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The Boston Diagnostic Aphasia Examination–Spanish Version: The influence of demographic variables

DAVID A. PINEDA,[1,2] MONICA ROSSELLI,[3] ALFREDO ARDILA,[1] SILVIA E. MEJIA,[1] MARIA G. ROMERO,[1,4] AND CLAUDIA PEREZ[4]

[1]Neuropsychology Program, University of San Buenaventura, Medellin, Colombia
[2]School of Medicine, University of Antioquia, Medellin, Colombia
[3]Department of Psychology, Florida Atlantic University, Davie, Florida
[4]Aphasiology Department, Hospital Leon XIII, Medellin, Colombia

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Abstract

The Boston Diagnostic Aphasia Examination Battery (BDAE) is one of the most widely used aphasia tests worldwide. Information about general population performance, however, is limited. This paper analyzes the effects of gender, age, socioeconomic status (SES), academic achievement, and occupation on the BDAE Spanish version. The BDAE was administered to a randomized sample of 156 occupationally active 19–60-year-old participants (75 male and 81 female) from two SES groups. Gender and age had a significant effect on some reading and writing subtests. Body-part naming and mechanics of writing scores were significantly decreased in the low SES group. Education had a significant impact over most of the BDAE subtests. A stepwise regression model showed that academic achievement was best able to predict the variance in BDAE scores with a low (<15%) to modest (>17%) but significant capability (*F* MANOVA $p < .01$). A factor analysis disclosed 7 factors that explained 67% of the total variance. (*JINS*, 2000, *6*, 802–814.)

Keywords: Boston Diagnostic Aphasia Examination, Language testing, Spanish-speakers, Educational effects

INTRODUCTION

The Boston Diagnostic Aphasia Examination (BDAE; Goodglass & Kaplan, 1972, 1983) is one of the most widely used aphasia test batteries. This extensive battery assesses different aspects of language performance. BDAE is a rather well studied test battery in abnormal populations and its validity has been extensively studied in aphasic individuals (Borod et al., 1980; Goodglass & Kaplan, 1983, 1986). Cluster analysis grouping different types of aphasic patients is available (Crary et al., 1992). Davis (1993) studied the reliability of the BDAE. Construct validity (Goodglass & Kaplan, 1972), and predictive validity (Garcia-Albea et al., 1986; Helms-Estabrooks & Ramsberger,1986) have also been analyzed. More recently, the BDAE has been used to analyze language changes associated with normal aging (Emery, 1986) and language decline in Alzheimer's disease patients (Jacobs et al., 1995; Osterweil et al., 1994; Randolph & Larson, 1988).

Few studies, however, have focused on BDAE performance in normal populations (Rosselli et al., 1990a; Welch et al., 1996). Borod et al. (1980) carried out a normative study of the BDAE among English-speaking populations age 25 through 85 years, from different levels of education ranging from zero years to college. Seven of the subtests were deleted from this norming study on the presumption that no failure should be anticipated from nonaphasic adults. The mean of most subtests indicated that a few individuals fall short of the maximum raw score by as much as 5 or 6 points. The lowest scores were observed in the group of subjects over 60 years of age with fewer than 9 years of schooling. The authors found that age showed significant differences less frequently than education. The effect of gender, SES, or occupation was not analyzed in that study. Heaton et al. (1991) studied the effects of age, gender, and level of education for the Complex Ideational Material subtest in 186 normal individuals. The sample included mainly males (82%) with a mean age of 57.3 ($SD = 16.1$) years, and a mean level of education of 13.0 ($SD = 2.7$) years. The percentage of variance accounted for age and gender was zero, whereas for education it was 9%.

Reprint requests to: David A Pineda, MD, Carrera 46 # 2 sur-45, Clinica Las Vegas, Consultorio 254, Medellín, Columbia. E-mail dpineda@epm.net.co

The BDAE has been translated and adapted to different languages, including Spanish. It was first translated into Spanish and published in Argentina in 1979 (Goodglass & Kaplan, 1979). A second edition was published in Spain in 1986 (Goodglass & Kaplan, 1986), which changed the *z* scores to percentiles, corrected some mistakes of the English into Spanish translation, and modified the direction of the number of paraphasias profile. Rosselli et al. (1990a) studied the effects of age, education, and gender on the Argentinean version of the BDAE. The BDAE was administered to 180 16- to 65-year-old normal Colombian participants. The sample was stratified into three educational levels (0–5, 6–12, and more than 12 years of education). There were marked differences among different age groups and in particular among educational levels. The influence of gender was minimal and was observed only in one subtest.

In neuropsychological testing, it has been established that language abilities are strongly associated with sociocultural and demographic variables (Ardila et al., 1994; Labov, 1983; Puente & McCaffrey, 1992; Taussig & Ponton, 1996). In individuals with limited or no education, the effects of brain lesions and demographic or cultural variables may be difficult to distinguish (Ardila et al., 1989; Rosselli et al., 1990). Diverse studies have illustrated the significant influence of age and schooling on neuropsychological test performance (e.g., Ardila & Rosselli 1989, 1992, 1994; Ardila et al., 1989, 1990, 1992; Craik et al., 1987; Ostrosky et al., 1985, 1986; Ostrosky-Solis et al., 1998; Ponton et al., 1996; Rosselli & Ardila, 1990; Rosselli et al., 1989, 1990b; Taussig et al., 1992).

Cross-cultural studies about the variability of normal neuropsychological performance have found that an individual's cognitive style, socioeconomic status, occupational skills, hobbies, and culture may influence test scores (Della Sala et al., 1995; Pierce et al., 1989; Rosselli, 1993; Rosselli & Ardila, 1990; Taussig & Ponton, 1996; Troyer et al., 1994). The effect of SES and type of occupation over the BDAE, however, has not been analyzed thoroughly.

In brief, the BDAE is a commonly used language test both in English and in Spanish. Research has shown that demographic variables influence test scores. Few normative data, however, are currently available. The aim of the present study was to analyze the effects of age, education, gender, SES, and type of occupation on variability of scores on the second edition of the BDAE–Spanish version, and to disclose the factor structure that may underlie this language test battery.

METHODS

Research Participants

The BDAE was administered to 156 19- to 60-year-old normal (75 male, 81 female) Colombian participants living in Medellin (population around 2,000,000 inhabitants). All participants were native Spanish-speakers. Participants were randomly selected from an official list of workers registered in the Occupational Department of the Social Security Institute of Antioquia (Medellín). At the time of the study all participants were healthy and actively working at middle and large sized industries in Medellin. Persons with antecedents of any neurological or psychiatric disorders were excluded from the sample.

