Intern. J. Neuroscience, 112:759–776, 2002

0020-7454/02 $12.00 + .00
DOI: 10.1080/00207450290025752

A CROSS-LINGUISTIC COMPARISON OF VERBAL FLUENCY TESTS

MÓNICA ROSSELLI

Florida Atlantic University
Davie, Florida, USA

ALFREDO ARDILA

Memorial Regional Hospital
Hollywood, Florida, USA

JUDY SALVATIERRA
MARTHA MARQUEZ
LUIS MATOS
VIVIANA A. WEEKES

Florida Atlantic University
Davie, Florida, USA

*The aim of this study was to compare oral fluency strategies of Spanish-English bilinguals in Spanish and English with Spanish and English monolinguals when given either phonemic (alphabetical) or semantic categorical cues. The use of grammatical words (words that play a grammatical function relating words within a sentence) or content words (words that have a meaning such as nouns, verbs, and adjectives) in the alphabetical categories is analyzed. This study also addresses the relation between productivity and the use of a semantic strategy to organize responses. Eighty-two right-handed participants (28 males and 54 females) with a mean age of 61.76 (*SD *= 9.30; range 50–84) and a mean educational level of 14.8 years (*SD *= 3.6; range 2–23) were selected.*

Received 10 January 2002.

The authors express sincere gratitude to Dr. Erika Hoff and Dr. Diego Rosselli for their valuable suggestions and editorial support.

Address correspondence to Monica Rosselli, PhD, Florida Atlantic University, College of Liberal Arts, Division of Psychology, 2912 College Avenue, Davie, Florida 33314, USA.

Forty-five of the subjects were English monolinguals, 18 were Spanish monolinguals, and 19 were Spanish-English bilinguals. Oral verbal fluency was tested asking subjects to generate words within phonemic (F, A, and S) and semantic (animals) categories. In the phonemic condition, performance of English and Spanish monolinguals was similar. Bilinguals produced significantly fewer words than English monolinguals in the categorical semantic condition but not in the phonological condition. In the phonological condition, English monolinguals generated significantly more grammatical words than Spanish monolinguals, and bilinguals produced a significantly higher number of grammatical words in English than in Spanish. Animal subcategories and semantic associations were similar in both languages for all groups. Results were discussed in terms of crosslinguistic differences in the recall of alphabetical words.

Keywords aging, bilingualism, fluency, language, naming, neuropsychology

Letter fluency tasks have been used to assess cognitive abilities since 1943, when Thurstone introduced them as part of a battery of mental ability tests (Thurstone & Thurstone, 1943). Since then, verbal fluency tests (also known as controlled oral word association test, COWAT) have become important clinical tools in neuropsychological assessment (Lezak, 1995; Spreen & Strauss, 1998). However, little is known about the normative performance of bilingual participants on these language tests. This study aimed to compare the performance and the productivity strategies of monolinguals and bilinguals in two types of Spanish-English oral verbal fluency tests.

Two different conditions of oral verbal fluency tests have been distinguished in neuropsychological assessment: (1) phonemic fluency (words beginning with a particular letter, usually F, A, and S), and (2) category or semantic fluency (words corresponding to a specific semantic category, such as animals, fruits, vegetables, etc.). Typically, the test score corresponds to the correct number of words produced in 1 min. A normal adult can produce, within 1 min, about 12 words beginning with a specific letter, and about 16 words corresponding to a semantic category (Spreen & Strauss, 1998). The level of performance, however, depends upon the letter or the semantic category used.

Verbal fluency tasks are widely used in clinical neuropsychology as measures sensitive to brain dysfunction (Bruyer & Tuyumbu,

1980; Parks et al., 1988; Perret, 1974; Ramier & Hécaen, 1970; Ruff, Allen, Farrow, Niemann, & Wylie, 1994). Difficulties in performing this test are found in cases of frontal damage, usually left and bifrontal lesions. Studies using regional cerebral blood flow measures have reported that frontal and temporal activation are observed while performing verbal fluency tests. Positron emission tomography (PET) studies have demonstrated that the frontal lobe is activated in phonemic generation whereas the temporal lobe is more active in semantic generation of words (Warburton et al., 1996).

Verbal fluency tests are sensitive to demographic variables. Large age and educational effects have been demonstrated in the semantic (Acevedo et al., 2000) and phonological conditions of the test, although the effects are stronger for the later condition (Ostrosky, Ardila, & Rosselli, 1999; Rosselli, Ardila, & Rosas, 1990). Ardila, Ostrosky-Solis, Rosselli, and Gomez (2000) found that educational level accounted for 38.5% of the variance in performance in the phonemic condition and for 23.6% of the variance in performance in the semantic condition. A moderate correlation between scores in both verbal fluency conditions has been reported (Ardila, Galeano, & Rosselli, 1998; Ardila, Rosselli, & Bateman, 1994).

