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ABSTRACT

This study was conducted in order to develop and evaluate a systematic screening method which could be used by counselors and school psychologists in the identification of first graders showing characteristics generally associated with learning disabilities. The study was conducted within three Title I schools in a large sourthern metropolitan school system and the method, believed appropriate for culturally different first graders, is generalizeable to other populations. The research was based upon a sample of 70 children, including 40 subjects who produced positive screening results. The screening battery composed of the Metropolitan Readiness Test, the Slosson Drawing Coordination Test, and the Wepman Auditory Discrimination Test was administered by teachers and school counselors. Test results were interpreted in terms of cut-off points and a hypothetical "diagnostic" profile. After eliminating metnally retardate suspects, 40 "diagnostic" subjects were identified. All subjects screening positive, together with a comparison group of 30 subjects drawn randomly from the original population, were further evaluated with the Wechsler Intelligence Scale for Children and Frostig. In addition, the classroom teachers rated each subject on a rating scale specially designed to reflect classroom performance factors believed to be characteristics of learning disabilities. Alpha and beta error analysis between the three sources of data showed total errors ranging between 14 and 18 percent. Analysis of variance indicated significant differences between 18 of the 28 major variables in the study. (Author/JM)

A SCREENING METHOD FOR EARLY IDENTIFICATION OF LEARNING DISABILITIES

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A SCREENING METHOD FOR EARLY IDENTIFICATION OF LEARNING DISABILITIES*

Introduction

A growing segment of the literature on learning disabilities is stressing the importance of early identification of children who are likely to experience difficulties shortly after entering the first grade. Keogh (1970) reports that the academic problems generated by learning disorders are noted by secondary, upper elementary, and primary school teachers. A consensus of research agrees that difficulties in learning do not "develop suddenly nor capriciously" and that "early identification is critical (p.310)." Bannatyne (1971) concurs the urgent need for early screening.

> It is worth emphasizing, again, the need for screening tests in the first grade which isolate potential learning disability cases and enable them to be taught correctly in the first place (p. 706).

Moreover, legislation found in states such as Tennessee stipulates the availability of a special curriculum via special education classes for those children with exceptional learning difficulties.

The literature relevant to screening for learning disabilities points to some fairly consistent patterns in the psychometric results obtained on the psychological tests which

*This paper is a modification of the senior author's doctoral dissertation "Screening for Learning Disabilities among Inner-City First Graders." The University of Tennessee, 1973.

have been predominantly used by school psychologists. Frostig (1969) selected a test battery for her own use in a program of educational therapy conducted at the Frostig Center. The battery included the Wepman Auditory Discrimination Test, the ITPA, and the WISC. The fourth test was her own Test of Developmental Visual Perception. She reported that scores on the Information and Comprehension subtests of the Wechsler Scale (WISC) (Wechsler, 1949) suggested the extent to which auditory and visual perception affect the conceptual processes involved in the subtests. She found the Coding subtest to be of particular significance and cited Tyson (1961) who found that a low score on Coding, a visual-motor task, was associated with poor performance in reading, writing, spelling, and computation. Further, the study indicated that children with severe learning difficulties "score high on Comprehension, have at least average Information scores, (and) show no difficulties on the Similarities subtest (p.22)." Hunter, et al. (1971) studied group differences on the WISC between non-readers and a control group of children who read at age-grade level. They found that the non-readers' inability to focus upon anything for a sustained period of time was reflected in low scores on the WISC Digit Span, Arithmetic, and Coding subtests. Significant differences were ascertained between the two groups. The authors suggest that "the most apparent characteristic of the (non-reader) is his deficit in attention, concentration, or immediate memory (p.575)."

This study was conducted in order to develop and evaluate a systematic screening method which could be used by counselors and school psychologists in the identification of first graders showing characteristics generally associated with learning disabilities. More specifically, the intent was to locate those tests in a screening battery which would best identify children who would have a high likelihood of producing those psychometric results on the WISC and the Frostig Developmental Test of Visual Perception (Frostig, 1963) which have frequently been found in the protocols of children with learning disabilities. For this study, it has been assumed that the results of the WISC and Frostig reflect those visual and auditory functional impairments which are characteristic of learning disabilities.

The evaluation involved an analysis of the psychometric results obtained from the psychological battery and an assessment of the subjects' classroom performance by means of teacher ratings.

Although this study was based on a sample of culturally different children, the method may be generalized to the general population of first graders.

METHOD

Selection of Tests

Screening Battery

The selection of the screening tests administered in this case was influenced by the time limitations usually

present whenever pupils must be identified for placement in special classes. At such time, the participation of teachers and counselors is actively sought and generally available. Therefore, the various tests and batteries included in the screening phase were administered by teachers and counselors.

The school system within which this research was carried out requests group administrations of the Metropolitan Readiness Tests (MRT) by first grade teachers for the assessment of the readiness level of each child entering school. The six subscales comprising this instrument sample a variety of curriculum related readiness skills and pre-supposes a number of basic functional competences for creditable responses. Each subscale item requires differential responses to auditorially or visually presented stimuli throughout graded levels of difficulty.

Other screening battery instruments administered by school counselors met the following characteristics.

1. Specialized psychological training was not necessary in order to obtain a valid administration.
2. The administration time was less than five minutes for each instrument.
3. The administration and scoring was relatively simple and objective.
4. Some of the instruments were capable of administration to small groups.

5. The instruments indicated possible deficits in either visual or auditory discrimination.

In view of these specifications, the Slosson Drawing Coordination Test (Slosson, 1963), and the Wepman Auditory Discrimination Test (Wepman, 1958) were selected for administration by the counselors. These instruments, together with the Metropolitan Readiness Tests (MRT) comprised the screening battery intended to assess relative degrees of school readiness with respect to visual-motor coordination, and visual and auditory discrimination.

Psychological Battery

The function of the screening devices is to provide preliminary information upon which the psychological staff member may base the decision to test further. In this study, the data obtained from the screening instruments was examined for deficits in visual and/or auditory discrimination and for indications of an uneven developmental rate in the acquisition of readiness skills.

For the cases when individual psychological testing was administered, the protocols were examined with reference to some of the criteria held to be representative of some of the characteristics generally associated with children who have learning disabilities. Because the study focused on subjects enrolled in the first grade and in view of the research data from Frostig (1969) and Hunter et al. (1971) the Wechsler

Intelligence Scale for Children (WISC) and the Frostig Developmental Test of Visual Perception (Frostig) were selected to compose the psychological battery. The psychometric criteria sought in this instance were:

1. A Verbal or Performance IQ of at least 80 on the WISC.
2. A definite scatter or difference of five or more scale score points between any subscales of the WISC.
3. A minimum difference of 15 points in either direction between Verbal and Performance IQs on the WISC.
4. A Frostig perceptual age of less than five on two or more of the five subtests of that instrument.

The presence of criteria Two or Three was considered to be interchangeable. Both of them were not required in the same protocol.

Subjects

The original pool of subjects was composed of 354 six year-old Negro children enrolled in all 12 sections of first grade classes located in three different public schools (herein referred to as School A, School B, and School C). No Caucasian children attended any of the first grade classes in any of the three participating schools.