Table 1 shows the demographic characteristics of the sample. Three age groups (ages 19–35, 36–50, and 51–60 years) and three academic achievement groups (defined by years of education: 1–9,10–15, and more than 16 years of education) are shown. Because the sample was selected from the factories and companies with more than 100 employees, and these organizations contract mainly qualified workers, only 10 (6.4%) of the participants had 5 or fewer years of education, only 1 (0.6%) had 1 year, and none were illiterate. The mean of years of education in Group 1 (1–9) was 6.4 ± 2.4, in Group 2 (10–15) it was 12.8 ± 1.5, and in Group 3 (16–22) it was 17.1 ± 1.4. It has to be noted that the Colombian educational system is not completely equivalent to the US educational system. Elementary education in Colombia is completed in the fifth grade, and secondary education in the 11th grade, when students obtain the mathematics and humanistic bachelor (*bachillerato*) diploma. Then they can apply to a technical institution or to a university. Technical studies usually require one to attend 2 or 3 years in a superior technical institute. University careers (medicine, psychology, law, engineering, education, etc.) generally require 5 to 6 years after the baccalaureate. Finally, if the student has obtained the professional diploma in a university he or she can study 2 to 5 additional years

Table 1. Demographic characteristics of the sample

Variable ($N = 156$)	Frequency	Percentage
Age (years)		
1. (19–35)	67	42.9
2. (36–50)	77	49.4
3. (51–60)	12	7.7
Gender		
M	75	48
F	81	52
Academic achievement (years of education)		
1. Basic (1–9)	25	16
2. Technical (10–15)	74	47.4
3. University (more than 16)	57	36.5
SES		
Low	109	69.9
High	47	30.1
Occupation		
1. Manual workers	35	22.5
2. Technicians	29	18.6
3. Office employees	17	10.9
4. Visuospatial professionals	27	17.3
5. High verbal activity professionals	48	30.7

in a training or research program in order to get a postgraduate degree.

The sample was also stratified into two socioeconomic status (groups *low* and *high*), and five occupations (manual workers, technicians, office employees, and two professional groups). The official city criteria were used to determine the socioeconomic status (SES) of the participants. Medellin has been divided by the City Administration Board into six socioeconomic areas, ranging from Level 1 (*lowest*) to Level 6 (*highest*). This division is taken into account for tax collection and city service payments. People living in Level 1 areas are usually unqualified factory workers, domestic workers, and the like, who earn the minimal wage. People living in Level 6 areas are high-income professionals, industry owners, and the like. Participants included in our sample were divided into two SES groups: *low* (City Levels 1, 2, and 3 according to the City Administration Board), and *high* (City Levels 4, 5, and 6).

Five occupational categories were identified using the Social Security Institute of Antioquia classification: (1) Group 1, including manual workers; (2) Group 2, consisting of qualified technicians; (3) Group 3, including office employees (secretaries, cashiers, counters, etc.); (4) Group 4, including professionals with college or graduate degrees with majors in those areas in which visuospatial skills are supposedly most important (e.g., architecture and engineering); and (5) Group 5, consisting of participants with university degrees with majors in which high verbal abilities are expected (e.g., business, law, social work, nursing, physical and occupational therapy, psychology, administration).

Instruments and Procedures

The BDAE–Spanish version (Goodglass & Kaplan, 1986) was adapted to the linguistic idiosyncrasies of the Spanish language spoken in Colombia. The words *goma*, *Sevilla*, *estación*, *andaluz*, and *gallego* were change to *caucho*, *Bogotá*, *terminal*, *antioqueño*, and *pastuso* respectively. Those items in which all participants performed perfectly (sentence length, oral agility, and verbal agility) were not included in further analyses. Animal naming was scored as the total production in 90 s. The second edition of the BDAE was preferred simply because it is currently in use in most Spanish-speaking countries. Both, the first and the second edition have been published by *Editorial Medica Panamericana*, a publishing company with a wide distribution in Spain and most Latin American countries. However, the first edition is difficult to find nowadays. Testing was performed by advanced speech pathology students who received 20 hr of training in the administration of the BDAE. Each of them had to successfully test 5 participants under supervision before starting to test the research participants. The evaluators did not know the hypothesis and purpose of the research. Each participant was individually tested in two 60-min sessions. A neuropsychology professor reviewed each participant's test scores.

Statistical Analyses

SPSS 8.0 software was used in order to define descriptive statistical measures. A multifactor analysis of variance (MANOVA) with *post-hoc* Bonferroni corrections for multiple comparisons was used to study the main effects of age, gender, level of education, socioeconomic status, and type of occupation and their interactions on the BDAE subtests. A Spearman's Rho correlation analysis for categorical, and nonnormal distributed numerical variables was done in order to define which independent variables should be included in a multiple regression analysis, and which of them were related to the BDAE continuous variables. A stepwise regression analysis was developed in order to define the prediction capability of several independent categorical variables on the variance of each dependent numeric continuous variable. In order to eliminate the collinear effect, only categorical independent variables with low or very low correlation coefficient ($r < .45$) were selected for the stepwise

Table 2. Performance on different BDAE subtests in 156 normal participants

BDAE Variables	*M*	*SD*	Range
Comprehension			
Word Discrimination	70.54	2.67	56–72
Body Part Identification	18.65	2.07	15–20
Commands	14.39	1.15	7–15
Complex Material	9.05	1.66	4–12
Automatic Speech			
Automatized Sentences	13.68	0.86	8–14
Singing & Rhythm	1.87	0.49	0–2
Repetition			
Words	9.98	0.11	9–10
High Probability	7.80	0.48	5–8
Low Probability	7.82	0.41	6–8
Oral Reading			
Words	29.87	1.22	15–30
Oral Sentences	9.87	0.78	1–10
Naming			
Responsive Naming	29.32	3.64	10–30
Confrontation Naming	94.93	2.67	80–96
Body-Part Naming	27.64	2.34	21–30
Animal Naming	25.88	6.45	10–45
Reading Comprehension			
Symbol Discrimination	9.71	1.21	6–10
Word Recognition	7.89	0.63	1–8
Oral Spelling	6.58	1.68	1–8
Word–Picture Matching	9.98	0.13	9–10
Sentences–Paragraphs	9.41	0.90	6–10
Writing			
Mechanics	4.94	0.42	0–5
Serial Writing	46.27	5.08	1–50
Primer-Level Dictation	13.66	1.57	1–14
Written Confrontation Naming	9.80	0.97	1–10
Spelling to Dictation	9.80	0.99	1–10
Sentences to Dictation	11.78	1.36	0–12
Narrative Writing	4.86	0.65	0–5

regression analysis. A factor analysis was performed using the varimax rotation to disclose the factors underlying the BDAE subtests.

