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THE PERFORMANCE OF LEARNING DISABLED, LOW-ACHIEVING, AND NORMAL-ACHIEVING ADOLESCENTS ON A SERIAL RECALL TASK: THE ROLE OF EXECUTIVE CONTROL

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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.)

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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 school settings in both Kansas and Missouri. School districts in Kansas which have participated or currently are participating in various studies include: Unified School District (USD) 437 Auburn-Washburn; USD 384, Blue Valley; USD 204, Bonner Springs; USD 308, Hutchinson; USD 500, Kansas City; USD 469, Lansing; USD 497, Lawrence; USD 453, Leavenworth; USD 480, Liberal; USD 233, Olathe; USD 290, Ottawa; USD 305, Salina; USD 450, Shawnee Heights; USD 512, Shawnee Mission; USD 464, Tonganoxie; USD 202, Turner; and USD 501, Topeka. Interlocal agencies in Kansas which have participated include: the Central Kansas Cooperative in Education, Salina; the East Central Kansas Special Education Cooperative, Paola; and the South Central Kansas Special Education Cooperative, Pratt. Parochial schools involved in our studies include: Bishop Miege High School, Shawnee Mission; Bishop Ward High School, Kansas City, Kansas; and O'Hara High School, Kansas City, Missouri. The Kansas State Department of Education also has been helpful in our research efforts.

Studies are also being conducted in several school districts in Missouri, including Center School District, Kansas City; the New School for Human Education, Kansas City; the Kansas City, Missouri School District; the Lee's Summit School District; the Raytown School District; and the School District of St. Joseph. In addition, school districts in Beaverton, Oregon; Delta County, Colorado; Elkhart, Indiana; Houston, Texas; Jonesboro, Arkansas; Montrose County, Colorado; Omaha, Nebraska; and Ottumwa, Iowa, have also participated in our studies. The Iowa Department of Public Instruction also has been helpful in our research effort.

Agencies currently participating in research in the juvenile justice system are the Overland Park, Kansas Youth Diversion Project; the Douglas, Johnson, Leavenworth, and Sedgwick County, Kansas Juvenile Courts; and the judicial district serving the Pittsburgh-Parsons, Kansas area. Other agencies which have participated in out-of-school studies are: Penn House and Achievement Place of Lawrence, Kansas; Kansas State Industrial Reformatory, Hutchinson, Kansas; the U. S. Military; and 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. Our sincere appreciation is expressed to all those who have contributed information to our research effort. 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.

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Abstract

Success on tasks requiring deliberate memorization depends, in part, on a student's ability to exert appropriate executive control during the learning session. Executive processes are invoked whenever an individual is required to match a specific mnemonic strategy to the requirements of a given task. Deficiencies in executive control are increasingly being implicated in mildly handicapped students' failure to transfer and generalize what they have learned. Very little data exist which describe the executive functioning of adolescents. The present study investigated the executive performance of learning disabled (LD) adolescents using a self-paced, serial recall task. LD adolescents' performance was compared to that of a group of low-achieving and a group of high-achieving adolescents. Both in terms of accuracy of recall and use of an appropriate memorization strategy, the high-achieving group outperformed a combined group of low achievers and LD students. With one exception, the performance of low-achieving and LD students did not differ when achievement was statistically controlled. For all three groups, accuracy of recall was significantly correlated with degree of use of an optimal mnemonic strategy. Finally, a large proportion of the LD adolescents were found to employ an appropriate executive strategy and, thus, could not be characterized as demonstrating deficient executive functioning.

THE PERFORMANCE OF LEARNING DISABLED, LOW-ACHIEVING, AND NORMAL-ACHIEVING ADOLESCENTS ON A SERIAL RECALL TASK: THE ROLE OF EXECUTIVE CONTROL

Concern about the information-processing characteristics of learning disabled (LD) students dates back to the beginning of the LD field (Hallahan & Cruickshank, 1973). Such concern has continued over the years (e.g., Chalfant & Scheffelin, 1969), and processing deficits remain a conceptual cornerstone of the current federal definition of LD. In recent years, considerable research related to the information-processing characteristics of both normal and handicapped individuals has been conducted. Yet, very little data have been published concerning the manifestation of these characteristics in LD adolescents. The data presented in the present report were gathered in the context of a larger epidemiological study of LD adolescents conducted by The University of Kansas Institute for Research in Learning Disabilities (KU-IRLD) during 1979-81. The larger study represented a systematic effort to study both the characteristics of LD adolescents and the environmental conditions surrounding these adolescents.[1]

The purpose of this research report is to summarize those findings of the epidemiological study which pertain to the information-processing capacities of LD adolescents as measured by a specific serial recall task. One of the tasks which has been used extensively to study the development of information-processing capacity in children and adults involves the presentation of serial lists of stimuli to be held in memory and recalled over short periods of time. A number of studies have demonstrated that when faced with serial recall tasks, mildly retarded and LD children perform less successfully than their nonhandicapped peers (Belmont & Butterfield, 1971; Torgesen, 1975, 1978).

One explanation of such poor memory performance among developmentally younger persons (including the mildly handicapped) is that these individuals fail to spontaneously apply specific mnemonic strategies when faced with serial recall tasks (Brown, 1974). That is, they fail to use processes such as verbal rehearsal. On the other hand, numerous training studies have demonstrated that even mildly retarded students can quickly be taught to use specific subordinate processes such as verbal rehearsal in the context of specific tasks (e.g., learning serial lists) (Brown, 1978). Transfer and generalization of what is learned has been more difficult to achieve, however, leading to the inference that less effective executive processing is a primary contributor to tally retarded).

Executive processes can be thought of as problem-solving skills. For example, when an individual is confronted with a certain task (e.g., memorization of lists), he/she must develop a plan for how to accomplish the task and select specific control processes (e.g., rehearsal of sets of items in the lists) in response to task demands (Butterfield & Belmont, 1977). Also, executive processes are involved when decisions about modification of the initial strategy are required. Thus, executive processes are considered a key to students' ability to transfer what they have learned in one situation to novel tasks or situations. Brown (1978) and Butterfield and Belmont (1977) prescribed direct training of executive functions in order to induce a general improvement in the cognitive performance of poor learners.

