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ABSTRACT

The legitimacy of using the criterion of low reading achievement in the study of learning and memory skills with learning disabled children was assessed, based on a comparison of 35 nondisabled students, 15 low readers, and 10 learning disabled high school students. Learning disabilities were defined as encompassing perceptual and/or processing difficulties and a deficit in scholastic achievement of at least 3 years, while the low reading achievement category was distinguished by being at least 4 years below grade level. A series of 13 memory/learning tests and subtests was administered to each student individually in two or three 45 minute sessions. The findings indicated many similarities in the performance of learning disabled and low reading students, but also identified some significant differences between these two groups, particularly in tasks involving visual input and/or visual processing. Analyses of tasks where the two groups differed significantly always found the low reading group performing better than the learning disabled group, with no significant differences between the low readers and the nondisabled subject in each of these cases. While there was overlap between the low reading and learning disabled populations, the data suggest that there are enough differences to preclude using these populations interchangeably under the generic title "learning disabilities." It is concluded that there is a need to specify carefully the criteria used in sample selection, and to limit conclusions about research findings to the particular population studied. (SEW)

A Comparison of Memory Skills in Normal, Low-reading, and Learning Disabled Adolescents

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ABSTRACT

The objective of this study was to investigate the legitimacy of using the criterion of low reading achievement in the study of learning and memory skills in learning disabled children. The subjects were 60 students (35 non-disabled, 15 low reading, and 10 learning disabled) enrolled in grades 10-12 of a northern Colorado high school. A series of 13 tests of learning and memory was administered to each subject. A MANOVA and post-hoc comparisons of means indicated many similarities in the performance of learning disabled and low reading subjects, but also identified some significant differences between these two groups, particularly in tasks involving visual input and/or visual processing. These results point to a need to specify very carefully the criteria used in sample selection, and to limit conclusions about research findings to the particular population studied.

In recent years, many researchers have directed their efforts toward the study of cognitive processing skills in learning disabled children. A close look at the methodologies of these studies indicates variability in the particular samples used. In some studies, children are sampled who have been specifically identified by their school as being learning disabled -- that is, they are children of normal intelligence who exhibit difficulties in a certain area of perception or cognitive processing. In other studies, the sample is selected on the basis of a different criterion, most typically low reading achievement. We refer you to several reviews illustrating this point: Harber (1981), Kavale and Nye (1981); Olson and Mealor (1981), and Torgeson and Dice (1980).

It is often assumed that all such research studies address the problems of the "learning disabled" child, regardless of the criterion used in selecting the sample. In the present study, learning disabled children (as defined by perceptual and/or processing difficulties) and low readers were compared with each other, and with normal children, in a variety of learning and memory tasks, to determine whether the learning disability--low reading equivalence is in fact a viable one.

METHOD

Subjects

The subjects were 60 students enrolled in grades 10-12 of a northern Colorado high school. Of these, there were 15 low readers, 10 learning disabled students, and 35 non-disabled ("normal") students. The low readers were taken from the school's Title I reading program, and showed reading achievement at least four years below grade level. The learning disabled subjects were students previously

identified in school staffings as learning disabled, and were being served by the school's learning disabilities specialist. These students showed at least a three-year deficit in scholastic achievement, despite normal intelligence, and exhibited difficulties in specific perceptual and/or cognitive processing skills. The non-disabled students were taken from study hall sessions. Two of the non-disabled subjects withdrew from school part way through the testing, and the data for these subjects is therefore incomplete.

Procedure

A series of 13 tests and subtests was administered to each subject individually in two or three 45-minute sessions. Specific instructions, test items, and order of testing were standardized for all subjects.