Procedure

Screening

The administration of the Metropolitan Readiness Test (MRT) to the 354 Ss was provided by each classroom teacher and was carried out approximately two weeks after the beginning of the school year. The following week, six counselors administered the Slosson Drawing Coordination Test (SDCT) in groups of three children at a time. The Wepman Auditory Discrimination Test (WADT) was administered individually. Figure 1 provides a flow chart of this procedure and of the entire experimental design.

After the scoring of the SDCT and WADT, the data for each of these two tests were sorted into two stacks depending on whether or not the scores fell above or below cut-off points which were set according to the considerations which follow. Since the SDCT is a visual-motor coordination test, the presence of a cultural bias was considered to be less likely; therefore the cut-off point was selected according to the norms specified in the manual.

The establishment of the WADT cut-off score was derived from the mean of the population of Ss for the three schools combined. The norms published in the manual were purposely disregarded because of the likelihood of bias resulting from the culturally different verbal model of speech to which the Ss had been conditioned. The population mean of 12 errors was selected as the cut-off score for the WADT.

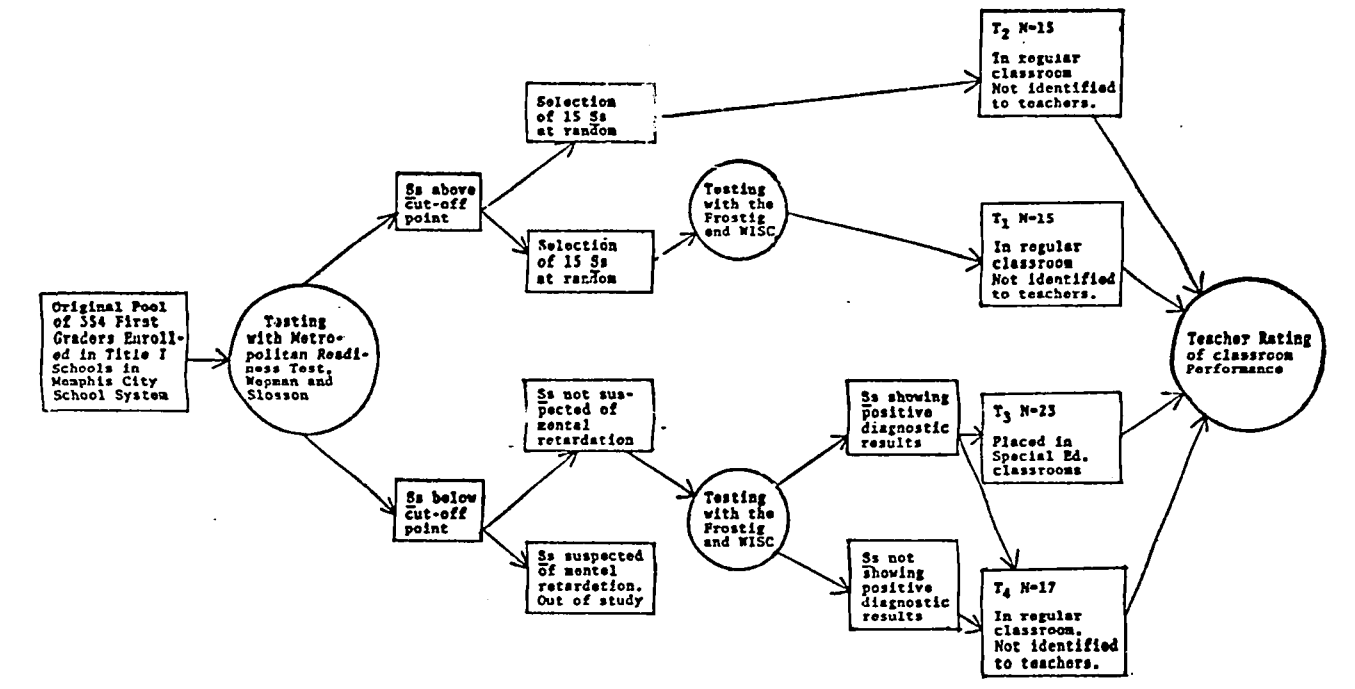


Figure 1. Flow chart of the research design.

The Ss with SDCT scores below 85% were examined, one at a time, with respect to their performance on the WADT and MRT. Particular attention was given to the profile delineated by the scores on the six subtests and the Total score of the MRT. Emphasis was placed on

1. An average or above average score on the Listening subtest.
2. A below average score on the Matching and Copying subtests.
3. A Total MRT score preferably below 38.

The rationale attaching diagnostic significance to scores on the Listening subtest was that successful performance on this task primarily reflects general intellectual competence rather than any specific factors associated with differential characteristics of learning disability. The Matching and Copying subtests, however, assess visual perception in the recognition of similarities and visual-motor control. Below average performance on these tests was interpreted as indicative of the types of deficits encountered with children having learning difficulties. Finally, a Total MRT score which was below average was interpreted as an index of subnormal development of readiness skills.

The means of the MRT subtests and Total had been computed from the population of scores for each school prior to the individual analysis described herein. Figure 2 illustrates the type of profile sought in the selection of Ss.

