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ABSTRACT

This research investigates whether the Computer-Based Academic Assessment System (CAAS), a battery of tests examining speed and accuracy at performing component reading skills, would be useful for identifying reading disability in college students. One important question was whether CAAS could distinguish reading disability from non-disability or learning disabilities of other types. CAAS reading tests were administered to college students with: (1) no disability; (2) reading disability; (3) general learning disability; and (4) disabilities outside of reading. Reading disabled and learning disabled students scored significantly lower overall than nondisabled students, and these two groups exhibited separate and distinct patterns of performance on CAAS tasks relative to the nondisabled participants. Findings suggest that CAAS may indeed be useful in identifying disabled college readers. Three tables and a bar graph illustrate the discussion. (Contains 25 references.) (Author/BEW)

# Using the Computer-Based Academic Assessment System (CAAS) to Identify Reading Disability in College Students: A Replication

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Abstract

This research investigates whether the Computer-based Academic Assessment System (CAAS), a battery of tasks assessing speed and accuracy at performing component reading skills, would be useful for identifying reading disability in college students. The question was whether CAAS could distinguish reading disability from non-disability and from other learning disabilities. CAAS reading tasks were administered to college students with no disability, reading disability, general learning disability, and disabilities outside of reading. Reading disabled and learning disabled students were significantly slower overall than nondisabled students, and these two groups exhibited distinct patterns of performance on CAAS tasks relative to nondisabled. These findings, along with those of Cisero et al. (1994), suggest that CAAS could be useful for identifying disabled college readers.

Using the Computer-based Academic Assessment System (CAAS)

to Identify Reading Disability in College Students: A Replication

Since the passage of the first legislation in 1975 (PL 94-142) mandating the provision of special services to students with disabilities, elementary and secondary educators have been faced with the challenge of identifying students with specific learning disabilities so that appropriate instructional accommodations could be made. The same challenge now faces professionals at posts ndary institutions due to two recent events. First, the Individuals with Disabilities Education Act (PL 101-476), passed in 1990, has extended the provision of services for disabled individuals to include post-high school settings such as employment and college. Second, and perhaps the result of the above-mentioned legislation, the number of learning disabled students entering colleges and universities has been increasing (Lewin, 1995; Vogel, 1982).

The issue of primary concern to learning disability specialists at the postsecondary level is how to distinguish those students who truly have a specific learning disability from students whose poor achievement is attributed to a lack of motivation or poor study habits, or from students who want a learning disabled diagnosis in order to be exempted from foreign language requirements. What makes differentiating these types of students difficult is that there is still no certainty about what exactly a specific learning disability is. Learning disability is still defined by exclusionary criteria. That is, a specific learning disability is a difficulty achieving normal levels of performance in listening, speaking, reading, writing, spelling, or mathematics that is <u>not</u> attributable to low intelligence, visual, hearing, or motor handicaps, emotional disturbance, or to economic, environmental, or cultural disadvantage (U.S. Office of Education, 1977).

This definition has had an enormous impact on the approach to identifying learning disabilities at all levels of education. Based on the notion that a learning disabled student's academic problems are not due to low intelligence, practitioners adopted an IQ-achievement discrepancy as the primary method of diagnosing learning disabilities. According to the IQ-achievement discrepancy approach, a learning disabled student would have "normal" IQ but standardized achievement test scores in one or more academic areas that are well below what would be expected from his or her IQ.

Since the adoption of the IQ-achievement discrepancy, evidence has accumulated to challenge the IQ-achievement discrepancy method on theoretical, empirical, logical, statistical, and practical grounds (e.g., Evans, 1990; Fletcher et al., 1994; Morrison & Siegel, 1991; Reynolds, 1981, 1985; Shepard, 1980; Siegel, 1989, 1992; Siegel & Heaven, 1986; Stanovich, 1991a, 1991b; Stanovich & Siegel, 1994). The inadequacy of the IQ-achievement discrepancy as a diagnostic technique has led researchers and practitioners to call for more appropriate procedures for identifying specific learning disabilities (e.g., Siegel, 1988, 1989; Stanovich, 1991a, 1991b). This need for alternative diagnostic techniques is especially urgent at the postsecondary level since there appears to be a lack of effective diagnostic tools that are specifically normed for college students (Woods, Sedlacek, & Boyer, 1990).

