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USING SPEEDED COGNITIVE, READING, AND ACADEMIC MEASURES TO DETERMINE THE NEED FOR EXTENDED TEST TIME AMONG UNIVERSITY STUDENTS WITH LEARNING DISABILITIES

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This study examined the relationship between scores on "speeded" cognitive and academic tests and the need for the accommodation of extended test time for normally achieving students (NA) and students with learning disabilities (LD). Often, in postsecondary settings the decision to provide the accommodation of extended test time is based largely on the diagnostic test scores in the student's LD documentation. Therefore, the primary purpose of this study was to evaluate the relationship between specific diagnostic tests and the need for the accommodation of extended test time. A secondary purpose was to investigate the relationships and predictive ability of five speeded cognitive tests, three speeded cluster scores, and two measures of timed reading. Correlations and logistic regression analyses were used to assess gain in score performance and predict the need for extended test time. Participants included 41 NA university students and 43 university students with LD. The findings indicated significant group differences on all speeded cognitive, reading, and academic tests, with the exception of Digit Symbol on the Wechsler Adult Intelligence Scale-III and Retrieval Fluency and Decision Speed tests on the Woodcock-Johnson III Tests of Cognitive Abilities. The Reading Fluency test and the Academic Fluency cluster of the Woodcock-Johnson Tests of Achievement III were the best predictors of students with LD who needed extended time on the multiple-choice reading comprehension test.

Extended test time is the most frequently requested and provided accommodation for postsecondary students with learning disabilities (LD) (Nelson & Lignugaris-Kraft, 1989; Yost, Shaw, Cullen, & Bigaj, 1994). Nationally, many requests for test accommodations are made by students in higher education each year. For example, at one large land-grant university, extended test time is arranged for approximately 12,000 exams per year to accommodate the 717 students with LD (Funckes, 2003). Recent data from the report "Who Took the GED?" indicated that the number of overall requests for specific LD accommodations in 2001 increased 162% over the number of requests in 2000 (GED Testing Service, 2002).

The Americans with Disabilities Act (ADA) and Section 504 of the Rehabilitation Act (Section 504) provide legal supports for students' right to have test accommodations. Both pieces of legislation have profoundly influenced the policies and practices surrounding accommodation decisions. With respect to these laws, disability service providers rely on the information provided in a student's diagnostic psychoeducational evaluation, including the test scores and the evaluator's recommendations, to determine the appropriate-

ness of an accommodation (Ofiesh & McAfee, 2000; Scott, 2002). Moreover, evaluators and clinicians use test scores as a basis for recommendations about disability-related accommodations (Gordon, Lewandowski, Murphy, & Dempsey, 2002).

Because the two most widely used tests with postsecondary students with LD—i.e., Wechsler Adult Intelligence Scale-III (WAIS-III; Wechsler, 1997) and the Woodcock-Johnson Tests of Cognitive Ability and Achievement III (WJ III COG and WJ III ACH; Woodcock, McGrew, & Mather, 2001)—include tests of processing speed, the scores on speeded cognitive tests are usually readily available in most diagnostic reports. More recently, measures of reading and academic fluency, such as the Reading Rate test of the Nelson Denny Reading Test (NDRT; Brown, Bennett, & Hanna, 1981) and the tests that comprise the WJ III ACH Academic Fluency cluster are being used to justify recommendations for extended test time.

Despite the common practice of analyzing results on speeded cognitive and academic measures, a standard method to guide the process of using documentation or test data to grant test accommodations does not exist. To begin to address this need, a model for decision making about extended test time that included the use of test data was developed (Ofiesh, Hughes, & Scott, 2004). Additional research is needed, however, to clarify and validate the relationships between diagnostic tests and the accommodation of extended test time. To date, only one study has evaluated the relationship between extended test time and processing speed (Ofiesh, 2000). Results indicated that the Visual Matching and Cross Out tests of the Woodcock-Johnson Tests of Cognitive Ability-Revised (WJ-R; Woodcock & Johnson, 1989) were fair indicators of the need for extended time on the NDRT, whereas the Digit Symbol test of the Wechsler Adult Intelligence Scale-Revised (WAIS-R; Wechsler, 1981) was not.

