) in their sample than the other investigators previously mentioned. After examining the results for their RD children as a group, Coleman and Rasof subdivided their subjects into above average, average, and below average underachievers. They found a significant difference

between Verbal and Performance IQ scores only for average underachievers. An ANOVA for the three groups by WISC subtests indicated no significant interaction. The subtest patterns were similar for all three groups with scores varying according to ability.

Coleman and Rasof also subdivided their RD group into mild and severe disabilities and found that the mildly disabled group scored significantly higher on the Digit Symbol and Picture Completion subtests than the severe group. Their results indicated that characteristic subtest scores and significant differences between Verbal and Performance IQ scores may be dependent on the IQ range of the RD children.

Hunter and Johnson (1971) also administered a behavioral rating to determine whether behavioral characteristics discriminated RD children. Their findings revealed RD children to be less self-confident and to have no preference for younger or older playmates as compared to a choice of older playmates by control subjects. They found no differences between groups for attention-seeking behavior, hyperkinetic behavior, or hypochrondrical behavior. However 34 percent of the RD children were rated as hyperactive during the testing session.

Ackerman, et al. (1971) also investigated the effect of neurological status and activity level on the WISC subtest scores. They found no relationship between these factors and scores on the WISC. They also found that the WISC did not separate severely disabled readers from either mildly disabled readers or from adequate readers with other learning disabilities.

Teacher Referral. No studies were reported that used the Years Below method for identifying RD children when sample selection was by teacher referral.

School Sample. Identification of RD children within school populations has been investigated by Bruce and Burks (1955); Belmont and Birch (1966); and Lyle and Goyen (1969). The investigators matched RD children with adequate readers on the basis of age, sex, and IQ in order to make comparisons between the two groups. The ages of children investigated ranged from the first through the eighth grade level. Bruce and Burks and Lyle and Goyen restricted the IQ range of their RD children to 90 and above on either of the WISC Verbal or Performance IQ measures, while Belmont and Birch set their cutoff point at 80.

In examing the relationship between Verbal and Performance IQ scores, Bruce and Burks (1955), and Lyle and Goyen (1969) found Performance scores to be significantly higher than Verbal scores, while Belmont and Birch found no differences. However, when Belmont and Birch regrouped their sample to include only those RD children whose IQ scores fell within the average range, they found Verbal IQ scores to be significantly lower than Performance IQ scores. All three studies also found that the characteristic subtest pattern of low scores on the Information, Arithmetic and Coding subtests emerged only when the IQ scores of the RD children fell within the average range. Although Performance scores tended to be significantly higher than Verbal scores, there was no consensus as to which one or ones of the subtests were responsible for the difference.

Bruce and Burks (1955), in addition to finding the characteristic low score subtest pattern for RD children, found that RD children were significantly high on Picture Arrangement, Block Design, and Compre-

hension subtests. They also found that the good readers were significantly higher on the Similarities subtest. Bruce and Burks hypothesized that the poor readers as a group "approach learning situations in a more concrete manner as a result of an inability to handle abstractions. Since the reading process inherently consists of abstractions strongly depending on memory functions, these children are handicapped (p. 493)."

Belmont and Birch (1966), in addition to making the usual comparisons on the WISC subtests did an intensive evaluation of Vocabulary subtest definitions for the average and retarded readers in the average range of intellectual functioning. Their analysis indicated that retarded readers knew fewer words and defined significantly more words descriptively and fewer words categorically than did the normal readers.

Lyle and Goyen (1969) used the double criterion of both teacher referral and years below grade level in identifying their RD children. In selecting their subjects they chose nine RD children and nine controls from each of six primary school grades in order that comparisons might be made across grade level. To insure that the groups were matched as closely as possible for the variables of teaching method, curriculum, and SES, both groups were drawn from the same classrooms in the same school and at the same time of year. In addition to finding the significant discrepancy between the Verbal and Performance IQ scores and the characteristic subtest pattern, Lyle and Goyen refuted the hypothesis put forth by McLeod (1965) and Neville (1961) that lower performances on the Information and Vocabulary subtests of the WISC are effects of reading retardation rather than correlated symptoms. The relevant analyses were based on the assumptions that, if they were

effects, the discrepancies between the groups should become greater with age, owing to the increasing reading fluency of the controls. Lyle and Goyen did not find this to be true. Lyle and Goyen hypothesized that the WISC deficits were not effects but symptoms correlated with reading disability and primarily of a verbal nature.

Discrepancy Method for Identifying RD Children

Clinic Sample. Hirst (1960) and Sawyer (1965) used a discrepancy method to identify RD children within clinic samples. The IQ scores of their subjects were 89 and above, while the ages ranged from eight years to fifteen years and four months. Both investigators also separated their subjects into mild and severe RD children, although the criteria for this distinction differed for both studies. Both investigators found similar WISC subtest patterns for mild and severe retarded readers.

Hirst (1960) designated mild RD subjects as those children who were achieving at a level less than two years below expected level based on Mental Age and severe RD subjects as those who were achieving at a level more than two years below the expected level. The Object Assembly, Block Design, Vocabulary and Similarities subtests were found to discriminate mild from severe RD children with severe RD subjects scoring significantly higher on the Object Assembly and Block Design subtests and significantly lower on the Vocabulary and Similarities subtests.

Sawyer used Bond and Tinker's formula to identify RD children. The severely retarded readers were defined as children whose progress was less than half the rate expected of them, while the mildly retarded

readers were children whose progress was at least half of that expected but were still one year below the expected level. Sawyer used Fisher's discriminant function for comparing WISC subtest scores and found that Arithmetic, Digit Span, Comprehension, Object Assembly, Picture Completion and Vocabulary subtests discriminated between mild and severely retarded readers.

Teacher Referral. Paterra (1963) and Silberberg and Feldt (1869) used subjects that had been referred for individual testing. Paterra's subjects were referred by teachers because of reading achievement which was lower than that expected on the basis of Mental Age. The subjects ranged in age from six years five months to fourteen years and six months. Mean IQ scores were not reported, although it was mentioned that IQ scores ranged from average through very superior. Paterra found that subtest variability depended on whether the Verbal IQ score or the Performance IQ score was higher. When the Verbal IQ score was higher than the Performance, no particular subtest pattern was evident. When the Performance IQ score was higher than the Verbal IQ score, a characteristic subtest pattern emerged with low scores on Information, Arithmetic, and Vocabulary and a high score on Picture Completion. Paterra also found a great deal of variation in the Similarities subtest score depending on which subtest score IQ was higher, the age, and IQ of the subject.

Silberberg and Feldt's subjects were first, second and third grade students referred for psychological evaluation. The Bond and Tinker formula was employed to determine reading deficiency and 36 percent of their population was identified as RD. In addition,

Silberberg and Feldt categorized their subjects according to whether or not their Performance IQ score was significantly greater than their Verbal IQ score. Significance was defined as a difference of 13 points or greater. The results indicated that retarded readers did not evidence a consistently higher WISC Performance IQ than Verbal IQ score. If a relationship does exist between reading disability and Performance IQ - Verbal IQ difference, it is not strong enough to be practically useful to school psychologists and educators. On the basis of a discriminant analysis, Silberberg and Feldt concluded that there is no characteristic WISC pattern that will discriminate RD children in grades one through three. Patterns in later grades may be a result rather than a cause of reading deficiency, reflecting the reduced environmental stimulation and experience accompanying school failure which logically follows an inability to learn to read.

School Population. Huelsman (1970) employed a discrepancy method to identify RD children within a broad-based (27 school districts, 10 states) school sample. His sample consisted of fourth graders who were at least one year and five months below their expected reading achievement based on their Mental Age. IQ score means were nor reported for this sample. Huelsman found a characteristic WISC subtest pattern of low scores on the Information, Arithmetic and Coding subtests; however, he found that only 23 out of 101 RD children had Performance IQ scores significantly higher than Verbal IQ scores.

A comparison of the results found by investigators employing the Years Below and discrepancy methods for identifying RD children would indicate that the extent to which the IQ range is restricted (average

range 90 - 109) accounts for similarities in the characteristics of children identified as RD. When samples are restricted to include only average IQ scores both methods may identify RD children whose Performance IQ scores are significantly higher than their Verbal IQ scores and who show a characteristic WISC subtest pattern.

In looking more closely at the specific Verbal subtests which the various investigators have found to discriminate RD children, considerable variation can be seen. Although low scores on the Information and Arithmetic subtests typify the characteristic subtest patterns found, this grouping does not hold true for all studies. For example, considerable variability seems to be related to the IQ range, age range, and the sample selection procedures employed in the study.

Studies have also varied considerably as to which Performance subtests have been found to discriminate RD children. Although the Coding subtest has frequently been found to be low, no specific Performance subtest pattern appears to have emerged from previous research.

Many of the published studies have lacked control groups, and some of the studies which did have control groups did not control for the most relevant variables. The most common methodological problems encountered include: lack of control for IQ; narrow IQ range; biased samples (clinic populations rather than school samples); lack of control for sex, chronological age (CA), mental age (MA), and grade level. It is often difficult to compare results of different studies due to the use of different criteria for identifying RD children. No investigation has yet compared the characteristics of RD children selected by different identification methods.

Statement of the Problem

The purpose of the present study is to compare the behavioral and test characteristics of RD children identified by three methods: the Years Below Grade Level, the Bond and Tinker discrepancy formula, and the Erickson Z-score discrepancy method. The Devereux Elementary School Behavior Rating scale which has previously been shown to identify profiles of differing patterns for children who are not learning effectively (Spivack and Swift, 1967, Swift and Spivack, 1969), is to be completed for each child by the teacher responsible for the child's reading instruction. The WISC and Spache Reading Diagnostic Scales were administered to obtain intelligence and reading achievement test characteristics for each child.

The study samples were drawn from the third grade of a public school system. Comparisons were made between experimental groups, identified by each of the three methods employing WISC Full Scale (FS) IQ, Verbal Scale (VS) IQ, and Performance Scale (PS) IQ as selection criteria, and their controls. Control groups for each experimental group were matched on the basis of sex and IQ scores. The comparison variables were the WISC IQ scores, the WISC subtests, the reading achievement scores, and the Devereux behavioral factors.

It is anticipated that RD children identified by the Years Below method will have the lowest IQ scores, while RD children identified by the Z-score method will have the highest FS IQ scores and those identified by the Bond and Tinker will have IQ scores which fall between those of the RD children identified by the Years Below and Z-score methods. It is expected that the largest number of WISC subtest differences will be found between the Z-score RD group and its control group, the smallest number

between the Years Below RD group and its control, and an intermediate number between the Bond and Tinker RD group and its control.

RD children identified by the three methods are expected to be rated as having a greater number of behavior problems than their controls, but no differences are expected among the three RD groups.

METHOD

Subjects

The subjects were all 119 third grade pupils of a North Carolina county elementary school. Two subjects were eliminated, one because of incomplete testing data and the other because of an IQ score below the cutoff point of a FS IQ of 75. The age range was eight years, zero months to nine years, three months, and included 55 males, 64 females, and 14 blacks.

Measures

Two Master's level psychologists administered the Wechsler Intelligence Scale for Children (Wechsler, 1949) and Spache Reading Diagnostic Scales[1] (Spache, 1972) to each pupil. Testing was begun mid-October 1973 and was completed by the end of February 1974. The Devereux Elementary School Behavior Rating Scale[2] (Spivack and Swift, 1967) was completed for each child by the teacher responsible for that child's reading instruction.

Research Design

Three methods for diagnosing RD children were employed: 1) Years Below Grade Level, 2) Bond and Tinker Expectancy Formula, and 3) Z-score

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[1]The Spache Reading Diagnostic Scale is a series of integrated tests developed to provide standardized evaluations of oral and silent reading skills and of auditory comprehension. Three Word Recognition Lists and twenty-two Reading Passages yield two reading levels, Word Recognition and Instructional, for each student. For the purpose of this study, a reading achievement score was obtained by taking a mean of the level achieved on the Word Recognition Lists and the Instructional Level.

[2]The Devereux Elementary School Behavior Rating Scale (DESB) consists of 47 items which are behavioral descriptions of typical classroom behaviors. The 47 items of the DESB have been factor analyzed into 11 behavioral factors. Each child is rated on how often he behaves as described in a given item, and the ratings are added together to obtain a raw score for each factor.

using the WISC FS IQ, VS IQ, and PS IQ scores as selection criteria where an IQ score was required. This procedure rendered nine RD groups. Each group was selected independently with replacement. Nine control groups, matched for sex and IQ were selected for comparison purposes.