One assessment technique that has received some support as a potential diagnostic for identifying specific reading disability in college students is the Computer-based Academic Assessment System (CAAS). The CAAS system measures the speed and accuracy of performance on a battery of computer-presented tasks designed to assess component processes involved in reading and mathematics (see Royer & Sinatra, 1994 for a detailed discussion). The CAAS system currently contains reading and mathematics batteries appropriate for elementary and middle school students and an adult-level reading battery for college students. Past research has documented evidence of the reliability and validity of the elementary-level CAAS reading system for the assessment of reading competence in nondisabled elementary school children (e.g., Royer & Sinatra, 1994; Sinatra & Royer, 1993). Research is currently being conducted to validate the elementary-level mathematics battery and the middle-school level reading and mathematics batteries (J. M. Royer, personal communication, November, 1995).

The present research investigates the validity of the CAAS reading system as a diagnostic technique for identifying reading disability in college students. A critical feature of a diagnostic technique for identifying reading disability is that it distinguish reading disability from non-disability and from other learning disabilities. Initial support for the diagnostic utility of the CAAS system has been obtained in a study by Cisero, Royer, Marchant, and Wint (1994). Using only the elementary-level CAAS reading tasks (because the adult-level tasks had not yet been developed), the authors found that the CAAS system could differentiate reading disabled, general learning disabled, and nondisabled groups of college students.

The present study attempts to replicate the Cisero et al. (1994) study using a CAAS battery that includes both elementary-level reading tasks and adult-level reading tasks. The accuracy and response time performance of groups of college students classified as nondisabled, reading disabled, learning disabled, and "other" (specific disabilities other than reading) were examined to determine whether the CAAS system could differentiate reading disabled students from nondisabled students and from students with other disabilities.

## Method

### Subjects

Thirty-seven learning disabled students were recruited from Disabled Student Services at a small college in western Massachusetts and a group of 42 nondisabled students at the same college participated for extra credit in their introductory psychology courses. Both the learning disabled group and the nondisabled group had a mean age of 21. The learning disabled group was also similar to the nondisabled group in ethnicity (94% and 84% Caucasian for disabled and nondisabled groups, respectively) and gender (63% and 64% female for disabled and nondisabled groups, respectively).[1]

After all data was collected, subjects were classified into one of four diagnostic categories. Subjects from the nondisabled sample comprised the nondisabled diagnostic category, and subjects from the learning disabled sample were classified into one of three remaining diagnostic categories. The first category, the reading disability (RD) category, contained disabled students who exhibited problems such as reading comprehension, word recognition, or decoding, or who were considered slow readers. The second category, called the generalized learning disability (LD) category, consisted of disabled students who had a general learning disability rather than a specific difficulty in one academic area. These were students who exhibited deficits in multiple areas of cognitive functioning, who have been identified as slow learners, or who needed untimed tests. The last category, termed "other," contained disabled students who had specific disabilities in areas other than reading (e.g.. math. Attention Deficit Disorder).

Classification of disabled subjects into the RD, LD, and "other" diagnostic categories was based on several sources of information. The primary source of information was the clinical judgment of the Counselor at Disabled Student Services who works with the students on a daily basis. The Counselor was asked to describe what she thought was the student's primary difficulty based on her responsibilities of arranging tutors and suggesting modifications of the curriculum to accommodate the student's disability. Other sources of data were used as supplements to the Counselor's observations and are briefly described below.

Student's self-report of difficulty. Students were asked what they thought their primary difficulty was.

Standardized IQ and achievement test scores. A subject would be considered reading disabled if he or she had a Full-Scale IQ, Verbal IQ, or Performance IQ score (any of these were accepted since sometimes only one of them was provided) of at least 85 and standardized reading scores at least 2 years below grade level or below the 30th percentile.[2]

Evaluator's report. Descriptions of the student's strengths and weaknesses from evaluation report summaries were used to aid in classification when test scores were missing.

History. A history of reading disability would be evident if test scores from elementary or secondary school indicated a disability, or if a history of reading problems was on file. Students with previous test score or history information indicating a specific learning disability other than reading (e.g., math) would fit the "other" diagnostic category.