The tests administered are described in detail in the Appendix included in your handout. However, we list them briefly here in their order of administration:

1. Digit Span (Auditory Presentation).
2. Memory for Words (Visual Presentation), with a subtest of Unrelated Words and a subtest of Related Words. In the latter subtest, both the number of words recalled and the amount of clustering by category were computed.
3. Memory for Sentences (Auditory Presentation).
4. Memory for Directions (Auditory Presentation).
5. Memory for Pictures (Visual Presentation), with a subtest of Unrelated Pictures and a subtest of Related Pictures. In the latter subtest, both the number of pictures recalled and the amount of clustering by category were computed.
6. Digit Span (Visual Presentation).
7. Memory for Unrelated Words (Auditory Presentation).

8. Memory for Sentences (Visual Presentation).
9. Paired Associates (Auditory Presentation), with three subtests: one in which No Instructions were given as to how to remember the words, one in which Imagery instructions were given, and one in which Verbal Mediation instructions were given.

One additional test, Proofreading, was administered to the first 24 subjects (13 non-disabled, 5 low reading, and 6 learning disabled subjects). Due to the lengthy administration time required for this test, it was discontinued for the remainder of the sample.

Standardized test results (the Otis-Lennon Mental Ability Test and either the Metropolitan Achievement Tests or the Stanford Achievement Tests) were obtained from the school records of the subjects.

RESULTS

The Otis-Lennon test scores were analyzed to determine whether there were any significant differences in intelligence among the three groups. A one-way analysis of variance of these scores, with a post-hoc comparison of means (using the Duncan Multiple Range Test), indicated a significantly higher mean for the non-disabled group ($\overline{X}$ = 108.8), with no significant differences between the low readers and the learning disabled group ($\overline{X}$s = 79.0 and 82.8, respectively).

Correlations between the tests and the achievement scores were positive; the majority of these were in the .40 to .60 range.

A multivariate analysis of variance and a discriminant analysis were used to analyze the differences in performance on the memory tasks for the three groups of subjects. Given the small number of subjects administered the Proofreading test, this task was omitted from the multivariate analyses. The results of this particular task will be discussed separately.

A MANOVA (Hotelling-Lawley Trace, F (32, 74) = 2.74, p<.001) indicated

overall differences among the three groups on the series of tests. Post-hoc comparisons of means were calculated using the Duncan Multiple Range Test. These means and their post-hoc comparisons are presented in Table 1 of your handout. For virtually every test, the non-disabled subjects showed the highest performance, while the learning disabled subjects showed the lowest. In most cases the performance of the low reading subjects was not significantly higher than that of the learning disabled subjects. However, in three tasks, the low readers performed significantly better than did the learning disabled subjects, and more closely resembled the performance of the non-disabled subjects. These tasks were: (1) Memory for Words (Visual Presentation) -- Unrelated, (2) Digit Span (Visual Presentation), and (3) Paired Associates -- Imagery. It should be noted that all three of these tasks involved either visual input or visual processing.

A discriminant analysis found the battery of tests to discriminate among the three groups with a high degree of accuracy. In this analysis, 84% of the non-disabled, 90% of the learning disabled, and 93% of the low readers were correctly classified.

The Proofreading test, as mentioned earlier, was not included in the above analyses due to the small sample sizes involved. However, the results are included here because of the dramatic differences found. A one-way analysis of variance (F (2, 21) = 52.38, $p<.001$), with a Duncan post-hoc comparison of means, indicated non-significant differences in the performance of the non-disabled and low reading groups ($\bar{X}$s = 17.7 and 16.8, respectively), with a significantly lower performance for the learning disabled group ($\bar{X}$ = 5.3). The test administrators observed that the learning disabled subjects spent much more time in performing this untimed task -- in some cases 30 minutes or more compared to the 5-10 minutes usually needed by the other subjects. Consistent with the other tests where low readers and learning disabled subjects were

significantly different, Proofreading was a visual task.

DISCUSSION

The results of this study indicate that, while there may be similarities between children classified as learning disabled and those classified as low readers, there are significant differences between the groups as well, most notably in tasks involving visual input or visual processing. Analyses of tasks where the two groups differed significantly always found the low reading group performing better than the learning disabled group, with no significant differences between the low readers and the non-disabled subjects in each of these cases.