RESULTS

Table 2 presents the means, standard deviations and ranges obtained by the whole sample, and Table 3 shows the performance on the subtests by different age groups. In general, differences were small. The two younger groups (19–35 and 36–50 years) performed significantly higher in the Word Picture Matching and Serial Writing subtests than the oldest group (age 51–60 years).

Academic achievement (years of education) had a significant effect in 10 out of the 25 analyzed BDAE subtests (see Table 4). Statistically significant differences were observed in most subtests when the group with the lowest level of education (1–9 years) was compared to the other two groups (10–15 and more than 16 years of schooling). Groups 2 (10–15 years) and 3 (more than 16 years) differed significantly in Animal Naming and Oral Spelling subtests. In the Appendix, mean test scores and standard deviations in two age and three education groups are presented. Unfortunately, the last age group becomes too small when divided into three education ranges.

Gender differences are presented in Table 5. Significant differences between men and women were not observed in any of the BDAE variables.

Few significant interactions between demographic variables were observed. Gender and level of occupation significantly interacted in the Word Reading ($F = 3.92$, $p = .006$) subtest; better scores were observed in female participants with higher occupational levels. A significant interaction between Gender × Age was observed on High ($F =$

Table 3. Performance on the BDAE by age groups

	Group ($N = 156$)								
	19–35 yrs $n = 67$		36–50 yrs $n = 77$		51–60 yrs $n = 12$				
Variable	*M*	(*SD*)	*M*	(*SD*)	*M*	(*SD*)	*F**	*p*	Group differ.
Comprehension									
Word Discrimination	70.7	(2.2)	70.6	(2.4)	68.4	(4.7)	1.221	.296	—
Body-Part Identification	18.7	(1.4)	18.9	(1.4)	18	(2.2)	0.448	.640	—
Commands	14.3	(1.0)	14.4	(1.3)	14.4	(0.6)	0.650	.523	—
Complex Material	8.9	(1.5)	9.2	(1.7)	8.5	(1.6)	0.226	.798	—
Naming									
Responsive Naming	29.3	(3.4)	29.6	(2.3)	29.4	(1.1)	0.382	.683	—
Confrontation	95.4	(1.5)	94.5	(3.3)	94.5	(2.7)	3.201	.044	—
Animal Naming	26.8	(6.0)	26.01	(6.5)	19.75	(5.5)	2.232	.111	—
Body-Part Naming	27.3	(2.3)	27.8	(2.2)	27.5	(2.6)	0.522	.594	—
Oral Reading									
Word Reading	29.7	(1.8)	29.9	(0.1)	29.7	(0.8)	1.134	.325	—
Oral Sentence	9.8	(1.1)	9.9	(0.1)	9.5	(1)	0.856	.427	—
Repetition									
Words	9.9	(0.1)	10	(0)	10	(0)	0.767	.466	—
High-Probability	7.8	(0.3)	7.8	(0.4)	7.4	(0.9)	1.492	.228	—
Low-Probability	7.8	(0.3)	7.8	(0.4)	7.5	(0.5)	4.549	.012	1–3 & 2–3
Reading Comprehension									
Symbol Discrimination	29.7	(1.8)	29.9	(0.1)	29.7	(0.8)	1.456	.237	—
Word Recognition	7.8	(0.8)	7.9	(0.1)	7.7	(0.8)	1.287	.279	—
Oral Spelling	6.7	(1.6)	6.6	(1.4)	5.3	(2.7)	0.205	.840	
Word–Picture Matching	9.9	(0.1)	9.4	(0.8)	9.1	(1.1)	3.232	.042	1–3 & 2–3
Sentences Paragraphs	9.3	(0.9)	9.4	(0.8)	9.1	(1.1)	0.174	.840	—
Writing									
Mechanics	4.9	(0.1)	4.9	(0.1)	5	(0)	0.001	.999	—
Serial Writing	46.9	(2.9)	46.7	(3.2)	39.4	(13.2)	5.808	.004	1–3 & 2–3
Primer-Level Dictation	13.7	(1.2)	13.7	(1.1)	12.9	(3.4)	0.526	.592	—
Written Confrontation	9.8	(0.9)	9.8	(0.3)	9.3	(2.3)	0.198	.821	—
Spelling to Dictation	9.8	(0.8)	9.8	(0.4)	9.0	(2.3)	0.844	.432	—
Sentences to Dictation	11.8	(1.3)	11.9	(0.4)	8.9	(2.9)	1.437	.241	—
Narrative Writing	4.8	(0.3)	4.9	(0.4)	4.6	(0.8)	0.827	.439	—

*MANOVA with multiple Bonferroni *post-hoc* comparisons.

Table 4. Performance on the BDAE by academic achievement

	Group (N = 156)								
	Basic n = 17		Middle n = 82		High n = 57				
Variable	M	(SD)	M	(SD)	M	(SD)	F*	p	Group differ.
Comprehension									
Word Discrimination	67.8	(4.4)	70.6	(2.4)	71.2	(1.6)	2.476	.088	—
Body-Part Identification	17.3	(1.9)	18.8	(1.2)	19.2	(1.4)	1.300	.276	—
Commands	13.7	(1.3)	14.4	(1.2)	14.4	(0.8)	2.515	.084	—
Complex Material	7.8	(1.8)	9.0	(1.5)	9.4	(1.5)	1.155	.318	—
Naming									
Responsive Naming	28.4	(4.8)	29.6	(2.2)	29.5	(2.6)	1.742	.179	—
Confrontation	92.5	(4.4)	95.0	(2.4)	95.5	(1.8)	2.913	.057	—
Animal Naming	19.4	(5.6)	25.1	(5.9)	28.9	(5.6)	9.822	.000	1–2, 1–3 & 2–3
Oral Reading									
Body-Part Naming	26.4	(2.0)	27.4	(2.4)	28.2	(2.0)	1.397	.251	—
Word Reading	28.8	(3.6)	29.9	(0.1)	30	(0)	4.388	.014	1–2 & 1–3
Oral Sentence	9.1	(2.2)	9.9	(0.1)	9.9	(0.1)	4.852	.009	1–2 & 1–3
Repetition									
Words	10	(0)	9.9	(0.1)	10	(0)	1.124	.328	—
High Probability	7.2	(0.8)	7.8	(0.4)	7.9	(0.2)	2.459	.089	—
Low Probability	7.6	(0.4)	7.8	(0.4)	7.8	(0.3)	0.367	.693	—
Reading Comprehension									
Symbol Discrimination	8.2	(3.0)	9.8	(0.5)	9.9	(0.2)	10.407	.000	1–2 & 1–3
Word Recognition	7.7	(0.7)	7.8	(0.7)	7.9	(0.2)	0.517	.598	—
Oral Spelling	4.2	(2.3)	6.5	(1.4)	7.2	(1.0)	8.484	.000	1–2, 1–3 & 2–3
Word–Picture Matching	9.8	(0.3)	10	(0)	10	(0)	5.031	.000	1–2 & 1–3
Sentences Paragraphs	8.6	(1.3)	9.3	(0.9)	9.7	(0.4)	2.371	.097	—
Writing									
Mechanic	5	(0)	4.9	(0.1)	4.9	(0.2)	1.735	.180	—
Serial Writing	38.5	(11.9)	47.1	(2.1)	47.2	(1.5)	9.996	.000	1–2 & 1–3
Primer-Level Dictation	12.8	(2.9)	13.7	(1.1)	13.7	(1.3)	0.938	.394	—
Written Confrontation	8.8	(2.6)	9.9	(0.2)	9.9	(0.4)	5.763	.004	1–2 & 1–3
Spelling to Dictation	8.7	(2.5)	9.9	(0.2)	9.9	(0.2)	5.356	.006	1–2 & 1–3
Sentences to Dictation	10.4	(3.5)	11.9	(0.1)	11.9	(0.4)	4.743	.010	1–2 & 1–3
Narrative Writing	4.6	(0.8)	4.9	(0.1)	4.8	(0.5)	2.012	.137	—