Related to the notion of an executive aspect of information processing is Torgesen's (1977) concept of the "inactive learner," which reveals the intimate relationship between effective executive functioning and adequate motivation to define and reach goals. Based on an extensive body of research in develop-mental psychology, Torgesen (1977) perceived the LD student as an "inactive learner," one who lacks a purposeful, goal-directed approach to various cognitive and academic tasks. Wong (1979) emphasized the usefulness of Torgesen's conceptualization, which provides a broad framework for understanding the performance of LD students. She pointed out that Torgesen, while not denying the importance of more subordinate or automatic processes, stressed the role of higher level control processes that can come under the student's conscious control. Recent research (Haines & Torgesen, 1979; Wong, 1982) has provided support for Torgesen's viewpoint. That is, various types of motivational and executive deficits are beginning to be documented in LD students. For example, Wong (1982) presented fifth-, sixth-, and seventh-grade LD, normal, and gifted students with a task that required them to select appropriate retrieval cues for later recall. Compared to normal and gifted children, she found that LD children lacked self-checking behaviors and behaviors associated with exhaustive and thorough searches for relevant information.

As mentioned, the present study was part of a larger epidemiological study of LD adolescents. One of the overall goals of the larger study was to compare the performance of LD adolescents with two other groups, a normally achieving group (i.e., students who were doing well in school) and a low-achieving group (i.e., a group of students who were failing in school, but who were not identified as handicapped). In this way, attention could be directed to the question of whether poor serial memory performance and the behaviors of the inactive learner were unique to school-defined LD students or whether they were characteristic of low-achieving students in general. Finally, the present study extended the investigation of executive deficiencies to include junior- and senior-high school LD students.

Methodology

Subjects

Three groups of adolescents participated in this study. The adolescents included volunteer LD students, low-achieving students, and normally achieving students in grades 7 through 12. LD students were those currently being served in programs for learning disabled students and validated by a team of two school psychologists and two LD teachers. Low-achieving (LA) students were students who had recently received one or more failing grades in required subjects, who scored below the 33rd percentile on group-administered achievement tests, and who were not receiving special educational services. Normally achieving (NA) students were those who demonstrated passing grades, scored above the 33rd percentile in achievement, and who were not receiving special educational services. The students and their parents agreed to the students' participation in this study.

The students represented a randomly selected subsample of students who participated in a larger study. Details regarding subject selection for the larger study are reported in Schumaker, Warner, Deshler, and Alley (1980).

A total of 160 LD students were selected. IQ and achievement data were available for 154 of these students. The mean percentile rank on the Written Language Cluster of the *Woodcock Johnson Psychoeducational Battery* (*WJPB*) for the LD students was 10.00 (*SD* = 13.90); the median was 6. The mean estimated IQ was 90.39 (*SD* = 12.13).

The total LA sample consisted of 169 students. Of these, achievement data were available for 163 students. The mean percentile rank on the Written Language Cluster of the *WJPB* was 21.90 (*SD* = 19.98), with a median of 17. For the same group, estimated full-scale IQ scores were available for 161 students. The mean estimated IQ was 93.93 (*SD* = 14.18).

One hundred and nine students made up the NA sample. Ability and achievement test data were available from school records for 105 of these students. The mean percentile rank on language arts achievement as measured by the Stanford Achievement Test (1973) for the NA group was 76.50 (SD = 18.49) and the median was 80. The mean ability score as measured by the Differential Aptitude Test (1973) for this group, expressed as a percentile rank, was 75.95 (SD = 21.37); the median percentile rank was 83.

Sample sizes and data on the average levels of ability and achievement of subgroups included in the three ANOVA designs used in this study are presented in Tables 1 through 7. Ability and achievement test scores are designated as "Marker Variables" in these tables. As can be seen from Tables 1, 2, and 3, average achievement and ability levels for the NA group are substantially above grade-level norms.

Setting

Subjects were drawn from three moderate-sized school districts in Northeast Kansas, designated as Districts A, B, and C. The LA and LD students were equally drawn from Districts A and B, whereas all subjects in the NA group attended District C, located in a university community. Participating students in District A were from families whose levels of income and education were, on the average, lower than those of District C, but higher than those of District B. On the average, students in District C were from families with the highest levels of education and income of any of the three districts.[2]

Measurement Systems

Achievement and aptitude test data. IQ and achievement test data for the LA and LD students were based on tests administered individually by KU-IRLD staff as part of the epidemiological study. IQ scores were estimated from performances on the Vocabulary and Block Design subtests of the Wechsler scales (Wechsler Intelligence Scale for Children-Revised (Wechsler, 1955) or Wechsler Adult Intelligence Scale (Wechsler, 1974)). These subtests were chosen because the scores resulting from combining the two subtests are highly correlated (r = .91) with the total test score (Sattler, 1974). To provide an estimate of each student's full-scale IQ, the Vocabulary and Block Design scaled scores were combined, and an estimate was made according to a procedure proposed by Tellegen and Briggs (1967). These authors recommended the calculation of a deviation quotient ($\bar{x}$ = 100, S.D. = 15) which takes into consideration the number of subtests administered, the correlations between those subtests, and the total number of scaled score points obtained by the student.

As part of the epidemiological study, the Reading, Mathematics, and Written Language Clusters of the Woodcock-Johnson Psychoeducational Battery (Woodcock & Johnson, 1977) were administered to the LA and LD students. For the present report, however, only the data from the Written Language cluster were included. This measure was used because it was previously found to be the best single discriminator of LD and LA students (Warner, Schumaker, Alley, & Deshler, 1980).

Aptitude and achievement data for the NA students were drawn from school records. For students in grades 10 through 12, aptitude scores (percentile ranks) were provided by the Differential Aptitude Test (Bennett, Seashore, & Wesman, 1973), whereas achievement levels were obtained using composite achievement on the Stanford Achievement Test (1973) (stated in terms of percentile ranks). For the NA students in grades 7 through 9, aptitude and achievement data consisted of the SRA Achievement Series (Madden, Gardner, Rodman, Korlsen, & Merwin, 1978) Language Arts Achievement score and Educational Ability score, respectively.

Memory processing task. Each student was individually administered a modified version of the Belmont and Butterfield (1969, 1971) circular recall task, hereafter referred to as the "Processing Task." The modified task was structured such that essential components of the Belmont and Butterfield task would be preserved while at the same time allowing for collection of data on large samples requiring minimal equipment and expense. The Processing Task consisted of 16 trials with seven words in each. Two of them were practice trials that were administered before the 14 experimental trials. The stimulus words consisted of one- or two-syllable nouns. None of the words in a given trial was an obvious associate of any of the other words in that trial.

For each trial, the examiner orally presented the seven words. The task was self-paced; that is, the student cued the examiner for the presentation of each word by tapping a pencil on the edge of the table. This cue was designed to be heard by the examiner and was also recorded on an audio tape recorder. The student could take as much time as he/she desired before providing the cue for the next word to be presented. The student could recall the words as soon as he/she wished after the seventh word had been presented.