When WISC FS IQ was used as the selection criterion, the following comparisons were made: PS IQ - VS IQ differences within RD and Control groups, comparisons among children not identified in common with regard to the selection criterion, comparisons between RD children and Control groups for reading achievement scores, comparisons among the RD groups for reading achievement scores, and comparisons between RD and Controls for all the WISC subtests.

When PS IQ was used as the selection criterion identical comparisons were made, however, with regard to the WISC subtests, comparisons between groups were made only for the Verbal subtests. When VS IQ was the selection criterion identical comparisons were made, with the WISC subtest comparisons being made only for the Performance subtests.

Comparisons were also made between each of the nine RD groups and their controls with regard to the 11 behavioral variables.

Procedure

Three diagnostic methods: 1) Years Below Grade Level, 2) Bond and Tinker Expectancy Formula and 3) Z-score employing three selection criteria: 1) Full Scale IQ, 2) Verbal Scale IQ and 3) Performance Scale IQ were used to identify RD children. Ten percent of the population was identified as RD by each method.

Full Scale IQ as Selection Criterion. Children were rank ordered in terms of their Spache reading achievement scores. The 10 percent of the population achieving the lowest reading scores were selected as meeting the Years Below Grade Level criteria for RD children. This selection method does not take IQ into consideration.

The Bond and Tinker Expectancy Formula, $\underline{/}\overline{(\text{years in school X IQ})/100 + 1.0)}\underline{/}$ = Expected Reading Grade, was employed to calculate an expected reading score for each subject using the WISC FS IQ where required by the formula. Discrepancies between the Expected reading score and the actual reading achievement score (Actual - Expected) were calculated for each subject. The 10 percent of the children with the largest discrepancies between expected and actual reading achievement (with the actual being less than the expected) were selected as RD children identified by the Bond and Tinker Expectancy Formula.

The Z-score method of diagnosing RD children is also based on a discrepancy model. The mean and standard deviation of the WISC FS IQ scores and the reading achievement scores for the entire subject population was calculated. A Z-score for both the FS IQ and reading achievement score was then calculated for each child. The Reading Achievement score was then subtracted from the FS IQ Z-score in order to derive a discrepancy measure. The discrepancy scores were then rank ordered, and the 10 percent of the children achieving the largest negative discrepancy scores are diagnosed as RD according to the Z-score method.

Control groups were selected for each of the three RD groups. The entire subject population other than those children identified as RD by that particular method constituted the group from which controls were selected. A control child matched for sex and FS IQ was selected for each individual RD child.

Performance Scale IQ as Selection Criterion. The Years Below Grade Level selection method does not take IQ into consideration; therefore, those children selected by this method were the same for the three IQ selection criteria.

The Bond and Tinker Expectancy formula was again employed to calculate an expected reading score for each subject using the WISC PS IQ where required by the formula, as described above.

Z-score discrepancies were calculated using the same procedure as described when FS IQ was the selection criterion. The discrepancy scores were then rank ordered and the 10 percent of the children receiving the largest negative discrepancy scores are diagnosed as RD according to the Z-score method.

Control groups were selected for these three RD groups in the same manner as when FS IQ is used as the selection criterion.

Verbal Scale IQ as Selection Criterion. The Years Below Grade Level selection method does not take IQ into consideration; therefore, those children selected by this method were the same for the three IQ selection criteria.

The Bond and Tinker Expectancy Formula was again employed to calculate an expected reading score for each subject using the WISC VS IQ where required by the formula, as described above.

Z-score discrepancies were calculated using the same procedure as previously described. The discrepancy scores were then rank ordered and RD children identified as before.

Control groups were selected for these three RD groups in the same manner as the Control groups described above.

RESULTS

Analyses of WISC Variables

The selection procedure rendered nine RD groups (i.e., three selection criteria for each of the three diagnostic methods) and nine matched Control groups for purposes of comparisons. Eighteen *t* test comparisons were made among the WISC PS IQ - VS IQ score differences for the RD groups selected by the three diagnostic methods and the three selection criteria and their Controls. Multiple *t* tests were conducted rather than an analysis of variance due to overlap of subjects within groups. Comparisons between RD children, identified by three diagnostic methods, on the basis of the IQ score used as a selection criterion were made. These comparisons included Years Below Grade Level versus Bond and Tinker, Bond and Tinker versus Z-score, and Z-score versus Years Below when FS IQ, PS IQ, and VS IQ were each used as a selection criterion, for a total of nine comparisons. Reading Achievement scores for RD children and their Controls were compared for the nine pairs of RD and Control groups. Comparisons between RD groups, identical to those comparisons made for the IQ score used as a selection criterion, were also made on the basis of reading achievement scores.

The WISC subtest patterns of children selected on the basis of the three diagnostic methods were analyzed in three ways: 1) comparison of RD and Control groups on all WISC subtests, 2) comparison of RD and Control groups on WISC Verbal subtests with WISC PS IQ score used as a covariate, and 3) comparison of RD and Control groups on WISC Performance subtests with WISC VS IQ score used as a covariate.

Multivariate analyses were performed on the WISC data comparing Controls with RD children selected by each of the three diagnostic methods: 1) Years Below Grade Level, 2) Bond and Tinker Expectancy Formula, and 3) Z-score with PS IQ and VS IQ scores serving as covariates when these variables were used as selection criteria. No significant differences were found for any of the nine comparisons of RD and Control groups on the variables considered. Appendix A presents the results of these analyses.

Comparison of WISC IQ and Subtest Scores when Full Scale IQ was the Selection Criterion

RD children were selected by the three diagnostic methods employing the WISC FS IQ as a criterion for those methods requiring an IQ score. Control subjects were selected for each RD child matching for WISC FS IQ and sex. Due to the limited sample from which Control subjects were selected, matches ranged from zero to six points.

The means and standard deviations (SDs) for the WISC IQ scores and subtests for the children selected by the three diagnostic methods and their Controls can be found in Table 1. RD children identified by the Years Below and Bond and Tinker methods tended to have lower mean FS, VS, and PS IQ scores than those children identified by the Z-score method. Larger differences between RD and Control groups were found for the VS IQ scores than for the PS IQ scores; however, these differences only ranged from three to six points. For the Years Below and Bond and Tinker methods RD children achieved lower VS IQ scores than Controls; however, for the Z-score method, Controls achieved lower VS IQ scores than RD children. In general, RD children

TABLE 1

Means and Standard Deviations for WISC IQ and Subtest Scores when Full Scale IQ is the Selection Criterion for Three Diagnostic Methods: 1) Years Below Grade Level, 2) Bond and Tinker Expectancy Formula, and 3) Z-score

WISC Variables	Reading Disabled		Control	
	Mean	SD	Mean	SD
Years Below Grade Level				
WISC FS IQ	93.25	5.29	96.16	5.68
WISC VS IQ	91.16	7.13	97.42	10.44
WISC PS IQ	95.83	8.94	95.25	8.20
Information	7.16	1.40	9.16	2.12
Comprehension	9.00	3.24	10.33	2.67
Arithmetic	7.92	2.10	8.83	2.58
Similarities	10.50	1.68	10.75	2.38
Vocabulary	8.00	2.41	10.50	2.17
Digit Span	8.92	2.19	8.66	2.06
Picture Completion	10.25	3.52	10.08	2.46
Picture Arrangement	9.58	1.73	9.25	2.05
Block Design	9.42	1.68	9.16	2.36
Object Assembly	9.08	2.23	9.08	1.68
Coding	9.08	3.20	9.08	2.42
Bond and Tinker Expectancy Formula				
WISC FS IQ	96.58	10.40	98.42	9.28
WISC VS IQ	94.25	11.97	97.33	11.63
WISC PS IQ	99.00	11.38	99.66	7.58
Information	7.42	1.68	8.58	2.15
Comprehension	9.08	3.55	10.50	2.15
Arithmetic	8.50	2.54	8.92	3.20
Similarities	11.42	2.68	11.16	2.52
Vocabulary	8.58	2.84	10.66	2.57
Digit Span	9.33	2.53	8.33	1.72
Picture Completion	10.50	3.45	10.58	2.74
Picture Arrangement	10.50	2.35	9.75	1.71
Block Design	10.08	1.56	9.42	2.02
Object Assembly	9.16	2.20	9.92	1.73
Coding	9.42	3.00	10.08	2.90

TABLE 1 -- Continued

WISC Variables	Reading Disabled		Control	
	Mean	SD	Mean	SD
	Z-score			
WISC FS IQ	115.08	14.12	113.33	11.20
WISC VS IQ	114.42	16.74	110.33	12.90
WISC PS IQ	116.58	10.06	114.08	9.65
Information	9.83	3.54	10.58	2.84
Comprehension	12.92	2.81	12.92	3.32
Arithmetic	10.00	3.41	10.08	3.42
Similarities	14.66	2.46	14.00	2.37
Vocabulary	12.50	2.43	12.58	2.74
Digit Span	10.58	4.30	9.58	2.02
Picture Completion	13.58	3.00	12.16	2.98
Picture Arrangement	12.92	2.78	10.83	2.20
Block Design	12.92	2.84	12.33	2.64
Object Assembly	12.00	2.13	11.75	1.96
Coding	10.42	3.32	12.92	3.32

achieved lower mean VS IQ scores than PS IQ scores for the three identification methods. These differences (PS IQ - VS IQ) were 2.16, 4.67, and 4.75 for Z-score, Years Below, and Bond and Tinker, respectively. A series of t tests on these PS IQ - VS IQ differences yielded significant results (t = 1.96, df = 11, $p < .05$) with the PS IQ being significantly higher than the VS IQ score for the Z-score method, but not for the Bond and Tinker or Years Below methods. No significant differences were found for PS IQ - VS IQ for any of the three Control groups.

When FS IQ was the selection criterion, only one child was identified in common by the three methods. Nine children were identified in common by the Years Below and Bond and Tinker methods. Three children were identified in common by the Bond and Tinker and Z-score method, and one child in common by Z-score and Years Below. A series of t test comparisons on these RD children not shared in common on the basis of their FS IQ scores yielded significant differences between children identified by the Bond and Tinker and Z-score groups (t = 2.20, df = 8, $p < .05$) and between the Years Below and Z-score groups (t = 2.60, df = 10, $p < .05$). However, no significant differences were found between those children identified by the Years Below and Bond and Tinker methods. (Table D, Appendix A, presents methods identifying individual RD children.)

Comparisons between RD and Control children on the basis of their reading achievement scores yielded significant differences between groups for the three diagnostic methods: Years Below (t = 4.50, df = 11, $p < .01$). The t tests comparing those RD children not shared in common by the diagnostic methods on the basis of [illegible]

by the diagnostic methods on the basis of their reading achievement scores yielded significant differences between children identified by the Bond and Tinker and Z-score groups ($t = 3.12$, $df = 8$, p .01) and between the Years Below and Z-score groups ($t = 3.02$, $df = 10$, p .01). However, no significant differences were found between those children not identified in common by the Years Below and Bond and Tinker methods.

Years Below Grade Level. Univariate analyses for the WISC subtests comparing the Control and RD groups selected by the Years Below Method are presented in Table 2. The RD children had Information ($F = 5.44$, $df = 1/21$, p .05) and Vocabulary ($F = 5.68$, $df = 1/21$, p .05) scores which were significantly lower than those of the Control children; however, no significant differences were found for the remaining subtests.

Bond and Tinker Expectancy Formula. Univariate analyses for the WISC subtests comparing the Control and RD groups selected by the Bond and Tinker method are presented in Table 3. No significant differences between RD and Controls were found for any of the subtests.

Z-score. Univariate analyses for the WISC subtests comparing the Control and RD children selected by the Z-score method are presented in Table 4. The analyses yielded no significant differences between RD children and their Controls for any of the subtests.

