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The University of Kansas
Lawrence, Kansas, 66045
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A COMPARISON OF LEARNING DISABLED ADOLESCENTS WITH SPECIFIC ARITHMETIC AND READING DISABILITIES

Edward L. Pieper and Donald D. Deshler

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The University of Kansas Institute for Research in Learning Disabilities is supported by a contract (#300-77-0494) with the Bureau of Education for the Handicapped, Department of Health, Education, and Welfare, U. S. Office of Education, through Title VI-G of Public Law 91-230. The University of Kansas Institute, a joint research effort involving the Department of Special Education and the Bureau of Child Research, has specified the learning disabled adolescent and young adult as the target population. The major responsibility of the Institute is to develop effective means of identifying learning disabled populations at the secondary level and to construct interventions that will have an effect upon school performance and life adjustment. Many areas of research have been designed to study the problems of LD adolescents and young adults in both school and non-school settings (e.g., employment, juvenile justice, military, etc.)

Co-Directors: Edward L. Meyen
Richard L. Schiefelbusch

Research Coordinator: Donald D. Deshler

Associate Coordinator: Jean B. Schumaker

Institute for Research in Learning Disabilities
The University of Kansas
313 Carruth-O'Leary Hall
Lawrence, Kansas 66045

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Cooperating Agencies

Were it not for the cooperation of many agencies in the public and private sector, the research efforts of The University of Kansas Institute for Research in Learning Disabilities could not be conducted. The Institute has maintained an on-going dialogue with participating school districts and agencies to give focus to the research questions and issues that we address as an Institute. We see this dialogue as a means of reducing the gap between research and practice. This communication also allows us to design procedures that: (a) protect the LD adolescent or young adult, (b) disrupt the on-going program as little as possible, and (c) provide appropriate research data.

The majority of our research to this time has been conducted in public school settings in both Kansas and Missouri. School districts in Kansas which are participating in various studies include: United School District (USD) 384, Blue Valley; USD 500, Kansas City; USD 469, Lansing; USD 497, Lawrence; USD 453, Leavenworth; USD 233, Olathe; USD 305, Salina; USD 450, Shawnee Heights; USD 512, Shawnee Mission, USD 464, Tonganoxie; USD 202, Turner; and USD 501, Topeka. Studies are also being conducted in Center School District and the New School for Human Education, Kansas City, Missouri; the School District of St. Joseph, St. Joseph, Missouri; Delta County, Colorado School District; Montrose County, Colorado School District; Elkhart Community Schools, Elkhart, Indiana; and Beaverton School District, Beaverton, Oregon. Many Child Service Demonstration Centers throughout the country have also contributed to our efforts.

Agencies currently participating in research in the juvenile justice system are the Overland Park, Kansas Youth Diversion Project and the Douglas, Johnson, and Leavenworth County, Kansas Juvenile Courts. Other agencies have participated in out-of-school studies--Achievement Place and Penn House of Lawrence, Kansas, Kansas State Industrial Reformatory, Hutchinson, Kansas; the U.S. Military; and the Job Corps. Numerous employers in the public and private sector have also aided us with studies in employment.

While the agencies mentioned above allowed us to contact individuals and supported our efforts, the cooperation of those individuals--LD adolescents and young adults; parents; professionals in education, the criminal justice system, the business community, and the military--have provided the valuable data for our research. This information will assist us in our research endeavors that have the potential of yielding greatest payoff for interventions with the LD adolescent and young adult.

ABSTRACT

Fortythree junior high learning disabilities programs were surveyed to identify students who were either specifically disabled in arithmetic or specifically disabled in reading. Existing test scores on file for arithmetic computation and reading word attack were utilized to identify possible candidates for the above groups. Students with arithmetic computation scores two years or more lower than reading word attack scores were considered as candidates for the specially disabled in arithmetic group (SLDARITH). Students with reading scores two years or more lower than arithmetic scores were consider as candidates for the specifically disabled in reading group (SLDREAD). All candidates were then administered the WRAT arithmetic and reading subtests. Using the WRAT arithmetic and reading discrepancies, the thirty students in each group with the largest discrepancies were selected as final subjects.