Crosslinguistic comparisons using verbal fluency scores are scarce, but preliminary results suggest similar performance across different languages. A number of studies provide evidence that, regardless of primary language, more exemplars are generated for the category animal than for fruit or vegetable (Ardila, Rosselli, & Puente, 1994; Bayles et al., 1989; Bolla, Gray, Resnik, Galante, & Kawas, 1998). Acevedo et al. (2000) found that the category in which language has the more pronounced effect was *vegetable*, with English participants scoring higher than Spanish participants. Inherent differences between English and Spanish might be responsible for these differences. For example, the semantic field of the English word "vegetables" is only partially coincidental with the semantic field of the Spanish word *vegetales*. In Spanish *vegetales* is a noun that includes all plants (Real Academia Española, 1992), whereas in English the noun refers to herbaceous plant used for food (Agnes, 2000). In addition, performance in fluency tests may depend upon the frequency of words beginning with that letter and the ortho-

graphic idiosyncrasies of the writing system. Snodgrass and Tsivkin (1995) found that category fluency was related to category size but letter fluency was not clearly related to the population size of first letter words, as measured by dictionary entries (Batting & Montague, 1969). Moreover, speakers of different languages might use different cognitive strategies (i.e., semantic clustering, phonological recall) when recalling words in a verbal fluency task.

Strategies used in performing fluency tasks have been analyzed. Troyer, Moscovitch, and Winocur (1997) investigated the ability to produce words within a phonemic or semantic category ("clustering") and shifting between categories ("switching"). Shifting correlated higher than clustering with the number of words generated in the phonemic condition. Younger people switched more frequently than older people, whereas older people produce larger clusters of words.

Few studies have addressed the effect of the speaker's language on verbal fluency test performance. Roberts and Le Dorze (1997) analyzed the similarities and differences in the performance of semantic verbal fluency in a group of 40 French-English bilinguals. Performance was similar in both languages for *foods* and *animals*. More between-language similarities than differences were found. The total correct and number of semantic associations did not differ across languages. For *animals*, however, the length of the semantic associations and the percentage of words in semantic associations were greater in French. More subcategory labels were used in French than in English; *animals* indicating a stronger semantic organization of responses in French. The authors suggest that some semantic fields may differ in people who learned both languages in childhood.

Verbal fluency tasks have been used to explore the lexicon organization of bilinguals (Snodgrass & Tsivkin, 1995). Snodgrass and Tsivkin investigated the mechanisms by which Russian native speakers store and retrieve Russian and English words. The authors hypothesized that fluency in Russian would be higher for categorical cues but fluency in English would be higher for alphabetical cues because native language words would have been stored by meaning whereas second language words would have been stored according

to dictionary usage. In other words, a categorical cue will be more effective for the native language whereas a letter cue will be more effective for a second language. Their results are not totally consistent with the hypothesis. Their bilingual sample produced more Russian than English words to categorical cues, whereas equal numbers of Russian and English words were produced to alphabetical cue.

The instructions for the phonological condition of the test include asking the subject to produce *as many words as possible* beginning with a specific letter. A question not yet raised is what types of sentence words (nouns, verbs, etc.) are used in different languages when words are recalled. When testing English and Spanish speakers we noted that English speakers frequently generated grammatical words such as prepositions and conjunctions. These words in fluency tests are extremely unusual in Spanish speakers.

We tested two hypotheses in three different types of subjects: (a) English monolinguals, (b) Spanish monolinguals, and (c) Spanish-English bilinguals. The first hypothesis was that a significantly higher number of grammatical words within a phonemic category are recalled by English monolinguals than by Spanish monolinguals, and by Spanish-English bilinguals when tested in English as compared to Spanish tests. The second hypothesis was that more semantic clusters are observed in bilingual subjects when compared to monolingual subjects in semantic fluency tasks. In addition, more semantic clusters are expected in the bilinguals' first language when compared to their performance in the second language.

This article reports a secondary analysis of previously presented data (Rosselli et al., 2000), which were collected to study the impact of bilingualism on verbal fluency (semantic and phonologic) and repetition tests in a bilingual and monolingual elderly sample. The results of Rosselli et al. showed equal performance of bilingual and monolingual participants on all tests except that of semantic verbal fluency. Bilinguals were less productive than monolinguals in the generation of *animals* using the second language (English). This secondary analysis is specifically designed to pinpoint the strategies used in Spanish and English in phonemic and semantic verbal fluency tests. Differences in strategies may suggest differences in lexical organization across languages.