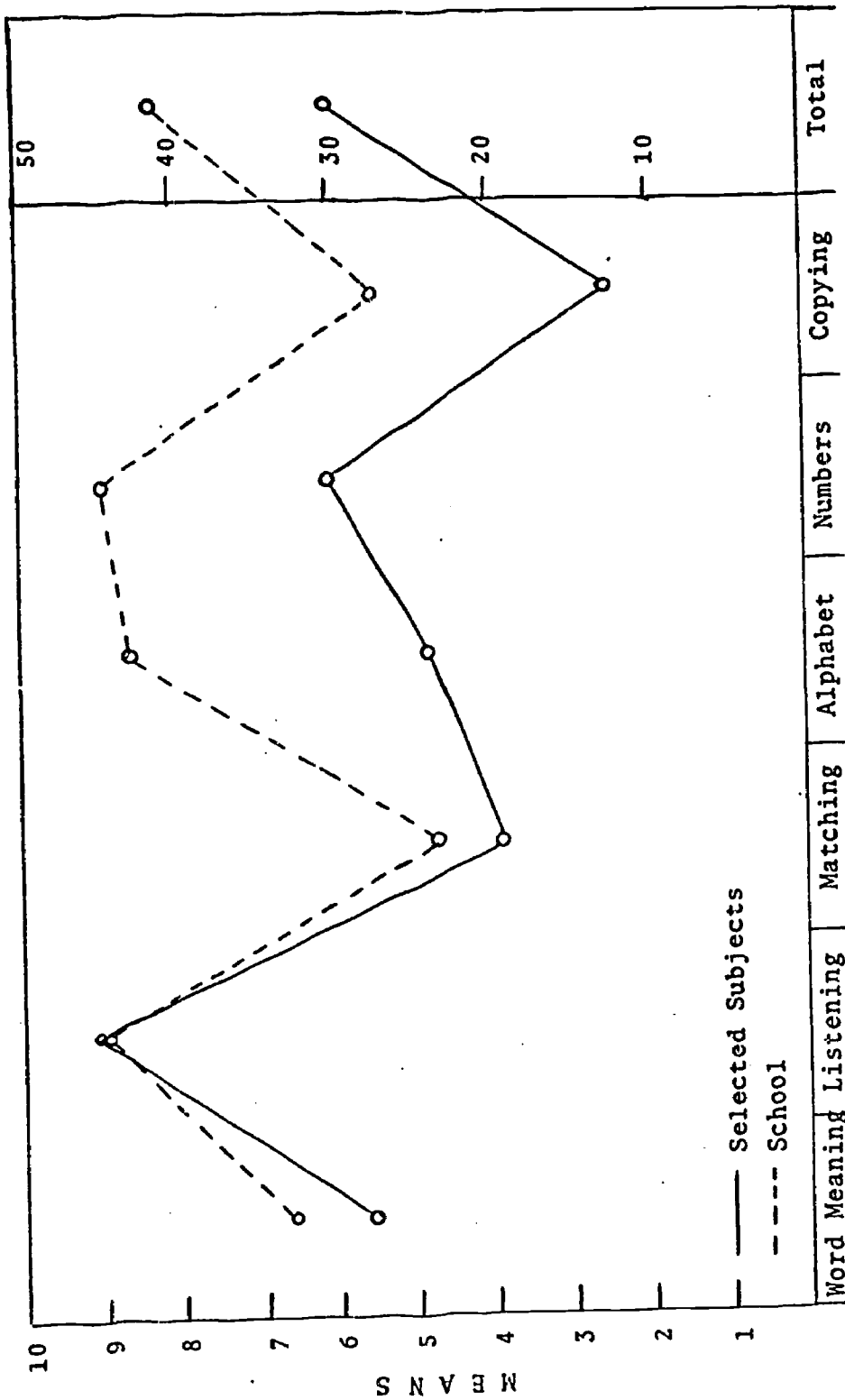


Figure 2. MRT diagnostic profile of Ss selected for further testing.
Data from School A.

If a S with a score below the cut-off on the SDCT demonstrated the desired profile characteristics on the MRT, the performance on the WADT was recorded and the S was scheduled for administration of the psychological battery.

The same procedure was followed for the stack of WADT containing more than 12 errors. The same MRT profile and Total score criterion were instrumental in the decision to test further, and the SDCT scores were recorded as described previously.

During this sorting out process, some Ss presented SDCT scores markedly below the majority of the others and/or markedly high on the WADT scores. The drawings on the SDCT for some subjects were unscorable and some WADT performances were invalidated because the S had not differentiated his answers and therefore had been unable to discriminate any of the phonemes. In these cases, the performance on the MRT was examined for the presence of a suspected very low profile and a very low MRT Total score. In all instances, when the above criteria were found the Ss were taken out of the study for suspected mental retardation. A total of 38 Ss from the three schools was thereby excluded from the research.

The screening procedure identified 40 Ss for further testing with the WISC and the Frostig. In School A and School B, the Ss whose psychometric results on these tests were diagnostic (N=23) received a special education placement while Ss from School C (N=17) who had been identified and could become

eligible for a LD class remained in their regular classroom placement. This situation presented the possibility to randomly select Ss from School C to compose two non-diagnostic groups and have them in classrooms with diagnostic Ss without identifying group membership to the teachers.

The non-diagnostic groups were selected in the following manner. From the remaining two stacks of SDCT and WADT which had non-diagnostic scores, the Ss from School A and School B (N=189) were removed and the 87 remaining Ss were listed as they appeared in the final stacks. The names on that list were numbered from 1 to 87 and, with the use of a Table of Random Numbers, 15 Ss were randomly selected for further testing with the WISC and the Frostig. This group was labeled T_1. Another group of 15 Ss (T_2) was also randomly selected for the only purpose of being evaluated by their teacher at some later date. The total array of 70 Ss, then, included 40 Ss whose screening test results were diagnostic, plus 15 Ss in T_1 and 15 Ss in T_2.

Psychological Testing

With the exception of the Digit Span, a complete WISC and Frostig battery were administered to each of the 40 Ss identified by the screening procedure and to the 15 Ss (T_1) randomly selected. A resulting group of 23 Ss constituted the third group in the study, or T_3. The 17 Ss in the last group, T_4, attended School C and remained in their regular classrooms. The Ss from T_1 were also tested and also remained in regular

classrooms.

Teacher Ratings

Toward the end of the first semester, the 70 Ss from T_1, T_2, T_3, and T_4 were rated by their teachers on selected aspects of classroom performance. A 5-point rating scale was specially designed to assess 10 characteristics of performance on behavior generally associated with learning disabilities (Appendix A). An interview was held with the six teachers whose students participated in the study and each S was scored on each of the 10 items.

The four teachers with Ss in T_1, T_2, and T_4 did not know which of the subjects had been identified as showing characteristics generally associated with learning disabilities. However, the two teachers of T_3, Special Education teachers who taught the 23 Ss identified in this study, were well aware of the Ss' classification.

Each item of the rating scale was assigned values ranging from one for "Poor" to five for "Excellent." Therefore, three points were assigned to an item if the performance or behavior of the Ss was judged by the teacher to be generally comparable to that of an "average" first grader. This procedure provided a total rating score ranging from 10 to 50 with a mid-point of 30 corresponding to an "average" first grader's rating. A score below 30 was interpreted as consistent with a pattern of classroom performance and behavior shown by children with a learning disability.

The purpose of this rating procedure was primarily to estimate the amount of alpha and beta errors resulting from the identification strategy developed in the study. Secondly, it provided information with regard to the degree of relationship existing between classroom performance as judged by teachers and the psychological variables assessed in this study. Thirdly, it permitted the evaluation and confirmation of measurable differences between children with and children without characteristics generally associated with learning disabilities.

RESULTS

The statistical analysis was intended to:

1. Assess the effectiveness of the selection strategy by determining the alpha and beta errors between (a) the screening results and the teacher ratings, (b) the screening results and the specified psychometric criteria for the WISC and Frostig, and (c) the WISC and Frostig and the Teacher ratings.
2. Assess the differences between the control and experimental groups on the Teacher ratings and the variables under study.

Alpha and Beta Errors

From the original pool of 354 who were administered the screening instruments, 38 Ss were tentatively suspected of mental retardation and dropped from the study, 40 Ss who had

obtained deficit scores on the screening instruments were tested with the WISC and Frostig, and 30 Ss with non-diagnostic scores were drawn at random from the remaining 87 Ss in School C. The teachers rated all 70 Ss selected in this manner. The amount of errors and correct identifications are summarized in the 2 x 2 tables below. The + sign indicates scores obtained below the cut-off points or in the diagnostic direction.

Screening	Teacher Ratings +	Teacher Ratings -	
+	37	3	40
-	7	23	30
	44	26	70

Screening	Teacher Ratings +	Teacher Ratings -	
+	53%	4%	57%
-	10%	33%	43%
	63%	37%	100%

The 2 x 2 table on the left indicates the frequencies, and the one on the right the percentages. The screening instruments identified 60 of the 70 children correctly or 86 percent according to teacher rating criteria. The alpha errors or false positives represented 4 percent (3 Ss) of the population and the beta errors were 10 percent or 7 Ss.