Three types of data were analyzed: (a) the size of the LD program and school for the two SLD groups, (b) WISC Verbal and Performance scores for the two SLD groups, and (c) arithmetic and reading achievement scores from previously administered tests and the WRAT for all students considered as candidates for the groups.

The results indicated that students with a specific disability in arithmetic were found in larger LD programs. There was no difference between the two groups on WISC Verbal scores. However, the SLDARITH group was significantly lower on WISC performance scores. An analysis of all candidates for the study reveal inconsistencies on previously administered arithmetic and reading tests in comparison to the WRAT Arithmetic and Reading subtests.

INTRODUCTION

The field of learning disabilities (LD) has grown so rapidly that the research base for this population has not been clearly established. As a result the LD definition has evolved from an unsound research foundation. In addition several other factors have contributed to the problems of definition. The positive connotation of the learning disabilities label, as opposed to that of mental retardation, has impelled parents to seek LD services rather than other programs for exceptional children (Ringelheim, 1978). Students who did not fit traditional categories of exceptionality have now been placed in programs for the learning disabled, as have students previously called "underachievers." Now LD programs comprise a heterogenous population. Senf (1978) described LD programs as serving students on the basis of academic difficulties rather than disabilities. What began as services for students with severe learning problems have now often become services for underachievement as well (Drozda, 1976). Services to students with disabilities in arithmetic, listening, writing, spelling, and thinking have generally been overshadowed by remedial reading.

An attempt to clarify the LD definition should begin with research validating the association between the two major components of the LD definition, i.e., academic task failure and psychological process disabilities. A greater understanding of each separate component, as well as their interaction, is needed to operationalize the definition. The LD definition specifically lists the following areas of academic

task failure: listening, thinking, speaking, reading, writing, spelling and mathematical calculations. Although seven academic areas are listed, reading has received the most attention.

In contrast the LD definition does not specifically list the psychological processes. In reviewing the literature, some of the following psychological processes have been associated with the learning disabled: visual, auditory and haptic perception, attention, discrimination, memory, sensory integration, concept formation, and problem solving. The definition cites a disorder in one of the psychological processes as the basis for the inability to perform academic tasks. However, difficulty in measuring and defining psychological processes has been a barrier in operationalizing the process component for identification and research purposes (Chalfant & King, 1975). Therefore a research priority in the field of learning disabilities should be to investigate the association between psychological processes and specifically defined academic task failures. In addition research is needed in the academic task failures which have been ignored, e.g., arithmetic.

Insight into defining a specific arithmetic learning disability can be obtained by empirically and systematically investigating the cognitive processes that have been associated with an arithmetic disability. Three areas of the learning disabilities field have yielded relevant findings: work with severe mental defectives, perceptual motor theorists, and contemporary LD research.

Early work with populations studied in clinics and hospitals investigated characteristics of individuals with severe mental disabilities. The terminology was medical and anatomical; it described

losses in ability to communicate, write, compute, think, etc., which resulted from neurological system dysfunctions. Physicians, describing patients with such characteristics, contributed a majority of the work. Henschen, Strauss, Werner, Gustman, and others studied adults and some children with severe mental deficits. Many of their measures were perceptual. Their major contribution to research was in describing studies of individuals with severe observable characteristics. Individuals with specific disabilities in arithmetic computation were found to have finger agnosia, visual-spatial problems, memory difficulties, and lack of understanding for the operations.

During the second era, the field tried to determine the perceptual and cognitive correlates of a learning disability. Research shifted from medical perspective to educational manifestation of perceptul disabilities. However, the theory of a neurological basis for the disability prevailed: "The work of Barsch, Frostig, Getman, Kephart, Cruickshank have posited that LD is the result of perceptual problems based on the neurological system' (Velluntino, Steger, Hardig, & Miles, 1977). The impact of this era is the persistent conclusion that the psychological-process components should be interpreted within the context of perceptual deficits (Mercer, Forgnone, & Wolking, 1976).

The third era, a contemporary phase of the LD field, has only begun to investigate the cognitive processes associated with a specific arithmetic disability. Studies by Cawley, Kosc, and Slade have identified visual-spatial and reasoning ability as correlates of an arithmetic disability.

Research during these three areas with indiviudals disabled in arithmetic has repeatedly reported difficulties in visual-spatial,

memory, and reasoning cognitive processes as associated characteristics.