Theoretical Rationale for Examining the Relationship between Speeded Measures and Test Time

Although speed as a cognitive construct has been examined for years (e.g., Hick, 1952; Jensen, 1982; Kail, Hall, & Caskey, 1999; Nettelbeck, 1994; Spearman, 1927), a variety of speeded constructs exist, including reaction time, inspection time, decision speed, cognitive efficiency, and processing speed. Furthermore, definitions of these constructs vary among researchers. For example, Sattler (2001) defined processing speed as an ability involving perceptual processing and speed, reflecting both mental and psychomotor performance, whereas McGrew and Flanagan (1998) defined processing speed as the ability to perform cognitive tasks automatically, especially when under pressure to maintain focused attention and concentration. Subsequently, one problem in evaluating research on cognitive speed as it relates to extended test time is that the nature of the speeded task can change depending on (a) the researcher's theoretical framework, (b) the nature of the study, (c) the nature of the task, and (d) the researcher's questions. Furthermore, these definitions and conceptualizations have changed as studies of the relationships among information processing, speed, and intelligence have evolved (Bates & Stough, 1998; Deary, McCrimmon, & Bradshaw, 1997; Kail et al., 1999).

In general, however, on a pure *speed* test, individual differences depend entirely on the speed of performance and test items are of relative ease, whereas on pure *power* tests, the differences are not based on speed and the items increase in difficulty (Anastasi, 1988). In reality, most "speeded" diagnostic tests, as well as classroom exams, combine speed and power. Thus, evaluators often use scores on these speeded diagnostic tests as part of the rationale to determine the appropriateness of extended test time. This procedure has face validity because a substantial body of literature supports the contention that some individuals with LD are slower than peers on a variety of timed cognitive and academic tasks (e.g., Bell & Perfetti, 1994; Geary & Brown, 1990; Hayes, Hynd, & Wisenbaker, 1986; Shaywitz, 2003; Wolff, Michel, Ovrut, & Drake, 1990). Furthermore, recent research has confirmed that many young adults with a childhood diagnosis of dyslexia are accurate but not fluent in their reading and that a neural basis exists for their persistent reading difficulties (Shaywitz et al., 2003). If specific test scores could help identify those students who need increased test time to demonstrate their knowledge, evaluators would be able to improve their accuracy in determining exactly which students are most likely to use and benefit from extended time.

Studies Involving Commonly Administered Speeded Cognitive and Academic Tests with Postsecondary Students with LD

Several studies have found that children and adolescents with LD score significantly lower than those who are NA on the Wechsler Coding subtest, the child-normed version of the adult Digit Symbol test (e.g., Ackerman, Dykman, & Peters, 1977; Johnson & Wollersheim, 1997; Vance, Wallbrown, & Blaha, 1978), and that this lower performance persists into adulthood (Cordoni, O'Donnell, Ramaniah, Kurtz, & Rosenshein, 1981; Slate, Frost, & Cross, 1991). Studies examining performance on the Digit Symbol test among college students with and without LD report findings that suggest both groups of students score in the average range but students with LD score significantly lower than their NA peers (Cordoni et al., 1981; Gregg, Jordan, Davis, Hoy, Coleman, & Knight, 2003; Ofiesh, 2000; Slate et al., 1991). Although no effect sizes were reported for these studies, all differences were significant ($p = <.05$). Similar findings have been reported on the WJ-R and WJ-III processing speed tests and clusters among postsecondary students with and without LD (Gregg, Coleman, Flaherty, Norris, Jordan, Hoy, & Davis 2003; Gregg, Jordan, et al., 2003; Ofiesh, 2000). Gregg, Jordan, et al. (2003) wrote that "college students with LD appear to be processing cognitive and linguistic information differently than their non-disabled peers, a pattern which has direct implications for assessment and accommodation selection" (p. 2). In contrast to the aforementioned studies, one study (Gregg & Hoy, 1985) compared the mean composite scores from the WJ-R COG and the WAIS-R scores of 50 college students with LD and found no significant within-group differences among any of the clusters, indices, or total performance scores.

Research investigating the performance of postsecondary students with LD on standardized tests of reading fluency or rate is limited. The reason for the limited number of studies is largely because few comprehensive tests have been

normed on the adult population and even fewer tests provide postsecondary norms. Researchers, however, are beginning to attend to reading fluency because individuals with LD appear to struggle with reading fluency and automaticity into adulthood (National Reading Panel, 2000; Shaywitz, 2003; Shaywitz et al., 2003). One of the first tests to measure speeded reading at the adult level was the NDRT Reading Rate test. The NDRT Reading Rate test is a one-minute assessment of the number of words read. No studies were found in the literature that compared NDRT Reading Rate test performance between postsecondary students with and without LD. One study compared speeded academic performance of college students with and without LD (Gregg, Coleman, et al., 2003). These researchers found that the WJ III ACH Reading Fluency test produced the largest mean difference between the LD and NA groups as compared to any of the other clusters and/or tests. In the majority of the studies on speeded differences between LD and NA groups, groups were matched on vocabulary test performance or broad intelligence scores.