The next step in the assessment of the effectiveness of the screening devices was to determine how many of the selected Ss would have WISC and Frostig results meeting the specified criteria (p. 6). For this computation, a total Frostig scale

score of 42 was selected because it represented the best value possible in keeping with the Frostig criteria of two or more subtests below age equivalence. The results are as follows, with + signs again representing scores obtained in the diagnostic directions:

Screening	WISC and Frostig +	WISC and Frostig -	
+	32	8	40
-	2	13	15
	34	21	55

Screening	WISC and Frostig +	WISC and Frostig -	
+	58%	15%	73%
-	3%	24%	27%
	61%	39%	100%

The psychological battery was administered to 55 Ss and the data indicated that 10 WISC and Frostig protocols, or 18 percent of the sample, did not meet the criteria. The largest amount of error was in the direction of the false positives which represented 15 percent of the total errors. The remaining 82 percent of the Ss identified with the screening instruments met criteria generally associated with placement in a first grade Learning Disability Class.

To compare the effectiveness of the psychological battery with that of the screening instruments, the same procedure was carried out with the 45 Ss whose WISC and Frostig

were diagnostic. These were compared with the Teacher ratings. The results are summarized in the 2 x 2 tables below.

WISC and Frostig	Teacher Ratings +	Teacher Ratings -	
+	29	3	32
-	3	10	13
	32	13	45

WISC and Frostig	Teacher Ratings +	Teacher Ratings -	
+	64%	7%	21%
-	7%	22%	29%
	71%	29%	100%

These results are similar to those obtained with the screening instruments. The alpha and beta errors total 14 percent and the psychological criteria agree with the teacher ratings in 86 percent of the cases. From the 55 Ss who were administered the screening instruments, the psychological battery and who were rated by their teachers, 2 Ss were, throughout the procedure, false positives and 1 S was a false negative.

Group Differences

Analyses of variance were computed on all the variables in order to ascertain the areas on which the groups differed. Means and standard deviations of all the variables were tabulated and are located in Appendix B and the analyses of variance and Tukey Tests for the study variables are listed in Tables I and II.

The analysis of variance for the Listening subtest of the MRT did not indicate any differences between groups

TABLE I

ANALYSIS OF VARIANCE AND TUKEY TEST FOR SCREENING VARIABLES AND TEACHER RATINGS

Variable	Source	SS	df	MS	F	Tukey (hsd)
MRT Listening	Between	25.77	2	12.88	2.06	
	Error	418.80	67	6.25		
	Total	444.57	69			
MRT Matching	Between	220.20	2	110.10	17.18*	m_{1+2} m_3 m_4
	Error	429.50	67	6.41		
	Total	649.70	69			
MRT Copying	Between	212.20	2	106.10	18.40*	m_{1+2} m_3 m_4
	Error	386.30	67	5.77		
	Total	598.50	69			
MRT Total	Between	10050.00	2	5026.00	42.98*	m_{1+2} m_3 m_4
	Error	7834.00	67	116.90		
	Total	17884.00	69			
WADT	Between	90.91	2	45.45	1.24	
	Error	2456.00	67	36.65		
	Total	2546.91	69			
SDCT	Between	85.59	2	42.79	6.95*	m_4 m_3 m_{1+2}
	Error	412.70	67	6.16		
	Total	498.29	69			

TABLE I (Continued)

Variable	Source	SS	df	MS	F	Tukey (hsd)		
Teacher Ratings	Between	2322.00	2	1161.00	23.15*	m_{1+2}	m_4	m_3
	Error	3360.00	67	50.15				
	Total	5680.00	69					
MRT Word Meaning	Between	34.78	2	17.39	5.22**	m_{1+2}	m_4	m_3
	Error	223.10	67	3.33				
	Total	257.88	69					
MRT Alphabet	Between	1060.00	2	530.10	32.72**	m_{1+2}	m_3	m_4
	Error	1085.00	67	16.20				
	Total	2145.00	69					
MRT Number	Between	637.30	2	318.60	39.44**	m_{1+2}	m_4	m_3
	Error	541.20	67	8.07				
	Total	1178.50	69					

* $p < .01$ $\quad F_{.99}(2,67) = 4.96$ $\quad F_{.95}(2,67) = 3.13$

$T_1 + T_2$, T_3 , and T_4. The selection of Ss for further testing had been based, in part, on a Listening score near the average score established in each school. The school means were not significantly different, therefore differences among groups were not anticipated.

On the Matching and Copying subtests of the MRT and the Total MRT scores (Table I), the same groups were significantly different at the 1 percent confidence level. The Tukey (hsd) test determined .01 level differences between $T_1 + T_2$ and T_3 and between $T_1 + T_2$ and T_4. There were no significant differences between T_3 and T_4. The symbol m in Table I refers to the mean of each group and the location of no significant differences is underlined. Since scores on these variables were determinants in the MRT diagnostic profile and a cut-off point at the school mean had been instrumental in selecting the Ss (p. 9), the significant differences between the means of the diagnostic and non-diagnostic groups had been anticipated.

The analysis of variance on the WADT did not indicate any significant differences between the three groups. The selection procedure had specified a cut-off point of 12 errors; however, inspection of the means on the three groups indicated small differences which suggested that the cut-off point was inadequate in differentiating groups.

The last instrument of the screening battery was the SDCT. The analysis of variance determined significant differences between the groups at the 1 percent level. The Tukey

test located significant differences ($p < .01$) between the means of the control groups and those of T_3 and T_4. Therefore, the cut-off point of 85 percent or 2 errors did provide a substantial amount of discrimination among the Ss in the original pool.

Finally, the Teacher ratings also discriminated among the 70 Ss who were evaluated by their teachers.

The other variables in the study were also analyzed for the presence or absence of significant differences between the groups. The information was sought in order to further ascertain the areas of skills and abilities where the groups may have differed.

The results of the three subtests of the MRT not emphasized in the diagnostic profile (Word Meaning, Alphabet, and Number) suggested that two of the three (Alphabet and Number) could provide alternate or additional information during the first phase of the selection.

The WISC contributed 13 variables to the study. The analysis of variance pointed out significant differences, either at the 5 or 1 percent level, on seven of these, and on four of the five Frostig tests (Table II).

In summary, the analyses of variance computed on all the variables in the study indicated statistically significant differences between the diagnostic and non-diagnostic groups on the diagnostic variables of the MRT. The selection of Ss with respect to their score on the Listening subtest, however, was designed not to create differences between these groups, and the analysis of variance did not indicate any significant

TABLE II

ANALYSIS OF VARIANCE AND TUKEY TEST
FOR WISC AND FROSTIG VARIABLES

Variable	Source	SS	df	MS	F	Tukey (hsd)
WISC Arithmetic	Between	63.45	2	31.72	4.26*	m_1 † m_3 m_4
	Error	387.50	52	7.45		
	Total	450.95	54			
WISC Vocabulary	Between	42.33	2	21.16	5.12**	m_1 †† m_3 m_4
	Error	215.00	52	4.13		
	Total	257.33	54			
WISC Picture Completion	Between	46.65	2	23.32	4.11*	m_1 m_4 m_3 ††
	Error	295.00	52	5.67		
	Total	341.65	54			
WISC Coding	Between	123.20	2	61.60	13.91**	m_1 m_4 m_3
	Error	230.30	52	4.43		
	Total	353.50	54			
WISC VIQ	Between	748.20	2	374.10	4.06*	m_1 m_3 m_4
	Error	4789.00	52	92.09		
	Total	5537.00	54			
WISC PIQ	Between	1499.00	2	749.60	4.91*	m_1 † m_4 m_3
	Error	7941.00	52	152.70		
	Total	9440.00	54			

TABLE II (Continued)