The purpose of this investigation was to identify a group of students homogeneously defined as exhibiting a "specific learning disability in arithmetic" and to determine if the cognitive processes: visual-spatial, visual-reasoning, and visual-memory are related to the academic task failure exhibited by this population.

If there is an association between the two components of the LD definition, i.e., psychological processes and academic task failure, disabilities in specific processes will result in certain academic task failures. The processes involved in the task failures of arithmetic and reading will differ. Therefore, students "specifically disabled in arithmetic calculation", students "specifically disabled in reading word recall", and normally achieving students were compared in the above cognitive areas.

Methods

Subjects

The three research groups were defined as follows:

"Specifically learning disabled in arithmetic" (SLD-ARITH), seventh-, eighth-, and ninth-grade learning disabled students whose arithmetic computation achievement grade level is two or more grades lower than their word recognition grade achievement level.

A contrast group of students was defined as:

"Specific learning disability in reading" (SLD-READ), seventh-, eighth-, and ninth-grade learning disabled students whose word recognition achievement level is 1½ or more grades lower than their arithmetic computation level.

A second contrast group of average achieving students was defined as follows:

Average achievers (AVE-ACH), seventh-, eighth-, and ninth-grade students attending regular classes who are perceived by their teachers as average achievers.

In order to identify the two groups of learning disabled students exhibiting specific discrepancies, a large number of schools were asked to participate in the study. Forty-three junior-high schools from the Kansas City, Kansas, and Kansas City, Missouri school districts as well as from school districts in a 70-mile radius from Kansas City participated.

Learning disabilities teachers from the forty-three schools volunteered to participate in identifying candidates for the two LD groups. In cooperation with the LD teacher, candidates for the study were identified on the basis of IQ, arithmetic and reading scores from test records, and school files. Students were required to meet the following criteria:

1. Currently receiving special services and labeled learning disabled by the school district.

2. Exhibiting an IQ above 80 on a standardized intelligence test.

3. Not receiving special services or labeled as emotionally disturbed.

4. On any previously administered arithmetic and reading achievement test, e.g., Wide Range Achievement Test (WRAT), Peabody Individual Achievement Test (PIAT), Key Math Diagnostic Arithmetic Test (Key Math), and Woodcock Reading Mastery Test, exhibiting one of the following:

(a) arithmetic achievement score two grades or more below reading achievement score (SLD-ARITH), (b) reading achievement score two grades or more below arithmetic achievement score (SLD-READ). In either case,

the lower of the two tests had to be below fifth grade to ensure that the student actually evidenced a specific disability.

Because of the large variance found on the above arithmetic and reading tests, students meeting the above criteria were retested with the WRAT so that all students would be considered for final selection on the basis of uniform test scores.

Thirty students from the SLD-ARITH pool and 30 students from the SLD-READ pool were chosen on the basis of the WRAT scores. The 30 students with the largest discrepancies between their arithmetic and reading scores were chosen. Because of smaller discrepancies found in the SLD-READ group, students with discrepancies smaller than 2.0 had to be included.

The students in this group represented a "specific learning disability in either arithmetic or reading." They represented 2% of the approximate 29,670 total enrollment of regular class students attending the 43 junior high schools and 5.3% of the LD population attending the schools.

The third group, AVE-ACH, was randomly selected from four schools which also had LD students participating in the study. Approximately the same number of seventh-, eighth-, and ninth-graders were chosen as in the two LD groups. Within each school, a teacher or guidance counselor selected the students according to the following criteria:

1. The teacher or counselor perceived the student as an average achiever in school.

2. The teacher or counselor perceived the student to be of average intellectual ability.

3. The teacher or counselor did not perceive the student as handicapped.

Description of Subjects

Descriptive data are provided for the thirty students in each of the three groups.

Age and grade. The mean ages and grades of the three groups were analyzed using an F-test for independent means. No differences were obtained across the three groups in age and grade level using an F-test for independent means. Table 1 lists these values.