The main reason for using the Counselor's observations as the primary source of data and for using the other sources as supplements is that the Counselor was the only independent data source that was consistently available for all students. For instance, standardized test score information was missing (missing IQ scores, achievement scores, or missing both) for 18 of the 37 subjects (48.6%) in the learning disabled sample. Moreover, information regarding whether there was a history of learning difficulties was missing in 24 of the 37 cases (64.9%).

The author and a graduate student independently classified disabled subjects into RD, LD, or "other" diagnostic categories. Subjects were classified as belonging to a diagnostic category if information from all available sources was consistent in indicating a reading disability, generalized learning disability, or other disability. Whenever information from different sources was inconsistent or when information was ambiguous, a subject was not classified.

Given the high agreement between the author and the graduate student rater in classifying disabled students (90.9%), only the classifications of the author were used in analyses. Seven disabled subjects were classified as reading disabled (RD), 10 as generalized learning disabled (LD), 17 as "other," and 3 subjects could not be classified.

CAAS Tasks

The CAAS system presents stimuli on a computer screen and examinees make responses into a microphone. The latency of an examinee's response is automatically recorded by the CAAS system and the examiner records response accuracy on-line by pressing a correct or incorrect button on a box connected to the computer.

The elementary CAAS reading battery consists of: a simple response time task, a letter identification task, word and pseudoword naming tasks, a category match task, and a semantics task. The adult version of the CAAS reading battery uses word, pseudoword, category, and semantics tasks analogous to the elementary version except with stimuli that are appropriate for college students. Examples of items in each of the elementary and adult tasks are presented in Tables 1 and 2, and a more complete description of each task is provided below.

Simple Response-Time Task. This task is a measure of the speed and accuracy of responding to non-verbal stimuli. Examinees respond to displays of "***" or "+++" by saying "star" or "plus." The task is the first administered and serves to acclimate the examinee to the testing situation.

Letter Identification Task. In this task, the examinee names an uppercase or lowercase letter that appears on the screen.

Elementary-level Word and Pseudoword Naming Tasks. The word naming task is a measure of word recognition skill. Examinees pronounce single 3- to 6-letter words. All words have been reported to be familiar to at least 80% of fourth grade students (Dale & O'Rourke, 1976).

The pseudoword task is a measure of decoding ability. Stimuli are pronounceable nonwords that have been derived from the real words by changing one letter in each word.

Adult-level Word and Pseudoword Naming Tasks. The adult word naming task consists of 1- to 3-syllable words with regular and irregular spelling patterns. Half of the 1-, 2-, and 3-syllable regular and irregular words are low frequency (defined as less than 50 occurrences per million) and half high frequency (over 100 occurrences per million) (Francis & Kucera, 1982). Pseudowords were constructed from the real words by changing one letter per syllable.

Elementary-level Category Match Task. The category match task measures the ability to activate concepts in semantic memory. Examinees are informed of the categories to be included in the task (transportation, animals, fruits, body parts, and clothes) and are then presented with pairs of words. Examinees indicate whether or not the words belong to the same category.

This task is identical to the elementary category task except that the categories are: politics, economy, and general science.

Elementary-level Semantics Task. This task assesses the application of semantic knowledge in sentence processing with a variation of the cloze procedure. Examinees are presented with sentences that contain a blank and a word above and below the blank. Subjects indicate which of the two words (which vary in semantic appropriateness) best fits the sentence.

Adult-level Semantics Task. This task is also identical to the elementary-level task except that the sentences are longer and the word choices are more complex vocabulary words (2- and 3-syllable regular and irregular words).

Phonological Processing Tasks. Table 2 displays stimuli from three phonological processing tasks that have recently been added to the adult-level CAAS battery. These tasks are visually presented "phonological awareness" tasks which measure an examinee's ability to detect rhyme, initial phonemes, and final phonemes in pairs of words. In each task there are four item types: (1) words that share target sound and spelling pattern, (2) words that share the target sound but are spelled differently, (3) words that share spelling pattern but not target sound, and (4) words that share neither target sound nor spelling pattern. For instance, in the rhyme task, words that rhyme and share spelling pattern are *shoot/boot*, words that rhyme but are spelled differently are *shoot/fruit*, words that do not rhyme but share spelling pattern are *shoot/foot*, and words that neither rhyme nor share spelling pattern are *shoot/walk*. All words in the three tasks are single syllable words that have been reported to be familiar to at least 80% of twelfth grade students (Dale & O'Rourke, 1976).