Studies Investigating Extended Test Time for Students with Learning Disabilities

Several studies investigated the effectiveness of extended time for college students with LD (Alster, 1997; Halla, 1988; Hill, 1984; Jarvis, 1996; Ofiesh, 2000; Runyan, 1991; Weaver, 1993). A variety of tests were used, including (a) the NDRT (Brown et al., 1981; Brown, Friscoe, & Hanna, 1993), either as a total score or one or both subtests (i.e., Vocabulary or Comprehension); (b) ASSET Elementary Algebra Test (American College Testing Program, 1989); (c) American College Test (ACT) Social Studies, English, and Math tests (American College Testing Program, 1981); (d) Graduate Record Exam (GRE; Educational Testing Service, 1986); and (e) teacher-developed classroom tests (Jarvis, 1996).

Overall, the results of these previous studies indicated that, under time constraints, students with LD score lower than their NA peers at statistically significant levels and receive increased benefit when provided with extended test time. In contrast to LD students, NA students appeared to either (a) not use the extra time, or (b) not make significant score gains with more time (Alster, 1997; Hill, 1984; Ofiesh, 2000; Runyan, 1991). For a more complete review of these studies, Ofiesh and Hughes (2002) provide an in-depth analysis of the literature on extended test time and postsecondary students.

Based on the premise that speeded cognitive and academic tests, as well as classroom tests, require responses within a certain timeframe, this study examined the relationship between scores from six speeded cognitive tests, three speeded clusters/indices, two measures of timed reading (reading fluency and rate), and a need for the accommodation of extended test time. Students with and without LD were included in the study to compare findings to previous research regarding differences in processing speed, reading fluency, and score gain under the condition of extended time. The use of test data to determine the need for extended time, however, was applied only to the students with LD.

This study addressed the following four questions:

1. Do speeded cognitive and reading test scores differ significantly between NA students and students with LD?
2. Are the gain scores between controlled and extended time test conditions on the Comprehension test of the NDRT significantly greater for students with LD than for NA students?
3. Can speeded cognitive test scores predict the probability that an individual with LD will need extended test time?
4. Can scores from measures of timed reading predict the probability that an individual with LD will need extended test time?

METHOD

Design

Using a quasi-experimental design, a logistic regression analysis was employed to model the probability that a student's "speeded" test score would predict the need for extended test time for students with LD. The model was based on the use of speeded tests from the WJ III COG and WJ III ACH and the WAIS-III as predictors of the probability of need for extended test time. Similar to several of the studies on the effectiveness of extended test time (Ofiesh, 2000; Runyan 1991; Weaver, 1993), the present study used the Comprehension section of the NDRT (Brown et al., 1993) to measure test performance under standard and extended time conditions.

The data analyses involved two phases. Phase one of the study provided comparative data between students with LD and NA students on measures of cognitive speed, timed reading, and score gain under extended time. The purpose of this analysis was to compare current findings with previous literature, as well as contribute new descriptive data on the revised WAIS-III and WJ III. Phase two of the data analysis involved only the students with LD.

Participants

Eighty-four undergraduate students who ranged in age from 18 to 25 years participated in the study. Table 1 displays the student characteristics. The sample consisted of 58 females and 26 males. English was the native language for all participants, and data were not collected on ethnicity. The NA group consisted of 41 students who were recruited from the undergraduate population. The 43 students with LD met the criteria for services from the Disability Resources Center, which included (a) full-time undergraduate, (b) 18 to 25 years, (c) diagnostic evaluation that met the criteria set by the Disabilities Resources Center, and (d) a LD that impacted reading according to student documentation. All of the NA participants met the same criteria with the exception of the LD diagnosis. Based on scores from the Kaufman Brief Intelligence Test (KBIT; Kaufman & Kaufman, 1990), the groups differed on intelligence, $t(81.4) = -3.75$, $p = <.01$ (two-tailed). The groups also differed in the number of males and females within each group, $\chi^2(1, N = 84) = 12.20$, $p = .05$. The independent contribution of intelligence and gender was evaluated as part of the data analysis.

Table 1
Characteristics of LD and NA Groups

Characteristics by Group	IQ (KBIT)		Age		Gender		
					Males	Females	
	M	*SD*	*M*	*SD*	*n*		*SD*
LD	100	8.9	20.70	1.67	24	19	.502
NA	106.8	7.8	20.68	1.51	34	7	.381

Instrumentation

Intelligence. The Kaufman Brief Intelligence Test (KBIT) was used to assess the intelligence levels of the participants. The test consists of two subtests, Vocabulary and Matrices, which are used to calculate a composite score. The Vocabulary subtest assesses students' word knowledge, and the Matrices subtest measures the ability to solve new problems by perceiving relationships and completing analogies. KBIT administration time ranged from 15 to 30 minutes. Because speeded tests are not included on this instrument, the KBIT provides a method to assess the independent contribution of a nonspeeded intelligence measure.