Insert Table 1 about here

WRAT arithmetic and reading. Arithmetic and reading WRAT scores were available for students in all three groups. Project staff administered the WRAT to the students in the AVE-ACH group. Table 2 tests the F-values obtained for comparison on mean arithmetic scores, mean reading scores, and mean discrepancy scores. Significant differences across groups were obtained on WRAT arithmetic, reading, and discrepancies as expected; the SLD-ARITH group was lowest in arithmetic and SLD-READ group lowest in reading.

Insert Table 2 about here

The mean discrepancy of the SLD-ARITH group was larger than the mean discrepancy of the SLD-READ group. In addition, the AVE-ACH group also exhibited an unexpected discrepancy with arithmetic being lower than reading. The range of discrepancies for the SLD-ARITH group was 8.8 to 2.5. The SLD-READ group's discrepancies ranged from 4.6 to 1.6.

A significant difference was found between the arithmetic and reading

discrepancies across the three groups. An individual analysis of the WRAT arithmetic and reading scores was performed in order to clarify the differences among the mean discrepancies. The mean actual grade placement level of the AVE-ACH students was 7.70. In comparing their grade placement level to their mean WRAT arithmetic and reading scores, the following values were obtained: 7.31 in arithmetic and 8.86 in reading. These achievement levels are not congruent with their grade placement. The arithmetic score was .39 grade levels below their grade placement while the reading score was 1.16 higher than grade placement. This discrepancy may be an artifact of the test. It appears that reading scores are inflated and that arithmetic scores are slightly lower.

Grade level inequalities of the arithmetic and reading subtests would affect the discrepancy magnitudes of the SLD-ARITH and SLD-READ groups. Higher reading scores would lower the SLD-READ discrepancies in that the lower academic scores in reading are inflated. Conversely, the SLD-ARITH would increase the reading and arithmetic discrepancy.

Total IQ. Different IQ tests had previously been adminstered to the groups. Subjects had scores on at least one of the following instruments: WISC or WISC-R, Stanford-Binet, Slosson, DAT, PPVT, Lorge-Thorndike, Otis Lennon, and SRA-STEA. The mean IQs of the three groups were compared using an F-test for independent means. In addition, a T-test was computed for the mean IQ of the two LD groups. The values are shown in Table 3.

Insert Table 3 about here

A significant difference was found in IQs among all three groups.

However, no difference was found between the two LD groups. The literature supports the findings that LD students have lower IQs than regular class students (Smith, Coleman, Dokecki, & Davis, 1977).

Instrumentation

Four subtests from the Woodcock-Johnson Psycho-Educational Battery, Cognitive Tests (1978), Spatial-Relations, Visual-Matching, Analysis-Synthesis, and Concept-Formation together with two different administrations of the Revised Visual Retention Test (Benton, 1974) were administered according to standardized procedures. The subtests will be discussed separately for each with the following aspects described: test behavior required, test format, test reliability, and test standard error of measurement.

Spatial-Relations Subtest 1 (Woodcock-Johnson)

Subjects were required to select from a series of shapes the component shape needed to make a whole shape. The shapes become progressively more abstract and complex. The test is both a timed and a power test. A three-minute time limit was employed.

Visual-Matching Subtest 2 (Woodcock-Johnson)

Subjects were required to identify and circle two identical numbers in a row of six. Visual-matching is both a timed and a power test. A two-minute time limit was employed. The tasks become more difficult, beginning with single-digit numbers and ending with five-digit numbers.

Analysis-Synthesis Subtest 3 (Woodcock-Johnson)

Subjects were required to analyze the components of an equivalency statement and reintegrate them to determine the components of a novel equivalency statement. Correct and incorrect feedback is provided

throughout the beginning and middle portions of the subtests. The test is in part a learning task in which new concepts are presented and explained. Items are arranged in increasing levels of difficulty.

Concept Formation Subtests 4 (Woodcock-Johnson)

Subjects were required to identify one of four rules which separates examples of concepts from noninstances of concepts. The items are in a form similar to Boolean algebraic equations and arranged in order of difficulty.

Benton Copying Subtest 5 Form C

Subjects were required on Form C Administration C to copy 10 5½ x 8½ geometric designs which became progressively more difficult. There was no time limit on the exposure of the design. A student received a score of one for each design correctly copied. Scoring procedures are listed in the manual. One project staff member scored all the Benton subtests. A reliability check revealed 94% agreement.