Procedure

Subjects were individually administered all elementary-level and adult-level CAAS tasks described above. For each task, subjects were told to respond as quickly and as accurately as possible. Tasks were presented in the following order: simple response time task, letter naming, word naming (elementary and adult level), pseudoword naming (elementary and adult level), phonological processing tasks (rhyme, initial phoneme, final phoneme), category match (elementary and adult level), and semantics (elementary and adult level) tasks. The adult-level tasks were presented after their corresponding elementary-level versions in order to decrease the amount of time needed for instruction since the task requirements for elementary and adult versions are similar. Administration of the above tasks took approximately one hour.

# Results

## Variables Included in Analyses

Administration of the CAAS elementary and adult reading batteries resulted in 26 CAAS variables (one accuracy and one response time score for each of the 13 tasks). Given the large number of variables, it was necessary to reduce the number of variables to as small a set as possible without sacrificing the wealth of information provided by the CAAS battery. Therefore, the reduction of variables involved combining data from similar tasks. Given that the elementary and adult versions of the word, pseudoword, category, and semantics tasks have similar task demands and assess the same cognitive processes (only at different levels of complexity), it would be reasonable to combine data from the elementary and adult tasks. Likewise, the three phonological processing tasks (rhyme, initial phoneme, and final phoneme) appear to tap a similar process, and therefore it would be reasonable to combine data from these tasks.

Support for combining tasks was provided by correlations which indicated a strong relationship between the elementary and adult tasks, and among the three phonological processing tasks. Correlations between elementary and adult task response times ranged from .58 to .88 ($p < .001$ for all correlations). Correlations between accuracy scores on the elementary and adult tasks were much lower (ranging from -.29 to .25). However, this is most likely due to restriction of range given that accuracy performance was at ceiling on nearly every task. Correlations among the three phonological processing tasks ranged from .84 to .94 ($p < .001$ for all correlations) for response time data, and from .39 to .44 for accuracy data (again lower correlations may have been due to restriction of range).

Scores from the elementary and adult tasks were combined to form composite word, pseudoword, category, and semantics measures, and scores from the three phonological processing tasks were also combined to form a phonological composite. This was done separately for accuracy and response time measures. The end result was 7 CAAS measures of either accuracy or response time performance: simple, letter, composite word, composite pseudoword, composite category, composite semantics, and phonological composite.

Analyses

CAAS accuracy and response time performance of students in the four diagnostic categories is displayed in Table 3. Separate multivariate analyses of variance were performed on accuracy and response time data with diagnostic category[3] (RD, LD, other, nondisabled) as a between-subject factor and task (simple, letter, word, pseudoword, category, semantics, phonological) as a within-subject factor. With respect to the accuracy analysis, diagnostic category was not a significant source of variance [$F$ (3, 71) = 2.48, MSE = 51.08, $p < .10$]. In contrast, the response time analysis revealed a significant effect of diagnostic category [$F$ (3, 71) = 22.71, MSE = .52, $p < .001$]. A set of planned contrasts comparing RD, LD, and "other" groups to the nondisabled group (to control for Type 1 error, the Bonferroni inequality was used to set alpha at .017) indicated that RD and LD groups were significantly slower overall than the nondisabled group [RD, $t$ (71) = 3.47, SE = .293; LD, $t$ (71) = 7.94, SE = .264].

The effect of task was significant in both the accuracy and the response time analysis [accuracy, $F$ (6, 426) = 51.09, MSE = 18.74, $p < .001$; response time, $F$ (6, 426) = 318.67, MSE = .11, $p < .001$].

As can be seen in Table 3, accuracy on the pseudoword and phonological composites was slightly lower than on the other tasks, and response time increased with task complexity.

A significant interaction between diagnostic category and task was obtained for the accuracy and response time analyses [accuracy, $F$ (18, 426) = 2.27, MSE = 18.74, $p < .01$; response time, $F$ (18, 426) = 8.61, MSE = .11, $p < .001$]. For both accuracy and response time data, the diagnostic categories showed different patterns of performance on CAAS tasks. Rather than displaying the performance patterns of the diagnostic categories separately for accuracy and response time data, a more concise and more easily interpretable presentation of the differential patterns of performance would be one that combines accuracy and response time performance. Figure 1, therefore, depicts the differential patterns of performance of the diagnostic categories when accuracy and response time are combined.