Speeded cognitive tests. The WAIS-III Digit Symbol test and the WJ III COG Visual Matching and Decision Speed tests were selected to assess processing speed. The WAIS-III Digit Symbol test requires examinees to copy symbols that are paired with numbers. The resulting test score is based on the number of symbols completed correctly within 2 minutes. The WJ III COG Visual Matching test measures the ability to locate and circle two identical numbers in a row of six numbers within 3 minutes (e.g., 8 9 5 2 7 9). The task progresses in difficulty from single-digit numbers to triple-digit numbers. The WJ III COG Decision Speed test requires examinees to quickly locate the two pictures in a row that are most similar conceptually within 3 minutes.

The WJ III COG Rapid Picture Naming, Decision Speed, and Retrieval Fluency were also administered. The WJ III COG Retrieval Fluency test requires examinees to name as many things as possible within three different categories, each with a 1-minute time limit (e.g., things to eat or drink). The WJ III COG Rapid Picture Naming test measures the ability to name simple pictures quickly within a 2-minute time limit. Two WJ III COG cluster scores were used in this study: Processing Speed, composed of Visual Matching and Decision Speed, and Cognitive Fluency, composed of Retrieval Fluency, Decision Speed, and Rapid Picture Naming.

Speeded reading and academic tests. The Nelson Denny Reading test (NDRT; Brown et al., 1993) was selected to measure a change in test performance under standard time and extended time conditions. It has two statistically equated alternate forms, G and H. Only the Reading Comprehension section and the Reading Rate section were used. The Reading Comprehension section is timed for 20 minutes and contains eight reading passages and 38 questions. The Reading Rate section is based on the rate of reading in the first minute of the Reading Comprehension section. In addition, the WJ III ACH Reading

Fluency test was administered. For this task, the examinee is allowed 3 minutes to read simple, short sentences and indicate whether the statement is true or false. Two additional tests from the WJ III Academic Fluency cluster were administered: Math Fluency and Writing Fluency. Math Fluency is timed for 2 minutes and requires completion of one-digit addition, subtraction, and multiplication problems. Writing Fluency has a 7-minute time limit and requires the examinee to write a series of simple sentences, each prompted by a picture and three words that must be included in the sentence.

Procedure

Recruitment. The participants with LD were a self-selected sample of students who had disclosed their disability and were receiving services from the University's Disability Resource Center at the time of the study. All students with LD received a letter from the director of disability services requesting their voluntary participation. The NA students were recruited in a variety of undergraduate classes in the College of Education, and flyers were posted around the campus. Both groups of students were told that the study examined learning and testing among university students. Each participant received $40 at the end of testing.

Test conditions. To control for differences in test order of the extended time and standard time administrations, as well as for test form (NDRT G or H), the NDRT administrations were counterbalanced. Before testing began, participants were randomly assigned to one of four treatment conditions. Table 2 shows the number of students with LD and NA students assigned to each group.

Table 2
Treatment Conditions

Condition	Frequency	Percent	Cumulative %
Students with Learning Disabilities			
1	12	29.9	29.9
2	7	16.3	44.2
3	14	32.6	76.7
4	10	23.3	100
Total	43	100	100
Normally Achieving Students			
1	10	14.4	24.4
2	11	26.8	51.2
3	11	26.8	78.0
4	9	22.0	100
Total	41	100	100

Note.—Condition 1: ND Form G, Standard Time; ND Form H, Extended Time.
Condition 2: ND Form H Standard Time; ND Form G, Extended Time.
Condition 3: ND Form H Extended Time; ND Form G Standard Time.
Condition 4: ND Form G Extended Time; ND Form H Standard Time.

Unequal samples were a result of students not showing up for testing or dropping out of the study. ANOVA procedures were used to assess differences in KBIT scores between the participants in the four-timed/extended time treat-

ment conditions. The NDRT manual states that one of the uses for the alternate form is to evaluate an extended time administration. Norms are provided for students who take the test with extended time and for administrators who want to compare those results to a normative sample of test-takers who took the test with extended time. In this study, the length of time extension for the extended time condition corresponded to the amount of time recommended by the test publishers for the extended time condition. Thus, the extended time administration increased the allowed time from 20 to 32 minutes. This time extension equated to 60% additional time under the extended time condition. However, only the standard norms were used as a basis for interpretation of both the standard and extended time scores, because the purpose of this study was to compare how students performed in relation to standard conditions. For both the standard and extended time administrations, students were told how much time they would have but they were not aware that they would be taking two forms of the NDRT. Upon random assignment to conditions, participants were contacted by one of six graduate students in School Psychology to schedule 2.5 hours of individual testing, including the designated treatment condition. The research associates followed standardized administration protocols provided by test publishers and participated in one training session.