*MANOVA with multiple Bonferroni *post-hoc* comparisons.

3.41, p = .03) and Low Probability Repetition subtests (F = 4.66, p = .01). Older male participants tended to score lower than female participants.

Only one statistically significant SES difference was found. Body-Part Naming scores were superior in the high-SES participants (Table 6). A significant interaction between SES × Academic Achievement was found in the Animal Naming subtest (F = 5.48, p = .02). Participants from a high SES and high academic achievement outscored the other groups.

Raw scores across the different occupational groups were rather similar. Highest score differences across groups were found in Serial Writing and Animal Naming subtests (Table 7). When comparing the occupational groups, however, no statistically significant differences were observed

Spearman's Rho correlation coefficient showed a low, but significantly negative correlation between gender, academic achievement, and occupational level. Female participants in our sample had a mild tendency to have lower education and hold lower-level jobs. Academic achievement was moderately but significantly correlated with the participants' SES (r = .39) and occupational level (r = .44). Only Confrontation Naming and Reading Comprehension of sentences and paragraphs presented a significant but low correlation with gender. Word Discrimination, Animal Naming, High Probability Repetition, Low Probability Repetition, and Serial Writing presented a modest negative, but significant correlation with age ($p < .05$). In general, the younger the participants; the better their performance. Fifteen of the BDAE variables presented positive and significant correlations with education and 16 subtest scores significantly correlated with occupation (Table 8).

Multiple categorical demographic and individual variables were used as independent variables. A full regression

Table 5. Performance on the BDAE by gender

	Male (n = 75)		Female (n = 81)			
Variable	*M*	(*SD*)	*M*	(*SD*)	*F**	*p*
Comprehension						
Word Discrimination	70.4	(2.6)	70.6	(2.6)	0.406	.525
Body-Part Identification	18.5	(1.7)	19.02	(1.2)	0.090	.765
Commands	14.2	(1.3)	14.4	(0.9)	0.228	.633
Complex Material	9.1	(1.6)	8.9	(1.6)	2.904	.090
Naming						
Responsive Naming	29.6	(2.3)	29.38	(3.1)	0.334	.564
Confrontation	94.8	(2.2)	95.01	(2.9)	0.364	.547
Animal Naming	25.6	(6.3)	26.07	(6.5)	0.012	.914
Body-Part Naming	27.5	(2.4)	27.7	(2.2)	0.031	.861
Oral Reading						
Word Reading	29.7	(1.7)	29.9	(0.1)	0.588	.445
Oral Sentence	9.7	(1.1)	9.9	(0.1)	0.682	.410
Repetition						
Words	9.9	(0.1)	9.9	(0.1)	0.000	.999
High Probability	7.7	(0.5)	7.8	(0.4)	0.678	.412
Low Probability	7.8	(0.4)	7.8	(0.2)	0.002	.961
Reading Comprehension						
Symbol Discrimination	9.6	(1.5)	9.8	(0.6)	0.006	.939
Word Recognition	7.8	(0.8)	7.9	(0.2)	1.052	.307
Oral Spelling	6.3	(1.9)	6.8	(1.3)	0.877	.351
Word–Picture Matching	9.9	(0.1)	10.0	(0)	1.291	.258
Sentences Paragraphs	9.2	(0.9)	9.5	(0.8)	2.283	.133
Writing						
Mechanics	4.9	(0.1)	4.9	(0.1)	0.113	.737
Serial Writing	45.6	(6.5)	46.8	(2.9)	0.069	.793
Primer-Level Dictation	13.4	(1.2)	13.8	(0.4)	1.694	.195
Written Confrontation	9.7	(1.3)	9.9	(0.3)	0.245	.622
Spelling to Dictation	9.7	(1.2)	9.9	(0.4)	0.348	.556
Sentences to Dictation	11.6	(1.7)	11.9	(0.3)	0.644	.424
Narrative Writing	4.8	(0.4)	4.9	(0.4)	0.092	.762

*MANOVA with multiple Bonferroni *post-hoc* comparisons.

model, using an F test to assess statistical significance ($p < .05$), and adjusted R^2 for predicting each BDAE continuous numeric variable, was performed. It was found that academic achievement was a significant predictor ($p < .01$), accounting for a small portion (<15%) of the variance in the scores of Word Discrimination, Complex Material, Oral Reading, Symbol Discrimination, Word/Picture Matching, Sentence and Paragraphs Reading, Written Confrontation, Spelling to Dictation, and Sentences to Dictation (see Table 9). Academic achievement also had a moderate significant (>17%) capability of predicting the variance in Oral Spelling. Occupation had a low but significant predictive power (<15%) on Confrontation Naming scores. Age and education were found to predict 21% of the variance in Animal Naming scores, and 18% of the variance in Serial Writing. Age and occupation were significant predictors of the variance in Low Probability Repetition. SES also had low but significant predictive power on the variance of Commands Comprehension and Body-Part Naming. These findings corroborate the results presented in Table 8 (zero-order correlations).