Summary. Significant WISC FS IQ differences were found between RD children not identified in common by the Bond and Tinker and Z-score methods. Significant differences were also found between RD children not identified in common by the Years Below and Z-score methods. No significant differences were found, however, between children not identified in

TABLE 2

Univariate Analyses Comparing RD and Control Groups on WISC Subtest Scores When Full Scale IQ is the Selection Criterion for Years Below Grade Level Method

Source: RD vs Control	df	MS	F
Verbal Subtests			
Information	1	24.00	7.40*
Error	21	3.24	
Comprehension	1	10.66	1.20
Error	21	8.84	
Arithmetic	1	5.04	0.90
Error	21	5.57	
Similarities	1	0.38	0.08
Error	21	4.24	
Vocabulary	1	37.50	5.68*
Error	21	6.59	
Digit Span	1	0.38	0.08
Error	21	4.52	
Performance Subtests			
Picture Completion	1	0.16	0.02
Error	21	9.23	
Picture Arrangement	1	0.66	0.18
Error	21	3.60	
Block Design	1	0.38	0.08
Error	21	4.20	
Object Assembly	1	0.00	0.00
Error	21	3.90	
Coding	1	0.00	0.00
Error	21	8.08	

*$p < .05$

TABLE 3

Univariate Analyses Comparing RD and Control Groups on WISC Subtest Scores When Full Scale IQ is the Selection Criterion for Bond and Tinker Expectancy Formula

Source: RD vs Control	df	MS	F
Verbal Subtests			
Information	1	8.16	2.20
Error	21	3.72	
Comprehension	1	12.04	1.39
Error	21	8.63	
Arithmetic	1	1.04	0.12
Error	21	8.36	
Similarities	1	0.38	0.06
Error	21	6.75	
Vocabulary	1	26.04	3.54
Error	21	7.34	
Digit Span	1	6.00	1.28
Error	21	4.70	
Performance Subtests			
Picture Completion	1	0.04	0.00
Error	21	9.72	
Picture Arrangement	1	3.38	0.80
Error	21	4.24	
Block Design	1	2.66	0.82
Error	21	3.26	
Object Assembly	1	3.38	0.86
Error	21	3.94	
Coding	1	2.66	0.30
Error	21	8.72	

TABLE 4

Univariate Analyses Comparing RD and Control Groups on WISC Subtest Scores When Full Scale IQ is the Selection Criterion for the Z-score Method

Source: RD vs Control	df	MS	F
Verbal Subtests			
Information	1	3.38	0.32
Error	21	10.30	
Comprehension	1	0.00	0.00
Error	21	9.44	
Arithmetic	1	0.04	0.00
Error	21	11.68	
Similarities	1	2.66	0.46
Error	21	5.84	
Vocabulary	1	0.04	0.00
Error	21	6.72	
Digit Span	1	6.00	0.53
Error	21	11.26	
Performance Subtests			
Picture Completion	1	12.04	1.34
Error	21	8.94	
Picture Arrangement	1	26.04	4.13
Error	21	6.30	
Block Design	1	2.04	0.27
Error	21	7.52	
Object Assembly	1	0.38	0.08
Error	21	4.19	
Coding	1	37.50	3.41
Error	21	10.99	

identified in common by the Years Below and Bond and Tinker methods. Significant PS IQ - VS IQ differences were found for the Z-score RD children but not for RD children identified by either Years Below or Bond and Tinker. No significant PS IQ - VS IQ differences were found for Control groups.

Significant reading achievement differences were found between RD children identified by the three diagnostic methods and their Controls. Comparisons between groups yielded significant differences in reading achievement between RD children identified by the Bond and Tinker and Z-score methods and also between RD children identified by the Years Below and Z-score methods. However, no significant differences were found between the children not identified in common by the Years Below and Bond and Tinker methods.

Very few subtest differences between RD and Control groups were found. No single subtest consistently discriminated the RD and Control children across the three diagnostic methods. Two subtests, Information and Vocabulary, discriminated Control and RD children, identified by the Years Below Grade Level method, with the latter achieving lower mean subtest scores. However, the univariate analyses yielded no significant differences between RD and Control Children on any of the subtests for either the Bond and Tinker or Z-score methods.

Comparison of WISC IQ and Subtest Scores when Performance Scale IQ was the Selection Criterion

RD children were selected by the three diagnostic methods employing the WISC PS IQ as a criterion when an IQ score was required. Control subjects were selected for each RD child matching for WISC PS IQ and

sex. Due to the limited sample from which Control subjects were selected close matches could not be made for every RD child. In order to eliminate variance due to less than perfect matches the PS IQ was used as a covariate in the analysis of the data.

The means and SDs for the WISC Verbal subtests for the children selected by the three diagnostic methods and their controls can be found in Table 5. RD children identified by the Years Below and Bond and Tinker methods tended to have lower FS, VS, and PS IQ scores than those RD children identified by the Z-score method. Also, Controls tended to achieve higher VS IQ scores than RD children, when PS IQ was the selection criterion, with a range of 12.75 (Bond and Tinker) to 14.66 (Z-score) points. In general, RD children achieved lower mean VS IQ scores than PS IQ scores for the three identification methods. These differences (PS IQ - VS IQ) were 4.67, 6.17 and 13.41 for Years Below, Bond and Tinker and Z-score, respectively. A series of t tests on these PS IQ - VS IQ differences yielded significant results ($t = 5.38$, $df = 11$, $p < .01$) with the PS IQ being higher than the VS IQ for the Z-score method. No significant differences for PS IQ - VS IQ were found for any of the three control groups.

When PS IQ was used as the selection criterion two children were identified in common by the three methods. Ten children were identified in common by the Years Below and Bond and Tinker methods. Six children were identified in common by the Bond and Tinker and Z-score methods and four children in common by the Z-score and Years Below methods. A series of t tests comparing those RD children not shared in common on the basis of their PS IQ scores yielded significant differences between the

TABLE 5

Means and Standard Deviations for WISC IQ and Verbal Subtest Scores when Performance Scale IQ is the Selection Criterion for Three Diagnostic Methods: 1) Years Below Grade Level, 2) Bond and Tinker Expectancy Formula, and 3) Z-score

WISC Variables	Reading Disabled		Control	
	Mean	SD	Mean	SD
Years Below Grade Level				
WISC FS IQ	93.25	5.29	102.00	9.18
WISC VS IQ	91.16	7.13	104.66	10.64
WISC PS IQ	95.83	8.94	98.58	7.22
Information	7.16	1.40	10.16	1.80
Comprehension	9.00	3.24	11.00	3.10
Arithmetic	7.92	2.10	10.16	1.94
Similarities	10.50	1.68	11.92	2.23
Vocabulary	8.00	2.41	11.92	2.90
Digit Span	8.92	2.19	9.16	1.94
Bond and Tinker Expectancy Formula				
WISC FS IQ	96.83	10.65	105.08	13.42
WISC VS IQ	93.75	11.69	106.50	15.34
WISC PS IQ	99.92	12.47	102.50	10.29
Information	7.42	1.68	10.16	2.44
Comprehension	9.08	3.55	11.83	3.22
Arithmetic	8.42	2.54	10.16	2.29
Similarities	11.42	2.68	12.08	2.84
Vocabulary	8.66	2.87	12.25	3.04
Digit Span	8.92	2.28	9.50	3.50
Z-score				
WISC FS IQ	106.50	8.66	114.66	8.94
WISC VS IQ	99.42	10.80	114.08	11.22
WISC PS IQ	112.83	7.08	112.75	7.06
Information	8.00	1.95	11.08	1.38
Comprehension	10.92	2.46	12.58	3.98
Arithmetic	8.25	2.14	10.50	2.46
Similarities	12.75	2.22	14.08	1.73
Vocabulary	10.58	2.61	13.50	2.28
Digit Span	8.75	2.52	11.25	3.64

children identified by the Bond and Tinker and Z-score groups (t = 7.39, df = 5, $p < .01$) and between the Years Below and Z-score groups (t = 6.97, df = 8, $p < .01$). However, no significant differences were found between those children identified by the Years Below and Bond and Tinker methods. (Table D, Appendix A, presents the methods identifying individual RD children.)

Comparisons between RD and Control children on the basis of their reading achievement scores yielded significant differences between groups for the three diagnostic methods: Years Below (t = 5.52, df = 11, $p < .01$), Bond and Tinker (t = 4.78, df = 11, $p < .01$) and Z-score (t = 6.59, df = 11, $p < .01$). A series of t tests comparing those RD children not shared in common by the diagnostic methods on the basis of their reading achievement scores yielded significant differences between children identified by the Bond and Tinker and Z-score groups (t = 2.22, df = 5, $p < .05$) and between the Years Below and Z-score groups (t = 2.07, df = 8, $p < .05$). However, no significant differences were found between those children not identified in common by the Years Below and Bond and Tinker methods.

Years Below Grade Level. Univariate analyses for the WISC Verbal subtests comparing Control and RD groups identified by the Years Below method are presented in Table 6. The RD children had significantlylower subtest scores than their Controls for the following Verbal subtests: Information (F = 18.54, df 1/21, $p < .01$), Arithmetic (F = 7.48, df = 1/21, p .05), and Vocabulary (F = 12.10, df = 1/21, $p < .05$).

TABLE 6

Univariate Analyses Comparing RD and Control Groups on WISC Verbal Subtest Scores with Covariance of the Performance Scale IQ for the Years Below Grade Level Method

Source: RD vs Control	df	MS	F
Verbal Subtests			
Information	1	49.22	18.54**
Covariate	1	1.60	0.60
Error	21	2.65	
Comprehension	1	15.65	1.66
Covariate	1	24.85	2.64
Error	21	9.38	
Arithmetic	1	31.74	7.48*
Covariate	1	1.41	0.33
Error	21	4.24	
Similarities	1	7.30	2.22
Covariate	1	16.88	5.13
Error	21	3.28	
Vocabulary	1	71.31	12.10**
Covariate	1	33.19	5.63
Error	21	5.89	
Digit Span	1	1.24	0.30
Covariate	1	8.68	2.12
Error	21	4.09	

**$p < .01$
*$p < .05$

Bond and Tinker Expectancy Formula. Univariate analyses for the WISC Verbal subtests comparing Control and RD groups identified by the Bond and Tinker method are presented in Table 7. Significant differences were found between groups for the Information (F = 10.56, df = 1/21, $p < .01$), and Vocabulary (F = 9.72, df = 1/21, $p < .01$) subtests with RD children achieving lower subtest scores.

Z-score. Univariate analyses for the WISC Verbal subtests comparing the Control and RD children identified by the Z-score method are presented in Table 8. The Information (F = 20.04, df = 1/21, $p < .01$), Arithmetic (F = 6.84, df = 1/21, $p < .05$), and Digit Span (F = 4.42, df = 1/21, $p < .05$) subtests discriminated the significantly lower scoring RD children from their Controls.

Summary. Significant WISC PS IQ differences were found between the RD children identified by the Bond and Tinker and Z-score methods. Significant differences were also found between RD children identified by the Years Below and Z-score methods. However, no significant differences were found between children identified by the Years Below and Bond and Tinker methods. Significant PS IQ - VS IQ differences with PS IQ being significantly higher were found for the Z-score RD children but not for the RD children identified by either the Years Below or Bond and Tinker methods. No significant PS IQ - VS IQ differences were found for Control groups.

Significant reading achievement differences were found between the RD children identified by the three diagnostic methods and their Controls. Comparisons between groups yielded significant differences in reading achievement between RD children identified by the Bond and Tinker

TABLE 7

Univariate Analyses Comparing RD and Control Groups on WISC Verbal Subtest Scores with Covariance of Performance Scale IQ for the Bond and Tinker Expectancy Formula

Source: RD vs Control	df	MS	F
Verbal Subtests			
Information	1	37.78	10.56**
Covariate	1	21.46	0.00
Error	21	3.58	
Comprehension	1	32.66	3.80
Covariate	1	74.24	8.74
Error	21	8.49	
Arithmetic	1	15.74	2.70
Covariate	1	6.10	1.04
Error	21	5.83	
Similarities	1	00.22	0.06
Covariate	1	95.08	27.44
Error	21	3.46	
Vocabulary	1	60.78	9.72**
Covariate	1	61.68	9.86
Error	21	6.24	
Digit Span	1	1.44	0.16
Covariate	1	3.47	0.38
Error	21	8.97	

**$p < .01$

TABLE 8

Univariate Analyses Comparing RD and Control Groups on WISC Verbal Subtest Scores with Covariance of the Performance Scale IQ for Z-score

Source: RD vs Control	df	MS	F
Verbal Subtests			
Information	1	57.20	20.04**
Covariate	1	2.98	1.04
Error	21	2.85	
Comprehension	1	17.02	1.85
Covariate	1	48.76	5.30
Error	21	9.19	
Arithmetic	1	30.70	6.84*
Covariate	1	22.98	5.12
Error	21	4.48	
Similarities	1	10.80	2.96
Covariate	1	10.56	2.89
Error	21	3.64	
Vocabulary	1	51.34	9.00**
Covariate	1	12.16	2.13
Error	21	5.70	
Digit Span	1	37.96	4.42*
Covariate	1	36.46	4.25
Error	21	8.57	

**$p < .01$
*$p < .05$

and Z-score methods and also between RD children identified by the Years Below and Z-score methods. However, no significant differences were found between children not identified in common by the Years Below and Bond and Tinker Methods.