Figure 1 shows the percentile performance of RD, LD, and "other" groups as compared to nondisabled performance (represented as the 50th percentile). These percentile scores were derived first by combining accuracy and response time scores of the subjects on each task into a single index of performance (called the combined index) using a transformation procedure[4] developed by Sinatra and Royer (1995). The combined indices of performance of the RD, LD, and "other" groups were then transformed into effect sizes. Effect sizes are calculated by subtracting the mean of the experimental group (RD, LD, and "other" groups) from the mean of the control group (nondisabled group) and dividing by the standard deviation of the control group. The result is a Z score indication of where the average disabled subject would score _if_ he or she were in the nondisabled group. For further clarity of presentation, the effect sizes were transformed into percentiles, whereby the nondisabled group (by definition of the effect size calculation) is represented at the 50th percentile.

Figure 1 shows that the "other" group, which contained students who had specific disabilities outside of reading, performed comparably to nondisabled students on most tasks, except for a slight drop in performance on the category and semantics tasks. The RD group performed as well as nondisabled on the simple and letter tasks, but was substantially worse on all other reading tasks, a pattern that would be consistent with a specific reading disability. In contrast, the LD group performed considerably worse than the nondisabled group across all tasks (at or below the 10th percentile), even on the simple task which has nothing to do with reading. This pattern indicates a difficulty in processing all types of information, from recognition of simple perceptual stimuli to sentence processing, and is consistent with this group's classification as having a wide range of cognitive deficits.

## Discussion

A critical characteristic of a diagnostic technique for identifying reading disability is that it distinguish reading disabled students from nondisabled students and from students with other learning disabilities. The present research suggests that the CAAS system may be useful for making the distinction among these types of students at the college level. College students identified as reading disabled and learning disabled were significantly slower than nondisabled college students at performing CAAS tasks. Moreover, the reading disabled and learning disabled groups demonstrated distinct patterns of accuracy and response time performance on CAAS tasks as compared to nondisabled performance.

These findings replicate the results obtained by Cisero et al. (1994) in two ways. First, the slower performance of reading disabled and learning disabled groups as compared to the nondisabled group was also found by Cisero et al. (1994). Second, and perhaps more important, the present study revealed differential patterns of accuracy and response time performance for the reading disabled and learning disabled groups as compared to nondisabled performance, and these patterns were similar to Cisero et al.'s (1994) finding of distinct patterns of response time performance (relative to nondisabled performance) of RD and LD college students.

The results of the present study and of Cisero et al. (1994), taken together, provide evidence that the CAAS system satisfies a basic requirement of a diagnostic technique for identifying reading disability. That is, the CAAS system can distinguish reading disability from non-disability and from other forms of learning disability.

A second requirement of a reading diagnostic is that it provide information about the specific nature of the reading problem. The reason is that a diagnostic tool not only should be able to identify a reading disability but also should be able to provide specific information that would be helpful in developing a remediation program that is tailored to the individual. Recent research evaluating the CAAS system on this requirement (e.g., Cisero, 1996; Cisero, Royer, Marchant, & Jackson, 1995) has indicated that individual profiles of CAAS performance are consistent with a student's diagnostic status (e.g., RD, LD, nondisabled) and with documented evidence of a student's disability (e.g., achievement test scores). A CAAS profile indicating specific strengths and weaknesses in component reading skills, however, provides much more information about the nature of a student's disability than a single standardized achievement test score. The findings of Cisero and colleagues (1996, Cisero et al., 1995), therefore, suggest that the CAAS system not only could be used to identify reading disability, but that a student's CAAS profile could also be useful in planning individualized intervention.

To date, research evaluating the validity of the CAAS system as a diagnostic tool for identifying specific reading disability indicates that the CAAS technique may be useful for identifying reading disability at the college level. A few caveats regarding the generalizability of the college-level CAAS studies are necessary, however. First, all of the research thus far has been conducted at a small New England college. Second, sample sizes of the reading disabled and learning disabled groups were small, ranging from as little as 7 to as high as 19. Therefore, while findings regarding the diagnostic utility of the CAAS system are encouraging, more research needs to be done at other colleges and universities across the country and with larger groups of learning disabled and nondisabled students.