Variable	Source	SS	df	MS	F	Tukey (hsd)
WISC FSIQ	Between	1093.00	2	546.70	5.82**	m_1 m_3 m_4
	Error	4885.00	52	93.95		
	Total	5978.00	54			
Frostig Eye-Motor Coordination	Between	55.91	2	27.95	8.96**	m_1 m_4 m_3
	Error	162.20	52	3.12		
	Total	218.11	54			
Frostig Form Constancy	Between	38.58	2	19.29	8.48**	m_1 m_4 m_3
	Error	118.30	52	2.27		
	Total	156.88	54			
Frostig Position-In-Space	Between	56.28	2	28.14	7.00**	m_1 m_4 m_3
	Error	209.00	52	4.02		
	Total	265.30	54			
Frostig Spatial Relations	Between	46.24	2	23.12	8.37**	m_1 m_3 m_4
	Error	143.60	52			
	Total	189.84	54			

** $p < .01$ $F_{.99}(2,52) = 5.08$

* $p < .05$ $F_{.95}(2,52) = 3.19$

† $p < .05$ for $m_1 - m_4$

†† $p < .05$ for $m_1 - m_3$

departure from equality. The scatter criteria on the WISC was substantiated with statistically significant differences on four of the subtests, Vocabulary, Arithmetic, Picture Completion, and Coding. Although all the Ss in the diagnostic groups met the criterion of one IQ score 80 or above, there were some significant differences indicated in the Full Scale IQ and the Verbal and Performance components. Finally, statistically significant group differences were ascertained on four of the five Frostig subtests. These differences substantiated the criteria of two or more subtests below age level.

Actuarial Composite Score Analysis

The purpose of this analysis was to investigate the potential utility of a composite score which might assist the psychological examiner in differentiating individual Ss who appear to be at a relatively high-risk level from those who may only be at a low-risk level of learning disability.

The group profiles of WISC subscale scores presented in Figure 3 graphically describe the differences in group means which were found to be statistically different at the .01 level (Vocabulary and Coding) and at the .05 level (Arithmetic and Picture Completion). This pattern corresponds to subscale low points recently identified by various authors as being sensitive to learning difficulties (McLeod, 1965; Frostig, 1967; Hunter, 1971; Bannatyne, 1971). In addition, the present study identified the fourth and fifth Frostig subtests as most strongly differentiating between Ss who obtained diagnostic or non-diagnostic

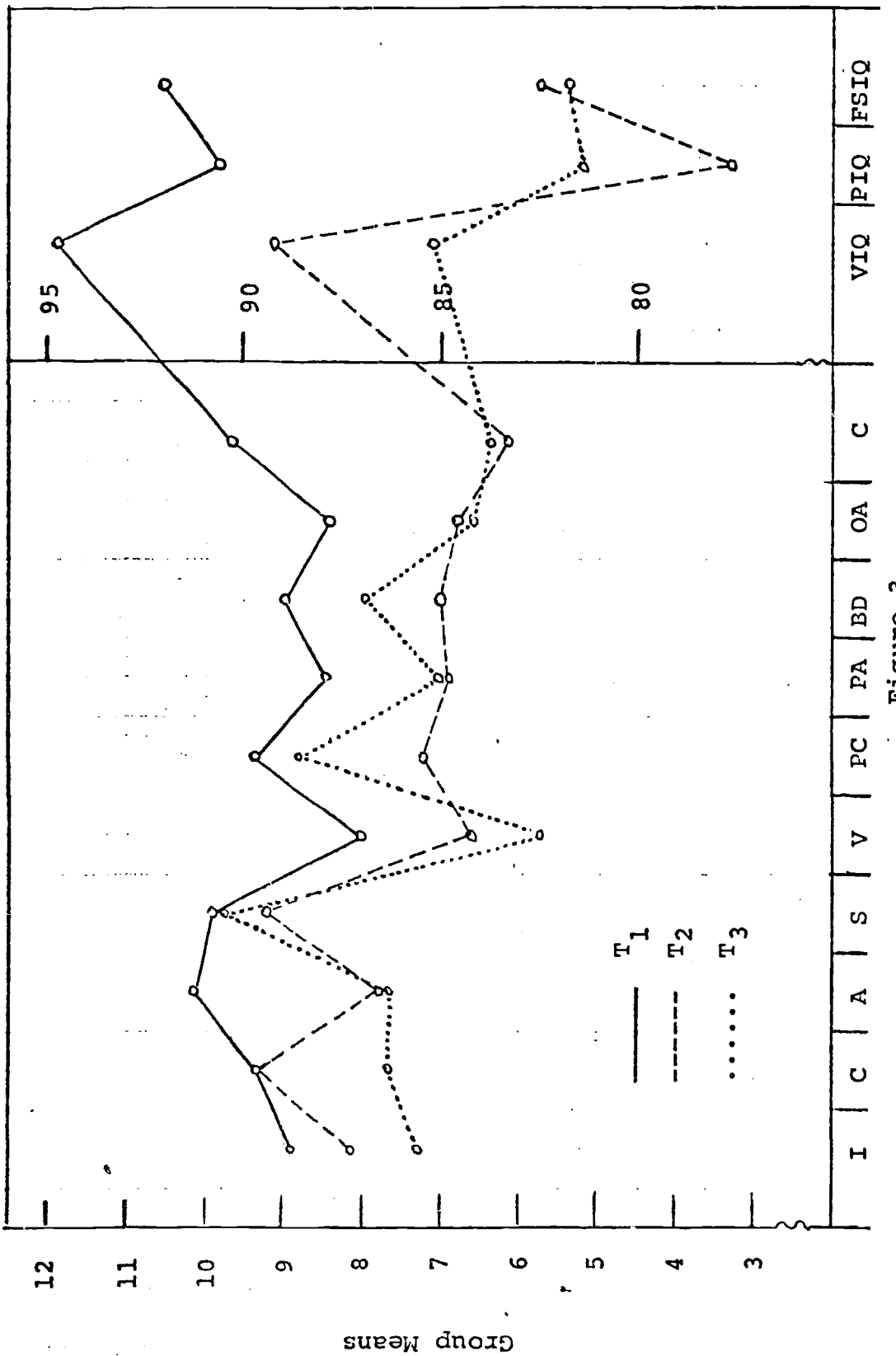


Figure 3

Group Profiles of WISC Subscale and Overall Scores

score patterns from the screening instruments (Figure 4). These findings suggested a further analysis of study data to relate screening results and teacher ratings to a composite score derived from this set of WISC and Frostig subscales.

To this effect, the 70 Ss in the 4 groups were regrouped on the basis of the number of diagnostic screening scores they had obtained. Diagnostic Ss were so labeled if they had three or more screening scores below the original cut-off. Those with less than three "diagnostic" scores were assigned to the non-diagnostic group (T_1). The Wepman results were omitted from this procedure because the research had shown that the original cut-off did not discriminate among the groups. The regrouping resulted in a loss of one S and a gain of 7 Ss to T_1.

Two preliminary composite scores were derived for each S who received a WISC and Frostig administration. The first score consisted of the sum of the scaled score values obtained by an S on the Arithmetic, Vocabulary, and Coding subtests of the WISC. The second score resulted from adding the fourth and fifth Frostig subscale scores. Frequency distributions for these scores, according to membership in either the diagnostic or non-diagnostic screening group by each S, were constructed and a cut-off score was set at one standard deviation below the mean of the non-diagnostic group. The following results were obtained, with the plus (+) sign indicating scores obtained below the cut-off points or in the diagnostic direction.

