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The effects of age, education, and ethnicity on verbal fluency

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Abstract

A group of 317 healthy participants between 54 and 99 years of age performed a verbal fluency task. The participants included Chinese, Hispanic, and Vietnamese immigrants, as well as White and African American English speakers. They were given 1 min to name as many animals as possible in their native language. The results showed that more animal names were produced by younger people and those with more education. Language background was also an important factor: The Vietnamese produced the most animal names and the Spanish speakers produced the fewest. The exaggerated difference between these two groups is attributed to the fact that Vietnamese animal names are short (predominantly 1 syllable) while the Spanish animal names are longer than any other language in this study (2 and 3 syllables per word). Finally, although the ethnic groups named different animals, and appeared to vary in the variety of animal names they used, these factors did not affect overall verbal fluency performance. (*JINS*, 1998, *4*, 531–538.)

Keywords: Language, Naming, Fluency, Ethnicity, Cross-cultural, Aging

INTRODUCTION

The population of the U.S. is becoming older and more culturally diverse. Between 1990 and the year 2030, the percent of the population over age 55 years will grow from 21 to 33% and that proportion over age 65 years old will grow from 12 to 20%. Minority representation in the older population has grown as well. Nonwhite elderly now constitute about 10% of people over 65 years in age. However, due to recent immigration and increased life expectancy, this segment of the population is expected to grow to about 30% during the next century (U.S. Senate Special Committee on Aging, 1987–1988).

Health care professionals are now faced with a growing number of patients who are old and from a variety of ethnic groups, and they need to have reliable and culturally fair assessment measures (LaRue, 1992). The present study was conducted to examine in detail the performance of healthy elders who differ in education and ethnic backgrounds on a commonly used neuropsychological test, verbal fluency (e.g., Benton & Hamsher, 1976; Lezak, 1995). Tests of verbal fluency typically require a subject to generate as many words as possible within a limited time from a particular semantic or letter category (e.g., "animals" or "words that start with *F*"). This task assesses language functions (vocabulary size, naming), speed of response, mental organization, search strategies, short term memory, and long term memory (e.g., Ruff et al., 1997). Verbal fluency is a popular neuropsychological test because it is easy and quick to administer, does not require writing or reading, and is sensitive to cognitive impairment from a variety of etiologies.

Verbal fluency deficits have been observed in patients with focal cortical brain lesions, particularly frontal lobe damage (Benton, 1968; Miceli et al., 1981; Pasquier et al., 1995; Vilkki & Holst, 1994), Parkinson's disease (Bayles et al., 1993 but cf., Hanley et al., 1990), schizophrenia (e.g., Allen et al., 1993), subcortical dementia (Cummings, 1994), closed head injury (Goldstein et al., 1994), Huntington's disease

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Table 1. Demographic information

		Age			Education		
Group	*N*	*M*	(*SD*)	Range	*M*	(*SD*)	Range
Age (years)							
54–74	195	70.0	(4.2)	54–74	10.3	(5.1)	0–22
75–99	122	80.8	(4.6)	75–99	10.1	(5.0)	0–20
Education (years)							
0–8	112	73.3	(7.5)	57–96	4.6	(2.5)	0–8
9+	205	72.7	(7.7)	54–99	13.3	(3.0)	9–22
Sex							
Male	112	73.4	(7.3)	57–96	11.5	(4.6)	0–20
Female	205	72.7	(7.8)	54–99	9.6	(5.2)	0–22
Ethnicity							
African American	54	72.8	(9.1)	59–99	11.6	(4.7)	0–22
White	58	76.6	(7.6)	61–96	12.3	(3.8)	6–20
Chinese	67	72.5	(7.3)	59–86	10.9	(5.5)	0–18
Hispanic	78	71.9	(7.1)	54–89	8.5	(5.4)	0–20
Vietnamese	60	71.6	(5.8)	62–87	8.6	(4.2)	0–16
Total	317	73.0	(7.6)	54–99	10.3	(5.0)	0–22

(Rosser & Hodges, 1994), and in vascular and Alzheimer type dementias (e.g., Binetti et al., 1995; Crossley et al., 1997; Miller & Hague, 1975). Interestingly, verbal fluency measures appear to discriminate better than many other measures of cognitive function between patients with early Alzheimer's disease and normal controls (Eslinger et al., 1985; Monsch et al., 1992; Taussig & Fernandez Guinea, 1995; Taussig et al., 1992). Verbal fluency may also be useful in distinguishing the cognitive impairment of dementia from that associated with depression (Kronfol et al., 1978), and in predicting which healthy elders, individuals with age-associated memory impairment, and those with Parkinson's, are most likely to develop dementia (Hänninen et al., 1995; Jacobs et al., 1995; Masur et al., 1994).