METHOD

Participants

There were eighty-two right-handed participants (28 males and 54 females) with a mean age of 61.76 (*SD* = 9.30) and a mean educational level of 14.8 years (*SD* = 3.6). Participants were South Florida residents from Miami-Dade and Broward counties. Participants volunteered to participate and claimed to be Spanish or English monolingual or Spanish-English bilingual. No significant differences in age ($F = 0.7$, $p < .491$) or education ($F = 1.05$, $p < .353$) were seen among groups.

All participants were carefully screened for any history of neurological or psychiatric problems using a structured interview. Participants lived independently and were able to successfully complete their daily life activities. Mini-Mental Status Examination (MMSE) (Folstein, Folstein, & Mc Hugh, 1975) and Beck's Depression Inventory—II (BDI-II) (Beck, Steer, & Brown, 1996) were used to rule out dementia and depression. All participants scored above 27 on the MMSE and below 5 in the BDI-II. The Boston Naming Test (BNT), English and Spanish versions (Kaplan, Goodglass, & Weintraub, 1983a, 1983b), was used to test naming proficiency. No significant differences were observed in the BNT scores among the groups studied. Groups were similar in their proficiency to name objects as measured by the BNT ($F = 0.76$, $p = .45$).

A questionnaire was used to assess participants bilingualism. Forty-five subjects claimed English as their only language, 18 participants claimed Spanish as their only language, and 19 participants considered themselves proficient in both English and Spanish.

Monolingual Sample

All English monolingual participants were born in the United States and spoke only English. All Spanish monolingual participants were Latin American immigrants living in the city of Hialeah (Miami-Dade County, Florida), in which approximately 95% of the population is Hispanic and Spanish is the language spoken in daily activities. Spanish monolingual participants had neither formal education

in English nor previous employment in which English was required. All Spanish monolinguals migrated to the United States after age 50 and had been living in the United States for an average of 5 years. Spanish monolinguals were unable to name, in English, more than five drawings of the BNT and were unable to answer demographic information when the questions were presented in English. In a self-report questionnaire, the Spanish monolingual participants stated that they watched television, listened to the radio, read the newspaper, and spoke to relatives and friends only in Spanish

Bilingual Sample

The bilingual participants were screened according to the information provided on a language background questionnaire. The following criteria were used to assess bilingual proficiency in Spanish and English: (1) The oral administration of a 20-item bilingual questionnaire that included the following types of questions: (a) What age and what manner did the participant acquire each language? (b) How much contact with Spanish and English did the participant acquire? and (c) What is the participant's preference in the use of each language (e.g., at home, at work, with friends, with relatives, to watch TV, to read)? Because schooling language is an important variable, only participants who received more than 5 years of formal education in English and used both languages at work for at least 10 years were selected. (2) Participants' self-rated language proficiency in speaking, understanding, reading, and writing in English and Spanish. Participants were asked to rate themselves on how well they understand, speak, write, and read Spanish or English: (a) not at all, (b) limited, (c) relatively well, (d) quite well, and (e) very well. Only those participants who responded "quite well" or "very well" to all questions were selected. The examiner was a proficient bilingual who was able to corroborate participant understanding and expression in both languages while doing the interview. The self-report proficiency in reading and writing in Spanish and English were not corroborated by the examiner. (3) Naming proficiency in Spanish and English was tested using the BNT. A normal score on the Spanish and English versions of the BNT. Norms correcting for age (Spreen & Strauss, 1998) were used. No signifi-

cant differences ($F = 0.01$, $p = .97$) were found between the Spanish BNT score (52.9 ± 6.1) and the English BNT score (52.4 ± 7.1) in the bilingual group.

All bilingual participants claimed Spanish as their first language; 9 (47%) bilingual participants had contact with English before age 12 and 10 (53%) after age 12. The mean age of exposure to the second language was 18.85 years ($SD = 14.24$) and the mean number of years that they had been exposed to English was 35.95 years ($SD = 13.37$). One participant was born in the United States, six in Puerto Rico, seven in Central America or the Caribbean, and five in South America. Fully 84% of the bilingual participants spoke Spanish at home during childhood and 16% spoke English and Spanish at home during childhood. All bilinguals used both languages on a daily basis for at least 10 years but 63% mainly spoke Spanish at home. At the time of evaluation, 26% spoke mainly English at home and 10% spoke English and Spanish at home; 56% mainly spoke English at work and 44% spoke English and Spanish. Fifty-two percent considered Spanish as their best spoken language, 38% English as their best spoken language, and 10% reported that they spoke English and Spanish at an equivalent level. All bilingual participants had been exposed to formal English instruction.