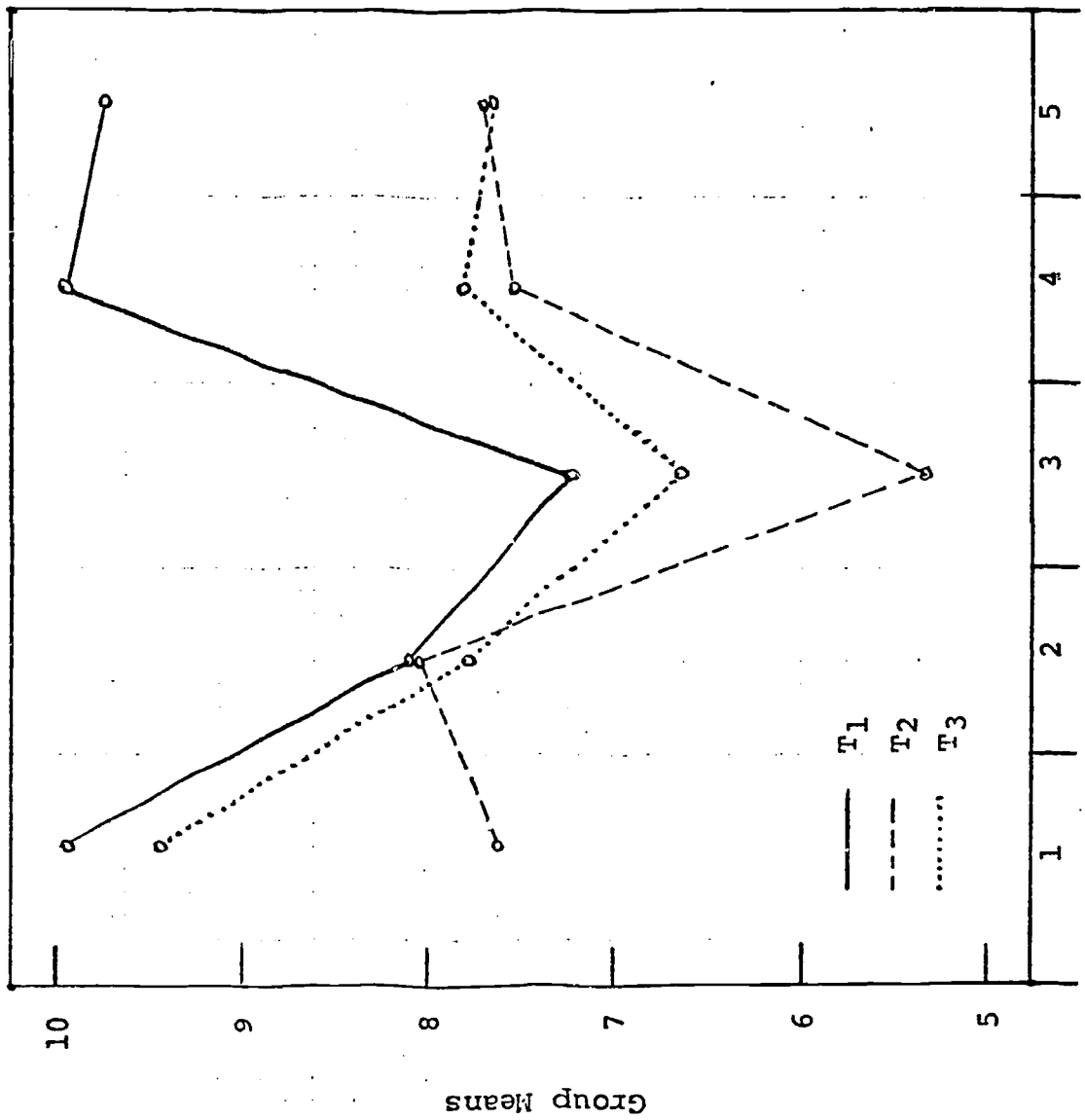


Figure 4
Group Profiles of Frostig Subscales

WISC Composite Score (WCS)

Screening	WCS +	WCS −	
+	25	9	34
−	4	17	21
	29	26	55

Screening	WCS +	WCS −	
+	46%	16%	62%
−	7%	31%	38%
	53%	47%	100%

In this comparison of results between screening and WCS, the total percentage of errors (23 percent) is 5 percent higher than the analysis (See p. 16, above) of alpha and beta errors done on both WISC and Frostig (18 percent). The rate of false positives remains virtually the same (1 percent difference) and the present analysis obtained this yield by purely actuarial procedures.

Teacher Ratings	WCS +	WCS −	
+	28	12	40
−	1	14	15
	29	26	55

Teacher Ratings	WCS +	WCS −	
+	51%	22%	73%
−	2%	25%	27%
	53%	47%	100%

The comparison of Teacher Ratings with the WISC Combined Score indicates 24 percent errors, 22 percent of which were false positives in comparison to 14 percent errors with 7 percent false positives on the previously described alpha and beta error analysis.

A similar analysis was conducted with a composite score from the fourth and fifth subtests of the Frostig Test.

Frostig Composite Score (FCS)

Screening \ FCS	+	-	
+	24	10	34
-	2	19	21
	26	29	55

Screening \ FCS	+	-	
+	43%	18%	61%
-	4%	35%	39%
	47%	53%	100%

Teacher Ratings \ FCS	+	-	
+	23	17	40
-	2	13	15
	25	30	55

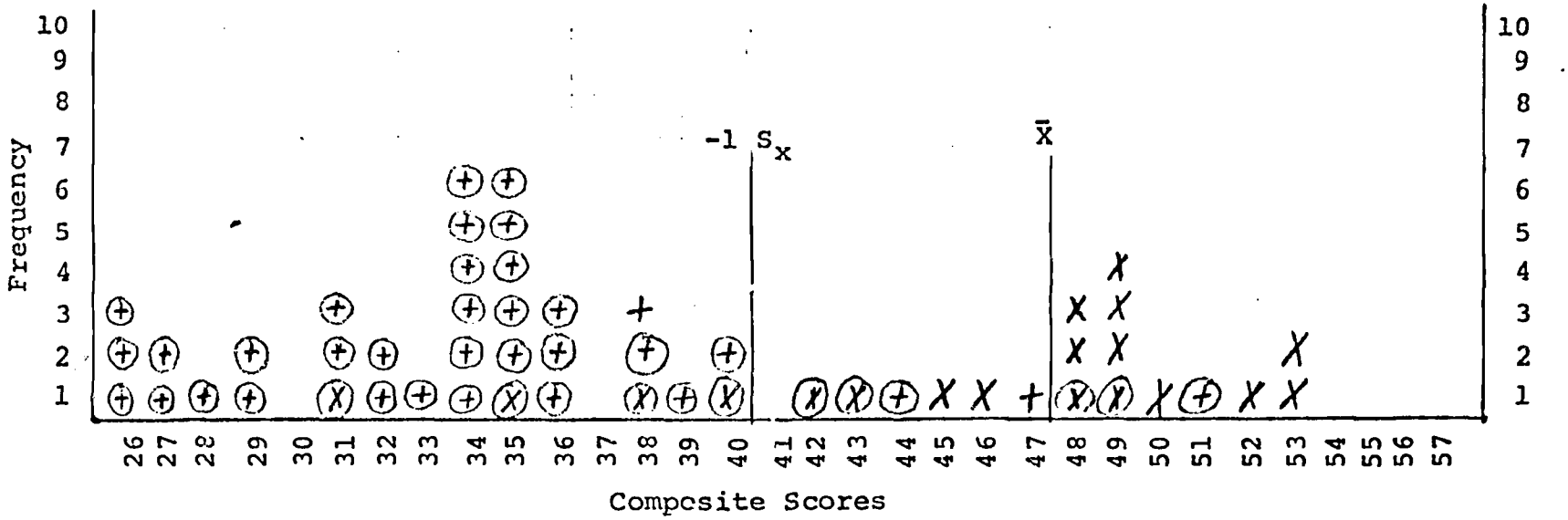
Teacher Ratings \ FCS	+	-	
+	42%	31%	73%
-	4%	23%	27%
	46%	54%	100%