The order in which the words had to be recalled was specified before presentation of the words. This order was different from the order in which the words were presented. During the first eight experimental trials (the first set), the student was required to recall the seven words of each trial in this order: the last three presented words in order and then the first four presented words in order (5-6-7-1-2-3-4). During the remaining six trials (the second set of trials), the student was required to recall the seven words of each trial in this order: the last four words in order and then the first three words in order (4-5-6-7-1-2-3). For example, if the student was presented with the words, "egg, bulb, camp, sail, lawn, army, test," then under the recall requirement for the second set of trials, the student would be correct if he/she said "sail, lawn, army, test, egg, bulb, camp." The entire session with each student was tape recorded, and student responses were recorded on coding sheets during the experimental sessions (see Appendix A).

Dependent measures. Four dependent measures were derived from a student's performance on the task. The first, called ACCURACY, was a measure of the student's accuracy across the 14 experimental trials. A "strict" scoring criterion was used; that is, a recalled word was scored as correct only if it was recalled in the correct position in the specified order. For example, under the recall requirement for the first set (5-6-7-1-2-3-4), the third word presented in a trial was scored as correct only if it was the sixth word recalled, or if the student indicated that he/she knew it was the word that should be recalled sixth. The percentage of words accurately recalled in all 14 trials served as the first dependent variable.

The second score, used as a measure of the amount of active memorization in which the student engaged, was Total Pause Time (TPT). A microprocessor was used to convert the audio signals (pencil taps) into digital data which could be interpreted by a computer. Trained individuals listened to recordings of each of the testing sessions and depressed a key on the microprocessor whenever they heard a pencil tap. The intervals between these depressions were recorded by the microprocessor and later "dumped" into a computer file. Six interword pause times were recorded for each of the 14 experimental trials, resulting in a total of 84 such times for each student's performance. The raw pause times were summed to yield a measure of the amount of active memorization engaged in by the student.

A third dependent measure, FIT, indicated the extent to which a student's performance corresponded to an "optimal" pause pattern. This pattern was designated as "optimal" by being typical of that used by normal adults. In addition, this particular pattern is theoretically efficient. It is referred to as a "cumulative-rehearsal, fast-finish pattern" (e.g., Barclay, 1979).

The measure of use of an optimal pause pattern utilizes normalized, rather than raw interword pause times. For each student, the set of six pause times (within one trial) was standardized to a mean of 400 (representing 4 seconds x 100) and a standard deviation of 100 (1 second x 100). This allowed for a direct comparison of patterns, since the mean and standard deviations of each pattern were the same. To measure the extent to which each student's trials corresponded to an optimal pause pattern, an Omega^2 statistic was used (Belmont, Ferretti, & Mitchell, in press). Theoretically, this statistic can range from -1.00 to +1.00, with larger scores in the positive direction indicating a greater correspondence or "fit" between two pause patterns.

For each of a given student's 14 trials, an Omega^2 was computed in which the student's normalized pause pattern was compared to the appropriate optimal pattern. For the first set of trials, the model pause pattern used between words was <u>350-400-450-600-300-300</u>. That is, the student would spend more and more time cumulatively rehearsing after each of the first four words were presented and then quickly ask for the last two words. For the second set of trials, the model was <u>350-500-650-300-300-300</u>.

Each of the 14 Omega^2's was then multiplied by 100 for computational convenience and summed to yield a FIT score. By measuring executive functioning in this way, students who adopted an optimal pause pattern early in the 14-trial series and consistently maintained such a pattern received the highest score.

In addition to the information gained from analyzing the FIT variable, a fourth dependent measure, Optimal Strategy Adoption, was employed to seek other information pertaining to the use of an optimal strategy. Of particular interest was the proportion of students in different groups who adopted an optimal strategy by the end of the 14 experimental trials. Consequently, the following steps were taken. As with the FIT variable, each trial for each student was converted to a set of normalized pause times. To construct a more descriptive indicator of optimal strategy use, the median normalized pause time (across the last six trials) for each of the six interposition intervals was computed for each student. If the median normalized pause time for the third interval (the interval between the presentation of the third and fourth words) was equal to or greater than 4.5 seconds, the student was credited with the adoption of an optimal strategy. The 4.5 second criterion was arbitrarily chosen; however, since the pause times had been normalized, the position with a median time of 4.5 seconds or higher tended, almost without exception, to be the longest of the six intervals. That is, when the 4.5 second criterion was met, the resulting pattern reflected the greatest amount of rehearsal at the interval predicted by a cumulative-rehearsal, fast-finish strategy.

By averaging across trials, the reliability of each student's pattern was increased. Second, by including only the last six trials, the effects of early adoption of the strategy were minimized. Of interest was whether or not a student could select an efficient strategy within a reasonable number of trials, not the speed with which he/she gained insight into the problem solution.

Reliability

Interrater reliability for the persons who transposed the pause times from audio tapes was determined. A total of 30 tapes were selected randomly.

For each of 24 tapes, a comparison by two listeners was made. For three tapes two comparisons (three listeners) were conducted, and for three tapes three comparisons were made (four listeners). For each of the 39 comparisons, pause times were compared item by item, and the percentage of pause times which corresponded with a difference less than or equal to .18 seconds was computed. Out of a total of 2730 comparisons, 2541 (93.1%) met the .18 second criterion.

Reliability of scoring for the ACCURACY variable was also computed. One scorer listened to and scored the live responses, while the other listened to and scored the tape-recorded responses. The two scorers' scoring sheets were compared item-by-item. An agreement was counted if the two scorers gave the same word the same number to indicate the same sequencing of the word. A disagreement was counted if the two scorers recorded a different number for the word. A total of 7,938 words were scored by the two scorers. There were 7,597 agreements (or 95.7% agreement) between the scorers.

Procedures

All students were tested individually. The examiner began by explaining the nature and requirements of the task (see Appendix B) and modelled the correct recall procedure. Then two practice trials were given to insure that the student understood the task requirements. During the two practice trials and the first set of experimental trials, a visual display of seven squares in a row was placed in front of the student. The last three squares in the set were shaded in. This visual display was used to cue the student to the correct recall requirement.

The first set of eight experimental trials followed the two practice trials. For each trial, students received general feedback on the correctness of their responses for each trial along with general verbal praise. For example, in providing feedback, the examiner said something like, "You got two of the last three words and one of the first four words. That's great!"

After the first set of eight experimental trials, the student was presented with a new visual display in which the last four squares were shaded, and the second recall requirement was described orally by the examiner. The student was then presented with the last six (second set) experimental trials and received feedback after each trial. At the end of the session, each student was thanked for his/her participation.