The particular measure of verbal fluency chosen for the present study was animal name generation. This was selected over other frequently used categories since it was thought that knowledge of animal names might vary less between different ethnic groups, in comparison to other frequently used categories such as grocery store items and words beginning with specific letters. The specific goals are to (1) investigate the effects of age, education, and primary language on animal naming; (2) compare type and variety of responses given across ethnic groups; and (3) provide normative data according to age, education, and primary language.

METHODS

Research Participants

The participants were 317 healthy older volunteers who participated in a normative study of the Cross-Cultural Neuropsychological Battery (Dick et al., 1995), that included assessment of verbal fluency. Each participant belonged to one of five ethnic groups: Chinese, Hispanic, Vietnamese, English speaking White and English speaking African American.[1] Chinese, Hispanic and Vietnamese participants were included because of the great number of immigrants from these cultures settling in the United States, particularly in southern California. Both White and African American English-speakers were included because it is known that individuals from these two ethnic groups perform differently on many language measures, and it is important to identify and understand how they differ on language measures that are commonly used to diagnose dementia and other cognitive disorders (e.g., Ripich et al., 1997). Effort was made to recruit participants to cover a wide range of old age and education for all five ethnic groups. All participants were judged to be healthy based on their responses on a health history questionnaire; volunteers who had a history of stroke, head injury, psychiatric, speech, language or memory problems were not included. The participant characteristics are shown in Table 1. The Chinese, Hispanic, and Vietnamese participants were all immigrants to the U.S., and continued to speak primarily their native language after immigration. Additional information about the non-English speakers' background is given in Table 2.

[1] Although "culture," "ethnic group," and "language" are not the same things, they are closely related, and language is the primary manner in which culture is communicated (Roseberry-McKibbin, 1995; Taylor, 1986). Although possibly an oversimplification, for the purposes of this paper the term "ethnic group" will be used to refer to each of the five cultures and language backgrounds of the participants. Each of the five groups are relatively homogenous: Each group consists of people currently living in southern California, who grew up speaking only one language in their homeland, and continue to speak primarily that language in the U.S.

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Table 2. Residential history and language use of immigrant participants

Ethnicity	Number of years residing in U.S. *M* (*SD*)	Age at immigration *M* (*SD*)	Percent who speak only their native language at home	Percent who watch TV and listen to radio only in their native language
Chinese	11.8 (9.3)	60.9 (9.1)	98%	61%
Hispanic	27.6 (19.6)	44.0 (19.1)	82%	53%
Vietnamese	7.0 (6.4)	64.3 (8.2)	98%	22%

Materials and Procedure

All participants were tested in their native language. They were asked to tell the examiner "all the animals you can think of in 1 min." One point was given for any animal. Both general category (e.g., *insect*, *fish*) as well as specific exemplars (e.g., *fly*, *salmon*) were given credit. Repeated responses were counted only once. The responses were reviewed and counted by the examiner, and double-checked by another native speaker for each language. Records of participants with particularly low fluency scores (i.e., the 2 participants who produced fewer than five animal names) were inspected to make sure that their history and performance on other measures were within the normal range.

RESULTS

The Effects of Age, Education, and Ethnicity

The number of animals named by each subgroup is presented in Table 3. To determine how age, education, and ethnicity affected performance, the data from the five ethnic groups were entered into a three-way multivariate analysis of variance (MANOVA) comparing performance by ethnicity (African American, White, Chinese, Hispanic and Vietnamese), age (young = 54–74 *vs.* old = 75–99), and education (0–8 years *vs.* 9 or more years). While the division of a continuous variable such as age or years of education into discrete categories (young *vs.* old; low *vs.* high education) is inherently arbitrary, the criteria used here were chosen to be consistent with, and comparable to, other research on the effects of age and education on verbal tasks (e.g., Crossley et al., 1997; Lezak, 1995). This analysis revealed main effects of age [$F(1,297) = 4.36$, $p = .038$], education [$F(1,297) = 12.01$, $p < .001$], and ethnicity [$F(4,297) = 5.54$, $p = .0003$], and no significant interactions. The effects of age and education are in the expected directions, with younger and more educated participants producing more animal names. These effects were confirmed by correlational analyses: The number of animals named was positively associated with education ($r = .36$, $p < .0001$), and negatively with age ($r = -.16$, $p = .004$). Age and education in this sample were not correlated ($r = -.03$; $p = .55$).