The Frostig combined score analysis yielded higher proportions of error than all the above analyses but the hypothesis that unique discriminating power might be obtained by combining the Frostig scores with WCS scores was suggested by the correlational data (Appendix B, also Coury, 1973) and the results of the analyses of variance. This hypothesis was tested in the following manner. For each S, a combined composite score consisting of the sum of each individual WCS and FCS scores was computed. A frequency distribution for this combined composite score was also constructed (Figure 5) with the cut-off set at one standard deviation below the mean of the non-diagnostic group. The alpha and beta errors were distributed as follows:

Combined Composite Score (CCS)

Screening	CCS +	CCS −	
+	31	3	34
−	4	17	21
	35	20	55

Screening	CCS +	CCS −	
+	56%	6%	62%
−	7%	31%	38%
	63%	37%	100%



X = Non-diagnostic group as determined by screening instruments

\+ = Diagnostic group as determined by screening instruments

O = Diagnostic teacher ratings

Cut-off set at one standard deviation below mean of overall group.

Figure 5

Distribution of A Composite Score Derived From WISC and Frostig Subtests

Teacher Ratings	CCS +	CCS −	
+	34	6	40
−	1	14	15
	35	20	55

Teacher Ratings	CCS +	CCS −	
+	62%	11%	73%
−	2%	25%	27%
	64%	36%	100%

These results indicate that an actuarial combined score analysis based on the most discriminating subscales of the WISC and Frostig produced the smallest percentage of errors obtained in this study.

The WISC FSIQ means of the diagnostic and non-diagnostic groups were ten points apart and statistically significant at the .01 level of confidence (See Table II). To test the hypothesis that the proportion of discrimination of individual cases achieved in the combined score analysis may be attributed to group differences in general intelligence scores, distributions were prepared for all WISC FSIQ, VIQ, and PIQ scores for all 55 Ss. As before, the cut-off points were set at one standard deviation below themean of the non-diagnostic screening group. The analysis provided the following proportions:

FSIQ

Screening	FSIQ +	FSIQ −	
+	18	16	34
−	5	16	21
	23	32	55

Screening	FSIQ +	FSIQ −	
+	33%	29%	62%
−	9%	29%	38%
	42%	58%	100%

VIQ

Screening	VIQ +	VIQ −	
+	20	14	34
−	4	17	21
	24	31	55

Screening	VIQ +	VIQ −	
+	36%	25%	62%
−	7%	31%	38%
	7%	56%	100%

PIQ

Screening	PIQ +	PIQ −	
+	17	17	34
−	4	17	21
	21	34	55

Screening	PIQ +	PIQ −	
+	31%	31%	62%
−	7%	31%	38%
	38%	62%	100%

If the hypothesis that the screening procedure differentiated Ss on general intelligence was correct, the sum of subscale scores for Arithmetic, Vocabulary, and Coding would be expected to assume roughly the same proportions as those given above for FSIQ, VIQ, and PIQ. The following combined comparison of alpha and beta errors derived from the above tables suggests this is not the case.

Combined Alpha and Beta Errors

FSIQ	38%
VIQ	32%
PIQ	38%
Combined Composite Score	13%

These results tend to indicate that the method of combined composite score is not grouping individuals on the basis of general intelligence but rather on indices which have already been isolated as being generally associated with characteristics of learning disability.

Discussion

The validity supports for this research rest, at present, upon several considerations.

1. The choice of the particular screening instruments and selection of cut-off points and profiles which may be sensitive to learning disabilities arose from experienced judgment.
2. The ratio of 40 diagnostic Ss to the original pool of 354 Ss is consistent with the frequently reported incidence

of learning disability at about 10 percent of the school population entering first grade. The analysis of all the data showed a combined Alpha and Beta error of 18 percent. However, the more significant comparisons lie in the proportions of each screening group which retained group membership after further assessment. There were 32 out of 40 Ss in the diagnostic group (or 80 percent) and 13 out of 15 Ss in the non-diagnostic group (or 87 percent) whose psychometric results substantiated the original classification. This degree of psychometric concordance may be viewed as contributing to the validity of the procedure.

3. The staffing of each diagnostic case by the Special Education specialist is a relatively independent validity support for the psychologist's screening and assessment procedures. In this study, all Ss referred to the Division of Special Education were accepted for placement in first grade learning disability classes.

4. Further substantiation was obtained with Teacher Ratings. All 70 Ss were rated by their classroom teachers on a specially designed scale reflecting classroom behavior and achievement patterns sensitive to learning disability characteristics. The degree of correspondence between results from screening, WISC and Frostig, and these ratings was assessed with two separate analysis of Alpha and Beta errors. The same finding of 14 percent in both instances provides additional support for the screening procedure.

5. Research authors mentioned earlier have identified some WISC subscales (particularly Arithmetic, Vocabulary, and Coding) as sensitive to the types of deficit functioning characteristic of learning disability. The Combined Score Analysis utilized these three WISC subscales and added two Frostig subtests which were found to be especially discriminating. The results of this analysis strongly indicate that a coherent proportion of total variance was differentiated and, in agreement with these authors, related to learning disabilities.

6. Finally, the hypothesis that study results primarily differentiated Ss on general ability rather than on learning disabilities, per se, was tested and rejected.

The value of the study lies in the capability of the screening procedure to identify children whose psychometric results on the WISC and Frostig are consistent with those found among children experiencing learning difficulties. Psychological workers in a large school system are frequently in need of screening techniques that can be administered quickly and simply to large numbers of children and on which they can make decisions which will provide an optimal yield.

The type of procedure assessed in this study, although complex in design, can be easily mastered by psychological workers in the field who are experienced in evaluating protocols in the light of various criteria.

The screening instruments can also be used in assisting first grade teachers who are interested in identifying potential

learning difficulties in order to provide individualized instruction. The screening battery would be administered at the beginning of the first grade or at the end of kindergarten to those who attended.