With the PS IQ as a covariate, both the Information and Vocabulary subtests discriminated RD children from Controls for the three diagnostic methods. The Arithmetic subtest discriminated Control and RD children identified by both the Years Below and Z-score methods. One subtest, Digit Span, discriminated RD and Control children identified only by the Z-score method. RD children score consistently lower than controls on all the subtests for which significant differences were found.

Comparison of WISC IQ and Subtest Scores when Verbal Scale IQ was the Selection Criterion

RD children were selected by the three diagnostic methods employing the WISC VS IQ score as a selection criterion where an IQ score was required. Control subjects were selected for each RD child matching for WISC VS IQ and sex. Due to the limited sample for which Control subjects were selected, close matches could not be made for every RD child. In order to eliminate variance due to less than perfect matches the VS IQ was used as a covariate in the analysis of the data.

The means and SDs for the WISC IQ scores and Performance subtests for the children selected by the three diagnostic methods and their controls can be found in Table 9. RD children identified by the Years Below method tended to have lower FS, VS, and PS IQ scores than those children identified by the Z-score method. The FS, VS, and PS IQ scores

TABLE 9

Means and Standard Deviations for WISC IQ and Performance Subtest Scores when Verbal Scale IQ is the Selection Criterion for the Diagnostic Methods: 1) Years Below Grade Level, 2) Bond and Tinker Expectancy Formula, and 3) Z-score

WISC Variables	Reading Disabled		Controls	
	Mean	SD	Mean	SD
Years Below Grade Level				
WISC FS IQ	93.25	5.29	97.25	6.70
WISC VS IQ	91.16	7.13	93.92	6.00
WISC PS IQ	95.83	8.94	101.16	8.28
Picture Completion	10.25	3.52	10.75	2.42
Picture Arrangement	9.58	1.73	9.58	1.56
Block Design	9.42	1.68	10.58	2.96
Object Assembly	9.08	2.23	10.58	1.98
Coding	9.08	3.20	9.42	2.19
Bond and Tinker Expectancy Formula				
WISC FS IQ	98.25	10.74	100.58	10.40
WISC VS IQ	97.75	11.97	97.755	11.68
WISC PS IQ	98.66	11.53	103.92	8.32
Picture Completion	11.08	3.94	10.25	2.30
Picture Arrangement	10.50	2.46	10.25	2.00
Block Design	9.58	1.68	11.25	2.52
Object Assembly	9.00	2.04	10.42	1.00
Coding	9.25	3.08	10.66	2.50
Z-score				
WISC FS IQ	108.08	13.13	114.50	9.90
WISC VS IQ	112.33	11.75	112.25	11.59
WISC PS IQ	101.92	14.22	114.16	8.99
Picture Completion	11.50	3.03	11.16	2.25
Picture Arrangement	10.83	2.66	11.50	2.06
Block Design	10.16	3.35	13.08	1.67
Object Assembly	9.42	2.02	11.92	1.67
Coding	9.50	2.43	12.50	3.23

of those RD children identified by the Bond and Tinker method fell midway between those of the other two groups. Control children tended to achieve higher PS IQ than RD children when VS IQ was the selection criterion. The differences ranged from a low of 5.33 (Years Below) to a high of 12.24 (Z-score) points. The Years Below and Bond and Tinker RD children achieved considerably higher VS IQ scores than PS IQ sc-res. These PS IQ - VS IQ differences were 4.67, .91, and -10.41 for Years Below, Bond and Tinker, and Z-score, respectively. A series of t tests on these PS IQ - VS IQ differences yielded a significant difference (t = 3.84, df = 11, $p < .01$) with the VS IQ being significantly higher than PS IQ for the Z-score group. However, no significant differences were found for either the Years Below or Bond and Tinker groups. Comparisons for the Control groups revealed significantly higher PS IQ scores for both the Years Below (t = 3.28, df = 11, $p < .01$), and Bond and Tinker (t = 2.79, df = 11, $p < .01$) methods but not for the Z-score method.

When VS IQ was used as the selection criterion, two children were identified in common by the three methods. Years Below and Bond and Tinker, Bond and Tinker and Z-score, and Z-score and Years Below identified eight, six and two children in common, respectively. A series of t tests comparing those RD children not shared in common on the basis of their VS IQ scores yielded significant differences between children identified by the three methods: Years Below versus Bond and Tinker (t = 3.57, df = 3, $p < .05$), Bond and Tinker versus Z-score (t = 5.00, df = 5, $p < .01$) and Years Below versus Z-score (t = 6.16, df = 9, $p < .01$) with RD children consistently scoring

lower. (Table D, Appendix A, presents methods identifying individual RD children.)

Comparisons between RD and Control children on the basis of their reading achievement scores yielded significant differences between groups, with RD children scoring lower, for the three diagnostic methods: Years Below (t = 4.61, df = 11, $p < .01$), Bond and Tinker (t = 5.60, df = 11, $p < .01$), and Z-score (t = 8.87, df = 11, $p < .01$). A series of t tests comparing those RD children not shared in common by the diagnostic methods on the basis of their reading achievement scores yielded significant differences between children identified by the Years Below and Bond and Tinker groups (t = 2.67, df = 3, $p < .05$), Bond and Tinker and Z-score groups (t = 3.22, df = 5, $p < .05$), and Years Below and Z-score groups (t = 3.02, df = 9, $p < .01$).

Years Below Grade Level. Univariate analyses for the WISC Performance subtests comparing the Control and RD groups identified by the Years Below Grade Level method are presented in Table 10. The analyses yielded no significant differences between groups for any of the subtests.

Bond and Tinker Expectancy Formula. Univariate analyses for the WISC Performance subtests comparing the Control and RD groups identified by the Bond and Tinker method are presented in Table 11. The RD children obtained Object Assembly scores which were significantly lower (F = 6.06, df = 1/21, $p < .05$) than those of Control children; however, no significant differences were found for the remaining subtests.

TABLE 10

Univariate Analyses Comparing RD and Control Groups on WISC Performance Subtest Scores with Covariance of the Verbal Scale IQ for the Years Below Grade Level Method

Source: RD vs Control	df	MS	F
Performance Subtests			
Picture Completion	1	0.29	0.03
Covariate	1	9.48	1.04
Error	21	9.10	
Picture Arrangement	1	0.02	0.01
Covariate	1	0.63	0.22
Error	21	2.82	
Block Design	1	8.39	1.38
Covariate	1	0.24	0.04
Error	21	6.08	
Object Assembly	1	10.96	2.40
Covariate	1	1.70	0.37
Error	21	4.58	
Coding	1	1.32	0.16
Covariate	1	2.69	0.34
Error	21	7.76	

TABLE 11

Univariate Analyses Comparing RD and Control Groups on WISC Performance Subtest Scores with Covariance of the Verbal Scale IQ for the Bond and Tinker Expectancy Formula

Source: RD vs Control	df	MS	F
Performance Subtests:			
Picture Completion	1	4.00	0.38
Covariate	1	12.44	1.20
Error	21	10.32	
Picture Arrangement	1	0.30	0.08
Covariate	1	29.22	7.48
Error	21	3.90	
Block Design	1	16.97	3.98
Covariate	1	11.50	7.48
Error	21	4.26	
Object Assembly	1	12.33	6.06*
Covariate	1	14.25	7.02
Error	21	2.03	
Coding	1	12.28	1.58
Covariate	1	9.58	1.23
Error	21	7.78	

*$p < .05$

Z-score. Univariate analyses for the WISC Performance subtests comparing the Control and RD children identified by the Z-score method are presented in Table 12. Significant differences between groups were found for the Block Design ($F = 9.51$, $df = 1/21$, $p < .01$), Object Assembly ($F = 13.55$, $df = 1/21$, $p < .01$) and the Coding ($F = 7.54$, $df = 1/21$, $p < .05$) subtests with RD children scoring consistently lower than their Controls.

Summary. Significant WISC VS IQ differences were found among the groups of RD children identified by the three diagnostic methods. Significant PS IQ - VS IQ differences, with VS IQ being significantly higher, were found for the Z-score RD children but not for RD children identified by either Years Below or Bond and Tinker. However, Control children for both the Years Below and Bond and Tinker methods had significantly higher PS IQ scores than VS IQ scores. Control children for the Z-score method did not have significant PS IQ - VS IQ differences.

Significant reading achievement differences were found between RD children identified by the three diagnostic methods and their Controls. Comparisons between groups yielded significant differences in reading achievement between RD children identified by the Years Below and Bond and Tinker methods, between the Bond and Tinker and Z-score methods, and between the Years Below and Z-score methods.

When the VS IQ was used as the covariate no single subtest discriminated between RD and Control children identified by the three diagnostic methods. One subtest, Object Assembly, discriminated RD and Control children for both the Bond and Tinker and Z-score methods.

TABLE 12

Univariate Analyses Comparing RD and Control Groups on WISC Performance Subtest Scores with Covariance of the Verbal Scale IQ for the Z-score Method

Source: RD vs Control	df	MS	F
Performance Subtests:			
Picture Completion	1	0.64	0.09
Covariate	1	11.98	1.74
Error	21	6.88	
Picture Arrangement	1	2.74	0.66
Covariate	1	37.70	9.10
Error	21	4.14	
Block Design	1	51.38	9.51**
Covariate	1	41.12	7.61
Error	21	5.40	
Object Assembly	1	37.69	13.55**
Covariate	1	17.43	6.26
Error	21	2.78	
Coding	1	54.29	7.54*
Covariate	1	28.94	4.02
Error	21	7.19	

**p < .01
*p < .05

Two subtests, Block Design and Coding, discriminated RD and Control children identified only by the Z-score method. The RD children scored consistently lower than their controls on all subtests for which significant differences were found.

Summary

The Multivariate analyses for the three diagnostic methods employing appropriate covariates yielded no significant differences between RD children and their Controls for any of the nine comparisons.

PS IQ - VS IQ differences were found to be significant for RD children identified by the Z-score method for each of the three IQ scores used as selection criteria. When FS IQ and PS IQ were used as selection criteria, PS IQ was significantly higher than VS IQ; however, when VS IQ was the selection criterion, PS IQ was significantly lower than VS IQ for the Z-score group. No significant PS IQ - VS IQ differences were found for RD children identified by either the Years Below or Bond and Tinker methods regardless of which IQ score was employed as the selection criterion. However, PS IQ was significantly higher than VS IQ for the Years Below and Bond and Tinker Control groups when VS IQ was the selection criterion. No significant difference was found for the Z-score Control group.

When VS IQ was employed as the selection criterion, *t* tests yielded significant differences between RD children not identified in common by the Years Below and Bond and Tinker methods, but not when either FS IQ or PS IQ were used as the selection criteria. Comparisons between RD children identified by the Bond and Tinker and Z-score and

also between RD children identified by Years Below and Z-score yielded significant differences between groups when each of the three IQ scores were employed as selection criteria.

Significant reading achievement differences were found between the RD children identified by the three diagnostic methods and their controls for each of the three IQ scores used as selection criteria. Comparisons between groups yielded significant differences in reading achievement between RD children identified by the Bond and Tinker and Z-score methods when FS IQ, PS IQ, and VS IQ were used as selection criteria. Comparisons between the Years Below and Bond and Tinker groups yielded significant reading achievement differences when VS IQ was employed as the selection criterion, but not when either FS IQ or PS IQ was used as the selection criterion.

Table 13 presents a summary of the significant subtest findings for the univariate analyses for the three diagnostic methods when each of the three IQ scores was used as a selection criterion.

For the Years Below method, Information and Vocabulary subtests yielded significant differences between RD children and Controls with RD children achieving lower subtest scaled scores than their Controls. For the Bond and Tinker and Z-score methods no significant differences between RD and Controls were found for any of the subtests.

When PS IQ was used as a selection criterion and covariate, univariate analyses were performed only on the Verbal subtests. For the Years Below method, significant differences were found on the Information, Arithmetic, and Vocabulary subtests. For the Bond and Tinker Expectancy Formula, the Information and Vocabulary subtests were

TABLE 13

Summary Table of Significant Univariate Analyses Comparing RD and Control Groups on WISC Subtests for Three Diagnostic Methods

Selection Criteria	Years Below	Bond and Tinker	Z-score
Full Scale IQ			
Verbal Subtests	Information Vocabulary	*	*
Performance Subtests	*	*	*
Performance Scale IQ			
Verbal Subtests	Information Arithmetic Vocabulary	Information Vocabulary	Information Arithmetic Vocabulary Digit Span
Verbal Scale IQ			
Performance Subtests	*	Object Assembly	Block Design Object Assembly Coding

*No significant differences

significant for the Z-score method, significant differences were found for the Information, Vocabulary and Digit Span subtests.