Materials

The following language functions were tested: (1) Verbal fluency within a phonemic category—Three 1-min oral fluency trials were given using the letters "F," "A," and "S" (Spreen & Strauss, 1998; Ardila, Rosselli, & Puente, 1994). (2) Verbal fluency within a semantic category—1-min fluency trials using *animals* as the semantic category were given (Spreen & Strauss, 1998; Ardila, Rosselli, & Puente, 1994).

Procedures

First, participants were interviewed to determine eligibility. This first structured interview included demographic description, neurological history, psychiatric background, and language history. The

MMSE, the BDI, and the BNT were administered to rule out cognitive decline, depression, and naming difficulties. If the subject met the inclusion criteria the researcher proceeded to administer the verbal fluency tests orally. The examiner wrote down the responses. To avoid errors in the scoring of the test due to the potential participants' foreign accent, the examiner was instructed to read to the subject his responses after he or she was done. Interview and test instructions were presented in Spanish to Spanish monolingual participants and in English to English monolingual participants. Bilingual subjects were interviewed and tested in Spanish and English. The subjects were encouraged to use only the language—English or Spanish—required for that particular test. Order of presentation of test language and presentation of tests was counterbalanced across subjects.

Scoring

The following scores were used:

1. **Total number of correct words.** The correct words for the letters F, A, and S, and for the *animals* category were counted. Intrusions (words corresponding to another category), perseverations (repeated words), and code-mixtures (words in English when performing in Spanish, and words in Spanish when performing in English) were not accepted. In Spanish, homophone errors (e.g., when producing words beginning with A to say "hacha," phonologically/atsha/) were accepted, even though there were very few. No homophone errors were found in English.
2. **Grammatical category.** Initially, in the phonological condition, words were divided into nouns, verbs, adjectives, prepositions, adverbs, etc. This classification turned out to be very complicated, because in English many words simultaneously correspond to more than one grammatical category. A general distinction between "content words" (open class) and "grammatical words" (closed class) was finally established. Content words were defined as words that have a meaning, such as nouns, verbs, and adjectives, and grammatical words are words that play a grammatical function relating words within a sentence, such as prepositions, conjunctions, and articles.

3. **Animals subcategory.** *Animals* were initially classified in 17 subcategories (e.g., birds, fish, insects, etc.) taken from Roberts and Le Dorze (1997). Further, the 17 subcategories were reduced to 10 because some were empty.
4. **Semantic associations.** In the semantic fluency condition a semantic association was considered when the participant produced two or more consecutive words belonging to the same subcategory (cluster). For example, if the subject said three water animals together, one semantic association was counted.

Two evaluators did the scoring of each test with a high inter-rater reliability. The Pearson correlation score was $r = .95$.

Statistical Procedures

Independent samples *t* tests were used to compare means for the bilingual and the monolingual groups and paired-sample *t* test procedures were used to compare the means of all variables for the bilingual group. In addition repeated-measure analyses of variance (ANOVAs) were used to analyze the letter effect for the phonological tests in the monolingual and bilingual groups.

RESULTS

Table 1 presents the means and standard deviations for each language test in Spanish and English for Spanish and English monolinguals and for bilinguals. Independent *t* tests demonstrated significant differences between groups only in the semantic fluency test scores. The bilingual group produced significantly fewer English words within the *animals* category than the monolingual English ($t = 2.01$, $p = .048$). However, no difference was found between the bilingual group and the Spanish monolinguals in the *animals* category ($t = 1.74$, $p = .09$). The bilinguals' generation of words within phonemic categories was almost identical in number to both the Spanish and English monolinguals (see Table 1). To further analyze the effect of the letter used in the phonological condition (F, A, and S) in the monolingual and bilingual groups, two repeated-measure

TABLE 1. Average number of words for letters F, A, and S and the category animals