Results

Comparison of Normal Achievers and Low Achievers

The purpose of the first of three analyses was to compare the normal achievers with the total group of poorly achieving students (the LD and LA students combined) on the first three dependent measures: ACCURACY, TPT, and FIT. The initial design used three separate analyses of variance (ANOVAs), one for each of the dependent variables. For each ANOVA, three factors were included. The first, classification, contained two levels--one for students with poor achievement (both LA and LD students) and one for the NA students. Only students from District A were included in the LA/LD sample because, in comparison to District B, District A students more closely approximated the students in District C (the district from which the normally achieving students were drawn) in terms of family variables such as status of fathers' occupations and level of parent education. The second factor, sex, consisted of two levels: male and female. Finally, a grade-level factor was included with the three levels: (a) seventh and eighth graders, (b) ninth and tenth graders, and (c) eleventh and twelfth graders. Because the sample sizes in each cell for this design (and others to be discussed) were not equal and because problems were associated with error rates involved in multiple comparisons across dependent variables, alpha was set equal to .01 for all statistical tests.

The means, standard deviations, and sample sizes associated with each of the cells in the first design are presented in Tables 1, 2, and 3. For the variable, ACCURACY, the ANOVA results were as follows. The main effect for classification was significant ($\underline{F}(1,251) = 97.07$; $\underline{p} = .0001$) as were the main effects for grade level ($\underline{F}(2,251) = 4.61$; $\underline{p} = .01$) and sex ($\underline{F}(1,251) = 12.96$; $\underline{p} = .001$). None of the interaction effects was significant. Thus, the NA students outperformed students in the LA/LD group; students in the higher grades performed better than students in the lower grades; and males scored higher than females.

For the variable, TPT, the sex factor was significant ($\underline{F}(1,251) = 7.90$; $\underline{p} = .005$). In general, males had longer total pause times than females. None of the other main effects was significant.

For the variable, FIT, the only significant effect was the classification main effect ($\underline{F}(1,251) = 15.43$; $\underline{p} = .0001$). NA students exhibited higher FIT scores than students in the combined LA/LD group. Thus, NA students were using strategies that were closer to the optimal strategy than the LA and LD students.

Subsequent to the above analyses, a further manipulation of the data for the dependent variable, ACCURACY, was made. In this analysis, the blocking factors were left the same, but the FIT variable served as a covariate to determine whether accuracy could be explained by the degree to which the students used the optimal strategy. The results of this manipulation showed that both classification and sex main effects remained significant, while the grade-level factor was no longer significant. Thus, the superior performance of the NA group over the LA/LD group and of males over females could not be explained entirely in terms of the use of an optimal strategy.

Comparison of Low Achievers and LD Students

The results of the previous analysis suggested that sex was an important factor that could be used to partition the variance associated with at least two of the three dependent variables under consideration. In addition, previous work (Warner et al., 1980) indicated that strong differences across school districts were likely to be found. Because of the relatively small sample of females in our data base, the data for males and females were analyzed separately. For the males, sufficient data existed such that school district (Districts A and B) could be used as an additional factor for comparison. For the females, data from the two school districts were pooled and the additional school district factor was not included. Thus, the design included three factors for males: (a) classification (LA and LD), (b) grade level (grades seven/ eight, nine/ten, and eleven/twelve), and (c) school district (districts A and B). For females, only two factors (classification and grade level) were used.

Males. The means, standard deviations, and frequencies associated with this analysis for the males are presented in Tables 4, 5, and 6. For the dependent variable, ACCURACY, all three main effects were significant. For the classification main effect ($F(1,225) = 7.27$; $p = .008$), male LA students, as a group, outperformed male LD students. For the district main effect ($F(1,225) = 39.24$; $p = .0001$), male students in the higher SES district (District A) scored higher than male students in the lower SES district (District B). For the grade-level main effect, ($F(2,225) = 4.70$; $p = .01$), male students in the higher grades were more accurate than males in the lower grades. None of the interaction effects was significant.

For the dependent variable, TPT, only one of the main effects, district, was significant ($F(1,225) = 16.21$; $p = .0001$). That is, male students in

District A exhibited longer pause times than male students in the District B. Again, none of the interaction effects was significant. Finally, no significant main effects or interaction effects were found for the variable, FIT.

Subsequent to the above analyses of the males' performances, the variables ACCURACY and TPT were subjected to a further analysis. This additional analysis was similar to the previous one, except that the Written Language Cluster score (WLC) was entered as a covariate. For both dependent variables, ACCURACY and TPT, only one significant effect was found: the district main effect. For the variable ACCURACY, the F associated with the district main effect was 16.99 ($df = 1,223$; $p = .0001$). For the TPT variable, the F associated with the district main effect was 1.288 ($df = 1,223$; $p = .0004$). Male students in District A achieved better scores than those in District B. The most important of the above results is that the previously found difference between LA and LD students no longer existed when the achievement measure was statistically controlled.

Females. The design used to measure the performance of LA and LD females utilized two factors: classification (LA and LD) and grade level (grades seven/eight, nine/ten, and eleven/twelve). The same three dependent variables were considered. The means, standard deviations, and frequencies for this design are presented in Table 7. For the variable ACCURACY, one significant effect was found, i.e., classification ($F(1,80) = 16.89$; $p = .0001$), that is, LA females outperformed LD females. For the variables TPT and FIT, none of the main effects or interactions was significant.

As with the analyses for the males, another analysis was conducted for the females in which the variable WLC served as a covariate. Using this procedure, the classification main effect for the variable ACCURACY remained significant ($F(1,78) = 10.78$; $p = .002$). Thus, even when LD and LA females' achievement levels were controlled, the LA females continued to outperform the LD females.

Proportion of Groups Adopting an Optimal Strategy

A determination was made as to the proportion of each of 15 groups that was credited with the adoption of an optimal strategy or pause pattern according to the Optimal Strategy Adoption measure. The groups included LD and LA students from each of three grade levels (7-8, 9-10, 11-12) in District A, the same groups from District B, and NA students from the three grade levels in District C.

Table 8 presents the proportion of each of the groups that exhibited an optimal pause pattern. For the six LA groups represented, the proportions ranged from .32 to .66. For the six LD groups, the proportions ranged from .40 to .48. For the three NA groups, the proportions ranged from .63 to .74. The proportions increased with age for each of the groups. As expected, the proportion of students in NA groups adopting an optimal strategy were higher than the proportion of students in the LA and LD groups adopting an optimal strategy. It should be noted, however, that substantial numbers of LA and LD students adopted an optimal strategy.