When VS IQ was used as a selection criterion and covariate, univariate analyses were performed only on the Performance subtests. Univariate analyses for the Years Below method yielded no significant differences. For the Bond and Tinker method, significant differences were found for the Object Assembly subtest, and for the Z-score method the Block Design, Object Assembly and Coding subtests were significant.

In summarizing the WISC subtest findings, when FS IQ was the basis for RD selection, significant differences between RD children and Controls, identified by the Years Below method, were found for the Information and Vocabulary subtests. When PS IQ was the selection criterion, RD children differed significantly from Controls on the Inofrmation and Vocabulary subtests for the three diagnostic methods and also on the Arithmetic subtest when only the Years Below and Z-score methods were considered. When VS IQ was the selection criterion, RD children identified by the Bond and Tinker and Z-score methods differed significantly from their Controls only on the Object Assembly subtest.

Analyses of Behavioral Factors

The Devereux Behavioral Ratings of children selected as RD on the basis of three diagnostic methods were analyzed in three ways: comparison of RD and Control groups on behavioral factors with 1) WISC FS IQ score as covariate, 2) with WISC PS IQ score as covariate, and 3) with WISC VS IQ score as covariate.

Multivariate analyses of covariance were performed for each of the three diagnostic methods: 1) Years Below Grade Level, 2) Bond and Tinker Expectancy Formula, and 3) Z-score with covariance for: 1) FS IQ, 2) PS IQ, and 3) VS IQ scores. No significant differences were found for any of the nine comparisons of RD and Control groups on the behavioral facotrs. Appendix A presents the results of these analyses.

The results of univariate analyses comparing the nine RD groups and their controls on the 11 Devereux factors follow.

Comparison of Devereux Behavioral Factors with WISC Full Scale IQ as Covariate

RD children selected as RD by the three diagnostic methods, employing WISC FS IQ as a criterion where an IQ score was required, and their controls were rated by their reading teachers on the Devereux Behavior Rating Scale. WISC FS IQ was used as a covariate in order to eliminate variance due to less than perfect matches.

The means and SDs for the Devereux behavioral factors for the children selected by the three diagnostic methods and their Controls when FS IQ was employed as a covariate can be found in Table 14.

Years Below Grade Level. Univariate analyses for the Devereux behavioral factors comparing the RD children selected by the Years Below method and their Controls are presented in Table 15. The RD children were rated significantly lower than Controls on the Creative Initiative factor ($F = 4.92$, $df = 1/21$, p .05); however, no significant differences were found for the remaining factors.

Bond and Tinker Expectancy Formula. Univariate analyses for the Devereux behavioral factors comparing the RD group selected by Bond and

TABLE 14

Means and Standard Deviations for Devereux Ratings when Full Scale IQ is the Selection Criterion for Three Diagnostic Methods: 1) Years Below Grade Level, 2) Bond and Tinker Expectancy Formula, and 3) Z-score

Behavioral Factors	Reading Disabled		Control	
	Mean	SD	Mean	SD
Years Below Grade Level				
Classroom Disturbance	15.08	4.20	14.25	3.88
Impatience	13.25	3.36	12.75	4.65
Disrespect-Defiance	9.16	4.56	7.50	3.00
External Blame	10.25	4.63	8.66	4.03
Achievement Anxiety	10.42	4.06	9.75	4.43
External Reliance	21.92	3.70	19.00	6.55
Comprehension	7.83	1.74	10.33	3.05
Inattentive-Withdrawn	15.25	5.17	13.75	5.28
Irrelevant Responsiveness	9.66	2.90	9.50	4.25
Creative Initiative	7.33	1.61	9.83	4.15
Closeness to Teacher	13.50	3.18	13.50	3.34
Bond and Tinker Expectancy Formula				
Classroom Disturbance	14.66	4.60	14.00	5.17
Impatience	13.75	3.19	12.33	4.72
Disrespect-Defiance	9.08	4.64	7.66	3.50
External Blame	9.83	4.97	9.75	4.18
Achievement Anxiety	11.08	4.76	10.75	4.22
External Reliance	21.50	4.23	18.33	5.78
Comprehension	7.75	1.91	10.83	3.12
Inattentive-Withdrawn	14.92	5.90	12.33	5.77
Irrelevant Responsiveness	9.00	3.24	9.33	4.43
Creative Initiative	8.50	3.68	10.75	4.54
Closeness to Teacher	14.58	4.60	15.33	2.84
Z-score				
Classroom Disturbance	10.16	4.44	10.75	6.12
Impatience	11.25	3.64	9.83	5.90
Disrespect-Defiance	5.92	2.64	5.92	2.71
External Blame	8.16	3.58	6.75	3.88
Achievement Anxiety	10.58	4.27	8.08	3.66
External Reliance	15.75	5.56	13.16	7.67
Comprehension	11.08	2.84	14.50	4.38
Inattentive-Withdrawn	10.00	5.52	8.16	6.45
Irrelevant Responsiveness	7.08	2.74	6.25	3.16
Creative Initiative	12.16	3.78	13.25	5.15
Closeness to Teacher	14.75	4.96	15.92	5.56

TABLE 15

Univariate Analyses Comparing RD and Control Groups on Devereux Ratings with Covariance of the Full Scale IQ for the Years Below Grade Level Method

Source: RD vs Control	df	MS	F
Classroom Disturbance	1	0.52	0.04
Covariance	1	101.62	8.22
Error	21	12.36	
Impatience	1	1.62	0.09
Covariance	1	0.12	0.00
Error	21	17.26	
Disrespect-Defiance	1	1.68	0.15
Covariance	1	97.56	8.86
Error	21	11.00	
External Blame	1	0.34	0.02
Covariance	1	139.27	10.61
Error	21	13.12	
Achievement Anxiety	1	0.26	0.02
Covariance	1	60.70	3.78
Error	21	16.02	
External Reliance	1	20.74	0.80
Covariance	1	76.08	2.92
Error	21	26.04	
Comprehension	1	24.38	4.15
Covariance	1	12.98	2.20
Error	21	5.87	
Inattentive-Withdrawn	1	5.94	0.21
Covariance	1	17.00	0.61
Error	21	27.78	
Irrelevant Responsiveness	1	7.72	1.08
Covariance	1	181.04	19.66
Error	21	7.17	
Creative Initiative	1	47.80	4.92*
Covariance	1	14.36	1.48
Error	21	9.71	
Closeness to Teacher	1	2.60	0.28
Covariance	1	36.42	3.87
Error	21	9.40	

*$p < .05$

Tinker method and their Controls are presented in Table 16. A significant difference was found for the Comprehension factor (F = 9.08, df = 1/21, $p < .01$) with RD children being rated lower. No significant differences were found for the remaining factors.

Z-score. Univariate analyses for the Devereux factors comparing the Control group and the RD group selected by the Z-score method are presented in Table 17. The analyses yielded a significant difference for the Comprehension factor (F = 8.48, df = 1/21, $p < .01$) with RD children receiving lower ratings.

Summary. With FS IQ as a covariate very few differences between the RD and Control groups were found. No single behavioral factor consistently discriminated between the RD and Control children across the three diagnostic methods. One factor, Comprehension, discriminated Control and RD children, with RD children being rated lower, identified by the Bond and Tinker and Z-score methods. One factor, Creative Initiative, discriminated Control and RD children identified by the Years Below children with RD children being rated lower than Controls.

Comparison of Devereux Behavioral Factors with WISC Performance Scale IQ as Covariate

Children identified as RD by the three diagnostic methods, employing WISC PS IQ as a criterion where an IQ score was required, and their Controls were rated on the Devereux Behavior Rating Scale by their reading teachers. WISC PS IQ was used as a covariate in order to eliminate variance due to less than perfect matches.

The means and SDs for the Devereux behavioral factors for the children selected by the three diagnostic methods and their controls when PS IQ was employed as a covariate can be found in Table 18.

TABLE 16

Univariate Analyses Comparing RD and Control Groups on Devereux Ratings with Covariance of the Full Scale IQ for the Bond and Tinker Expectancy Formula

Source: RD vs Control	df	MS	F
Classroom Disturbance	1	0.40	0.02
Covariance	1	104.06	5.17
Error	21	20.12	
Impatience	1	11.76	0.69
Covariance	1	0.06	0.00
Error	21	16.99	
Disrespect-Defiance	1	7.10	0.48
Covariance	1	66.80	4.60
Error	21	14.51	
External Blame	1	0.83	0.05
Covariance	1	133.18	8.46
Error	21	15.74	
Achievement Anxiety	1	0.02	0.00
Covariance	1	43.89	2.30
Error	21	19.10	
External Reliance	1	47.58	2.02
Covariance	1	72.30	3.08
Error	21	23.49	
Comprehension	1	48.03	9.08**
Covariance	1	36.82	6.96
Error	21	5.29	
Inattentive-Withdrawn	1	28.18	0.92
Covariance	1	104.68	3.40
Error	21	30.70	
Irrelevant Responsiveness	1	3.46	0.33
Covariance	1	117.25	11.43
Error	21	10.26	
Creative Initiative	1	21.64	1.51
Covariance	1	74.37	5.19
Error	21	14.32	
Closeness to Teacher	1	1.52	0.11
Covariance	1	38.06	2.82
Error	21	13.50	

**$p < .01$

TABLE 17

Univariate Analyses Comparing RD and Control Groups on Devereux Ratings with Covariance of the Full Scale IQ for Z-score

Source: RD vs Control	df	MS	F
Classroom Disturbance	1	1.13	0.04
Covariance	1	25.38	0.88
Error	21	28.78	
Impatience	1	17.33	0.84
Covariance	1	96.28	4.66
Error	21	20.64	
Disrespect-Defiance	1	0.07	0.01
Covariance	1	14.11	2.06
Error	21	6.84	
External Blame	1	16.77	1.54
Covariance	1	78.65	7.20
Error	21	10.92	
Achievement Anxiety	1	45.10	3.44
Covariance	1	72.18	5.50
Error	21	13.12	
External Reliance	1	57.17	1.76
Covariance	1	305.24	9.38
Error	21	32.50	
Comprehension	1	81.94	8.48**
Covariance	1	97.05	10.04
Error	21	9.66	
Inattentive-Withdrawn	1	29.12	0.97
Covariance	1	164.48	5.48
Error	21	29.96	
Irrelevant Responsiveness	1	5.98	0.78
Covariance	1	32.74	4.28
Error	21	7.63	
Creative Initiative	1	12.56	0.90
Covariance	1	157.75	11.33
Error	21	13.91	
Closeness to Teacher	1	6.98	0.24
Covariance	1	8.42	0.29
Error	21	28.70	

** $p < .01$

TABLE 18

Means and Standard Deviations for Devereux Ratings when Performance Scale IQ is the Selection Criterion for Three Diagnostic Methods: 1) Years Below Grade Level, 2) Bond and Tinker Expectancy Formula, and 3) Z-score

Behavioral Factors	Reading Disabled		Control	
	Mean	SD	Mean	SD
Years Below Grade Level				
Classroom Disturbance	15.08	4.20	11.58	4.96
Impatience	13.25	3.36	9.50	3.56
Disrespect-Defiance	9.16	4.56	5.83	2.88
External Blame	10.25	4.63	6.66	3.55
Achievement Anxiety	10.42	4.06	8.16	3.16
External Reliance	21.92	3.70	14.83	5.04
Comprehension	7.83	1.74	11.92	2.15
Inattentive-Withdrawn	15.25	5.17	9.16	4.90
Irrelevant Responsiveness	9.66	2.90	8.42	4.10
Creative Initiative	7.33	1.61	11.75	4.54
Closeness to Teacher	13.50	3.18	14.33	4.14
Bond and Tinker Expectancy Formula				
Classroom Disturbance	15.33	4.60	11.83	4.62
Impatience	13.58	3.23	10.00	3.28
Disrespect-Defiance	9.50	4.46	5.83	2.88
External Blame	9.42	4.80	7.42	4.12
Achievement Anxiety	10.50	4.08	9.42	3.08
External Reliance	20.50	3.68	16.08	6.14
Comprehension	8.42	2.54	12.00	2.76
Inattentive-Withdrawn	13.83	5.46	10.50	6.12
Irrelevant Responsiveness	9.33	3.22	8.83	4.06
Creative Initiative	8.75	3.82	11.50	4.08
Closeness to Teacher	14.08	4.14	15.00	4.00
Z-score				
Classroom Disturbance	11.33	4.64	11.25	3.88
Impatience	11.42	3.34	9.92	4.30
Disrespect-Defiance	5.66	2.64	5.83	1.80
External Blame	6.33	3.92	7.92	3.45
Achievement Anxiety	9.58	4.64	7.92	2.42
External Reliance	17.16	5.75	12.42	4.87
Comprehension	10.33	3.42	13.50	3.20
Inattentive-Withdrawn	11.66	6.47	7.08	3.32
Irrelevant Responsiveness	7.08	2.84	7.00	1.76
Creative Initiative	11.16	3.71	12.66	3.14
Closeness to Teacher	15.42	4.83	13.75	4.22

Years Below Grade Level. Univariate analyses for the Devereu-behavioral factors comparing the Control and RD groups selected by the Years Below method are presented in Table 19. The RD children were rated significantly higher than Controls on Impatience ($F = 6.12$, $df = 1/21$, $p < .05$), External Reliance ($F = 7.82$, $df = 1/21$, $p < .05$) and Inattentive-Withdrawn ($F = 7.82$, $df = 1/21$, $p < .05$). However, RD children were rated significantly lower than Controls on the Comprehension ($F = 23.47$, $df = 1/21$, $p < .01$) and Creative Initiative ($F = 9.01$, $df = 1/21$, $p < .01$) factors.