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Footnotes

[1]No attempt could be made to match disabled and nondisabled students on ability since IQ and SAT scores of nondisabled students were not available.

[2]Since Disabled Student Services was not equipped with the necessary staff to handle diagnostic assessments, students were required to obtain assessments from outside professionals. Therefore, the types of tests used to diagnose students varied, and classification of subjects as having a reading disability or other disabilities in this study could not be systematically made on the basis of a common set of standardized IQ and achievement tests.

[3]One subject in the LD category was excluded from the analyses due to missing data on the phonological processing tasks.

[4]The procedure for combining accuracy and response time begins with converting accuracy scores to inaccuracy scores so that a high (low) inaccuracy score and a high (low) response time score both indicate poor (good) performance. Next, an examinee's inaccuracy score is divided by the sample standard deviation and his/her response time score is divided by its corresponding sample standard deviation. Each of the resulting scores is then squared. The squared scores are then added together and the square root is taken. The result is called the combined index. See Sinatra and Royer (1995) for a more detailed explanation and evidence for the validity of the combined index.

Table 1

Examples of CAAS Tasks

| Task | Sample Stimuli |
|---|---|
| Simple | *** +++ |
| Letter | A, g, K, n |
| Word | you goes horse banner |
| Pseudoword | yob poes porse danner |
| Category | YES: car/truck<br>arm/leg<br>NO: bus/stool<br>nose/apple |
| Semantics | The farmer *planted*/played the corn. |
| Adult Word | sprint, plight, kitten, canoe, baritone, pseudonym |
| Adult Pseudoword | sprict, clight, fitken, yanob, larotine, psendinom |
| Adult Category | YES: delegation/ballot<br>stock/bullish<br>NO: voter/gene<br>atoms/retail |
| Adult Semantics | A district attorney's job is to *prosecute*/perpetrate the defendant. |

Table 2

Examples of Stimuli in Phonological Processing Tasks

| Task | Stimulus Pair |
|---|---|
| Rhyme | |
| Same Sound/Similar Spelling | pain main |
| Same Sound/Different Spelling | shoe two |
| Different Sound/Similar Spelling | food good |
| Different Sound And Spelling | trip late |
| Initial Phoneme | |
| Same Sound/Similar Spelling | chain chair |
| Same Sound/Different Spelling | phase flush |
| Different Sound/Similar Spelling | knit kite |
| Different Sound And Spelling | child open |
| Final Phoneme | |
| Same Sound/Similar Spelling | size doze |
| Same Sound/Different Spelling | trace lass |
| Different Sound/Similar Spelling | cheese chess |
| Different Sound And Spelling | niece splurge |

Table 3

Accuracy and Response Time (RT) Performance on CAAS Tasks of Students in Different Diagnostic Categories

| Task | Diagnostic Category | | | |
|---|---|---|---|---|
| | Nondisabled | RD | LD | Other |
| Simple Accuracy[a] | 98.9 (2.59)[c] | 100.0 (0.00) | 97.6 (5.33) | 99.6 (1.73) |
| Simple RT[b] | .569 (.121) | .578 (.109) | .822 (.364) | .604 (.092) |
| Letter Accuracy | 99.5 (1.68) | 99.2 (2.22) | 100.0 (0.00) | 99.7 (1.43) |
| Letter RT | .526 (.083) | .524 (.076) | .623 (.067) | .549 (.09) |
| Word Accuracy | 96.2 (3.20) | 93.1 (3.59) | 91.9 (4.19) | 96.4 (2.45) |
| Word RT | .633 (.153) | .799 (.112) | 1.07 (.328) | .663 (.127) |
| Pseudoword Accuracy | 91.2 (7.47) | 82.3 (12.32) | 87.2 (5.85) | 93.2 (4.88) |
| Pseudoword RT | .975 (.615) | 1.66 (.469) | 1.78 (.494) | 1.14 (.492) |
| Category Accuracy | 94.1 (5.41) | 93.8 (3.08) | 93.8 (4.21) | 93.3 (4.37) |
| Category RT | 1.39 (.275) | 1.87 (.425) | 2.22 (.411) | 1.56 (.351) |
| Semantics Accuracy | 93.2 (6.62) | 94.5 (4.11) | 91.8 (5.03) | 93.3 (6.22) |
| Semantics RT | 2.30 (.515) | 2.94 (.688) | 3.74 (.646) | 2.64 (.669) |
| Phonological Accuracy | 89.3 (5.65) | 84.5 (5.83) | 88.8 (4.10) | 90.4 (3.78) |
| Phonological RT | 1.49 (.476) | 2.20 (.540) | 3.17 (1.19) | 1.78 (.502) |

n=75, [a]accuracy measured as percent correct; [b]response time measured in seconds; [c]standard deviation