Discussion

Two sets of comparisons were of interest in the present study--comparisons between normally achieving and low-achieving (including LD) students on the one hand, and LA and LD students on the other. Concerning the first set of comparisons, it is clear that the NA students outperformed the combined group of LA and LD students both in terms of accuracy of recall (ACCURACY) and the efficacy and quality of the memory strategies adopted (FIT). Assuming that the process or strategy a student utilizes affects accuracy of recall, an activity of further interest was to determine if differences in accuracy could be explained in terms of the adoption of optimal pause patterns. Whereas the $\underline{F}$ value associated with ACCURACY was reduced when the covariate FIT was introduced, significant differences between the groups remained. Thus, the NA group's superior performance could not be explained totally in terms of the use of an optimal strategy. Correlation coefficients between the three dependent variables (presented in Table 9) demonstrated that within each of the three major groups (LA, LD and NA), ACCURACY was influenced to some extent by the use of an optimal strategy or pause pattern.

Significant differences on the dependent measures in the first analysis were also found across grade levels and between sexes. Whereas there was a reliable increase in ACCURACY as grade level increased, such a relationship was not found for the other two dependent variables. Even for the variable, ACCURACY, improvement with age was not dramatic. For example, the mean percent correct for seventh-/eighth-grade LA/LD males was 48.2; for LA/LD males in the eleventh and twelfth grades, the mean percent correct was 50.0.

Differences between males and females were found for the variables ACCURACY and TPT. These differences are paralleled by differences in general aptitude. As shown in Table 1, the mean IQ of the males was higher than that of the females.

In the second analysis, the comparison of greatest interest was that between LA and LD males. Without the introduction of the writing covariate, these two groups differed only on the ACCURACY variable, with LA males outperforming LD males. With the WLC variable (which largely indicates performance on spelling, punctuation, and grammar tasks) controlled statistically, differences in accuracy were no longer statistically significant. This finding is consistent with the more general conclusion, derived from an analysis of a large epidemiological data base (Warner et al., 1980), that once LD and LA students are equated in terms of academic achievement, none of the other variables studied consistently differentiates the two groups.

The second analysis also provided a comparison of males from two school districts. Male students in District A, the higher SES district, received higher ACCURACY scores and higher TPT scores than did male students in District B. These main effects were maintained even when writing achievement was controlled statistically. Although statistical tests of IQ differences between districts were not conducted, an inspection of the means of Table 2 reveals that the means for IQ associated with students in District A were higher than those in District B. Such general deficiencies in the academic/cognitive performance of students in the lower SES district are also consistent with other findings from our larger data base (Warner et al., 1980). District differences such as these pose a serious obstacle for the development (in the context of national or state policy) of consistent operational definitions of learning disabilities. Warner and his associates pointed out that districts serve the lowest of their low achievers in LD programs, and that average levels of achievement for LD students (based on national norms) can differ considerably across school districts.

In the third analysis, in which LA and LD females were compared, LA females were found to outperform LD females on the variable ACCURACY. This difference remained significant after the introduction of the written language covariate. This finding is important because it represents an exception to the more general finding in our data base that LD and LA groups are not reliably different once achievement is controlled. In our data base as well as in LD programs in general (Lerner, 1976), the majority of students are males. Thus, most of the research data in the field of learning disabilities are data obtained from males without sufficient consideration of sex differences in LD populations. A careful examination of such sex differences may hold considerable promise for a better understanding the phenomenon of learning disabilities. One hypothesis is that, due to cultural biases, academic/cognitive deficits need to be more severe in females than in males in order for female students to receive special education services.

As mentioned earlier, Torgesen (1977) and Wong (1979) have characterized LD students as "inactive" learners. Adequate executive functioning as defined here presupposes an active, goal-seeking approach to the task at hand. Whereas the data in the present report lend support to the characterization of the LD student as an inactive learner (in comparison to normally achieving students), these data also point to important limitations regarding this characterization. First, executive functioning, as measured by the FIT variable, did not serve to differentiate LD males and females from their respective counterparts in the LA groups. Thus, whereas a "passive," relatively immature approach to this task may characterize a significant number of LD students, it also characterizes a significant number of LA students. In other words, passive learning is related to poor achievement in general rather than learning disabilities in particular. Second, during the final six experimental trials (see Table 9) between 40% and 48% of the LD students (depending on grade level and school district) had adopted an optimal pause pattern, making it difficult to characterize the LD group, as a whole, as inactive.

Certain cautionary statements need to be made regarding the above findings. First, the comparisons reported here are based on a laboratory task. Slight modifications in the task (e.g., an expansion of the number of words presented in each trial) might lead to different results (e.g., Barclay, 1979). Likewise, it should not be concluded that patterns of difference found here would necessarily characterize the groups on tasks more like those typically presented in the classroom.

In summary, in comparison to a group of students showing normal achievement in school, the LD group exhibited deficiencies both in the products (ACCURACY) and processes (FIT) associated with their performance on a processing task with the qualification that a significant proportion of LD students exhibited relatively adequate executive functioning. Differences in accuracy could not be accounted for entirely in terms of the adoption of an optimal strategy, leaving open the question of what other factors contribute to accurate recall. Neither LD females nor LD males differed from low achievers on measures of how they approached the task. The finding that, for the males, low achievers outperformed LD students in accuracy, is tempered by prior achievement differences between the groups. For the female LD students, lower accuracy continued to distinguish them from their low-achieving counterparts even after achievement was controlled.

The results of this study and others generated from our data base lead to a characterization of school-defined LD adolescents as poor performers across a variety of academic/cognitive measures. One problem with this characterization is the nature of the data on which it is based. That is, a <u>group</u> of LD students is typically compared to a <u>group</u> of normal achieving students, and the LD students are found to perform more poorly <u>as a group</u> on a given task. In this way, inadequate attention is paid to individual differences among the LD students themselves. Cognitive theories on which the present study is based offer the promise of identifying a small number of individual difference variables which might in turn serve as a basis for selecting significant subgroups of LD students.

For example, some LD students might be characterized as not having executive deficiences, but rather as having deficiencies associated with the rapid and automatic manipulation of codes associated with written language (e.g., Stanovich, 1982; Torgeson and Houck, 1980). Other LD students might be characterized as having satisfactory skill in manipulating codes, but inadequate executive skills. Still a third group may, exhibit both types of deficiency. One of the limitations in our current knowledge about LD and and low achieving students is that we lack data on the proportions of students who make up the three groups just identified, as well as other important subgroups (Deshler, et al., 1983).

The identification of broad subgroups of LD should lead to a refinement of current definitions of learning disabilities, as well as to intervention techniques which are targeted to specific types of deficiencies. Future research should address such problems.

Footnotes

1. Other data from the larger epidemiological study are contained in Research Reports 12 through 20, available from the KU-IRLD. The reader is encouraged to interpret the data cited in the present report in the context of the other reports.