An exploratory factor analysis with varimax rotation disclosed seven factors with eigenvalues over 1.0 that accounted for 67% of the variance (Table 10). Factor 1 explained 30.2% of the variance and its load was nearly 3 times higher than the Factor 2 load (11.9%). Factor 3 explained only 6.8% of the variance. Each of the other four factors explained less than 5% of the variance.

Table 11 describes the possible cognitive factors underlying the BDAE. Variables inside each factor were selected using a high correlation coefficient over .61. However, most of the variables in the factors presented correlation coefficients over .70. Factor 1 is formed by reading subtests, Factor 2 includes writing subtests. Factor 3 is formed by Confrontation Naming, Commands, and Word Discrimination, and underlies a semantic factor. Factor 4 is a semantic

Table 6. Performance on the BDAE subtests by SES (low and high)

	Group (N = 156)					
	Low		High			
Variable	M	(SD)	M	(SD)	F*	p
Comprehension						
Word Discrimination	70.1	(3.0)	71.5	(1.1)	3.079	.081
Body-Part Identification	18.5	(2.7)	19.3	(1.0)	1.069	.303
Commands	14.2	(1.3)	14.7	(0.4)	2.765	.099
Complex Material	8.8	(1.6)	9.5	(1.5)	2.062	.153
Naming						
Responsive Naming	29.6	(1.9)	29.1	(4.0)	2.404	.123
Confrontation	94.6	(2.9)	95.5	(1.8)	0.471	.494
Animal Naming	25.5	(6.3)	26.7	(6.7)	1.334	.250
Body-Part Naming	27.1	(2.3)	28.8	(1.7)	10.92	.001
Oral Reading						
Word Reading	29.8	(1.4)	30	(0)	0.067	.796
Oral Sentence	9.8	(0.9)	9.9	(0.14)	0.040	.842
Repetition						
Words	9.9	(0.13)	10	(0)	0.591	.443
High Probability	7.7	(0.5)	7.9	(0.2)	0.150	.699
Low Probability	7.7	(0.4)	7.8	(0.3)	0.205	.652
Reading Comprehension						
Symbol Discrimination	9.5	(1.4)	10	(0)	0.283	.596
Word Recognition	7.8	(0.7)	7.9	(0.1)	0.260	.611
Oral Spelling	6.3	(1.8)	7	(1.1)	0.028	.867
Word–Picture Matching	9.9	(0.1)	10	(0)	0.074	.786
Sentences Paragraphs	9.2	(0.9)	9.7	(0.6)	0.637	.426
Writing						
Mechanics	4.9	(0.1)	5	(0)	4.111	.044
Serial Writing	45.8	(5.9)	47.2	(1.4)	0.030	.862
Primer-Level Dictation	13.5	(1.8)	13.9	(0.2)	0.635	.427
Written Confrontation	9.7	(1.1)	9.8	(0.3)	0.702	.403
Spelling to Dictation	9.7	(1.0)	9.9	(0.2)	0.000	.987
Sentences to Dictation	11.7	(1.4)	11.9	(0.4)	0.069	.793
Narrative Writing	4.9	(0.3)	4.8	(0.5)	1.069	.303

*MANOVA with multiple Bonferroni *post-hoc* comparisons.

fluency factor and is integrated by Animal Naming. Factor 6 includes Repetition of Words and represents only 4.4% of the total variance of the BDAE factorial structure. Factor 7 is a motor factor.

DISCUSSION

The results of this study demonstrate that there is high variability in the BDAE scores among normal participants. The subtest score ranges were rather wide. Some participants scored more than 3 standard deviations below the mean. In other words, some normal participants scored at the *brain-damaged* range.

The heterogeneity of the BDAE scores was determined mainly by the participants' level of education and, to a lesser degree, age. Gender did not have a significant effect. However, gender interacted with age and education; although, the direction of the interaction was determined by education (the highest level, the highest scores) and age (the oldest group, the lowest scores) in both genders. Socioeconomic status and type of occupation did not have an important effect over the BDAE subtests, but they significantly correlated with education level. In other words, the crucial variable was the educational level. SES differences may be significant just as a result of the correlation between SES and education. The most important educational differences were observed between the lowest-educated group (1–9 years of education, M 6.4 $\pm$ 2.4) and the other two groups (10–15, and more than 16).

The study performed by Rosselli et al. (1990a) found a significantly poor performance on most of the BDAE subtests among subjects with very low education (0–5 years of education); likewise Borod et al. (1980) found the lower scores in participants with fewer than 9 years of schooling.

Table 7. Performance on the BDAE by occupational group

	Group (N = 156)									
	Manual workers (n = 35)		Technicians (n = 29)		Office employees (n = 17)		Visuospatial professionals (n = 27)		Verbal professionals (n = 48)	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Comprehension										
Word Discrimination	69.1	(3.6)	70	(2.5)	71	(1.2)	70.8	(2.4)	71	(2.0)
Body-Part Identification	17.7	(1.6)	18	(1.4)	19.2	(1.0)	19.3	(1.0)	19.1	(1.5)
Commands	14.0	(1.3)	14.2	(1.7)	14.5	(0.6)	14.5	(0.6)	14.5	(0.8)
Complex Material	8.2	(1.9)	9.3	(1.6)	9.3	(1.4)	9.2	(1.3)	9.2	(1.5)
Naming										
Responsive Naming	29.2	(3.4)	29.9	(0.1)	28.8	(4.8)	30	(0.0)	29.4	(2.9)
Confrontation	93.5	(3.8)	94.4	(3.1)	94.9	(2.9)	95.8	(0.6)	95.7	(1.0)
Animal Naming	23.3	(6.8)	24.5	(5.3)	27.3	(5.5)	25.5	(6.5)	28.1	(6.3)
Body-Part Naming	26.8	(2.1)	27.8	(2.6)	27.4	(2.3)	28	(2.1)	27.9	(2.3)
Oral Reading										
Word Reading	29.4	(2.5)	30	(0.0)	30	(0.0)	30	(0.0)	30	(0.0)
Oral Sentence	9.5	(1.6)	10	(0.0)	9.9	(0.2)	9.9	(0.1)	9.9	(0.1)
Repetition										
Words	10	(0.0)	10	(0.0)	10	(0.0)	9.9	(0.1)	9.9	(0.1)
High Probability	7.5	(0.7)	7.7	(0.5)	7.8	(0.3)	7.9	(0.3)	7.9	(0.2)
Low Probability	7.6	(0.5)	7.8	(0.4)	7.8	(0.3)	7.8	(0.3)	7.8	(0.3)
Reading Comprehension										
Symbol Discrimination	9	(2.2)	9.7	(0.9)	9.8	(0.4)	10	(0.0)	9.9	(0.2)
Word Recognition	7.8	(0.5)	7.7	(1.3)	8	(0.0)	7.8	(0.3)	7.9	(0.1)
Oral Spelling	5.4	(2.2)	6.5	(1.5)	7.5	(0.7)	6.7	(1.3)	7.0	(1.2)
Word–Picture Matching	9.9	(0.2)	10	(0.0)	10	(0.0)	10	(0.0)	10	(0.0)
Sentences Paragraphs	8.8	(1.3)	9.4	(0.8)	9.5	(0.7)	9.7	(0.4)	9.6	(0.6)
Writing										
Mechanics	4.9	(0.1)	5	(0.0)	4.9	(0.2)	5	(0)	4.9	(0.2)
Serial Writing	42.8	(9.4)	47.1	(1.8)	47.2	(1.7)	47.5	(1.5)	47.2	(1.6)
Primer-Level Dictation	13.3	(2.1)	13.6	(1.8)	13.4	(2.4)	13.8	(0.36)	13.8	(0.3)
Written Confrontation	9.3	(1.8)	9.8	(0.3)	10	(0)	10	(0)	9.9	(0.2)
Spelling to Dictation	9.3	(1.8)	9.9	(0.18)	9.8	(0.3)	9.9	(0.2)	9.9	(0.2)
Sentences to Dictation	11.2	(2.5)	12	(0.0)	12	(0.0)	11.9	(0.3)	11.9	(0.4)
Narrative Writing	4.8	(0.6)	4.9	(0.3)	4.7	(0.7)	4.9	(0.2)	4.9	(0.2)