	Monolinguals				*Bilinguals*			
	English (n = 45)	*Spanish (n = 18)*	*t*	*p*	*English (n = 19)*	*Spanish (n = 19)*	*t*	*p*
F	12.9 (5.4)	11.7 (4.1)	0.62	.434	12.5 (5.0)	11.3 (4.3)	1.47	.157
A	10.7 (5.1)	11.8 (4.6)	0.78	.378	10.7 (5.4)	12.3 (4.6)	1.48	.155
S	13.8 (5.4)	11.4 (3 8)	1.73	.088	12.4 (3.9)	11.6 (5.4)	0.72	.480
Animals	16.8 (5 2)	16.7 (3.8)	0.02	.942	14.2 (4.1)	14.5 (3.8)	0.46	.645

Note. Standard deviations are in parentheses

procedures were used. In the first repeated-measure ANOVA, the letter of the alphabet (F, A, or S) was the within-subject factor and group (monolingual and bilingual) was the between-subject factor. This analysis demonstrated a significant letter effect ($F = 4.08$, $p = .02$), with no group effect ($F = 0.46$, $p = .49$) and with a significant interaction ($F = 6.58$, $p = .003$). In English there was a difference in the number of words produced by letter. The highest generation of words was for the letter S and the lowest for the letter A. This letter effect was not observed in the performance of the Spanish monolingual group. In the second repeated-measure procedure the means of the phonological test were analyzed using two within-subject factors, language of test (Spanish and English) and the test letter (F, A, and S). No main effects were observed (language effect: $F = 0.39$, $p = .84$; letter effect: $F = 0.56$, $p = .57$).

The number of "content words" and "grammatical words" in the alphabetical fluency task was calculated in both the monolingual and bilingual participants (Table 2). Spanish monolinguals almost exclusively generated content words, whereas among English monolinguals, grammatical words represented 8% of the total number of words. The difference in the number of grammatical words between the two monolingual groups was statistically significant ($t = 8.75$, $p = .004$). Accordingly, bilinguals produced a significantly greater number of grammatical words in English than in Spanish ($t = 3.08$, $p = .006$).

Table 3 presents the *animals* subcategory means found in English and Spanish. Performance in the subcategories among groups was similar. Spanish monolinguals, however, generated more birds

TABLE 2. Frequency of different category of words in the letter fluency test

	Monolinguals				*Bilinguals*			
	English (n = 45)	*Spanish (n = 18)*	*t*	*p*	*English (n = 19)*	*Spanish (n = 19)*	*t*	*p*
Content words	34.58 (13.72)	34.06 (11.3)	0.02	.877	34.00 (12.99)	34.47 (13.25)	0.185	.856
Grammatical words	2.91 (2.70)	0.94 (1.26)	8.75	.004	1.74 (1.37)	0.74 (0.93)	3.08	.006
Total	37.53 (14.39)	34.46 (12.94)	0.46	.499	35.74 (13.74)	35.21 (13.81)	0.19	.846

Note. Means and standard deviations (in parentheses) are presented.

(t = 11.26, p = .001) and insects (t = 12.50, p = .001) than English monolinguals, whereas English monolinguals produced an increased amount of wild animals relative to Spanish monolinguals. Bilinguals generated more water animals in Spanish than in English (t = 2.54, p = .022). The number of semantic associations was similar in Spanish and English monolinguals, but in bilinguals the number of semantic clusters was significantly higher in Spanish than in English (t = 2.37, p = .030)

DISCUSSION

The results of this study show crosslinguistic similarities in oral verbal fluency scores in Spanish-English bilinguals and English and Spanish monolinguals. These similarities were observed for both the phonological and semantic conditions of the test. The number of semantic associations was also similar in English and Spanish monolinguals. Our results using semantic verbal fluency tasks support the findings reported by Roberts and Le Dorze (1997) who found that for animal fluency, total correct and number of semantic associations did not differ across French and English. In our study, generation of *animals* was virtually identical in monolingual English and Spanish participants, but it was significantly decreased in the performance of bilinguals in the English language. Two explanations might account for this difference. The first one attributes the

TABLE 3. Frequency of different category of animals in the semantic fluency test and number of clusters