2. The exact measures of socio-economic status are described in Research Report 12, available from the KU-IRLD. In general they are based on paper and pencil reports from parents who participated in the larger epidemiological study. No statistical tests of the significance of mean differences across the school districts were made.

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PROCESSING TASK WORD LIST

SUBJECT: ______________________ DATE __________ SEX: M___ F___ SCHOOL ________________

TIME OF DAY: ____________________ RA ______________________________________

Practice Trials

A	LOCK	TUBE	SEAT	HAM	CAB	BOOK	PIG	
B	LION	COIL	BONE	SPOT	POP	WINE	BOCK	

Trials — Position 4

1	4 SEA 1	5 GOAT 2	6 PIT 3	7 CORD 4	1 EYE 5	2 BOLT 6	3 TRAP 7	
2	TIRE	SIGN	FLAG	RING	CITY	BAND	HUT	1st Recall
3	NEST	STAR	WEED	JAR	DOLL	CARD	BABY	Requirement
4	SHOP	FAN	CHIN	LAKE	MAN	BATH	TOOL	
5	TAIL	SLED	KNEE	CLUB	DRUM	OIL	MICE	
6	SHOE	FARM	MILK	GULE	PIPE	KEY	ROOT	
7	BOY	CENT	TENT	DOOR	WELL	LIST	PAN	
8	SOUR	CAT	LIP	WALL	DUST	PONY	MUD	
9	5 HAIR 1	6 SAFE 2	7 CAP 3	1 DESK 4	2 FACE 5	3 TAG 6	4 BUG 7	
10	BED	SINK	PEN	FOX	CAR	MOON	OVEN	2nd Recall
11	FAT	BELL	POLL	RUG	STEP	NET	CELL	Requirement
12	OAK	BOAT	WHIP	LANE	COW	DOT	PET	
13	EGG	BULB	CAMP	SAIL	LAWN	ARMY	TEST	
14	BANK	KID	ROCK	GUN	MEAL	COAL	WIRE	

Position 3

APPENDIX B

PROCEDURES AND INSTRUCTIONS
PROCESSING TASK--CURRICULAR RECALL

Start tape recorder and leave running throughout task.

RA: "This is subject number----."

RA: "O.K. (student's name), I'm going to ask you to remember some words that I say. I want you to tap your pencil on the edge of the table like this.

Tap the pencil and hand it to the student. The pencil is unsharpened.

RA: "Tap your pencil."
(Student taps pencil)
RA: "Boat. Tap your pencil again."
(Student taps pencil)
RA: "Hat."

Place in front of the subject the card with seven blank squares.

RA: "Now, this card has seven squares on it. Let's practice a list of seven words. You tap your pencil and I'll say a word. Listen carefully, I will say each word only once. After I have said all seven words, I will raise my hand."

Go through Practice List A. The student taps pencil. RA says words, then raises hands. RA points to the position of the word on the card as he/she says it.

RA: "Good, (student's name). That's the idea. Do you remember any of the words that I said?"
(Student says some words)
RA: "Good, that's the idea."

Switch cards. Display the 3-4 card (last three squares are shaded).

RA: "O.K. Now let's go through another list--Each time you tap your pencil I will say a word. When I've said seven words I'll raise my hand. Then I want you to say the last three words in order (point to the black squares) and then say the first four words in order. So, for example, if I said, 'Cat-mouse-dog-bear-car-train-bus,' you would try to say the words back in this order:

First the last three: car-train-bus (pointing)

and then the first four: cat-mouse-dog-bear.

Will you point out the right order? (Subject points. RA corrects if necessary and says "Good.")

Even some adults find this hard, so I don't expect you to get all of the words right--but I want you to try your best to see how many you can remember.

You can tap your pencil as slowly or as fast as you want; go at your own pace and take as much time as you need to do as well as you can.

Read Practice List B and raise your hand. If the subject does not respond in 10 seconds say, "Can you tell me some of the words?" If the student starts remembering some words followed by a pause, wait five seconds and say, "Do you remember any more?"

RA: "When you are finished just say, 'I'm done'."

If the subject says some words back, but says them in the wrong order (e.g., backwards), after he/she is finished show him/her what he/she said, and then give the correct order. (This is the only time this correction should be made.)

Go through 8 experimental trials with this first recall requirement (3-4).

Before each list (and pointing to the visual display of the squares) say, "Remember--say the last three words and then say the first four. Tap your pencil when you're ready for the first words."

After each list, give the student feedback as to how he/she did, like this: "You got two of the last three and one of the other ones. That's great, very good", etc.

After the eighth experimental trial, put down the new recall requirement visual display in front of the student and say:

(4-3 card: last four squares are shaded)

RA: "Now let's try something different. I want you to say the last four words and then the first three (Pointing to the display), so that if I say "Cat-mouse-dog-car-plane-bus-truck" you would say "Car-plane-bus-truck-cat-mouse-dog" (pointing).

Ready . . .

Present the last six trials with the new recall requirement. Keep it natural and provide lots of encouragement and praise for the correct responses, ignoring incorrect ones.

1. Each RA is responsible for turning in Clear tape recordings which easily pick up the student's voice and the pencil taps. If there are any problems with this, or if you have any other questions about the task, please call me immediately.

In this regard, make sure that the student is tapping the pencil clearly during the practice trials (and throughout the task for that matter). Also, make sure that the batteries are working.

2. Obtain a clipboard and read the words from the list on the clipboard, so that the student can't see the words as you read them.

3. You must say each word right after the pencil tap and be very consistent with this.

4. Please go through the task with at least two friends before you give it to a student in the study. If questions arise during the sessions with friends, please call.

5. After the practice trials, you no longer need to point to the squares as you say the words.

6. If, during a trial, the student asks you to repeat a word, repeat it and write (R after the word on the recording sheet). After the trial, remind the student that you can only say the word once.

7. Be sure to record all the student's recall responses on the recording sheet. If something unusual happens during a trial, note it on the right side of the sheet, especially if it's something that might lead us to throwing out the whole trial when we analyze the data, e.g., someone comes into the room, and the student is completely distracted.

If the student starts out and says three words and then says, "No . . . I mean. . . ." as if editing out something, then put brackets around the words you think were edited out. These bracketed words will not be included in the analysis of the data.

If the student says, "I can't go on," say, "I know this is hard, you are doing fine. I just want you to try a few more."

If you are using an external microphone, have it closer to the student, but say the words in a natural and normal tone of voice. If everything isn't clearly picked up, we will have to make an adjustment.

Sample 3 4 5 apple ____ 1/6 ____ 2 Recording
dog cat fence post tree pip shoe

(For the 4th response, student says "something" or "I forgot that one. . ." etc.)