Bond and Tinker Expectancy Formula. Univariate analyses for the Devereux behavioral factors comparing the Control and RD groups selected by the Bond and Tinker method are presented in Table 20. The RD children were rated significantly higher on Impatience ($F = 6.57$, $df = 1/21$, $p < .05$), External Reliance ($F = 4.32$, $df = 1/21$, $p < .05$) and Disrespect-Defiance ($F = 5.62$, $df = 1/21$, $p < .05$). However, RD children were rated significantly lower on the Comprehension factor ($F = 11.32$, $df = 1/21$, $p < .01$).

Z-score. Univariate analyses for the Devereux behavioral factors comparing the Control and RD groups selected by the Z-score method are presented in Table 21. The RD children were rated significantly higher on the External Reliance ($F = 5.32$, $df = 1/21$, $p < .05$) and Inattentive-Withdrawn ($F = 4.81$, $df = 1/21$, $p < .05$) factors. However, a significant difference was also found for the Comprehension factor ($F = 9.54$, $df = 1/21$, $p < .01$) with RD children receiving lower ratings.

Summary. Two factors, External Reliance and Comprehension, discriminated RD from Control children across the three methods. RD

TABLE 19

Univariate Analyses Comparing RD and Control Groups on Devereux Ratings with Covariance of Performance Scale IQ for the Years Below Grade Level Method

Source RD vs Control	df	MS	F
Classroom Disturbance	1	48.68	2.58
Covariance	1	70.90	3.76
Error	21	18.80	
Impatience	1	75.66	6.12*
Covariance	1	3.98	0.32
Error	21	12.34	
Disrespect-Defiance	1	45.50	3.59
Covariance	1	55.32	4.36
Error	21	12.66	
External Blame	1	47.46	3.64
Covariance	1	101.60	7.80
Error	21	13.01	
Achievement Anxiety	1	25.52	1.87
Covariance	1	4.66	0.34
Error	21	13.62	
External Reliance	1	234.66	15.04**
Covariance	1	103.10	6.61
Error	21	15.59	
Comprehension	1	91.06	23.47**
Covariance	1	3.11	0.80
Error	21	3.88	
Inattentive-Withdrawn	1	206.86	7.82*
Covariance	1	2.79	0.10
Error	21	26.43	
Irrelevant Responsiveness	1	2.09	0.22
Covariance	1	81.26	8.69
Error	21	9.34	
Creative Initiative	1	108.64	9.01**
Covariance	1	1.74	0.14
Error	21	12.06	
Closeness to Teacher	1	9.80	0.80
Covariance	1	41.44	3.36
Error	21	12.30	

**$p < .01$
*$p < .05$

TABLE 20

Univariate Analyses Comparing RD and Control Groups on Devereux Ratings with Covariance of Performance Scale IQ for the Bond and Tinker Expectancy Formula

Source: RD vs Control	df	MS	F
Classroom Disturbance	1	56.33	3.00
Covariance	1	74.11	3.94
Error	21	18.77	
Impatience	1	70.80	6.57*
Covariance	1	6.66	0.62
Error	21	10.77	
Disrespect-Defiance	1	62.14	5.62*
Covariance	1	78.28	7.07
Error	21	11.06	
External Blame	1	12.20	0.84
Covariance	1	137.16	9.52
Error	21	14.41	
Achievement Anxiety	1	5.56	0.41
Covariance	1	5.52	0.41
Error	21	13.44	
External Reliance	1	87.74	4.32*
Covariance	1	138.00	6.80
Error	21	20.28	
Comprehension	1	64.26	11.32**
Covariance	1	35.69	6.28
Error	21	5.68	
Inattentive-Withdrawn	1	55.67	1.64
Covariance	1	30.50	0.90
Error	21	33.82	
Irrelevant Responsiveness	1	0.06	0.00
Covariance	1	69.06	6.38
Error	21	10.82	
Creative Initiative	1	32.96	2.49
Covariance	1	65.42	4.94
Error	21	13.23	
Closeness to Teacher	1	4.74	0.27
Covariance	1	0.18	0.01
Error	21	17.36	

**$p < .01$
*$p < .05$

TABLE 21

Univariate Analyses Comparing RD and Control Groups on Devereux Ratings with Covariance of Performance Scale IQ for Z-score

Source: RD vs Control	df	MS	F
Classroom Disturbance	1	0.04	0.00
Covariance	1	0.08	0.00
Error	21	19.18	
Impatience	1	13.58	0.88
Covariance	1	3.65	0.24
Error	21	15.34	
Disrespect-Defiance	1	0.17	0.03
Covariance	1	0.52	0.10
Error	21	5.32	
External Blame	1	15.03	1.05
Covariance	1	0.04	0.00
Error	21	14.26	
Achievement Anxiety	1	16.76	1.18
Covariance	1	3.39	0.24
Error	21	14.21	
External Reliance	1	136.69	5.32*
Covariance	1	84.80	3.30
Error	21	25.70	
Comprehension	1	61.16	9.54**
Covariance	1	107.06	16.70
Error	21	6.40	
Inattentive-Withdrawn	1	126.78	4.81*
Covariance	1	28.62	1.08
Error	21	26.33	
Irrelevant Responsiveness	1	0.04	0.00
Covariance	1	1.18	0.20
Error	21	5.80	
Creative Initiative	1	13.98	1.99
Covariance	1	112.86	16.07
Error	21	7.02	
Closeness to Teacher	1	16.30	0.86
Covariance	1	53.72	2.82
Error	21	19.02	

**$p < .01$
*$p < .05$

children were rated as being consistently higher on External Reliance and consistently lower on the Comprehension factor. One factor, Impatience, discriminated RD children from their Controls for the Years Below and Bond and Tinker methods, with RD children obtaining higher ratings. Another factor, Inattentive-Withdrawn, discriminated RD children from Controls for both the Years Below and Z-score methods with RD children again being rated higher than Controls. Two subtests, Creative Initiative and Disrespect-Defiance, discriminated RD children from Controls for the Years Below and Bond and Tinker methods, respectively. RD children were rated lower than Controls on Creative Initiative but higher on Disrespect-Defiance.

Comparison of Devereux Behavioral Factors with WISC Verbal Scale IQ as Covariate

RD children selected by the three diagnostic methods, employing WISC VS IQ as a selection criterion where an IQ score was required, and their Controls were rated on the Devereux Behavior Rating Scale by their reading teacher. WISC VS IQ was used as a covariate in the analyses in order to eliminate variance due to less than perfect matches.

The means and SDs for the Devereux behavioral factors for the children selected by the three diagnostic methods and their Controls when PS IQ was employed as a covariate can be found in Table 22.

Years Below Grade Level. Univariate analyses for the Devereux Behavioral factors comparing the Control and RD groups selected by the Years Below method are presented in Table 23. Significant differences were found between RD and Control children for the Comprehension

TABLE 22

Means and Standard Deviations for Devereux Ratings when Verbal Scale IQ is the Selection Criterion for Three Diagnostic Methods: 1) Years Below Grade Level, 2) Bond and Tinker Expectancy Formula, and 3) Z-score

Behavioral Factors	Reading Disabled		Control	
	Mean	SD	Mean	SD
Years Below Grade Level				
Classroom Disturbance	15.08	4.20	14.50	5.87
Impatience	13.25	3.36	12.83	5.22
Disrespect-Defiance	9.16	4.56	8.00	3.72
External Blame	10.25	4.63	9.75	4.02
Achievement Anxiety	10.42	4.06	10.83	4.34
External Reliance	21.92	3.70	18.42	5.88
Comprehension	7.83	1.74	10.66	2.34
Inattentive-Withdrawn	15.25	5.17	13.58	4.48
Irrelevant Responsiveness	9.66	2.90	9.92	4.38
Creative Initiative	7.33	1.61	10.16	3.54
Closeness to Teacher	13.50	3.18	14.75	2.56
Bond and Tinker Expectancy Formula				
Classroom Disturbance	13.58	5.05	14.75	5.54
Impatience	13.00	3.76	14.32	5.45
Disrespect-Defiance	8.83	4.86	8.08	3.60
External Blame	9.75	5.02	9.33	4.20
Achievement Anxiety	11.08	4.68	10.58	4.20
External Reliance	21.33	4.34	16.16	5.84
Comprehension	8.16	2.08	10.83	3.18
Inattentive-Withdrawn	14.50	6.08	12.42	4.25
Irrelevant Responsiveness	8.83	3.38	9.58	4.38
Creative Initiative	8.83	3.76	10.66	3.96
Closeness to Teacher	14.92	4.46	14.08	4.03
Z-score				
Classroom Disturbance	11.25	3.74	12.75	5.70
Impatience	11.83	3.35	11.50	5.16
Disrespect-Defiance	5.75	3.14	6.33	2.93
External Blame	7.50	3.70	6.92	3.28
Achievement Anxiety	8.83	3.78	9.08	3.28
External Reliance	18.50	4.92	13.58	6.30
Comprehension	10.58	2.58	13.50	3.90
Inattentive-Withdrawn	10.58	4.42	10.75	6.38
Irrelevant Responsiveness	7.50	2.50	7.75	2.98
Creative Initiative	11.75	3.84	11.58	3.02
Closeness to Teacher	16.33	4.84	11.83	4.06

TABLE 23

Univariate Analyses Comparing RD and Control Groups on Devereux Ratings with Covariance of the Verbal Scale IQ for the Years Below Grade Level Method

Source: RD vs Control	df	MS	F
Classroom Disturbance	1	1.20	0.04
Covariance	1	1.99	0.07
Error	21	27.23	
Impatience	1	4.44	0.24
Covariance	1	27.20	1.44
Error	21	18.89	
Disrespect-Defiance	1	3.04	0.18
Covariance	1	24.26	1.42
Error	21	17.02	
External Blame	1	0.02	0.00
Covariance	1	38.44	2.14
Error	21	17.90	
Achievement Anxiety	1	8.03	0.54
Covariance	1	74.52	4.98
Error	21	14.96	
External Reliance	1	76.36	3.03
Covariance	1	2.89	0.11
Error	21	25.18	
Comprehension	1	36.38	9.32**
Covariance	1	12.42	3.18
Error	21	3.90	
Inattentive-Withdrawn	1	12.40	0.51
Covariance	1	4.82	0.20
Error	21	24.30	
Irrelevant Responsiveness	1	1.54	0.10
Covariance	1	9.12	0.65
Error	21	14.02	
Creative Initiative	1	58.44	8.18*
Covariance	1	16.46	2.30
Error	21	7.14	
Closeness to Teacher	1	10.28	1.18
Covariance	1	1.02	0.12
Error	21	8.68	

**$p < .01$
*$p < .05$

(F = 9.32, df = 1/21, $p < .01$) and Creative Initiative (F = 8.18, df = 1/21, $p < .01$) factors with RD children receiving lower ratings.

Bond and Tinker Expectancy Formula. Univariate analyses for the Devereux behavioral factors comparing the Control and RD groups selected by the Bond and Tinker method are presented in Table 24. RD children were rated significantly higher than Controls on the External Reliance factor (F = 6.70, df = 1/21, $p < .05$) and significantly lower than Controls on the Comprehension factor (F = 9.22, df = 1/21, $p < .01$).

Z-score. Univariate analyses for the Devereux behavioral factors comparing the Control and RD groups selected by the Z-score method are presented in Table 25. RD children were rated significantly higher than Controls on External Reliance (F = 6.37, df = 1/21, $p < .05$) and Closeness to Teacher (F = 5.92, df = 1/21, $p < .05$) factors, and significantly lower than Controls on the Comprehension factor (F = 7.48, df = 1/21, $p < .01$).