Benton Memory Subtest 6 Form D

Subjects were required on Form D Administration D to view a geometric design for 10 seconds and after a 15 second delay reproduce the design from memory. A memory-for-design score was obtained by subtracting the reproduction score on Administration D from the copying score on Administration C. The difference score (discrepancy between Administration C – Administration D) represented the loss of points attributed to the added task of encoding and retrieving the design from memory.

Results

The primary investigation compared the three groups of students,

SLD-ARITH, SLD-READ and AVE-ACH on the six cognitive tests. Results from that analysis revealed significant differences among the groups on several of the cognitive variables. A detailed report of these findings can be found in Research Report No. 26 available from The University of Kansas Institute for Research in Learning Disabilities.

The purpose of this report is to present ancillary findings obtained by analyzing additional data available on the two LD groups. Three types of additional information were available: (a) school and LD class size for the two LD groups, (b) WISC scores for the two LD groups, and (c) achievement scores on a variety of measures for any students considered for inclusion in the two LD groups. Results from several analyses will be presented.

School and Class Size

LD class size and school size for students in the SLD-ARITH and SLD-READ groups were compared. Students in these two groups had been selected from 43 junior high schools on the basis of severity of discrepancy between arithmetic and reading scores. The students within the two groups were often taken from different schools. Therefore, an analysis of LD program size and school size for the two LD groups was conducted using a t-test for independent means. The results indicated the mean class size of the two SLD-groups was significantly different. The mean size of the LD class attended by the SLD-ARITH group was 28.0 while that of the SLD-READ group was 22.6. Students with specific difficulties in arithmetic (SLD-ARITH) were found in larger LD programs.

A further analysis was performed on the total school enrollments of the two SLD-groups. The mean enrollment of the schools attended by the SLD-ARITH group was 777, with that of the SLD-READ group being

291. When compared with a t-test, a significant difference was not found.

WISC Verbal and Performance Scores

WISC verbal and performance scores of the SLD-ARITH and SLD-READ groups were compared. Two separate comparisons were conducted. No difference was found between the groups on verbal IQ using a t-test for independent means. The SLD-ARITH group exhibited a mean of 93.7 and the SLD-READ group a mean of 90.8. In contrast, significant differences between the groups were found on the performance subtest. The mean for the SLD-ARITH group was 93.7 and the SLD-READ group 101.6. The performance scores of students with a specific disability in arithmetic were poorer than those of students with a specific disability in reading.

Achievement Scores

Several comparisons were made of arithmetic and reading achievement discrepancies. Several steps had been employed to select the students for final inclusion in the SLD-ARITH and SLD-READ groups. First, arithmetic and reading scores on any test previously administered by the LD teachers were used. Students showing a two-year or greater discrepancy between arithmetic and reading with either being lower were identified. These students were then administered the WRAT by project staff. From these students, the 30 students with the largest discrepancies were selected.

The arithmetic and reading scores for any of the students considered in the above steps were analyzed. Several comparisons were made using the different arithmetic and reading tests. Within the first section, discrepancies were analyzed for students who exhibited arithmetic scores lower than reading scores. In the second section, discrepancy scores were analyzed for students whose reading scores were lower than arithmetic scores.

Arithmetic lower. Students listed in this analysis exhibited a two-year discrepancy with arithmetic lower than reading by two grade levels. The scores were on a variety of previously administered tests. All students had been readministered the WRAT by project staff. A majority of the previously administered arthmetic and reading tests were PIATs, therefore, the analysis was subdivided into two parts, (a) students previously administered the PIAT, and (b) students previously administered tests other than the PIAT.

When the discrepancies for the students with original arithmetic and reading PIATs are compared to the discrepancies on the retest WRATs (see Table 4) using an F test for the difference between independent means, no difference between the discrepancies were found. Table 2 lists these values.

Insert Tables 4 and 5 about here

The scores for students lower in arithmetic remained stable across the two tests. However, when a Pearson correlation was computed on the two distributions of discrepancies, a correlation of .0008 was obtained indicating no relationship betwen individual scores across the two measures.