(Both the 1st and 6th responses were tree.)

R
(You repeated the word.)

(The 5th word spoken was apple, which is not on the original list.)

Table 1

Descriptive Statistics for Groups Associated with First Analysis

Grades 7 - 8

Groups	Dependent Variables			Marker Variables	
	Accuracy	TPT	FIT	IQ	Achievement
Male LA/LD	Mean = 48.18 S.D. = 19.93 N = 38	Mean = 254.32 S.D. = 257.82 N = 38	Mean = 356.39 S.D. = 402.50 N = 38	Mean = 95.24 S.D. = 11.66 N = 37	Mean = 506.29 S.D. = 17.60 N = 38
NA	Mean = 67.12 S.D. = 16.62 N = 17	Mean = 201.94 S.D. = 91.94 N = 17	Mean = 542.12 S.D. = 421.49 N = 17	Mean %ile = 81.47 S.D. = 19.52 Median = 90.0 N = 17	Mean %ile = 76.59 S.D. = 17.69 Median = 81.00 N = 17
Female LA/LD	Mean = 32.53 S.D. = 16.93 N = 15	Mean = 118.33 S.D. = 37.25 N = 15	Mean = 73.20 S.D. = 261.16 N = 15	Mean = 85.59 S.D. = 13.34 N = 15	Mean = 499.35 S.D. = 13.41 N = 15
NA	Mean = 62.00 S.D. = 14.82 N = 19	Mean = 195.05 S.D. = 82.70 N = 19	Mean = 454.37 S.D. = 394.30 N = 19	Mean %ile = 86.67 S.D. = 12.80 Median = 88.0 N = 18	Mean %ile = 81.68 S.D. = 17.16 Median = 86.00 N = 18

Note 1. Statistics for the normally achieving group are based on percentile ranks.

Note 2. Sample sizes vary slightly due to missing data.

Table 2

Descriptive Statistics for Groups Associated with First Analysis

Grades 9 - 10

Groups	Dependent Variables			Marker Variables	
Male	**Accuracy**	**TPT**	**FIT**	**IQ**	**Achievement**
LA/LD	Mean = 55.61 S.D. = 15.92 N = 36	Mean = 218.19 S.D. = 174.47 N = 36	Mean = 375.33 S.D. = 423.21 N = 36	Mean = 97.85 S.D. = 10.97 N = 34	Mean = 515.75 S.D. = 17.59 N = 36
NA	Mean = 76.62 S.D. = 17.51 N = 13	Mean = 327.77 S.D. = 134.85 N = 13	Mean = 457.15 S.D. = 422.19 N = 13	Mean %ile = 85.85 S.D. = 14.61 Median = 91.00 N = 13	Mean %ile = 79.83 S.D. = 19.32 Median = 86.00 N = 13
Female					
LA/LD	Mean = 42.07 S.D. = 19.80 N = 15	Mean = 148.60 S.D. = 48.39 N = 15	Mean = 225.80 S.D. = 385.80 N = 15	Mean = 90.80 S.D. = 10.58 N = 15	Mean = 527.07 S.D. = 18.18 N = 15
NA	Mean = 65.28 S.D. = 15.00 N = 25	Mean = 231.12 S.D. = 126.35 N = 25	Mean = 497.89 S.D. = 415.89 N = 25	Mean %ile = 76.58 S.D. = 18.84 Median = 82.0 N = 24	Mean %ile = 74.84 S.D. = 17.55 Median = 78.0 N = 25

Note 1. Statistics for the normally achieving group are based on percentile ranks.

Note 2. Sample sizes vary slightly due to missing data.

Table 3

Descriptive Statistics for Groups Associated with First Analysis

Grades 11 - 12

Groups	Dependent Variables			Marker Variables	
Male	Accuracy	TPT	FIT	IQ	Achievement
LA/LD	Mean = 50.03 S.D. = 18.79 N = 36	Mean = 220.03 S.D. = 166.28 N = 36	Mean = 333.39 S.D. = 383.27 N = 36	Mean = 108.89 S.D. = 12.90 N = 37	Mean = 516.92 S.D. = 18.11 N = 37
NA	Mean = 72.18 S.D. = 15.48 N = 11	Mean = 238.64 S.D. = 159.66 N = 11	Mean = 639.55 S.D. = 442.25 N = 11	Mean %ile = 63.18 S.D. = 21.64 Median = 59.00 N = 11	Mean %ile = 83.36 S.D. = 19.04 Median = 92.00 N = 11
Female					
LA/LD	Mean = 47.06 S.D. = 20.89 N = 18	Mean = 195.00 S.D. = 213.87 N = 18	Mean = 416.94 S.D. = 356.30 N = 18	Mean = 98.76 S.D. = 12.49 N = 17	Mean = 523.71 S.D. = 16.55 N = 17
NA	Mean = 70.35 S.D. = 15.07 N = 20	Mean = 201.60 S.D. = 145.46 N = 20	Mean = 436.85 S.D. = 399.04 N = 20	Mean %ile = 63.79 S.D. = 23.97 Median = 68.00 N = 19	Mean %ile = 69.45 S.D. = 18.98 Median = 75.50 N = 20

Note 1. Statistics for the normally achieving group are based on percentile ranks.

Note 2. Sample sizes vary slightly due missing data.

Table 4

Descriptive Statistics Associated with the Second Analysis: Males

Grades 7 - 8

Groups	Dependent Variables			Marker Variables	
District A	Accuracy	TPT	FIT	WLC[a]	IQ
LA	Mean = 56.25 S.D. = 11.89 N = 20	Mean = 236.55 S.D. = 251.17 N = 20	Mean = 417.85 S.D. = 321.33 N = 20	Mean = 516.70 S.D. = 9.60 N = 20	Mean = 99.74 S.D. = 10.36 N = 19
LD	Mean = 39.22 S.D. = 23.33 N = 18	Mean = 274.06 S.D. = 270.89 N = 18	Mean = 288.11 S.D. = 477.31 N = 18	Mean = 494.72 S.D. = 17.38 N = 18	Mean = 90.50 S.D. = 11.32 N = 18
District B					
LA	Mean = 28.85 S.D. = 16.88 N = 20	Mean = 143.80 S.D. = 84.76 N = 20	Mean = 65.05 S.D. = 187.75 N = 20	Mean = 496.30 S.D. = 17.89 N = 20	Mean = 82.65 S.D. = 14.39 N = 20
LD	Mean = 29.15 S.D. = 21.87 N = 20	Mean = 184.45 S.D. = 94.82 N = 20	Mean = 255.15 S.D. = 353.06 N = 20	Mean = 480.60 S.D. = 20.66 N = 20	Mean = 89.60 S.D. = 12.32 N = 20

<u>Note</u> Sample size vary slightly due to missing data.