Data analysis. All raw scores were converted into standard scores and analyzed using SPSS for Windows, Version 11.5.0 (Norusis, 2002). *T* tests were used to analyze differences between LD and NA groups on processing speed, speeded reading, and academic scores, and score gain under extended time. Univariate analysis of variance (ANOVA) was used to assess differences in KBIT scores between the participants in the four-timed/extended time treatment conditions. In addition to KBIT standard scores, Pearson and point-biserial correlation coefficients were used to evaluate the independent contribution of intelligence to the need for extended test time.

Based on data from performance under standard and extended time conditions on the NDRT, a gain score and a need variable were derived. The gain score was calculated by subtracting the standard time test score from the extended time test score. The gain score was used to (a) compare mean score differences between the LD and NA groups under the extended time test condition and (b) determine category of need (i.e., need or no-need) for the binary variable.

In the logistic regression analysis, the gain score was recoded into a binary variable called the need/no-need variable, where a "1" represented "need" by meeting one or more of the following conditions: (a) lack of completion of the test with standard time, (b) lack of completion of the test under both standard and extended time, and (c) an increase of six or more points with extended time regardless of completion on the standard test. The need (1) variable was coded in this manner to account for the test behavior of students who simply guessed on the remaining answers when it became apparent time was running out. The no-need (0) variable represented one or more of the following conditions: (a) no change in score between standard and extended time conditions, (b) a decrease of six or more points regardless of test completion on

either test, and (c) a difference of less than six points. The use of a six-point demarcation was based on the average number of scaled score points between the grade equivalent scores for the 13th through 18th grades. The difference of the scores between these grades ranged from five to six points. Therefore, using the inherent characteristics of the NDRT, if a student increased or decreased by six points, that would equate to a meaningful change on the NDRT. On the NDRT, each test item is worth two points, so a six-point difference is equal to three additional correct responses.

Logistic regression analysis (Agresti, 1996), a nonlinear, nonparametric statistical procedure, was used to predict the probability that a student would need extended test time based on processing speed or speeded reading and academic scores. In the SPSS program, the parameters for this analysis that make the observed results most "probable" were automatically established where the probability of the observed results decreased less than .01 (Norusis, 2002). This study used a classification table to compare predictions to observed outcomes. Only those tests that were significantly correlated with the need variable were used as predictor variables in the logistic regression equation.

RESULTS

Differences between Normally Achieving Students and Students with Learning Disabilities

Table 3 depicts a comparison of the means for each group on all speeded tests. The results of the *t* tests for independent means indicated significant differences between NA students and students with LD on most speeded measures. (See Table 4.) The effect size was calculated by dividing the mean difference by the standard deviation of the NA group (Cohen, 1988). Bonferroni correction procedures were employed resulting in a significance level of .01. When compared to the NA group, the LD group performed significantly lower on all tests with the exceptions of the WAIS-III Digit Symbol, WJ III COG Retrieval Fluency, and WJ III COG Decision Speed.

Table 3
Mean Speeded Test Scores for Normally Achieving Students and Students with Learning Disabilities

	NA (N = 41)		LD (N = 43)	
	M	*SD*	*M*	*SD*
WJ III Academic Fluency	109.41	13.07	96.35	14.11
WJ III Decision Speed	108.10	16.04	100.81	13.83
WAIS-III Digit Symbol	10.85	2.73	9.86	3.11
WJ III Retrieval Fluency	103.29	9.19	100.02	7.85
WJ III Rapid Picture Naming	102.95	11.64	92.77	12.43
WJ III Visual Matching	106.51	12.89	97.84	10.96
WJ III Cognitive Fluency	105.20	13.89	95.72	13.17
WJ III Reading Fluency	107.39	14.19	93.91	14.49
WJ III Processing Speed	108.17	13.68	99.16	11.91

Table 4
T Tests for Independent Means between NA and LD Groups

Variable	*t*	*df*	*p*	Mean Difference	Effect Size
WJ III Academic Fluency	-4.40	82	<.001	-13.07	.9
WJ III Decision Speed	-2.23	82	.028	-7.28	.5
WAIS-III Digit Symbol	-1.55	82	.124	-.99	.4
ND Reading Rate	-2.96	82	.004	-19.49	.8
WJ III Retrieval Fluency	-1.76	82	.083	-3.27	.2
WJ III Rapid Picture Naming	-3.87	82	<.001	-10.18	.9
WJ III Visual Matching	-3.33	82	<.001	-8.68	.7
WJ III Cognitive Fluency	-3.21	82	.002	-9.47	.7
WJ III Reading Fluency	-4.31	82	<.001	-13.48	.9
WJ III Processing Speed	-3.22	82	.002	-9.01	.7

Note.—2-tailed.