A further analysis was performed on previously administered tests (other than the PIAT arithmetic) with reading. Table 6 lists these discrepancy scores and the retested WRAT scores. Again an F test for independent means was computed for original discrepancies on tests such as the Key Math, Woodcock Diagnostic Reading Test, Stanford Achievement Test PIAT, etc., in comparison to the discrepancies on the retested WRAT. Table 7 lists these values.

Insert Tables 6 and 7 about here

The F value revealed that there was no difference between the mean differences on the two distributions of arithmetic-reading discrepancies. In addition, a Pearson correlation coefficient was computed between the two distributions. A correlation of .378 was obtained but failed to reach significance. Again, although there was no difference between the means of the distribution, the discrepancies in both distributions did not correlate with one another. This analysis indicated that with a population of students lower in arithmetic than reading, there is a lack of consistency between scores on various measures.

Reading lower. Students listed within this analysis were not necessarily included in the final samples. However, they were students who: (a) all had a two-year discrepancy on previously administered tests other than the WRAT, and (b) were retested with the WRAT and may or may not have qualified with severe discrepancies.

Students listed in this analysis exhibited a two-year discrepancy with reading lower than arithmetic. The scores were on a variety of previously administered tests. All students had been readministered the WRAT by project staff. Students previously administered the PIAT were analyzed first, followed by an analysis of students previously administered tests other than the PIAT. Table 8 lists the scores.

Insert Table 8 about here

An F test for independent means was computed for the two distributions of discrepancy scores. Table 9 lists these values.

Insert Table 9 about here

There is a significant difference between the means of the two discrepancy score distributions indicated by an F value of 31.05. The discrepancies were larger on the PIAT tests. A Pearson correlation coefficient was computed between the two distributions. A correlation coefficient of .11 was obtained. There was not a significant correlation between discrepancy scores on the two distributions. In addition discrepancy scores on various previously administered reading and arithmetic tests other than the PIAT reading combined with PIAT arithmetic were analyzed. Table 10 lists the discrepancy scores for previously administered tested and retested WRATs. An F test was also computed on these two distributions. Table 11 lists these values.

Insert Tables 10 and 11 about here

A significantly large F was obtained, indicating that the mean discrepancy of the previously administered tests was larger than the mean WRAT discrepancy. In addition, a Pearson correlation was computed for the two distributions. A correlation coefficient of -.21 was obtained for the two distributions indicating a negative correlation between scores.

Both differences between mean discrepancies and a lack of correlation was found between the distribution of previously administered tests and the WRAT. Within the SLD-READ group there was a lack of consistency across various arithmetic and reading instruments.

Discussion

Three areas of data were analyzed: (a) class size and school size of SLDARITH and SLDREAD groups, (b) verbal and performance scores of the SLDARITH and SLDREAD group, and (c) arithmetic and reading discrepancies scores on a variety of achievement tests for students considered as candidates for the SLDARITH and SLDREAD groups. Class and School Size

When the students from the SLDARITH and SLDREAD group were compared, it appeared that there was no difference between the size of the schools for the two SLD groups. However, the SLDARITH students were found to be in larger LD programs than the SLDREAD group.

One possible reason for this difference can be explained in the following hypothesis: LD programs have served students with an academic task failure in reading as a first priority. Few programs, materials, and literature are available on the student learning disabled in arithmetic. Therefore, smaller programs must target their resources on the student with the highest priority--the reading disabled. In examining larger LD programs in larger schools, it is found that more support services, aides, materials, and building resources are available. Thus, with more sophisticated services available, there may be a tendency to refer students with specific disabilities in areas other than reading, such as arithmetic. Several alternative hypotheses must also be considered. Further research regarding referral and types of students served as learning disabled represents an area which can contribute important information to the field.

WISC verbal and performance scores. No difference was found for total IQ scores of the two SLDgroups on any of the previously administered tests. However, significant differences were found when comparing

students (25 SLDARITH students and 27 SLDREAD students) with WISC scores. However, no difference was found between the groups on verbal IQ using a *t*test for independent means. The SLDARITH group exhibited a mean 93.7 and the SLDREAD group a mean of 90.8. In contrast, significant differences between the groups were found on the performance subtest. The mean for the SLDARITH group was 93.7 and 101.6 for the SLDREAD group.