[a]WLC: <u>Woodcock-Johnson Psychoeducational Battery</u>, Written Language Cluster.

Table 5

Descriptive Statistics Associated with the Second Analysis: Males

Grades 9 - 10

Group	Dependent Variables			Marker Variables	
District A	Accuracy	TPT	FIT	WLC[a]	IQ
LA	Mean = 57.90 S.D. = 18.82 N = 20	Mean = 239.05 S.D. = 220.11 N = 20	Mean = 403.85 S.D. = 435.04 N = 20	Mean = 526.80 S.D. = 9.29 N = 20	Mean = 101.11 S.D. = 9.86 N - 18
LD	Mean = 50.00 S.D. = 16.16 N = 17	Mean = 185.29 S.D. = 92.88 N = 17	Mean = 331.00 S.D. = 407.48 N = 17	Mean = 503.65 S.D. = 16.74 N = 17	Mean = 94.18 S.D. = 10.94 N = 17
District B					
LA	Mean = 37.27 S.D. = 18.71 N = 22	Mean = 136.95 S.D. = 51.68 N = 22	Mean = 240.14 S.D. = 323.93 N = 22	Mean = 502.04 S.D. = 11.08 N = 22	Mean = 35.86 S.D. = 8.80 N = 22
LD	Mean = 38.00 S.D. = 18.33 N = 20	Mean = 160.00 S.D. = 82.29 N = 20	Mean = 317.85 S.D. = 386.43 N = 20	Mean = 493.20 S.D. = 18.48 N = 20	Mean = 88.75 S.D. = 13.16 N = 20

<u>Note</u> Sample sizes vary slightly due to missing data.

[a] WLC: <u>Woodcock-Johnson Psychoeducational Battery.</u> Written Language Cluster.

Table 6

Descriptive Statistics Associated with the Second Analysis: Males

Grade 11 - 12

Group	Dependent Variables			Marker Variables	
District A	Accuracy	TPT	FIT	WLC[a]	IQ
LA	Mean = 55.76 S.D. = 19.22 N = 17	Mean = 216.70 S.D. = 200.25 N = 17	Mean = 374.18 S.D. = 414.91 N = 17	Mean = 527.701 S.D. = 10.68 N = 17	Mean = 111.12 S.D. = 12.78 N = 17
LD	Mean = 44.89 S.D. = 17.29 N = 19	Mean = 223.00 S.D. = 134.52 N = 19	Mean = 296.89 S.D. = 360.05 N = 19	Mean = 508.79 S.D. = 18.12 N = 19	Mean = 101.68 S.D. = 11.78 N = 19
District B					
LA	Mean = 42.55 S.D. = 15.06 N = 20	Mean = 122.75 S.D. = 60.13 N = 20	Mean = 319.25 S.D. = 358.25 N = 20	Mean = 511.10 S.D. = 13.89 N = 20	Mean = 92.57 S.D. = 10.42 N = 20
LD	Mean = 40.39 S.D. = 13.70 N = 23	Mean = 151.09 S.D. = 57.68 N = 23	Mean = 249.30 S.D. = 332.56 N = 23	Mean = 498.74 S.D. = 19.65 N = 23	Mean = 90.64 S.D. = 8.98 N = 22

Note. Sample sizes vary slightly due to missing data.

[a]WLC: _Woodcock-Johnson Psychoeducational Battery_, Written Language Cluster.

Table 7

Descriptive Statistics Associated with the Third Analysis: Females

Grade Level	Classification	Dependent Variables			Marker Variables	
		Accuracy	TPT	FIT	WLC[a]	IQ
7-8	LA	Mean = 39.77 S.D. = 11.00 N = 13	Mean = 137.08 S.D. = 42.06 N = 13	Mean = 104.08 S.D. = 226.01 N = 13	Mean = 511.00 S.D. = 15.06 N = 13	Mean = 88.69 S.D. = 10.33 N = 13
	LD	Mean = 25.00 S.D. = 13.88 N = 14	Mean = 110.57 S.D. = 19.33 N = 14	Mean = 136.12 S.D. = 262.29 N = 14	Mean = 495.36 S.D. = 28.94 N = 14	Mean = 82.21 S.D. = 12.90 N = 14
9-10	LA	Mean = 42.75 S.D. = 24.20 N = 16	Mean = 150.38 S.D. = 70.54 N = 16	Mean = 281.62 S.D. = 345.76 N = 16	Mean = 523.25 S.D. = 22.72 N = 16	Mean = 88.80 S.D. = 11.75 N = 16
	LD	Mean = 32.14 S.D. = 13.79 N = 14	Mean = 134.57 S.D. = 53.48 N = 14	Mean = 47.64 S.D. = 234.04 N = 14	Mean = 515.00 S.D. = 14.08 N = 14	Mean = 84.93 S.D. = 9.11 N = 14
11-12	LA	Mean = 54.06 S.D. = 17.48 N = 18	Mean = 133.72 S.D. = 44.43 N = 18	Mean = 433.83 S.D. = 331.15 N = 18	Mean = 526.17 S.D. = 16.95 N = 18	Mean = 96.50 S.D. = 14.13 N = 18
	LD	Mean = 30.00 S.D. = 11.60 N = 10	Mean = 157.10 S.D. = 80.76 N = 10	Mean = 177.20 S.D. = 264.17 N = 10	Mean = 504.80 S.D. = 16.68 N = 10	Mean = 85.70 S.D. = 7.57 N = 10

<u>Note.</u> Sample sizes vary slightly due to missing data.

[a]WLC: <u>Woodcock-Johnson Psychoeducational Battery.</u> Written Language Cluster.

Table 8

Proportions of Each Group Exhibiting an Optimal Pause Pattern

Grade Level	District A		District B		District C
	LA	LD	LA	LD	NA
7 - 8	.59	.42	.33	.43	.63
9 - 10	.56	.44	.32	.40	.67
11 - 12	.66	.44	.57	.48	.74

Table 9

Correlation between the Three Dependent Variables within the LA, LA, and NA Groups

Group	Accuracy-TPT	Accuracy-FIT	TPT-FIT
LA	.08 (n = 167)	.51★ (n = 169)	-.02 (n = 168)
LD	.21★ (n = 155)	.49★ (n = 160)	.23★ (n = 159)
NA	.41★ (n = 105)	.34★ (n = 106)	-.21 (n = 109)

Note. Sample sizes vary slightly due to missing data.

★$p \leq .01$, two-tailed test