Summary. Only one factor, Comprehension, discriminated RD children from Control children consistently across the three diagnostic methods, with RD children being rated consistently lower. The External Reliance factor discriminated RD from Control children for both the Bond and Tinker and Z-score methods with RD children obtaining higher ratings. Creative Initiative and Closeness to Teacher discriminated RD from Control children for the Years Below and Z-score methods respectively. RD children were rated lower than Controls on Creative Initiative; however, they were rated as being higher in their need for Closeness to the Teacher.

TABLE 24

Univariate Analyses Comparing RD and Control Groups on Devereux Ratings with Covariance of the Verbal Scale IQ for the Bond and Tinker Expectancy Formula

Source: RD vs Control	df	MS	F
Classroom Disturbance	1	7.72	0.28
Covariance	1	52.42	1.94
Error	21	26.98	
Impatience	1	1.02	0.04
Covariance	1	0.34	0.01
Error	21	22.98	
Disrespect-Defiance	1	3.78	0.26
Covariance	1	93.30	6.33
Error	21	14.72	
External Blame	1	1.34	0.08
Covariance	1	151.38	9.88
Error	21	15.31	
Achievement Anxiety	1	1.67	0.08
Covariance	1	37.60	1.98
Error	21	18.96	
External Reliance	1	162.54	6.70*
Covariance	1	72.66	2.99
Error	21	24.27	
Comprehension	1	43.78	9.22**
Covariance	1	59.62	12.56
Error	21	4.74	
Inattentive-Withdrawn	1	26.86	1.02
Covariance	1	52.48	1.99
Error	21	26.53	
Irrelevant Responsiveness	1	3.01	0.25
Covariance	1	85.46	7.14
Error	21	11.96	
Creative Initiative	1	20.74	1.47
Covariance	1	32.74	2.32
Error	21	14.08	
Closeness to Teacher	1	4.08	0.22
Covariance	1	3.40	0.18
Error	21	18.78	

**$p < .01$
*$p < .05$

TABLE 25

Univariate Analyses Comparing RD and Control Groups on Devereux Ratings with Covariance of the Verbal Scale IQ for Z-score

Source: RD vs Control	df	MS	F
Classroom Disturbance	1	13.31	0.60
Covariance	1	46.98	2.12
Error	21	22.16	
Impatience	1	0.68	0.04
Covariance	1	9.62	0.50
Error	21	19.38	
Disrespect-Defiance	1	2.00	0.22
Covariance	1	14.44	1.60
Error	21	8.98	
External Blame	1	2.10	0.19
Covariance	1	37.16	3.35
Error	21	11.08	
Achievement Anxiety	1	0.36	0.02
Covariance	1	13.96	1.12
Error	21	25.50	
External Reliance	1	146.38	6.37*
Covariance	1	221.50	9.64
Error	21	22.97	
Comprehension	1	51.56	7.48**
Covariance	1	95.20	13.82
Error	21	6.89	
Inattentive-Withdrawn	1	0.14	0.00
Covariance	1	101.15	3.78
Error	21	26.76	
Irrelevant Responsiveness	1	0.35	0.05
Covariance	1	28.89	4.38
Error	21	6.58	
Creative Initiative	1	0.14	0.02
Covariance	1	65.85	7.00
Error	21	9.40	
Closeness to Teacher	1	121.74	5.92*
Covariance	1	8.42	0.40
Error	21	20.56	

**$p < .01$
*$p < .05$

Summary

The multivariate analyses for the three diagnostic methods, employing the appropriate covariate, yielded no significant differences between RD groups and their Controls for any of the nine analyses.

Table 26 presents a summary of significant behavioral factor findings for the univariate analyses for the three diagnostic methods when each of the three IQ scores were used as selection criteria.

For the Years Below method when FS IQ was covaried, the Creative Initiative variable discriminated the RD groups from Controls with Controls receiving higher ratings. For the Bond and Tinker and Z-score methods RD children were rated significantly lower than Controls on the Comprehension factor.

When PS IQ was the covariate, univariate analyses for the Years Below method found RD children to be rated significantly higher than Controls on the Impatience, External Reliance and Inattentive-Withdrawn factors, but significantly lower than Controls on the Comprehension and Creative Initiative factors. For the Bond and Tinker method RD children were rated significantly higher on the Impatience, Disrespect-Defiance, and External Reliance factors, however, they were rated significantly lower than Controls on Comprehension. When the Z-score diagnostic method was employed, RD children were rated significantly higher on the External Reliance and Inattentive-Withdrawn factors, but significantly lower on the Comprehension factor.

When the VS IQ score was the covariate, univariate analyses for the Years Below method yielded significant differences on the Comprehension and Creative Initiative factors with RD children receiving lower ratings.

TABLE 26

Summary Table of Significant Univariate Analyses Comparing RD and Control Groups on Devereux Factors for Three Diagnostic Methods

Selection Criteria	Years Below	Bond and Tinker	Z-score
Full Scale IQ	Creative Initiative	Comprehension	Comprehension
Performance Scale IQ	Impatience External Reliance Comprehension Inattentive-Withdrawn Creative Initiative	Impatience Disrespect-Defiance External Reliance Comprehension	External Reliance Comprehension Inattentive-Withdrawn
Verbal Scale IQ	Comprehension Creative Initiative	External Reliance Comprehension	External Reliance Comprehension Closeness to Teacher

For the Bond and Tinker method RD children were rated significantly higher on External Reliance and significantly lower on Comprehension. For the Z-score method RD children were rated higher on External Reliance and Closeness to Teacher, but were rated lower on Comprehension than Control children.

In general, when FS IQ was the selection criterion, Comprehension discriminated RD children from Controls for both the Bond and Tinker and Z-score methods, but only one factor, Creative Initiative, discriminated RD children from Controls for the Years Below method. When PS IQ was the selection criterion, External Reliance and Comprehension discriminated RD children from Controls for the three diagnostic methods. Impatience discriminated RD children from Controls for both the Years Below and Bond and Tinker methods while Inattentive-Withdrawn discriminated RD children from Controls for both Years Below and Z-score. Creative Initiative and Disrespect-Defiance discriminated RD children from Controls for Years Below and Z-score, respectively. When VS IQ was the selection criterion, only Comprehension discriminated RD children from Controls for the three methods. External Reliance discriminated RD children from Controls for both Bond and Tinker and Z-score and Creative Initiative and Closeness to Teacher discriminated RD children from Controls for Years Below and Z-score, respectively.

In addition, for the Years Below method the Creative Initiative factor discriminated RD children from Controls when each of the three IQ scores were used as selection criteria. Also, Comprehension discriminated RD children from Controls for both the Bond and Tinker and Z-score methods when each of the three IQ scores were used as selection criteria.

DISCUSSION

The following discussion will focus upon the results of the current study in terms of: 1) WISC profile, 2) Devereux Behavioral Factors, and 3) grade level.

WISC Profile

The finding that the multivariate analyses for the three diagnostic methods employing the appropriate covariate yielded no significant differences between RD children and Controls for any of the nine comparisons remains unexplained. It is suggested that the high inter-correlations among the subtests might be implicated in the finding (Wechsler, 1949, pg. 11).

The results of the univariate analyses suggested that the Wechsler profile may be a function of the method of selection and the IQ score used as criterion. When RD children were selected and matched on FS IQ score, no characteristic subtest pattern emerged. When PS IQ score was the criterion for selection and matching, a characteristic profile did emerge, with the Z-score RD group showing the largest number of subtest differences. With PS IQ score held constant, Z-score RD children and Control children differed considerably on their mean VS IQ scores. The Z-score RD group was the only group for which a significant PS IQ - VS IQ score difference was found. It is very likely that the PS IQ - VS IQ difference accounts for the characteristic subtest pattern.

When VS IQ score was used as the selection criterion, those children selected by the Z-score method again showed the largest number of subtest differences when compared with their Controls, with RD children achieving lower subtest scores. Significant differences between RD and Control children on PS IQ scores were found only for those RD children selected by the Z-score method. Again, Z-score RD children showed the largest number of subtest differences when compared with their Controls, with RD children achieving lower subtest scores. Significant differences between RD and Control children on PS IQ scores were found only for those RD children selected by the Z-score method. It should be noted that only for the Z-score RD group was PS IQ found to be significantly lower than VS IQ, whereas no significant differences between PS IQ and VS IQ scores were found for the Years Below and Bond and Tinker RD groups and the Z-score Control group. The significant difference between RD children and Controls on the Performance subtests may possibly be accounted for by these overall differences in PS IQ scores. The fact that Z-score RD children achieved lower PS IQ scores than VS IQ scores appears to be in contradiction to previous findings (Neville, 1961; Kallos, Grabow and Guarino, 1961; Hunter and Johnson, 1971; and Ackerman, Peters and Dykman, 1971). However, only in the present study have VS IQ scores been held constant, thereby allowing PS IQ scores to vary. That this finding occurs only with Z-score RD children when VS IQ score is used as the selection criterion suggests that the results are dependent on method of selection and type of IQ score.

It is significant to note that the Z-score procedure identifies children falling within the average and above average IQ ranges, whereas the Years Below and Bond and Tinker methods select children shose scores tend to fall below the lower limit of the average range. That the Z-score method more closely approximates the characteristic WISC profile for RD children than does either the Years Below or the Bond and Tinker methods, is strongly suggested by other research studies which exclude children whose IQ scores are below 90.

In analyzing PS IQ - VS IQ differences in subjects chosen from a clinic population, Neville (1961), Kallos, Grabow, and Guarino (1961), Hunter and Johnson (1971), and Ackerman, Peters, and Dykman (1971) found PS IQ to be significantly higher than VS IQ. Coleman and Rasof (1963), however, did not find PS IQ socres to be significantly higher than VS IQ scores. The major difference between Coleman and Rasof's RD children and those of the other investigators was the IQ range of the children selected as RD. Coleman and Rasof's RD children had IQ scores ranging from 70 to 136, whereas the other investigators limited theit investigation to children whose IQ scores fell within the average range (90 - 110). When Coleman and Rasof regrouped their RD children to include only those whose IQ scores fell within the average range, they found that PS IQ scores were significantly higher than VS IQ scores.

In investigating RD children identified in a school population, similar findings appear. Bruce and Burks (1955) and Lyle and Goyen (1969) limited their sample to the average IQ range and found PS IQ scores to be significantly higher than VS IQ scores. Belmont and

Birch (1966) identified RD children by the Years Below method from a wider IQ range and found no significant PS IQ - VS IQ differences. However, Belmont and Birch regrouped their RD children to include only those whose IQ scores fell within the average limits and then found PS IQ to be significantly higher than VS IQ. Paterra (1963) examined children referred by teachers for individual testing because they were not reading at the level expected on the basis of their mental age. Paterra's results suggested that when no characteristic WISC subtest pattern was evident, PS IQ scores were not significantly higher than VS IQ scores.

In addition, Coleman and Rasof did not find a characteristic subtest pattern for RD children unless they limited their RD subjects to include only those whose IQ scores fell within the average range. Belmont and Birch similarly regrouped their RD children and found that a characteristic subtest pattern emerged only when VS IQ was significantly lower than PS IQ, and the overall IQ scores fell within the average range.

The present study found that children identified as RD by the Years Below and Bond and Tinker methods did not have PS IQ scores which were significantly higher than VS IQ scores, regardless of which selection criterion was used, while children identified by the Z-score method had significantly higher PS IQ scores than VS IQ scores. However, children identified as RD by the Z-score method also had significantly overall IQ scores than the children identified as RD by either the Years Below ot the Bond and Tinker methods. Most of the children identified by the Z-score method fell within the above average

[illegible]

IQ range, while those identified by the Years Below and Bond and Tinker methods often fell below the lower limit of the average IQ range. The present findings are consistent with those of other investigators (Coleman and Rasof, 1963; and Belmont and Birch, 1966) who included children whose IQ scores fell outside the average range as RD subjects.

It appears, then, that the characteristic subtest pattern may be a function of differences in VS IQ rather than overall intelligence as measured by FS IQ. Other investigators (Coleman and Rasof, 1963; Belmont and Birch, 1966; and Paterra, 1963) also support this conclusion, finding that when PS IQ scores were not higher than VS IQ scores, RD children showed no characteristic subtest pattern. However, when PS IQ scores were higher the characteristic pattern of low Information, Arithmetic and Vocabulary (also high PS) did appear. Also, Performance subtest patterns could be due to differences between RD and Control children on PS IQ scores. The fact that no characteristic subtest pattern emerged when FS IQ score was the selection criterion, in the present study, further supports this conclusion.