The performance scores of students with a specific disability in arithmetic were poorer than those of students with a specific disability in reading. Thus, a further analysis of the relationship between the cognitive tasks on the WISC performance subtests and an arithmetic task failure should be investigated. Unfortunately, these data were not available.

The WISC verbal scores were low for both the SLDARITH and SLDREAD groups. Although the SLDREAD scores were lower, a significant difference was not found. The SLDREAD group had lower verbal scores than performance scores. In decoding there may be a relationship between poor performance and the cognitive processes measured by the WISC verbal subtest and a specific task failure in reading. In addition, the SLDARITH had low scores on the verbal subtest indicating that some of the verbal cognitive subtests may also be related to arithmetic difficulties.

In summary, both verbal and performance scores were low for the SLDARITH group. The SLDREAD group obtained higher scores in performance and clearly lower scores on verbal measures. These findings indicate a need for future research to define academic task failures existing in one area and then compare and contrast the relationship of cognitive problems associated with each. With enough studies in these areas the theorized relationship between task failure and cognitive processes may be substantiated.

Arithmetic and Reading Test Scores

The LD students considered as candidates for the study had been administered a variety of arithmetic and reading tests. Many students were administered tests other than the WRAT. The following findings were obtained in the analysis. First, students' performance on arithmetic and reading subtests across different instruments varied significantly. Often scores in the academic tasks of arithmetic and reading could not be predicted from arithmetic and reading scores yielded by other instruments. The largest inconsistency was found between different reading subtests.

If students are to be identified as LD on the basis of academic task failure and cognitive problems, instruments are needed which consistently measure these behaviors. The results of the above analyses indicate a large variance between different academic test scores. This variance has been documented with other investigators. For example, Harmer and Williams (1978) and Williamson (1979) found variations in the reading and arithmetic test scores of LD students on instruments such as the WRAT, PIAT, CAT, and SAT. The first two of these studies compared the WRAT and PIAT and found the WRAT arithmetic scores to be lower in both.

Summary

Difficulty in defining and conducting research with learning disabled students rests on measuring the two components of the federal definition of learning disabilities. Data from this study suggest that when learning disabilities are specifically defined, differences can be found on the two components (psychological processes and academic performance) of the definition. Although, the information presented regarding

psychological variables is descriptive in nature, it does demonstrate the need for further research on the cognitive abilities of LD adolescents. The second component of the definition, academic task failure, was also substantiated by these data. This portion of the study illustrated the need for further research on assessment measures as inconsistencies in performance were evident on various measures.

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Table 1
Mean Ages and Grades of SLD-ARITH, SLD-READ, and AVE-ACH

Group	Mean	Standard Deviation	F
		Age	
SLD-ARITH	13.90	.78	1.59
SLD-READ	14.11	1.16	
AVE-ACH	13.66	.97	
		Grade	
SLD-ARITH	7.83	.59	3.91
SLD-READ	7.80	.84	
AVE-ACH	7.70	.79	

*$P < .05$.
**$P < .01$.

Table 2
F-Test SLD-ARITH, SLD-READ, and AVE-ACH on the WRAT

Group	Mean	Standard Deviation	F
		WRAT Arithmetic	
SLD-ARITH	3.63	.87	47.88**
SLD-READ	6.02	1.08	
AVE-ACH	7.31	2.15	
		WRAT Reading	
SLD-ARITH	7.80	1.83	84.45**
SLD-READ	3.56	.95	
AVE-ACH	8.86	2.02	
		Discrepancy	
SLD-ARITH	4.16	1.51	25.57**
SLD-READ	2.51	.72	
AVE-ACH	2.02	1.28	

*$P < .05$.
**$P < .01$.

Table 3
F-Tests for Mean IQs Across
SLD-ARITH, SLD-READ, and AVE-ACH

Group	Mean	Standard Deviation	
	All 3 Groups		F-value
SLD-ARITH	94.2	9.90	17.78**
SLD-READ	95.2	8.01	
AVE-ACH	108.76	13.08	
	SLD-ARITH and SLD-READ		F-value
SLD-ARITH	94.2	9.90	.102
SLD-READ	95.2	8.01	

*$P < .05$.
**$P < .01$.