	Monolinguals				*Bilinguals*			
	English	*Spanish*	*t*	*p*	*English*	*Spanish*	*t*	*p*
Animal subcategory								
Birds	1.11 (1.47)	2.81 (2.37)	11.26	.001	1.44 (1.2)	1.41 (0.90)	0.30	.768
Farm/ domestic	2.64 (1.92)	3.25 (2.41)	1.02	.316	2.44 (1.54)	2.61 (2.01)	0.94	.361
Fish	0.22 (0.42)	0.13 (0.34)	0.69	.409	0.28 (0.46)	0.35 (0.50)	0.56	.579
Insects	0.27 (0.58)	1.19 (1.47)	12.50	.001	0.62 (1.07)	0.35 (0.61)	1.14	.269
Pets	1.89 (0.61)	1.75 (0.77)	0.52	.470	1.83 (0.79)	2.06 (0.54)	0.80	.431
Prehistoric	0.02 (0.33)	0.02 (0.25)	0.01	.964	0.02 (0.24)	0.00 (0.00)	1.00	.332
Reptiles	1.33 (1.45)	1.50 (1.03)	0.17	.674	1.44 (1.15)	1.76 (1.27)	0.97	.342
Rodents	0.76 (1.03)	0.25 (0.45)	3.61	.062	0.56 (0.70)	0.59 (0.86)	0.00	.990
Water animals	0.91 (1.49)	1.13 (2.09)	0.19	.660	0.22 (0.55)	1.06 (1.21)	2.54	.022
Wild	7.47 (3.81)	4.48 (1.59)	6.91	.011	5.17 (2.40)	4.37 (2.32)	0.85	.589
Semantic associations								
No. of clusters	8.38 (3.99)	6.76 (3.07)	2.26	.138	5.56 (2.53)	7.06 (2.90)	2.37	.030

low performance of bilinguals to differences in language proficiency between bilingual and monolingual participants. However, if this explanation were correct, differences between the monolingual and bilingual groups would also have emerged in the phonological condition. In addition, the groups were tested for language proficiency using the BNT and no significant differences were found among groups. The second plausible explanation of this difference is that bilingual participants experienced interference between the two languages when performing the semantic category fluency task in the second language. Semantic verbal fluency only includes the recall

of concrete nouns while phonemic fluency does not. Concrete nouns may share more elements of their representations across languages than nonconcrete words (de Groot, 1992). The semantic fluency tasks may therefore promote more language interference.

The similarity in monolinguals' Spanish and English performance is not surprising. Both monolingual groups were matched by age and education. The performance of the English monolingual groups is similar to the performance of adults with more that 11 years of education reported by other authors (Spreen & Strauss, 1998; Mitrushina, Boone, & D'Elia, 1999). In our English monolingual group the letter A was significantly more difficult than the letters S and F, and the letter S was the easiest. This pattern of difficulty in letter fluency tests has been previously reported (Spreen & Strauss, 1998; Yeudall, Fromm, Reddon, & Stefanyk, 1986). Although the letters F, A, and S have high dictionary frequency, the letter A has higher dictionary frequency than the other two letters. It seems that the number of words produced within a given letter is not directly related to dictionary volume. The ceiling imposed by the time limit of this task seems to prevent the individual from making full use of dictionary-driven opportunities for generating words (Spreen & Strauss, 1998).

Few studies are available to compare the equivalence of the letters F, A, and S in English and Spanish. Our results show no significant letter effect on the Spanish alphabetical verbal fluency scores in any of the groups studied. Ponton et al. (1996) gave the FAS test to a large Spanish-speaking sample in the United States. The authors report a mean total score of 33 (SD = 9.88) in the subsample with ages between 50 and 75 and with educational level higher than 10 years. Ardila and Rosselli (1989) reported similar results with an elderly monolingual Colombian sample. The authors did not report the mean score by letters.

Our results show crosslinguistic differences in the used of grammatical words during the recall of alphabetical words. In the phonological fluency condition, grammatical words were frequently produced in English but not in Spanish. This difference was observed not only in monolinguals but also in the bilingual participants when performing in English and Spanish. The explanation for this difference is not clear. However, two explanations could be proposed.

(1) The frequency of grammatical words beginning with F, A, and S is higher in English than in Spanish. Nonetheless, the relative frequency of use might be more important than the absolute frequency. In Spanish, many grammatical words begin with F, A, and S. Five out of 18 Spanish prepositions begin with these letters. Interestingly, only one Spanish-speaking subject produced one single preposition in our sample, whereas 25 English prepositions were recorded in the total sample. (2) Grammatical categories are more clearly distinguished in Spanish than in English. Not always, but usually, a word is a noun, or a verb, or an adjective, etc. In English, quite frequently the very same word can simultaneously be a noun and a verb, a noun and an adjective, etc. Our results may suggest that grammatical boundaries are stronger in Spanish than in English.

Our two monolingual samples produced the same average number of *animals*; however, some between-group differences were observed in the animal subcategories. English monolinguals produced more wild animals than Spanish monolinguals and Spanish monolinguals generated more birds and insects. These differences, however, were not corroborated in bilinguals when performing in each language. We suspect that these between-language differences are related not only with the language idiosyncrasies, but also with the subjects' early life experiences. Birds and insects may be seen more frequently in tropical and subtropical Latin American areas than in North America. All Spanish monolinguals in our sample were immigrants to the United States from tropical countries. The increased number of wild animals generated by English speakers, however, most likely is not derived from direct experience only, but mediated through books, television, school learning, etc.