A reading gain score was calculated for each participant by subtracting the reading comprehension test score associated with the standard time administration from the extended time administration. Among the students with LD (n = 43), 30 participants met the criteria for needing more time. Among the NA students (n = 41), 14 met the criteria. Under standard test time, the mean score for students with LD was 202.65 (SD = 23.44) and the mean score for NA students was 230.66 (SD = 13.92). Under extended time, the mean score for students with LD was 218.74 (SD = 19.38) and the mean score for NA students was 234.24 (SD = 12.74). A significant difference existed between the gain scores for the NA and LD groups (t = 3.79, df = 82, p < .00, two-tailed). Students with LD increased an average of 16.14 points, whereas the NA students increased an average of 3.59 points. The 12.55 score point difference between the groups resulted in a significantly greater gain in points for the LD group.

Use of Speeded Tasks to Predict Extended Test Time

Because previous researchers have found a moderate correlation between ability and speeded tasks (Bates & Stough, 1998; Jensen, Larson, & Paul, 1988; Neubauer & Knorr, 1998), and the NA and LD groups differed significantly in mean KBIT scores, ANOVA procedures were used to assess differences in KBIT scores between the participants in the four-timed/extended time treatment conditions. The results of this analysis indicated no significant differences in KBIT scores among groups between the four test conditions, $F(3, 76) = 1.28$, $p = .29$. Therefore, any differences associated with those conditions could not be attributed to differences on the KBIT. A logistic regression procedure was then used to model the probability that a person belonged to either the "need" extended time group or the "no-need" extended time group based on speeded test scores. ANOVA procedures were also used to assess the influence of gender between the LD and NA participants in the four-timed/extended time treatment conditions. The results of this analysis indicated that there were no significant differences in gender among groups between the four test conditions, $F(3, 76) = 2.11$, $p = .11$.

To evaluate the use of speeded test scores as predictor variables of the need for extended time in the logistic regression analysis, the Pearson and point biserial correlations between the dichotomous "need" variable, the speeded test

scores, and the KBIT were evaluated. (See Table 5.) Alpha correction procedures were not employed to evaluate the correlations, because the large number of correlations would have increased the likelihood of a type II error. The KBIT scores were included in the correlation matrix to evaluate further the relationship between a general intelligence test and the need for extended time. The KBIT score did not correlate significantly with any of the speeded cognitive or reading scores, nor did it correlate significantly with the "need" variable.

Table 5
Intercorrelations between Variables for Students with LD

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Need		-.38*	-.36*	-.06	-.081	-.26	-.19	-.17	.04	-.10	-.23	-.01
2. Reading Fluency	-.38*		.96**	.43**	.61**	.55**	.65**	.47**	.50**	.59**	.47**	.07
3. Academic Fluency	-.36*	.96**		.43**	.67**	.61**	.72*	.52**	.53**	.65**	.47**	.09
4. ND Reading Rate	-.06	.42**	.43**		.43**	.25	.38*	.37	.48**	.45**	.03	.29
5. Visual Matching	-.08	.61**	.67**	.43**		.57**	.90**	.41**	.38*	.53**	.29	.09
6. Decision Speed	-.26	.55**	.61**	.25	.57**		.87**	.43**	.50**	.80**	.40**	.25
7. Processing Speed	-.19	.65**	.72**	.38*	.90**	.87**		.47**	.49**	.74**	.38*	.18
8. Retrieval Fluency	-.17	.47**	.52**	.37*	.41**	.42**	.47**		.61**	.64**	.23	.22
9. Rapid Picture Naming	.04	.50**	.53**	.48**	.38*	.50**	.49**	.61**		.92**	.22	.28
10. Cognitive Fluency	-.10	.59**	.65**	.45**	.53**	.80**	.74**	.64**	.92**		.33*	.30
11. Digit Symbol	-.23	.47**	.47**	.03	.29	.40**	.38*	.23	.22	.33*		-.11
12. KBIT	-.01	.07	.09	.29	.09	.25	.18	.21	.28	.30	-.11	

* $p < .05$ (2-tailed). ** $p < .01$ (2-tailed).

The only measures that were significantly correlated with the "need" variable were the WJ III ACH Reading Fluency test ($r = -.38$, $p < .01$) and the WJ III ACH Academic Fluency cluster ($r = -.36$, $p < .02$), indicating that as fluency decreased the "need" variable increased. Before these two speeded variables were applied in the logistic regression analysis, ANOVA procedures were again used to determine if the groups differed on these variables between treatment conditions. Because of the differences between the groups on the KBIT, the KBIT scores were covaried in the ANOVA. After KBIT scores were accounted for, no statistically significant differences were found by group between the conditions on the WJ III ACH Reading Fluency variable, $F(3, 75) = .731$, $p = .54$, and the Academic Fluency variable, $F(3, 75) = .769$, $p = .52$.