Taken together, these results strongly suggest that low education dramatically influences the BDAE variables, allowing significant low scores.

In Borod et al.'s study, seven subtests (Oral Word Reading, Visual Confrontation Naming, Symbol and Word Discrimination, Word–Picture Matching, Mechanics of Writing, Serial Writing, and Primer Level Dictation) were deleted on the presumption that no failures should be anticipated from nonaphasic adults. In our study, performance on six of these seven subtests was significantly decreased in the low-educated participants. Thus, it seems advisable that the neuropsychological tests used in the assessment of language should include in their normalization sample those individuals with low education levels. This will reduce the likelihood of having false positives or committing a Type II error in clinical practice. Taussig and Ponton (1996), among others, consider education a significant contributor to neuropsychological test performance. They suggest four levels of education (<6, 7–10, 11–15, >16 years) to be included in any research design. If the sample in this study had not included the low-educated group (1–9 years of schooling), no significant educational effects would have been observed. However, it would have been desirable to include some more restricted ranges of education as was recommended above, but the nature of our sample, obtained in companies with more than 100 employees, which demand a minimum of education for contracting workers, made it difficult to obtain samples with lower education levels. Further, it will be important to research samples that include farmers, domestic workers, and other unqualified workers, who may have lower education levels.

Although the influence of education has been confirmed by most authors (e.g., Anastasi, 1988; Ardila et al.,1989; Cronbach, 1990; Pierce et al., 1989; Ponton et al., 1996;

Table 8. Significant Spearman's Rho correlation coefficients ($p < .05$) among all variables

	Gender		Age		Academic achievement		SES		Occupation	
Variable	*r*s	(*p*)	*r*s	(*p*)	*r*s	(*p*)	*r*s	(*p*)	*r*s	(*p*)
Gender	—		.09	(ns)	−.17	(.02)	−.05	(ns)	−.17	(.02)
Age		—			−.17	(.02)	.05	(ns)	−.06	(ns)
Academic achievement				—			.44	(.000)	.35	(.000)
SES							—		.35	(.000)
Occupation									—	
Comprehension										
Word Discrimination	−.06	(ns)	−.17	(.02)	.31	(.000)	.27	(.000)	.23	(.003)
Body-Part Identification	−.18	(.02)	.09	(ns)	.34	(.000)	.31	(.000)	.31	(.003)
Commands	−.06	(ns)	−.06	(ns)	.13	(ns)	.12	(ns)	.14	(ns)
Complex Material	.05	(ns)	−.01	(ns)	.25	(.000)	.21	(.007)	.15	(ns)
Naming										
Responsive Naming	−.06	(ns)	−.05	(ns)	.05	(ns)	.15	(ns)	.00	(ns)
Confrontation	−.15	(.04)	−.14	(ns)	.32	(.000)	.18	(.02)	.34	(.000)
Animal Naming	−.03	(ns)	−.24	(.003)	.42	(.000)	.10	(ns)	.28	(.000)
Body-Part Naming	−.04	(ns)	−.00	(ns)	.25	(.001)	.32	(.000)	.18	(.02)
Oral Reading										
Word Reading	−.08	(ns)	−.03	(ns)	.25	(.001)	.15	(ns)	.22	(.005)
Oral Sentence	−.07	(ns)	−.04	(ns)	.20	(.009)	.21	(.007)	.16	(.04)
Repetition										
Words	.00	(ns)	.17	(.02)	.03	(ns)	.03	(ns)	−.09	(ns)
High Probability	−.18	(ns)	−.29	(.000)	.17	(.03)	.17	(.03)	.31	(.000)
Low Probability	−.06	(ns)	−.23	(.003)	.14	(ns)	.09	(ns)	.18	(.02)
Reading Comprehension										
Symbol Discrimination	−.01	(ns)	−.14	(ns)	.35	(.000)	.32	(ns)	.28	(.001)
Word Recognition	−.01	(ns)	.03	(ns)	.04	(ns)	.13	(ns)	.05	(ns)
Oral Spelling	−.12	(ns)	−.13	(ns)	.41	(.000)	.16	(.03)	.26	(.001)
Word–Picture Matching	−.14	(ns)	−.12	(ns)	.22	(.005)	.10	(ns)	.19	(.01)
Sentences Paragraphs	−.25	(.001)	−.06	(ns)	.30	(.000)	.24	(.003)	.24	(.002)
Writing										
Mechanics	−.00	(ns)	.09	(ns)	−.12	(ns)	.04	(ns)	−.03	(ns)
Serial Writing	−.05	(ns)	−.18	(.02)	.12	(ns)	.02	(ns)	.16	(.04)
Primer-Level Dictation	−.01	(ns)	−.13	(ns)	.14	(ns)	.20	(.01)	.05	(ns)
Written Confrontation	.02	(ns)	−.04	(ns)	.15	(ns)	.00	(ns)	.15	(ns)
Spelling to Dictation	−.06	(ns)	−.11	(ns)	.18	(.02)	.16	(.03)	.17	(.03)
Sentences to Dictation	−.04	(ns)	−.14	(ns)	.17	(.03)	.13	(ns)	.16	(.04)
Narrative Writing	−.03	(ns)	.05	(ns)	.00	(ns)	.01	(ns)	.02	(ns)