The yield of the screening battery can further be increased, first, by encouraging teachers to maintain quality of test administration in keeping with standard procedures. Second, the clinical orientation of the psychological staff member can improve the usefulness of the procedure through the qualitative evaluation of the SDCT drawings and of the performance on the MRT Copying subtest. The nature of the errors, i.e., eye-hand coordination versus perceptual deficit, brings additional input to the kind of remedial exercises which the teacher can provide. Further, if the Alphabet subtest of the MRT were substituted for the Matching subtest, the false positive errors might be reduced. The cut-off score would be based, again, on the school mean. As for the Frostig subtests, the data indicated that only the Position in Space and Spatial Relations subtests provided significant information. The yield of the screening strategy would probably not be altered if the three other subtests were not administered, and the testing time would be reduced.

Finally, the psychological examiner may find it additionally helpful to cluster the WISC Arithmetic, Vocabulary, and Coding subscales with the fourth and fifth Frostig subtests. A markedly low cluster score on these five variables was found to be strongly related to learning disability.

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TEACHER INTERVIEW

SCHOOL _____

TEACHER _____

PUPIL _____

As compared with an average first grader, what is the present level of functioning of the student in

	Poor	Below Aver.	Aver.	Above Aver.	Excel.
1. Learning to read (e.g. developing word attack skills)	____	_____	_____	_____	_____
2. Expressing him or herself verbally	____	_____	_____	_____	_____
3. Eye-hand coordination (e.g. handwriting or number writing skills)	____	_____	_____	_____	_____
4. Sequencing letters (e.g. reversals, mirror vision)	____	_____	_____	_____	_____
5. Arithmetic (e.g. basic number concepts, place value and basic skills in addition)	____	_____	_____	_____	_____
6. Social interaction (e.g. developing peer relationship behavior commensurate with age)	____	_____	_____	_____	_____
7. Learning to tell right from left	____	_____	_____	_____	_____

	Poor	Below Aver.	Aver.	Above Aver.	Excel.
8. Paying attention to teacher's instructions (e.g. listening, understanding and implementing)	____	____	____	____	____
9. Finishing assignments without more than average coaxing	____	____	____	____	____
10. Self-control (e.g. can respond appropriately to situations requiring delay. Does not seem to demonstrate spontaneous random behaviors)	____	____	____	____	____

APPENDIX B

CODING ASSIGNMENT TO VARIABLES

Test	Variable	Code
MRT	Word Meaning	1
	Listening	2
	Matching	3
	Alphabet	4
	Number	5
	Copying	6
	Total	7
WADT	Wepman Auditory Discrimination Test	8
SDCT	Slosson Drawing Coordination Test	9
WISC	Information	10
	Comprehension	11
	Arithmetic	12
	Similarity	13
	Vocabulary	14
	Picture Completion	15
	Picture Arrangement	16
	Block Design	17
	Object Assembly	18
	Coding	19
	Verbal IQ	20
	Performance IQ	21
	Full Scale IQ	22
Frostig	Eye-Motor Coordination	23
	Figure Ground	24
	Form Constancy	25
	Position in Space	26
	Spatial Relations	27
Rating	Teacher Ratings	28

Var.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Var.
1		20*	30	47	41	22	52	-36	-08	05	-01	13	13	39	01	16	02	25	18	22	19	23	25	10	14	20	25	13	1
2			55	35	31	25	55	05	-29	28	19	25	17	11	15	21	25	19	28	28	32	37	18	24	27	33	45	31	2
3				62	51	36	71	07	-17	17	29	36	13	32	07	30	21	22	40	35	31	40	07	12	30	45	48	36	3
4					76	43	88	-19	-21	25	34	40	06	44	28	38	24	22	56	44	40	51	26	16	33	48	43	59	4
5						50	84	-10	-30	19	16	37	12	30	23	39	36	32	54	35	53	54	34	12	36	53	44	59	5
6							66	08	-48	01	01	17	-07	23	14	38	29	44	33	11	43	34	13	11	19	25	47	36	6
7								-11	-38	15	23	39	17	35	28	43	32	36	53	38	51	54	32	18	39	51	57	59	7
8									-14	-13	-13	-20	-17	-20	-12	16	23	12	-09	-28	05	-12	-02	02	-29	-04	04	-03	8
9										-00	11	-05	06	-19	-20	-38	-08	-37	-10	-02	-31	-21	-25	-25	-19	-31	-49	-38	9
10											26	60	20	29	27	12	15	02	29	69	21	53	-09	-07	24	29	04	24	10
11												20	17	30	02	22	-03	04	12	62	06	38	-24	28	-05	10	-04	25	11
12													15	32	44	30	36	18	47	69	46	69	25	-06	31	46	28	45	12
13														19	01	-02	-04	09	19	58	14	41	22	09	14	08	26	15	13
14															19	30	-13	28	42	69	20	46	09	23	33	37	27	36	14
15																29	46	50	42	27	69	61	28	10	42	46	24	48	15
16																	37	49	35	28	65	58	27	44	07	56	39	52	16
17																		53	32	08	71	52	27	30	17	40	31	35	17
18																			35	19	77	61	25	40	08	39	49	37	18
19																				44	61	65	28	12	32	62	44	55	19
20																					35	78	09	13	27	38	26	44	20
21																						86	42	31	25	64	55	58	21
22																							32	28	32	64	51	62	22
23																								20	13	44	45	36	23
24																									-04	23	21	13	24
25																										28	26	48	25
26																											51	56	26
27																												52	27

* Decimals omitted

Figure 6. Correlation matrix for 28 psychological variables.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Group T_1	$\bar{X}$	7.00	10.00	5.63	12.00	12.40	5.33	53.00	12.27	2.67	8.87	9.33	10.13	9.93	5.00	9.40	8.47	8.73	8.40	9.60	94.73	90.53	92.00	9.93	8.13	7.20	9.93	9.73	33.33
	S	1.51	1.77	2.13	2.50	3.15	1.92	7.43	6.70	2.47	1.68	3.15	1.92	3.56	2.14	2.59	2.03	3.31	3.25	2.80	10.75	14.45	11.86	2.22	2.26	1.47	2.15	1.98	9.93
Group T_2	$\bar{X}$	6.67	9.33	5.73	11.20	11.27	5.87	50.07	12.33	2.53																			33.53
	S	1.95	1.99	3.06	5.27	3.77	2.50	14.91	5.81	1.80																			6.85
Group T_3	$\bar{X}$	5.30	9.26	3.17	4.22	5.30	2.43	27.65	14.83	4.60	8.13	9.35	7.78	9.35	6.61	7.26	6.91	7.00	6.83	6.13	89.17	77.78	82.22	7.65	8.04	5.30	7.57	7.70	20.39
	S	1.59	3.03	2.66	4.51	2.34	2.71	11.37	4.69	3.19	2.16	2.39	3.32	2.01	2.19	2.12	2.52	3.07	2.71	1.71	7.95	12.62	8.97	1.07	2.40	1.22	1.95	1.26	6.38
Group T_4	$\bar{X}$	5.59	9.12	1.29	3.17	6.47	1.71	26.88	14.18	4.88	7.29	7.65	7.65	9.76	5.71	8.76	7.00	7.94	6.59	6.41	85.06	81.41	81.71	9.41	7.76	6.76	7.82	7.65	24.88
	S	1.77	2.67	2.23	3.13	2.32	2.39	7.05	7.38	1.90	2.08	3.10	2.42	3.21	1.79	2.54	2.40	2.82	2.00	1.87	10.55	9.74	8.46	2.06	2.46	1.86	1.94	1.84	5.07

Figure 7. Means and standard deviations for 28 psychological variables.