Devereux Behavioral Factors

In comparing RD children and Controls on Devereux behavioral factors, behavioral differences appeared to be a function of method of selection and the IQ score used as the criterion. Overall, Comprehension appeared to be the one basic factor that discriminated RD children from Controls particularly when FS IQ was the selection criterion. However, when PS IQ was the selection criterion, the factors of Impatience, External Reliance, Comprehension, and

Inattentive-Withdrawn discriminated RD children from Controls. These are the same factors which make up the Devereux patterns identifying underachievers and other children who are not learning effectively (Swift and Spivack, 1967; and Spivack and Swift, 1969).

When PS IQ was the selection criterion, large differences between RD children and Controls on VS IQ scores were found. It is possible that the behavioral factors discriminating the groups are highly related to verbal skills and that these behavioral differences may be accounted for by VS IQ score differences found between RD and Control children.

When VS IQ score was the selection criterion, fewer behavioral factors discriminated RD children from Controls. However, Comprehension remained a discriminating factor for the three selection methods. That the Comprehension factor was consistently found to discriminate between RD and Control children strongly suggests that Comprehension is a critical factor in reading skills. The items for the Comprehension factor include the ability to understand what is heard or read, to apply what has been learned to a new situation, and to be able to answer when questioned.

The Devereux factors of Comprehension, Impatience, External Reliance and Inattentive-Withdrawn are similar to some of the clinical symptoms described by other investigators as characterizing RD children: perceptual problems, coordination problems, difficulties with abstract concepts, visual and auditory memory problems, and emotional problems (Clements and Peters, 1962; Clements, 1969; Spraings, 1969; Johnson and Myklebust, 1967; and Bond and Tinker, 1973). The

Devereux Behavior Rating Scale, however, concerns itself with behaviors that are directly related to the classroom setting rather than behaviors identified in a clinical testing situation. Therefore, the Devereux Scale does not include hyperactivity as such, but the components of the Impatience factor (rushing, unwillingness to go back over work, and attention seeking) are closely related to hyperactivity. In the present study, Impatience did discriminate RD children from Controls as would be expected according to the characteristic pattern identified by other investigators (Clements and Peters, 1962; Clements, 1969; Spraings, 1969; Johnson and Myklebust, 1967; and Bond and Tinker, 1973).

Grade Level

Third graders were chosen as the subjects for this study to minimize the possibility of confounding IQ scores and reading achievement scores. During the first three grades children are typically taught the basic reading skills and are not yet proficient enough to derive significant amounts of information from their reading materials. Beginning with the fourth grade, however, children are expected to read independently to derive increasingly greater amounts of information from the material read. It may be assumed that this information is likely to be represented on IQ test items in addition to information derived from other sources. Thus, the child who does not learn to read at his "expected" rate may well be penalized on future IQ test scores.

Most of the studies in which a characteristic WISC profile was found for RD children identified in a school population (Bruce and Burks, 1955; Belmont and Birch, 1966; and Lyle and Goyen, 1969)

utilized subjects who were in the fourth grade or higher. Lyle and Goyen (1969), however, chose their subjects equally from the six primary grades. A double criterion of both teacher referral and a Years Below Grade Level method was used to identify RD children. They concluded that the WISC profile was an effect rather than a symptom of RD, based on the theory that if the WISC profile was an effect of RD, the relative WISC deficits for RD children should become greater with age due to the effect of increased information obtained through reading. However, these investigators did not find the differences between RD children and Controls to increase with age, as was the case with the differences in reading achievement. It must be kept in mind, however, that the IQ scores of their RD children were limited to the average range (90 - 110). This restriction would systematically eliminate those lower IQ children whose IQ scores were directly affected by an inability to obtain knowledge from reading materials.

Silberberg and Feldt (1968) investigated a population of first, second and third graders referred for psychological evaluation. They identified 36 percent of this population as RD employing the Bond and Tinker discrepancy method. In addition, they also subdivided their population as to whether or not PS IQ was significantly higher (13 points in this case) than VS IQ. They found that RD children did not have characteristic WISC profiles, suggesting that the WISC profile is an effect rather than one of the possible precursors of RD. No strong conclusions can be made, since the lack of consistent findings in the literature could be attributed to a number of factors, the most important of which are subject selection procedures and methodological

variables. A longitudinal, rather than a cross-sectional, study, in which RD children are identified in the early grades, would possibly give a more accurate description of changes in WISC deficits due to reading difficulties as children progress from grade to grade.

Conclusions

The results of the present study indicate that the WISC profile may not be a reliable indicator of RD because WISC subtest patterns appear to be a function of verbal intelligence level and the method used to identify the RD group. Considerable error, therefore, may occur if WISC subtest variablility is used clinically to identify RD children.

The results also indicate that both the Years Below and the Bond and Tinker methods tended to identify the same third grade children as RD; both groups were characterized by low IQ scores and poor reading skills. One possible reason for the lack of differences between these two methods is that the Bond and Tinker method assumes that all children enter the first grade with no reading skills, although, in fact, higher IQ children do enter school with some reading skills. Because of this assumption, the formula predicts a restricted range of expected reading achievement scores for the third grade children with relatively low expectations fro higher IQ children.

Children identified as RD by both the Years Below and Bond and Tinker methods were found to have lower mean IQ scores than that of the population from which they were selected. These children were also the poorest readers, with mean reading achievement scores one and

one-half years below grade placement, two and one-half years below the class mean, and two years below the mean for their Controls.

Because the Years Below method requires less testing and fewer computations than the Bond and Tinker method, the former method would be preferable in situations where the aim of the school is to bring RD children closer to the class mean. A remedial reading program for children identified by the Years Below method should emphasize comprehensive reading and language skills. On the other hand, if the aim of the school is to maximize each child's potential the Z-score method would be preferable for identifying RD children. Their remediation program should emphasize those areas which show specific deficits which may be indicated by the subtest profile.

The results of the comparisons on behavioral ratings suggest that comprehension ability should be investigated more fully, since it consistently discriminated RD children from Controls regardless of the method of identification or the IQ scores employed as selection criterion.

Other behavioral factors which showed differences between RD and Control children, however, appeared to be related to the IQ score used as the selection criterion. The largest number of behavioral differences were found when PS IQ was used as a criterion, suggesting that differences in verbal ability are correlated with teachers' appraisal of behavior problems. Further research investigating the nature of this relationship would greatly clarify the clinical reports of high incidences of behavior problems in RD children.

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APPENDIX A

TABLE A

MANOVA Comparing RD and Control Group Scores on WISC Subtests for Three Diagnostic Methods: 1) Years Below Grade Level, 2) Bond and Tinker Expectancy Formula, and 3) Z-score

Source: RD vs Control	df	MS	F
	Years Below Grade Level		
WISC Subtests	1	48.39	0.86
Error	11	47.81	
	Bond and Tinker Expectancy Formula		
WISC Subtests	1	48.50	0.85
Error	11	47.92	
	Z-score		
WISC Subtests	1	47.26	1.63
Error	11	46.34	

TABLE B

MANOVA Comparing RD and Control Group Scores on WISC Verbal Subtests with Covariance of Performance Scale IQ for the Three Diagnostic Methods: 1) Years Below Grade Level, 2) Bond and Tinker Expectancy Formula, and 3) Z-score

Source: RD vs Control	df	Generalized Variance	F
Years Below Grade Level			
Verbal Subtests	1	26.66	3.30
Covariate	1	50.88	2.58
Error	6	25.86	
Bond and Tinker Expectancy Formula			
Verbal Subtests	1	26.88	3.10
Covariate	1	94.02	6.94
Error	6	26.10	
Z-score			
Verbal Subtests	1	26.77	3.28
Covariate	1	43.68	1.82
Error	6	25.97	

TABLE C

MANOVA Comparing RD and Control Group Scores on WISC Performance Subtests with Covariance of Verbal Scale IQ for the Three Diagnostic Methods: 1) Years Below Grade Level, 2) Bond and Tinker Expectancy Formula, and 3) Z-score

Source: RD vs Control	df	Generalized Variance	F
Years Below Grade Level			
Performance Subtests	1	22.62	0.52
Covariate	1	24.84	0.36
Error	5	22.48	
Bond and Tinker Expectancy Formula			
Performance Subtests	1	22.48	1.86
Covariate	1	35.44	2.06
Error	5	22.04	
Z-score			
Performance Subtests	1	23.06	3.86
Covariate	1	39.92	2.68
Error	5	22.30	

TABLE D

Methods Identifying Individual RD Children

RD	FS IQ YEARS BELOW	FS IQ BOND AND TINKER	FS IQ Z-SCORE	PS IQ YEARS BELOW	PS IQ BOND AND TINKER	PS IQ Z-SCORE	VS IQ YEARS BELOW	VS IQ BOND AND TINKER	VS IQ Z-SCORE	FS IQ	PS IQ	VS IQ	TOTAL
KH	X	X	X	X	X	X	X	X		3	3	2	8
FB	X	X		X	X	X	X	X		2	3	2	7
JD	X	X		X	X		X	X	X	2	2	3	7
HR	X	X		X	X		X	X	X	2	2	3	7
TG	X	X		X	X		X	X		2	2	2	6
MP	X	X		X	X		X	X		2	2	2	6
MS	X	X		X	X		X	X		2	2	2	6
CS	X	X		X	X		X	X		2	2	2	6
EC	X	X		X	X	X	X			2	3	1	6
LH	X	X		X	X	X	X			2	3	1	6
JB		X	X		X	X		X	X	2	2	2	6
DC		X	X			X		X	X	2	1	2	5
TP			X			X		X	X	1	1	2	4
RC			X		X	X				1	2	0	3
JC	X			X			X			1	1	1	3
AS	X			X			X			1	1	1	3
DW			X			X				1	1	0	2
DM			X						X	1	0	1	2
GL			X						X	1	0	1	2
RS								X	X	0	0	0	2
DF			X							1	0	1	1
TH			X							1	0	1	1
DT			X							1	0	2	1
VY			X							1	0	0	1
BB									X	0	0	1	1
EC									X	0	0	1	1
MF									X	0	0	1	1
AR									X	0	0	1	1
NC						X				0	1	0	1
DR						X				0	1	0	1
ST						X				0	1	0	1

TABLE E

MANOVA Comparing RD and Control Group Ratings on the Devereux Behavioral Factors with Covariance of Full Scale IQ for the Three Diagnostic Methods: 1) Years Below Grade Level, 2) Bond and Tinker Expectancy Formula, and 3) Z-score

Source: RD vs Control	df	Generalized Variance	F
Years Below Grade Level			
Behavioral Factors	1	56.10	0.63
Covariate	1	1,227.98	3.10
Error	11	55.61	
Bond and Tinker Expectancy Formula			
Behavioral Factors	1	56.30	1.69
Covariate	1	1,228.58	3.13
Error	11	55.32	
Z-score			
Behavioral Factors	1	54.06	1.00
Covariate	1	1,217.23	3.07
Error	11	53.37	

TABLE F

MANOVA Comparing RD and Control Group Ratings on the Devereux Behavioral Factors with Covariance of Performance Scale IQ for the Three Diagnostic Methods: 1) Years Below Grade Level, 2) Bond and Tinker Expectancy Formula, and 3) Z-score

Source: RD vs Control	df	Generalized Variance	F
Years Below Grade Level			
Behavioral Factors	1	55.84	3.24
Covariate	1	3,137.57	1.52
Error	11	54.40	
Bond and Tinker Expectancy Formula			
Behavioral Factors	1	56.06	3.12
Covariate	1	3,190.52	2.48
Error	11	54.64	
Z-score			
Behavioral Factors	1	52.81	3.28
Covariate	1	3,243.19	3.73
Error	11	51.36	

TABLE G

MANOVA Comparing RD and Control Group Ratings on the Devereux Behavioral Factors with Covariance of Verbal Scale IQ for the Three Diagnostic Methods: 1) Years Below Grade Level, 2) Bond and Tinker Expectancy Formula, and 3) Z-score

Source: RD vs Control	df	Generalized Variance	F
Years Below Grade Level			
Behavioral Factors	1	56.19	0.96
Covariate	1	2,150.52	1.70
Error	11	55.52	
Bond and Tinker Expectancy Formula			
Behavioral Factors	1	57.75	1.92
Covariate	1	2,257.72	3.54
Error	11	56.68	
Z-score			
Behavioral Factors	1	55.41	2.03
Covariate	1	2,162.02	1.98
Error	11	54.30	