Rosselli & Ardila, 1990; Rosselli et al., 1990b), Reitan and Wolfson (1995), have challenged this statement. They proposed that age and education are not essential variables in neuropsychological test performance. The sample used by these authors, however, had a mean of 11 years of education. Failing to obtain a significant effect of education on neuropsychological tests may have been the result of using a sample with a higher and restricted educational range that reduced the variability of the scores. It is clear that the effect of education over cognitive tests is not linear; for example, there are very large differences in test performance between illiterate people and those with 3 years of education. But the magnitude of this difference is going to decrease if we compare people with 3 years of education to those with 6 years of schooling. This difference will further decrease as the level of education of the comparison groups increase. Years of education may have an effect over test performance, reaching the ceiling of the test, and will allow a plateau profile (Ardila, 1998; Ostrosky-Solis et al., 1998). No differences, or just minimal differences, in test performance are expected, for example, when comparing groups with 12 and 15 years of schooling.

According to our data, BDAE heterogeneity was caused by education. When age groups were compared, significant differences were observed between the oldest and the youngest groups on only three variables. Interactions between Age × Education also produced significant differences in very few variables. Most reading subtests and writing subtests were significantly influenced by the participant's level of education. The level of education, however, did not sig-

Table 9. Stepwise regression analysis with multiple categorical independent variables

Dependent variables	Independent variables (selected model)	Fitting results *t*-value	Full regression, adj. prediction percentage	ANOVA *p*
Comprehension				
Word Discrimination	Academic Achiev.	4.157	9.5	.0001
Body-Part Identification	Academic Achiev.	2.246	13.1	.0000
	Occupation	2.243		
Commands	SES	2.394	3	.01
Complex Material	Academic Achiev.	3.169	5.5	.001
Naming				
Confrontation	Occupation	4.209	9.7	.0000
Animal Naming	Age	−2.230	21	.0000
	Academic Achiev.	5.804		
Body-Part Naming	SES	4.378	10.5	.0000
Oral Reading				
Word Reading	Academic Achiev.	2.504	3.3	.01
Oral Sentence	Academic Achiev.	2.901	4.6	.004
Repetition				
High Probability	Academic Achiev.	2.397	12.7	.0000
	Occupation	2.316		
Low Probability	Age	−2.573	6.4	.002
	Occupation	2.229		
Reading Comprehension				
Symbol Discrimination	Academic Achiev.	4.281	10.1	.0000
Oral Spelling	Academic Achiev.	6.372	20.4	.0000
Word–Picture Matching	Academic Achiev.	3.553	7	.0005
Sentences Paragraphs	Academic Achiev.	4.472	10.9	.0000
Writing	Age	−2.929	18	.0000
Serial Writing	Academic Achiev.	4.736		
Written Confrontation	Academic Achiev.	3.207	5.7	.001
Spelling to Dictation	Academic Achiev	3.647	7.4	.0004
Sentences to Dictation	Academic Achiev.	2.980	4.8	.003

nificantly influence language comprehension. Word generation turned out to be one of the most sensitive subtests to level of education. Age, on the other hand, had a significant effect on just a few of the BDAE subtests. It has been pointed out that education has a stronger effect than age on neuropsychological test performance (Ardila & Rosselli, 1989). Albert and Heaton (1988) suggested that, when education is controlled, no significant changes on verbal intelligence would be observed among elderly populations. One or two years of schooling may be enough to produce a significant change on the scores of verbal comprehension, verbal fluency, and conceptual abilities tests (Ostrosky-Solis et al., 1998).

SES had a minimal effect over the BDAE subtests. Only in Body-Part Naming did high-SES individuals outscore low-SES participants. The influence of SES on psychological tests (Anastasi, 1988) is frequently mentioned but poorly understood. Poor test performance has been described in low-SES groups. This SES effect, however, may indeed be the result of its significant association with educational level. In our study, the correlation between SES and education level was .44.

The effects of SES frequently interact with other demographic variables. Craik et al. (1987) observed that memory loss associated with aging was linked to SES. Ardila and Rosselli (1994) found that naming, verbal fluency, and verbal com-

Table 10. Factorial analysis of the BDAE ($N = 156$)

Factor	Eigenvalue	Percentage of variance	Cumulative percentage of variance
1	7.552	30.2	30.2
2	2.971	11.9	42.1
3	1.710	6.8	48.9
4	1.208	4.8	53.8
5	1.171	4.7	58.5
6	1.101	4.4	62.9
7	1.032	4.1	67.0

Table 11. Factorial structure of the BDAE rotated varimax

Factor	Variable	Correlation coefficients
1. Oral Reading	Words	.90
	Sentences	.85
2. Writing	Primer-Level Dictation	.74
	Serial Writing	.73
	Spelling to Dictation	.70
3. Semantic	Confrontation Naming	.75
	Commands Comprehension	.63
	Word Discrimination	.61
4. Semantic Fluency	Animals Naming	.78
5. Lexical Graphic Attention	Reading Word Recognition	.82
6. Repetition	Word Repetition	.86
7. Motor	Writing Mechanics	.92

prehension were influenced by an interaction between Age × SES on 5-to-12-year-old children. SES had a significant effect in younger children's test scores but this effect decreased in older children. In younger children score differences were related to SES, whereas with advancing age, education became progressively more influential. Some research studies have shown that low-SES individuals receive quantitatively and qualitatively less stimulation at home in comparison with the high-SES persons. This differential stimulation contributes to the development of different behavioral styles (Cravioto & Arrieta, 1982). The results of these research studies indicate that development in an impoverished social environment results in insufficient stimulation, which may affect performance in neuropsychological tests.

The factor analysis disclosed that seven factors accounted for 67% of the variance in the BDAE performance. The first two factors were represented by a reading and a writing factor. These two factors, which together explained 42.1% of the variance, are structured by learning academic skills. Reading and writing are evidently the two verbal subtests most sensitive to level of education. To the best of our knowledge, no previous factor analysis of the BDAE with normal populations has been done. Factor analyses with the BDAE in aphasic individuals, however, are available. Goodglass and Kaplan (1983) described a factor analysis with 242 aphasic patients. They concluded that Auditory Comprehension, Repetition–Recitation, Reading, and Writing were factors of equal importance, followed by Fluency and Paraphasia factors. Interestingly, factor structure in aphasic and normal individuals appeared quite similar.