Since the five ethnic groups differed in age [$F(4,312) = 4.104$, $p = .0018$] and education [$F(4,312) = 8.285$, $p < .0001$], the ethnicity data were reanalyzed using an analysis of covariance (ANCOVA) procedure controlling for age and education. This analysis confirmed a significant effect of ethnicity, independent of age and education [$F(4,310) = 11.27$, $p < .0001$]. Simple contrasts showed that (1) the Hispanic group produced significantly fewer animal names than the Chinese, White, and Vietnamese groups ($p < .01$); and (2) the Vietnamese produced more animal names than the Chinese, White, and Hispanic groups ($p < .01$). While these simple contrasts highlight significant differences between pairs of ethnic groups, it is clear that performance of the groups is continuous, with the Vietnamese scoring highest and Hispanics scoring lowest (Table 3).

Because the only significant ethnic differences derive from the contrast between relatively high numbers of animals named by the Vietnamese and the relatively low number of animals named by the Spanish-speakers, our discussion of the ethnic differences focuses on these two extreme cases. One likely explanation of the ethnic differences may be the languages themselves. Several prior studies have suggested that linguistic factors, rather than cognitive ability, may in-

Table 3. Number of animal names produced in 60 s, according to age, education, sex, and ethnicity

Group	*M*	*SD*
Age (years)		
54–74	16.0	5.0
75–99	14.4	4.3
Education (years)		
0–8	13.5	4.2
9+	16.4	4.7
Sex		
Men	16.4	4.4
Women	14.7	4.8
Ethnicity		
African American	15.2	4.4
White	16.7	4.2
Chinese	15.3	5.1
Hispanic	12.8	3.9
Vietnamese	17.3	5.2
Total	15.5	4.6

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fluence neuropsychological test performance. For instance, poor performance of healthy Spanish speakers on a test of verbal letter fluency was explained by the fact that words beginning with these letters (*F*, *A*, and *S*) are less common in Spanish than in English (Loewenstein et al., 1994; Loewenstein & Rubert, 1992; Lopez & Taussig, 1991). In another study, Chinese speakers outperformed Spanish speakers on a standard digit span task (Dick et al., 1995; Teng, 1996) and the group difference was attributed to the fact that all Chinese digits are monosyllabic, whereas in Spanish, seven of the nine digits are multisyllabic.

A comparable linguistic hypothesis might explain the extremes of the Spanish and Vietnamese animal naming reported here. Since word length is a parameter that is likely to affect a word production task, we calculated the proportion of responses that contained one, two, or more than two syllables for each ethnic group (Figure 1). The results indicate that while almost 80% of the Vietnamese responses were monosyllabic (and the remainder disyllabic), the Spanish speakers produced no monosyllabic words at all, and produced a greater proportion of multisyllabic words than any other language group. The average number of syllables per response was longest for the Spanish group (2.6 syllables per word) and shortest for the Vietnamese (1.2 syllables per response). It appears then, that the extremes of the Vietnamese high ranking and the Hispanic low ranking on the verbal fluency task itself are mirrored by their extreme low and high rankings in word length.

How might word length affect animal fluency? A simple explanation based on increased articulatory time for longer words would imply that Spanish speakers just did not have enough time to produce more animal names. If that were the case, we would expect Hispanic participants to generate animal names throughout the entire 60 s, while other groups might have finished earlier during that interval. However, the proportion of animal names generated in the first 30 s

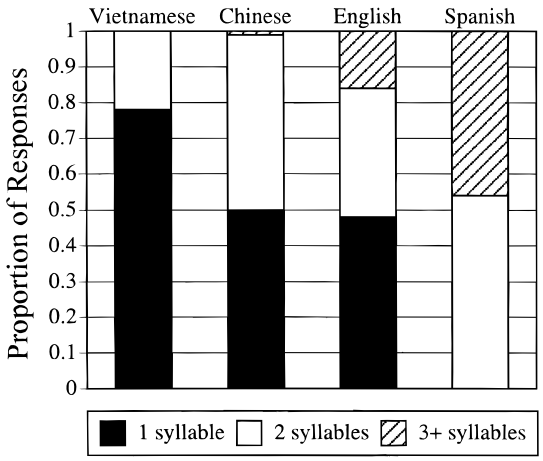

Fig. 1. Response length in four languages: proportion of animal name responses containing one, two, and three or more syllables for four language groups.