Table 4
Discrepancy Scores of SLD-ARITH Students
Previously Administered PIAT and Retested
WRAT Scores

Arithmetic test name	Reading test name	Discrepancy	WRAT Discrepancy
PIAT	PIAT	3.8	3.4
		2.0	2.0
		5.2	4.4
		2.6	3.4
		3.0	4.4
		2.0	5.3
		3.0	1.8
		2.4	5.6
		4.4	3.3
		7.2	3.8

Table 5
F Test Comparing Mean
Discrepancies of Scores on
PIAT Arith, PIAT Read in
Comparison to Retested WRAT Arith
and Read Discrepancies for SLD-ARITH

Test	Mean	Variance	F
PIAT	3.56	3.74	.075
Retested WRAT	2.44	1.39	

**$P < .05$
*$P < .05$

Table 6
Discrepancy Scores of SLD-ARITH
Students Previously Administered Tests
(Other Than the PIAT) and Retested
WRAT Scores

Arithmetic test name	Reading test name	Discrepancy	WRAT Discrepancy
Key Math	PIAT	4.1	4.3
SAT	SAT	2.6	1.8
		3.4	6.2
		3.6	4.4
		3.1	.1
Stanford Diag Math	Silvaroli	1.9	1.8
Key Math	Woodcock Reading	1.0	2.9
Woodcock-Johnson	Woodcock-Johnson	2.0	3.3

Table 7
F Test Comparing Mean
Discrepancies of Scores
on Various Arith and
Read Tests in Comparison to Retested
WRAT Arith and Read Discrepancies

Tests	Mean	Variance	F
Tests other than PIAT Arith and PIAT Read or WRAT Arith and WRAT Read	2.71	.93	.257
Retested WRAT	3.1	3.15	

**P < .05.
*P < .01.

Table 8
Discrepancy Scores of SLD-READ Students
Previously Administered PIAT Reading and PIAT Arithmetic
Retested with WRAT

Reading test name	Arithmetic test name	Discrepancy	WRAT Discrepancy
PIAT	PIAT	1.5	.1
		8.5	2.7
		2.2	1.3
		4.7	2.0
		6.9	3.0
		5.0	2.3
		5.8	- .6
		4.8	.7
		2.6	1.1
		4.2	1.7
		4.3	.7
		4.0	-2.5
		2.3	-1.3
		3.5	-2.9
		3.9	- .7
		2.5	.5
		2.6	8.8
		2.3	- .1
		6.8	.7
		2.7	.5
		2.5	2.5
		2.5	- .5
		2.8	2.3
		3.1	.5
		2.7	3.1
		2.6	- .3
		4.6	2.9
		8.8	1.3
		3.1	.7
		2.7	.5
		4.6	1.7

Table 9
F Test Comparing Mean Discrepancies of Scores on PIAT Read, PIAT Arith in Comparison to Retested WRAT Read and Arith Discrepancies for SLD-READ

Test	Mean	Variance	F
PIAT	3.87	1.08	31.05
Retested WRAT	3.36	4.16	

**P .05.
*P .01.

Table 10
Discrepancy scores of SLD-READ Students Previously Administered Various Combinations of Reading and Arithmetic Tests and Retested with WRAT

Reading test name	Arithmetic test name	Discrepancy	WRAT Discrepancy
Woodcock Reading	PIAT	2.1	- .5
		2.8	1.9
		2.7	1.4
		5.3	-1.3
		3.2	- .7
Woodcock Reading	Key Math	2.4	- .2
		2.8	.2
		2.9	.2
		2.5	.1
		3.5	1.5
		3.3	.2
		3.7	2.6
		2.8	.5
		2.0	.4
		2.3	1.9
Silvaroli	Key Math	4.0	-3.1
SAT	SAT	2.5	1.6
		5.2	.6
		2.2	- .9
		3.4	-1.6
Silvaroli	Key Math	2.4	1.4
Stanford Diag. Read	Silvaroli	4.2	1.8
CTBS	CTBS	2.5	1.2

Table 11
F Test Comparing Mean Discrepancies
of Scores on Previously
Administered Reading and Arithmetic Tests Other Than the PIAT
and Retested WRAT

Test	Mean	Variance	F
Various tests	3.07	.443	61.03
WRAT	.79	1.70	