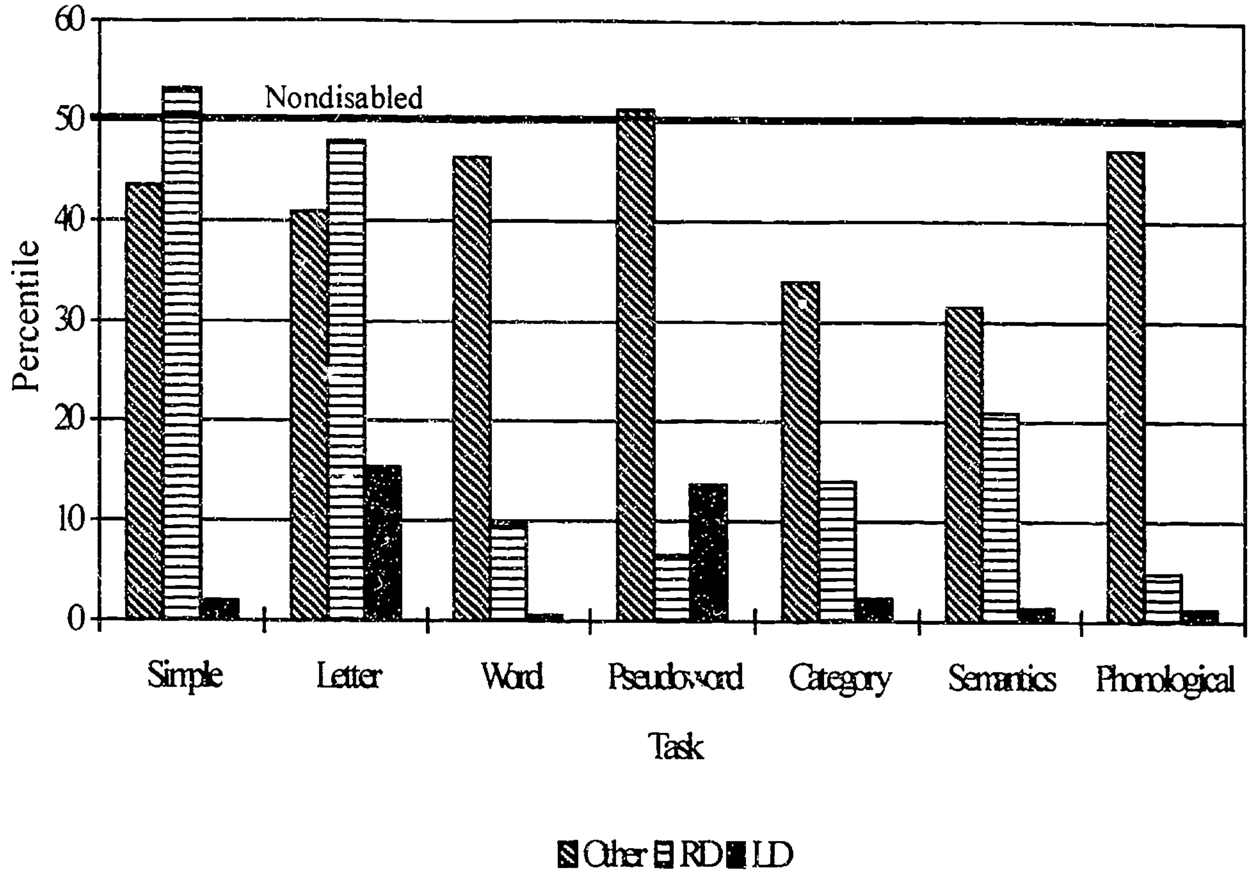


Figure 1. Percentile performance of RD, LD, and "Other" groups on CAAS tasks as compared to nondisabled students. Nondisabled students are represented by the solid line at the 50th percentile.