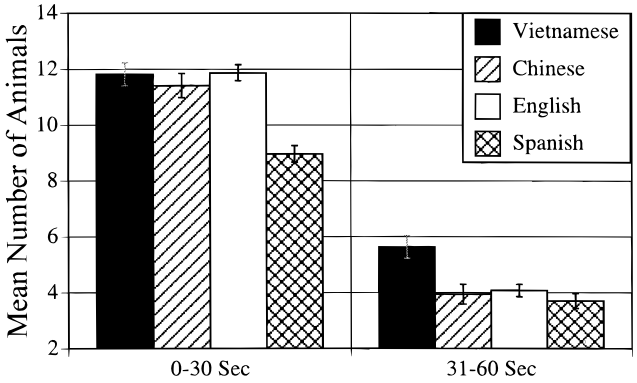

Fig. 2. Animal naming in 0–30 *versus* 31–60 s: mean number (and standard error) of animal names generated in 0–30 s *versus* 31–60 s by speakers of four languages.

versus the last 30 s (Figure 2), shows that all groups, including the Hispanic, produced the majority of responses in the first 30 s. Since all groups produced most of their responses in the first 30 s, performance appears not to be limited by the length of time it takes to articulate the words, or even particularly determined by the 60-s cut-off. In addition to the obvious word production (articulation) requirements, performance on animal fluency also requires lexical access and memory (e.g., Ruff et al., 1997), and it is well known that word length affects these processes: Longer words take more time to retrieve from semantic memory (e.g., le Dorze, 1992), and are less successfully stored and manipulated in working memory (Baddeley, 1990; Caplan et al., 1992; Cowen, 1994). Based on the data presented here, we therefore propose that a great amount of the variance attributed to ethnicity in our analysis is actually due to linguistic differences—word length—of the languages sampled.

Recognizing that age and education may not affect all ethnic groups equally (e.g., the educational systems of one country may differ from that of another), the relation between age, education, and verbal fluency within each ethnic group was investigated by a forward stepwise linear regression. Table 4 shows the results of this analysis by displaying the percent of variance of verbal fluency explained by age and education for each group. Figure 3 shows the mean performance of age and education subgroups for each ethnicity

Table 4. Percent variance in animal name generation accounted for by education and age for five ethnic groups

Ethnic group	Education	Age
African American	–	–
White	10%	16%
Chinese	16%	10%
Hispanic	10%	–
Vietnamese	14%	–
Entire sample	12%	2%

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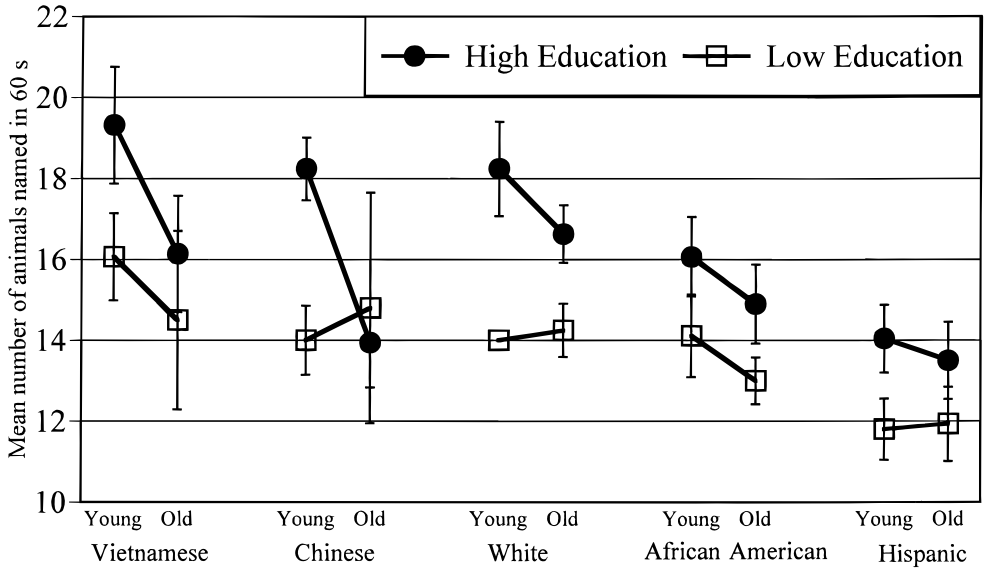