None of the WJ III COG Processing Speed or Cognitive Fluency clusters or tests, or the WAIS-III Digit Symbol test, correlated significantly with the "need" variable. Therefore, no logistic regression analysis was conducted using these variables as predictors of the need for extended time. There was no indication based on the significance levels in the correlation matrix that speeded cognitive test scores used in this study would be good predictors of the need for extended time as "need" was operationalized.

Given that the NDRT Reading Rate scores did not correlate significantly with the need variable, only the WJ III ACH Reading Fluency test and the Academic Fluency cluster were used as predictor variables in the logistic regression analysis. Results indicated that both Reading Fluency ($p = .02$) and Academic Fluency ($p = <.03$) predicted whether students would need extended

test time. For both the Reading Fluency and Academic Fluency variables, the coefficients were -.06, with standard errors of .027 and odds ratios of .94, which were significant at the <.05 level.

A classification table was used to compare the predicted probability of a participant needing or not needing extended time with the actual outcomes of the study. In general, the classification table indicates that the predictor variables were better at classifying individuals who needed extended time than students who did not need extended time. Overall, the percentage of correct classifications, both for "need" and "no-need," was 74.4% for Reading Fluency and 72.1% for Academic Fluency. Specifically, 93.5% of the students who needed extended test time (29/31) were correctly classified using the Reading Fluency test and 25% of the students who did not (3/12) were correctly classified. Using the Academic Fluency cluster, 90.3% of the students who needed extended test time (28/31) were correctly classified and 25% of the students who did not were correctly classified.

DISCUSSION

Differences between Groups

The results of the *t* tests support the findings of previous research in that postsecondary students with LD performed at a slower and more variable rate than NA students. Of those tests that significantly differentiated the groups, the largest difference was seen on the ND Reading Rate, followed by the WJ III ACH Reading Fluency test, and the Academic Fluency cluster. The smallest difference was seen on the WJ III COG Visual Matching test. All the measures of processing speed as well as reading fluency and reading rate for students with LD were significantly lower than their NA peers, with the exceptions of the WAIS-III Digit Symbol, WJ III COG Retrieval Fluency, and WJ III COG Decision Speed tests. This finding on the WAIS-III Digit Symbol subtest is in contrast to previous literature that documented significant score differences among postsecondary populations of students with and without LD.

It appears that the degree of neurological impact that is often but not always seen among students with LD on the Digit Symbol or Coding tests of the Wechsler scales may not be as pronounced among postsecondary students with LD, despite the presence of diagnosed LD. Additionally, in both the Ofiesh (2000) study and the present study, participants were students at competitive 4-year colleges. Thus, scores on the WAIS-III Digit Symbol subtest may differ among students at differing types of postsecondary institutions (e.g., open-admissions community college vs. competitive-admissions four-year university) (Runyan, 1991; Weaver, 1993).

Two possible hypotheses may explain why a difference was not found between groups on the WJ III Retrieval Fluency test. First, individuals do not perform with much variation on this test and the distribution of scores is quite narrow. For students between the ages of 20 and 29 years, the standard deviation for the *W* score on this test is 3.56, whereas on other tests for these ages, the standard deviation is much larger (e.g., Writing Fluency *SD* = 19.16, Math Fluency *SD* = 12.06, Visual Matching *SD* = 28.91). Thus, it is unlikely that differences in performance would be significant within this age group when ana-

lyzing standard scores. Most of the growth in this ability occurs during the early years as vocabulary develops. Second, although Retrieval Fluency is a timed test, it is unlike other timed measures in format because the person does not sustain the same pressured rate of responding. When asked to name as many animals as possible within a 1-minute period, most people begin their response by retrieving animal names rapidly. Once this initial pool has been exhausted, the examinees then slow down and become more reflective and strategic for the remainder of the 1-minute period. Because students with LD are similar to NA peers in knowledge and vocabulary, this slowed-down period may actually allow them the needed time to catch up.

As with the findings of Gregg et al. (2003), the findings of this study demonstrate that postsecondary students with LD seem to process information differently than their NA peers despite having average to above-average intelligence. These students need more time because they have the knowledge and capabilities to answer questions correctly, but slow reading may hamper their performance. Moreover, when KBIT scores were co-varied, intelligence did not contribute significantly to differences in Reading Fluency or Academic Fluency between the groups and conditions. This finding suggests that even when measures of ability (i.e., KBIT) are accounted for, students with LD have limited automaticity with basic academic skills when compared to their NA peers.