The number of semantic clusters was similar in Spanish and English monolinguals, but higher in Spanish than in English for the bilingual group. This difference may be explained by the fact that Spanish was the native language for all bilinguals, and therefore they have a more solid semantic base in Spanish. Roberts and Le Dorze (1997) found that their English-French bilinguals presented with more subcategory labels in the generation of animals in French than in English. The authors stated that this richer pattern of associations in one language might be the result of early acquisition of vocabulary in French over English.

It can be conjectured that when an individual is required to say names of animals, the most prototypical elements will be produced. The most prototypical elements for the animal category in both languages and for all groups—for English speakers as for Spanish speakers, in English as in Spanish for bilinguals—were found to be wild animals and farm/domestic animals. However, this study does not consider the possibility of other language differences between groups. Research using ratings of prototypicality and familiarity suggests that bilingual and monolinguals have somewhat different category structures (Segalowitz & Poulin-Dubois, 1990; Roberts & Le Dorze 1997).

The present study suggests that there are similarities between the performance of Spanish and English speakers in verbal fluency test scores. However, crosslinguistic differences emerge in the type of words and in the categorization process that are used by English and Spanish speakers. These crosslinguistic differences are clearly observed in monolingual speakers but are less evident in Spanish-English bilinguals, which supports previous findings of different category structure in bilinguals when compared to monolinguals. Future research should evaluate the influence of bilingualism variables, such as age of acquisition of the second language and frequency of use of primary and secondary languages, over verbal fluency tasks. Finally, it should be emphasized that, given the importance of verbal fluency tests in neuropsychology, more crosslinguistic analyses should be developed to understand the factors influencing verbal generation in normal and brain-damaged populations.

REFERENCES

Aecvedo, A., Loewenstein, D. A., Barker, W. W., Harwood, D. G., Luis, C., Bravo, M., Huewitz, D. A., Aguero, H., Greenfield, L., & Duara, R. (2000). Category fluency test: Normative data for English and Spanish speaking elderly. *Journal of the International Neuropsychological Society, 6,* 760–769.

Agnes, M. (2000). *Webster's New World College Dictionary*. Foster, City, CA: IDG Books Worldwide.

Ardila, A., Galeano, L. M., & Rosselli, M. (1998). Toward a model of neuropsychological activity. *Neuropsychology Review, 8,* 171–190.

Ardila, A., Ostrosky-Solis, F., Rosselli, M., & Gomez, C. (2000). Age related cognitive decline during normal aging: The complex effect of education. *Archives of Clinical Neuropsychology, 15,* 495–514.