Fig. 3. Animal naming in five ethnic groups: mean number (and standard error) of animal names generated in 60 s by speakers from five ethnic groups, stratified by educational level (*low* = 0–8 years; *high* = 9 + years) and age (*young* = 54–74 years; *old* = 75–99 years).

and illustrates the basic similarity in the ways that age and education affect performance of the five ethnic groups.

Variety and Type of Responses

Qualitative analysis of the responses affords a unique opportunity to investigate ethnic differences in vocabulary, vocabulary size, and the relation between vocabulary size and verbal fluency. The specific animal names generated by each group demonstrate how regional differences affect vocabulary content. Although the most frequently mentioned animals have much in common across all language groups (we found *dog*, *cat*, *horse*, and *elephant* to be among the 10 most frequently mentioned animals in all languages), the frequency of other animals varied dramatically between groups: *ox* and *buffalo* were common for Vietnamese; *burro* was frequently mentioned by Spanish speakers; *rat* was a common response by the Chinese, but not the others; giraffe was frequently named by English speakers but not the others.

The variety of animal names generated by each group can be assumed to reflect vocabulary size: Groups with larger animal vocabularies will use a greater variety of animal names. To determine differences in vocabulary size between ethnic groups, we counted the number of different animal names used by each ethnic group. Because this figure does not take into account the overall number of responses, we also calculated the ratio of the total number of unique animals named in a language to the total number of responses. A relatively small set of animal names that everyone in the language group uses results in a low fraction; a large pool of animal names results in a larger fraction. The total number of unique animal names and the ratios show the Chinese used the most restricted set of animal names and the Whites used the widest variety (Table 5). Insofar as this is an accurate gauge of vocabulary size, it appears that vocabulary size (of a group) is not related to performance on the verbal fluency task. That is, the groups that used the least variety (Chinese and Vietnamese) were not the groups that produced the fewest animal names; and the group that used the greatest variety (White) was not the group who produced the most animal names. The groups that produced the greatest and least variety (White and Chinese, respectively) produced equal numbers of animals in the verbal fluency task.

Sex Differences

It is generally accepted that women outperform men on measures of verbal fluency and that women's performance holds up better in aging (e.g., Lezak, 1995). However, there are some exceptions to this trend. For instance, Crossley et al. (1997) found that older women outperformed men on letter fluency (naming words that begin with specific letters), but

Table 5. Variety of animal names produced in 60 s by older speakers from five ethnic groups

Ethnicity	Number of unique animal names	Unique: Total ratio
African American	105	.15
White	132	.18
Chinese	71	.09
Hispanic	129	.14
Vietnamese	93	.10

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not on a measure of semantic category fluency (naming animals). Although an investigation of sex differences was not a primary goal of this study, and the number of participants and variables (age, education, ethnicity, and sex) preclude a reliable analysis with ANOVA due to empty cells, a preliminary analysis testing the effect of sex alone in our data was significant [$F(1,316) = 9.75$, $p = .002$]. Interestingly, the effect was in the opposite direction from what would typically be expected: Men produced an average of two more animals than women did (male $M = 16.4$; female $M = 14.7$). Although this result is dissimilar to other reports, it should be interpreted with caution, considering the contribution of other potent factors (primarily ethnicity and education) in this sample.

DISCUSSION

These data confirm that both age and education are important variables affecting animal name generation: younger individuals and those with more education produced more animal names than older participants and those with less education. These findings are consistent with other reports (on single language groups) that have found education and age both affect performance on verbal fluency tasks (e.g., Benton et al., 1983; Corey-Bloom et al., 1996; Crossley et al., 1997; Spreen & Strauss, 1991; Tomer & Levin, 1993; Wertz, 1979). The finding of decreased performance with age is likely due to a combination of (1) age-related slowing demonstrated on many timed tasks (e.g., Nebes & Madden, 1988), and (2) impaired naming in older healthy individuals, even in untimed tests (e.g., Au et al., 1995; Nicholas et al., 1985). The significant correlation of higher verbal fluency scores with more education is consistent with the benefits of education seen on language tasks in general (e.g., Neils et al., 1995).