Score Gain with Extended Time

Similar to many studies on extended test time, students with LD made significantly greater gains under the extended time condition than did their NA peers, increasing an average of 16 points. The substantial score gain of the LD group and the fact that some students in the NA group qualified as "needing more time" are important for several reasons. First, these findings support previous findings that some students without LD make substantial gains with extended time, but not to the same degree as students with LD (Alster, 1997; Hill, 1984; Ofiesh, 1997; Runyan, 1991; Weaver, 1993). A 12.6-point score difference existed between students with LD and NA students. Furthermore, this finding suggests that if a test is intended to be primarily a power test, more time should be provided for all students (Weaver, 1993).

Second, these findings support Vogel's (1986) contention that the processing characteristics of postsecondary students with LD are similar to the normal variance in cognitive functioning of students without LD, but these characteristics become disabilities because of their severity and frequency. Ofiesh (2000) noted that the accommodation of extended test time allows some students with LD the opportunity to perform similar to their NA peers but the normal variance in cognitive functioning and test taking (i.e., influence of stress, lack of sleep, normal variations in reading ability, motivation, "mental blocks") still exists for both groups.

Reading Fluency and Academic Fluency as Indicators of Need for Extended Test Time

The results of the logistic regression analysis indicated that the WJ III ACH Reading Fluency score was a good indicator of the need for extended time. These findings suggest that the WJ III ACH tests of Reading Fluency and the cluster of Academic Fluency are correlated with performance under timed and extended time conditions on the NDRT. Specifically, the results suggest that, for persons with LD, as the WJ III Reading Fluency and Academic Fluency scores decrease, the probability increases that a person will need and benefit from extended test time. This finding is supported by a recent study that indicated that the Reading Fluency test and Academic Fluency cluster were the most significant indicators of the need for accommodation among postsecondary students with LD (Gregg, Coleman, et al., 2003). Although the results are presented in terms of one-point increases and decreases, in reality people responsible for making decisions about accommodations in postsecondary settings would not make a decision based on one test score, one test, or one point.

The value in the logistic regression results stems from its use as one tool in the analysis of factors used to make the recommendation for extended test time. The results from this study suggest that academic tasks that include both power and speed, specifically the Reading Fluency and Academic Fluency scores from the WJ III ACH, were good predictors of need on a reading-based multiple-choice test. When the log odds are calculated in terms of 15 standard score points (i.e., one standard deviation unit), they begin to hold greater meaning. For example, recognizing that Exp (B) is the predicted odds of improvement, and as Reading Fluency decreases, a student is 1.06 times as likely to improve as not to improve, we see the probability of a very small likelihood of improvement. However, if Reading Fluency decreases by 2 units, a student is 1.12 (1.06^2) times as likely to improve. As a Reading Fluency score drops by one standard deviation, a student is 2.40 (1.06^15) times as likely to improve. In other words, for each improvement in the Reading Fluency score, the odds improve by a factor of 1.06^k. In fact, all seven students included in the percentile rank range of 3 to 8 (SS 70-79), which is approximately 1.5 to 2 standard deviations below the normative sample mean, needed and benefited from extended test time.

LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

This study provides a good foundation regarding the validity of using speeded diagnostic tests to aid in decisions about extended time. The results do not, however, provide evaluators with a precise scientific method to ground their decisions. More research needs to be conducted on how to make effective decisions about extended time, but the challenge remains that in the environment of higher education little consistency exists among the tests to be accommodated. This differs substantially from conducting accommodation studies that apply to large-scale standardized tests (e.g., SATs) where the possibility exists to make decisions based on factors such as (a) the performance of the students without LD (i.e., effect size or "criterion boost"); (b) a clearly

defined construct including the role of speed; (c) an examination of the test completion rates based on different populations of examinees; (d) results of differential item functioning studies; and (e) an understanding of the characteristics of postsecondary students with LD (Ofiesh, 2005). Additionally, the results of this study are related only to performance on a standardized reading-based multiple-choice test, and therefore it is unclear how these results would generalize to the amount of time needed for essay exams or other test formats. The study also raises questions regarding speeded cognitive tasks and their relationships to academic tasks. More studies are needed to clarify the differences among processing speed measures and the role that different types of speeded tasks play in the justification of accommodations for postsecondary students with LD.

The justification for the recommendation of extended time and a person's actual need for extended time cannot be documented by test scores alone. Diagnosis of LD and the selection of specific accommodations must be tailored to each student's needs. This process of selection of accommodations is guided by several considerations, including the evaluator's specific recommendations, the individual's history of need for accommodations and educational and medical background, the severity of the disability, the information obtained from interview data, and behavioral observations (Ofiesh et al., 2004). Nevertheless, the most critical accommodation for postsecondary students with LD is the provision of extra time. As Shaywitz (2003) has noted, "Dyslexia robs a person of time; accommodations return it" (p. 314). We hope that future research will continue to clarify how test scores can be used to help evaluators justify and support the need for extended test time.

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