Ardila A., & Rosselli, M. (1989). Neuropsychological characteristics of normal aging. *Developmental Neuropsychology, 5,* 307–320.
Ardila, A., Rosselli, M., & Bateman, J. R. (1994). Factorial structure of cognitive activity. *Behavioural Neurology, 7,* 49–58.
Ardila, A., Rosselli, M., & Puente, A. (1994). *Neuropsychological assessment of Spanish speaker*. New York: Plenum Press.
Batting, W. F., & Montague, W. E. (1969). Category nouns for verbal items in 56 categories: A replication and extension of the Connecticut category norms. *Journal of Experimental Psychology Monograph, 80,* 1–46.
Bayles, K. A., Salmon, D. P., Tomoeda, C. K., Jacobs, D., Caffrey, J. T., Kazniak, A. W., & Troster, A. I. (1989). Semantic and letter category naming in Alzheimer's patients: A predictable difference. *Developmental Neuropsychology, 5,* 335–347.
Beck, A. T., Steer, R. A., & Brown G. K. (1996). *Beck Depression Inventory—II. Manual*. San Antonio, TX: Psychological Corporation.
Bolla, K. I., Gray, S., Resnik, S. M., Galante, R., & Kawas, C. (1998). Category and letter fluency in highly educated older adults. *Clinical Neuropsychologist, 12,* 330–338.
Bruyer, R., & Tuyumbu, B. (1980). Fluence verbale et lesions du cortex cerebrale: Performances et types d'erreurs. *Encephale, 6,* 287–197.
De Groot, A. M. B. (1995). Determinants of bilingual lexicosemantic organization. *Computer Assisted Language Learning, 8,* 151–180.
Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). Mini Mental State: A practical method for grading the cognitive state of patients for clinician. *Journal of Psychiatric Research, 12,* 189–198.
Kaplan E., Goodglass, H., & Weintraub, S. (1983a). *The Boston Naming Test* (2nd ed.). Philadelphia: Lea & Febiger.
Kaplan E., Goodglass, H., & Weintraub, S. (1983b). *Prueba de Denominacion de Boston* (2nd ed.). Philadelphia: Lea & Febiger.
Lezak, M. D. (1995). *Neuropsychological assessment* (3rd ed.). New York: Oxford University Press.
Mitrushina, M. N., Boone, K. B., & D'Elia, L. F. (1999). *Handbook of normative data for neuropsychological assessment.* New York: Oxford University Press.
Ostrosky, F., Ardila, A. & Rosselli, M. (1999). "Neuropsi": A brief neuropsychological test battery in Spanish with norms by age and educational level. *Journal of the International Neuropsychological Society, 5,* 413–433.
Parks, R. W., Loewenstein D. A., Dodrill, K. L., Barker, W. M., Yoshii, F., Chang, J. Y., Emran, A., Apicella, A., Sheramata, W. A., & Duara, R. (1988). Cerebral metabolic effects of verbal fluency tests: A PET scan study. *Journal of Clinical and Experimental Neuropsychology, 10,* 565–575.
Perret, E. (1974). The left frontal lobe of man and the suppression of habitual responses in verbal categorical behavior. *Neuropsychologia, 12,* 323–330.
Ponton, M., Sates P., Herrera, L., Ortiz, F., Urrutia, C. P., Young, R., D'Elia, L. F., Furst, C., & Namerow, M. (1996). Normative data stratified by age and education for the Neuropsychological Screening Battery for Hispanics (NeSBHIS): Initial report. *Journal of the International Neuropsychological Society, 2,* 96–104.
Ramier, A. M., & Héccaen, H. (1970). Role respectif des attaintes frontales et la lateralisation lesionelle dans le deficits de la "fluence verbale." *Revue Neurologique, 123,* 17–22.
Real Academia Española. (1992). *Diccionario de la lengua española*. Madrid: Editorial Espasa.
Roberts, P. M., & Le Dorze, G. (1997). Semantic organization, strategy use, and productivity in bilingual semantic verbal fluency. *Brain and Language, 59,* 412–449.
Rosselli, M., Ardila, A., Araujo, K., Weekes V. A., Caracciolo, V., Padilla, M., & Ostrosky, F. (2000). Verbal fluency and repetition skills in healthy older Spanish-English bilinguals. *Applied Neuropsychology, 7,* 17–24.
Rosselli, M., Ardila, A., & Rosas, P. (1990). Neuropsychological assessment in illiterates II: Language and praxis abilities. *Brain and Cognition, 12,* 281–296.

Ruff, R. M., Allen, C. C., Farrow, C. E., Niemann, H., & Wylie, T. (1994). Figural fluency: Differential impairment in patients with left versus right frontal lobe lesions. *Archives of Clinical Neuropsychology, 9,* 41–55.

Segalowitz, N., & Poulin-Dubois, D. (1990). The structure of categories, typicality gradients, perceived linguistic familiarity and cross-linguistic comparisons. *Cahiers de Psychologie Cognitive European Bulletin of Cognitive Psychology, 10,* 491–512.

Snodgrass, J. G., & Tsivkin, S. (1995). Organization of the bilingual lexicon: Categorical versus alphabetic cuing in Russian-English bilinguals. *Journal of Psycholinguistic Research, 24,* 145–163.

Spreen, O., & Strauss E. (1998). *A compendium of neuropsychological tests* (2nd ed.). New York: Oxford University Press.

Thurstone, L., & Thurstone, T. (1943). *The Chicago Tests of Primary Mental Abilities.* Chicago: Science Research Associates.

Troyer, A. K., Moscovitch, M., & Winocur, G. (1997). Clustering and switching as two components of verbal fluency: Evidence from younger and older healthy adults. *Neuropsychology, 11,* 138–146.

Yeudall, L. T., Fromm, D., Reddon, J. R., & Stefanyk, W. O. (1986). Normative data stratified by age and sex for 12 neuropsychological tests. *Journal of Clinical Psychology, 43,* 918–946.

Warburton, E., Wise, R. J. S., Price, C. J., Weiller, C., Harad, U., Ramsay, S., & Frackowiak, R. S. J. (1996). Noun and verb retrieval in normal subjects studies with PET. *Brain, 119,* 159–179.