These findings also go beyond previous reports in several ways. First, while previous studies have shown an age effect on fluency tasks, this study demonstrated an age effect within the elderly population, documenting a difference between the "young old" and the "old old" (see also Crossley et al., 1997).

Second, the strength of the correlations and the variance accounted for in the regression analysis indicated that age and education were not equally important: Education appeared to be a more potent variable than age in predicting the performance of this older sample.

Third, these results documented the interaction of age, education, and ethnicity. The generalization gleaned from the whole group analysis (that education was more important than age in predicting performance) did not hold for all ethnic groups. The regression analyses using age and education to predict fluency performance for each ethnic group showed that education was the better predictor of performance for all but the English speakers. This is likely due to the fact that the effects of education are most pronounced at lower education levels; the two English speaking groups showed the least effect of education and also had the highest education levels. Just as the effects of education are most pronounced in populations with relatively little education, the effects of age are most pronounced in the older groups—the largest effect of age was seen in the oldest group (White).

Fourth, there was a somewhat unanticipated finding that the ethnic groups differed in the number of animal names they generated, even after controlling for the effects of age and education. Theoretically, both cultural and linguistic factors could account for the differences between language groups. For instance, unfamiliarity or unwillingness to perform this type of task might affect performance. More likely, facts about the languages themselves are important. The striking difference between the Hispanic group who produced fewest and the Vietnamese who produced most animal names, was explained by linguistic differences. Because the Hispanic and Vietnamese groups were well matched in age (71.9 *vs.* 71.6 years, respectively) and education (8.5 *vs.* 8.6 years, respectively), we can be relatively sure that these factors were not responsible for their extremely different performance levels. A close look at linguistic differences between the two languages suggests that word length of animal names produced, which was longest in Spanish and shortest in Vietnamese, played a crucial role in verbal fluency performance.

Fifth, analysis of the specific animal names produced in the verbal fluency task suggested that the variety of animal names available to a language group does not affect fluency performance. For example, although Chinese participants drew from the most restricted set of animal names, they produced the same mean number of animal names as the English speakers, who used the greatest variety of animal names. The explanation for the differences in variety of animal names may simply be exposure. Whites, who used the widest variety of animal names, were probably exposed to a larger number of animals through books, television, movies, and zoos. These experiences may not be as common in other, and particularly rural, parts of the world, where many of our non-English-speaking participants originated. Importantly, this finding suggests that animal fluency is reliable even with people who have limited personal experience and a relatively restricted animal vocabulary.

Finally, although we have shown that age, education, and language affect performance on a verbal fluency task, it is also important to note that there is considerable performance overlap among the subgroups. Eighty-three percent of all subjects gave more than 10 animal names in the allotted time period. From the studies that are comparable to ours, reporting 60 s of animal name generation (e.g., Crossley et al., 1997; Goodglass & Kaplan, 1983; Newcombe, 1969; Tomer & Levin, 1993), it appears that the mean for healthy English speakers is between 14 and 20 words, depending on their age and educational level. Suggested cutoff points for normal performance are 13 for individuals under 70 and 10 for persons over 70 (Strub & Black, 1993). Our data largely confirm these guidelines, but add more specific normative information for a group of older people, strat-

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Table 6. Number of animal names produced in 60 s by older participants from four language groups, at two levels of education

	Low education (0–8 years)			High education (9+ years)		
Language	*M*	(*SD*)	(*N*)	*M*	(*SD*)	(*N*)
English	14.0	(2.4)	25	16.5	(4.6)	87
Chinese	13.0	(5.0)	22	16.6	(4.8)	45
Spanish	11.9	(3.8)	40	13.9	(3.9)	37
Vietnamese	15.4	(5.4)	25	18.7	(4.6)	35

ified by the two most potent factors revealed here: language and education (Table 6).

Since neuropsychologists and speech–language pathologists now routinely assess language and cognitive abilities of older individuals from a range of ethnic groups, the data presented here should help insofar as they provide normative information on a useful test. Our data shed some light on the causes of variability within the normal population, and more clearly delineate the range of normal performance.

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