Our data support the notion that, while there is overlap between low reading and learning disabled populations, there are enough differences to preclude using these populations interchangeably under the generic title "learning disabilities." In light of evidence cited earlier for the widespread use of reading achievement as a selection criterion for subjects in learning disabilities research, it would appear that the generalizability of a substantial number of studies in the field must be questioned. Of particular interest must be the many studies in which selection criteria are not clearly defined.

Given the present ambiguity in definitions of learning disabilities, and the resulting differences in criteria used to identify learning disabled children, it is probably unrealistic to expect all research studies to sample the same types of subjects. However, we do suggest, first, that all research studies addressing learning disabilities state <u>specifically</u> the criteria used in sample selection. Keogh, Major, Omori, Gandara, and Reid (1980) have proposed that researchers utilize a standard set of "marker variables" in describing the populations sampled. Further, we must become more sensitive to the fact that

the conclusions drawn about one learning disabled population may not be generalizable to another population categorized as learning disabled on the basis of a different set of criteria.

Table 1

Post-hoc Comparisons of Means

Test	N	$\overline{X}$s		
		Non-dis.	Low-rdr.	LD
1. Digit Span: Auditory Presentation	60	15.7	13.3	12.6
2. Memory for Words: Visual Presentation				
2A. Unrelated Words	60	17.9	16.3	13.1
2B. Related Words				
2B1. # Recalled	60	20.7	18.1	15.3
2B2. Clustering	60	9.0	5.4	3.9
3. Memory for Sentences: Auditory Pres.	60	39.2	33.7	32.5
4. Memory for Directions: Auditory Pres.	60	33.4	28.1	28.4
5. Memory for Pictures: Visual Presentation				
5A. Unrelated Pictures	59	71.4	70.8	66.5
5B. Related Pictures				
5B1. # Recalled	59	71.7	68.0	62.8
5B2. Clustering	59	36.7	26.3	22.7
6. Digit Span: Visual Presentation	58	20.9	19.3	16.4
7. Memory for Unrelated Words: Auditory Pre.	58	14.0	10.1	10.1
8. Memory for Sentences: Visual Presentation	58	40.8	34.9	32.1
9. Paired Associates: Auditory Presentation				
9A. No Instructions	58	3.4	3.1	2.1
9B. Imagery Instructions	58	5.2	4.7	3.3
9C. Verbal Mediation Instructions	58	3.7	2.5	1.9
Proofreading	24	17.7	16.8	5.3

Note: Lines connecting two or more means indicate no significant differences among means at the .05 level.

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APPENDIX

Description of the Tests and Subtests

1. Digit Span (Auditory Presentation). This test consisted of 24 items ranging from two to nine digits in length, with three items of each length. Each item was administered with digits presented in a monotone one second apart. The task involved serial recall, where all digits were to be recalled in correct sequence for the item to be scored as correct. A subject who correctly recalled an item of a particular length was given credit for any non-administered items of the same length, and the first item at the next level was presented. Subjects who could not correctly recall an item were presented the second, and if necessary the third, item of the same length. If a subject failed all three items of a particular length, it was assumed that the subject would fail any longer items not yet presented, and testing stopped. The subject's score was the number of items recalled correctly plus the additional items for which the subject was given credit.

2. Memory for Words (Visual Presentation). A series of six 5x8 cards was presented. On each card were nine words which, once the card was removed, were to be repeated in any order (free recall). All words were high-frequency, commonly used words in the English language (A or AA in Thorndike & Lorge, 1944).

2A. Unrelated Words. The first three cards each consisted of nine words judged not to be related to one another semantically in any obvious way. The total number of words recalled was computed.

2B. Related Words. The latter three cards each consisted of nine words which could be categorized into three semantic categories of three words each (e.g., "chair -- vegetable -- nurse -- hospital -- table -- meat -- desk -- doctor -- fruit" could be categorized as "furniture," "food," and "medical"). Total number of words recalled, and the number of times the subject recalled two related words in sequence (clustering), were calculated.