In conclusion the results from this study support the significant influence of demographic variables, particularly education, on the BDAE. Even simple language abilities such as repetition may be significantly affected by education. The external validity of a neuropsychological test increases when variables such as education are considered in the normalization process.

Although an analysis of the effect of demographic variables on the BDAE–Spanish version was previously reported by Rosselli et al. (1990), the present study adds the following aspects:

1. The current study uses the latest BDAE–Spanish version. Rosselli et al.'s study used the first BDAE edition.

2. The number of demographic variables analyzed here is higher. Rosselli et al. (1990a) analyzed only the effects of age, education, and gender. The current study analyzes not only the effects of age, education, and gender, but also SES and occupation effects.

3. It advances the statistical analysis of the BDAE: Multiple regression analysis and stepwise regression analyses were developed in order to define the prediction capability of several independent categorical variables on the variance of each dependent numeric continuous variable. A factor analysis was performed using an orthogonal varimax rotation to disclose the factors underlying the BDAE subtests.

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APPENDIX

Mean scores and standard deviations (in parentheses) in the different BDAE subtests. Age 19–35 years.

	Education (years)					
	1–9		10–15		>16	
BDAE subtest	*M*	(*SD*)	*M*	(*SD*)	*M*	(*SD*)
Comprehension						
Word Discrimination	70.1	(2.0)	70.7	(2.5)	71.1	(1.9)
Body-Part Identification	18.1	(1.5)	18.6	(1.5)	19.3	(1.2)
Commands	14.0	(1.1)	14.5	(1.0)	14.3	(1)
Complex Material	8.3	(2.3)	8.9	(1.4)	9.2	(1.5)
Automatic Speech						
Automated Sentences	13.8	(0.7)	13.8	(0.4)	13.8	(0.4)
Singing & Rhythm	1.8	(0.7)	1.9	(0.3)	1.9	(0.4)
Repetition						
Words	10.0	(0)	9.9	(0.2)	10.0	(0)
High Probability	7.6	(0.7)	7.9	(0.4)	8.0	(0)
Low Probability	7.7	(0.7)	9.9	(0.3)	8.0	(0)
Oral Reading						
Words	28.2	(5.0)	30.0	(0)	30.0	(0)
Oral Sentences	8.8	(3.0)	10.0	(0)	9.9	(0.2)
Naming						
Responsive Naming	27.8	(6.0)	29.9	(0.4)	29.1	(4.2)
Confrontation Naming	93.8	(3.2)	95.7	(0.9)	95.8	(0.7)
Body-Part Naming	26.6	(2.4)	27.1	(2.5)	28.1	(1.9)
Animal Naming	21.3	(6.0)	26.4	(5.8)	29.6	(4.8)
Reading Comprehension						
Symbol Discrimination	8.8	(2.9)	9.9	(0.2)	10.0	(0)
Word Recognition	7.9	(0.3)	7.8	(1.2)	7.9	(0.3)
Oral Spelling	5.6	(2.1)	6.6	(1.6)	7.3	(1.1)
Word–Picture Matching	9.9	(0.3)	10.0	(0)	10.0	(0)
Sentences–Paragraphs	8.3	(1.3)	9.4	(0.9)	9.7	(0.5)
Writing						
Mechanics	5.0	(0)	5.0	(0)	4.9	(0.3)
Serial Writing	44.7	(7.2)	47.2	(1.5)	47.6	(0.9)
Primer-Level Dictation	13.3	(1.1)	13.7	(1.7)	14.0	(0)
Written Confrontation Naming	8.9	(2.6)	9.9	(0.2)	10.0	(0)
Spelling to Dictation	9.2	(2.3)	9.9	(0.2)	9.9	(0.2)
Sentences to Dictation	10.7	(3.6)	12.0	(0)	12.0	(0)
Narrative Writing	4.8	(0.7)	4.9	(0.3)	4.9	(0.3)

Mean scores and standard deviations (in parentheses) in the different BDAE subtests. Age 36–50 years.

	Education (years)					
	1–9		10–15		>16	
BDAE subtest	*M*	(*SD*)	*M*	(*SD*)	*M*	(*SD*)
Comprehension						
Word Discrimination	68.9	(3.8)	71.1	(1.3)	71.4	(1.3)
Body-Part Identification	18.4	(1.3)	19.0	(0.9)	19.3	(1.7)
Commands	14.0	(1.4)	14.6	(1.0)	14.6	(0.7)
Complex Material	7.9	(2.0)	9.4	(1.4)	9.5	(1.7)
Automatic Speech						
Automated Sentences	13.0	(1.5)	13.8	(0.6)	13.8	(0.8)
Singing & Rhythm	1.8	(0.6)	1.9	(0.5)	1.8	(0.6)
Repetition						
Words	10.0	(0)	10.0	(0)	30.0	(0)
High Probability	7.5	(0.9)	7.9	(0.3)	7.9	(0.3)
Low Probability	7.6	(0.5)	7.9	(0.4)	7.9	(0.4)
Oral Reading						
Words	29.9	(0.4)	30.0	(0)	30.0	(0)
Oral Sentences	10.0	(0)	10.0	(0)	9.9	(0.2)
Naming						
Responsive Naming	30.0	(0)	29.2	(3.8)	29.9	(0.6)
Confrontation Naming	91.1	(5.5)	94.7	(3.0)	95.5	(2.3)
Body-Part Naming	26.4	(2.7)	28.0	(2.2)	28.5	(2.2)
Animal Naming	21.0	(4.2)	24.0	(6.9)	28.5	(2.2)
Reading Comprehension						
Symbol Discrimination	9.4	(1.1)	9.7	(1.0)	9.9	(0.4)
Word Recognition	8.0	(0)	8.0	(0)	7.9	(0.2)
Oral Spelling	5.3	(2.1)	6.5	(1.5)	7.2	(1.0)
Word–Picture Matching	10.0	(0)	10.0	(0)	10.0	(0)
Sentences–Paragraphs	9.1	(1.3)	9.6	(0.8)	9.6	(0.5)
Writing						
Mechanics	5.0	(0)	4.9	(0.2)	4.9	(0.2)
Serial Writing	42.3	(6.8)	47.8	(1.5)	47.4	(1.2)
Primer-Level Dictation	13.5	(0.9)	13.9	(0.3)	13.6	(1.9)
Written Confrontation Naming	9.8	(0.5)	9.9	(0.2)	9.9	(0.4)
Spelling to Dictation	9.4	(1.0)	9.9	(0.3)	9.9	(0.2)
Sentences to Dictation	12.0	(0)	12.0	(0)	11.8	(0.7)
Narrative Writing	5.0	(0)	5.0	(0)	4.8	(0.7)