3. Memory for Sentences (Auditory Presentation). Sixteen sentences of increasing length (two each of 5, 7, 9, 11, 13, 15, 17, and 19 words) were constructed from high-frequency words (20+ per million in Thorndike and Lorge, 1944). Each set was presented to the subject in a normal speaking voice, with each word being clearly enunciated. The subject's task was to repeat each sentence verbatim. Each response was scored as 3 points (0 errors), 2 points (1 error), 1 point (2 errors), or 0 points (3 or more errors).

4. Memory for Directions (Auditory Presentation). The subject was given a sheet with ten boxes, each containing shapes, pictures, letters, and/or numbers. The subject was then given verbal instructions (consisting of from two to six discrete parts) as to what to do with each box; the instructions had to be held in memory before being performed. One point was given for each discrete part of the instruction correctly executed.

5. Memory for Pictures (Visual Presentation). A series of 28 cards was presented, each with from two to nine pictures of objects. The task was free recall, with one point given for each picture correctly recalled.

5A. Unrelated Pictures. The first 16 cards each consisted of from two to nine pictures of objects judged to belong to different semantic categories. The total number of pictures recalled was computed.

5B. Related Pictures. The latter 12 cards each consisted of from four to nine pictures of objects which could be grouped into two or three categories (e.g., "airplane -- violin -- piano -- boat" could be grouped as "vehicles" and "musical instruments"). The number of times the subject recalled two related pictures in sequences (clustering), in addition to the total number recalled, was calculated.

6. Digit Span (Visual Presentation). This test was parallel in construction to Test 1. Items were presented on 5x8 cards, with presentation time based on the number of digits in the item (one second per digit).

7. Memory for Unrelated Words (Auditory Presentation). The subject was presented with 24 strings of unrelated words, ranging from two to nine words in length, with three items of each length. All words were high-frequency (A or AA in Thorndike and Lorge, 1944). The task involved serial recall, where all words were to be recalled in correct sequence for the item to be scored as correct. A subject who correctly recalled an item of a particular length was given credit for any non-administered items of the same length, and the first item at the next level was presented. Subjects who could not correctly recall an item were presented the second, and if necessary the third, item of the same length. If a subject failed all three items of a particular length, it was assumed that the subject would fail any longer items not yet presented, and testing stopped. The subject's score was the number of items recalled correctly plus the additional items for which the subject was given credit.

8. Memory for Sentences (Visual Presentation). This test was parallel in construction to Test 3. Items were presented on 5x8 cards, with presentation time equal to one second per word.

9. Paired Associates (Auditory Presentation). Three subtests, each with six paired-associates, were presented. All six pairs for a given subtest were presented auditorially in succession. The subject was then given the first word of each pair and asked to recall the second. All words were high frequency, commonly used words (A or AA in Thorndike and Lorge, 1944). In addition, words in subtests A and B were highly concrete and easily imaginable (values of 6.25 or higher on the C and I scales in Paivio, Yuille, and Madigan, 1968). For subtest C, the words were not easily visualized (values less than 5.00 on the I scale in Paivio et al., 1968).

9A. No Instructions. No specific instructions as to how to learn the words were presented.

9B. Imagery Instructions. Prior to the presentation of the word pairs, the subject was given instructions as to how to use visual imagery in learning and remembering the words.

9C. Verbal Mediation Instructions. Prior to the presentation of the word pairs, the subject was given instructions as to how to use verbal mediation in learning and remembering the words. It was judged that the low "visualizability" of the words would make the use of visual imagery unlikely for these word pairs.

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10. Proofreading. The subject was asked to read a one-page passage in which there were 20 spelling errors. The misspelled words were very common words which the great majority of adolescents would know how to spell (e.g., "To have come all this way for nohting!"). Five each of four types of errors occurred: omissions, where a letter was left out, additions, where a letter was added, substitutions, where an incorrect letter replaced a correct one, and reversals, where two letters in sequence were reversed. The number of errors identified was calculated.