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**BRIEF COMMUNICATION**

# Verbal (animal) fluency scores in age/grade appropriate minority children from low socioeconomic backgrounds

GEORGE P. PRIGATANO, JENNIFER A. GRAY, AND VICKY T. LOMAY

Division of Neurology, Barrow Neurological Institute, St. Joseph's Hospital and Medical Center, Phoenix, Arizona

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**Abstract**

Two hundred-thirteen children in grades 1 through 8 were asked to rapidly generate as many names of animals as they could in 60 seconds. These children were age appropriate for their grade level in school, did not receive any form of special education services, and as a group showed (estimated) average intellectual ability. They were primarily from minority (particularly Hispanic) backgrounds and came from families with low socioeconomic status. Normative data are presented. Hierarchical multiple regression analysis revealed that the age range/grade level score accounted for 21.5% of the variability in fluency scores and the Vocabulary level of the child accounted for an additional 5.7%. Level of performance on this animal fluency task was not lower than what has been reported in primarily white children from middle socioeconomic backgrounds. (*JINS*, 2008, *14*, 143–147.)

**Keywords:** Semantic fluency, School-age children, Minority, Low socio-economic status, Norms, Developmental changes

## INTRODUCTION

Verbal fluency refers to the capacity of a person to self-generate, in rapid fashion, names of different words beginning with a given letter of the alphabet (i.e., phonemic fluency) or within some semantic category (e.g., animals, fruits, vegetables). Category fluency scores may detect cognitive decline in the elderly (Manly et al., 1999) and have been shown to be negatively affected following traumatic brain injury in children (Levin et al., 2001). Adverse effects were especially noted in older children with left frontal lesions. Normal functioning school age children and young adults have been reported to show activation in the left inferior frontal gyrus and the left medial frontal gyrus, as well as the mesial frontal areas, including the supplementary motor regions, and the thalamus and the left parietal area when silently generating names of animals, food, clothing, furniture, toys, and TV shows (Gaillard et al., 2003). Clearly a complex neurocircuitry underlies this simple task which is developmentally sensitive (Anderson et al., 2001).

Baron (2004) notes that verbal fluency tasks involve several cognitive processes. In addition to linguistic and ideational skills, working memory may be involved because the person is asked not to repeat previous words stated. Inhibitory control is important, because some words come to mind that must be excluded if they constitute an incorrect response. Collectively, this simple-appearing task may be a marker of "executive function" (Delis et al., 2001).

Studies that report on the capacity of school-age children to rapidly generate animal names within 60 seconds repeatedly show higher scores as children age from 6 to 12 years (Halperin et al., 1989). Effect sizes for age (which covaries with grade level) typically account for about 25% of the variance with correlations being in the range of +.50 for school-age children, ages 6 through 14 (Matute et al., 2004). Differences in rapid generation of animal names between boys and girls, during the school-age years, are often not found (Ardila & Rosselli, 1994; Halperin et al., 1989; Riva et al., 2000) and if they are reported, gender differences are minimal (Regard et al., 1982).

Of particular concern has been the question of whether or not cultural or ethnic differences exist on verbal fluency tasks and whether norms for different languages or ethnic backgrounds are needed. Gladsjo et al. (1999) argued that

Correspondence and reprint requests to: Dr. George P. Prigatano, Clinical Neuropsychology, Barrow Neurological Institute, St. Joseph's Hospital and Medical Center, 222 West Thomas Rd., Suite 315, Phoenix, Arizona 85013. E-mail: gprigat@chw.edu



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age, education, and race are significant predictors of categorical fluency performance in normal adults. Gasquoine (1999) noted, however, that there might be multiple moderating variables that account for ethnic differences. He pointed out, for example, that with Hispanic Americans "English language fluency, length of residency within the United States, years of education, and persistence of poverty, all impact test performance" (p. 376). These and other variables may account for differences observed in different races or ethnic groups. In keeping with this observation, Benito-Cuadrado et al. (2002) noted that for a Spanish population, years of education accounted for 22.6% of variability in scores. Including age in the linear regression model accounted for an additional 10% of the variability in their adult sample. Educational level has been shown to influence fluency scores in normal subjects from different countries (e.g., Egeland et al., 2006; Kosmidis et al., 2004; Mack et al., 2005; Van der Elst et al., 2006).

Presently, no normative data are available for minority school-age children who come from low socioeconomic backgrounds who reside in the United States. This information is important for pediatric neuropsychologists when evaluating minority children with known or suspected brain disorders who come from low socioeconomic backgrounds. Recent research has suggested that some aspects of language and executive functioning may be adversely affected in young children from low socioeconomic backgrounds (Hurks et al., 2006; Noble et al., 2005). In the present study, we provide regional (Southwest) normative data on 213 school-age children. Most of the students were of Hispanic background, and came from low socioeconomic families.

## METHODS

### Participants

Two hundred-thirteen children in grades 1 through 8 were selected from a public school district in central Phoenix, Arizona. Most of the students were described by school district records as non-white and from families with low socioeconomic status. During the two years of this study (2004 and 2005), 91% and 90%, respectively of children were identified as students from African-American, American Indian, Hispanic, and "other than White" backgrounds. In both years, 83% of these children were described as Hispanic.

During the two years of the study, 88% and 90% of the children in this public school district qualified for the Free or Reduced Lunch Program. To qualify for the Free Lunch Program, their family's annual income had to be $28,638.00 or lower. To qualify for the Reduced Lunch Program, the annual income of the family had to be at or below $40,756.00.

Children who were older than their grade level and/or were receiving special education services were excluded. Children who spoke a language other than English in the classroom were also excluded. One hundred-thirty of the 213 children were female (61%). The majority of children were right-handed ($N=188$; 88.3%).

### Procedures

Children were recruited from 5 out of 6 schools within the public school district. Parental consent was obtained *via* the mail. The study was approved by the Institutional Review Board of St. Joseph's Hospital and Medical Center, Phoenix, Arizona.

All testing was done on the school campus by either a resident in clinical neuropsychology or a graduate student trained to administer neuropsychological tests. Testing, on average, was completed within 90 minutes.

The children were a part of a standardization study for the Barrow Neurological Institute (BNI) Screen for Higher Cerebral Functions for School-Age Children (Prigatano & Gagliardi, 2005). As part of that study, they were administered an adaptation of the Fuld Object Memory Evaluation (FOME; Fuld, 1981). The first distracter task was a verbal fluency task of rapid animal naming. Children were given the following instructions for this task: "I want you to name as many animals as fast as you can within 60 seconds. This can be any type of animal. Do you have any questions?" The child received credit for all unique animal names generated, repetitions of the same word were not counted in the total. If the child responded with a subordinate category name, such as fish, and also provided a specific example of a fish (e.g., trout), credit was given for the specific example (and all other examples given; e.g., carp, salmon) but not for the subordinate category (e.g., fish). If only a subordinate category was given (e.g., fish), with no other specific examples, then credit was given for the word fish. If a derivative was provided along with a correct response (e.g., dog, doggy) credit was not given for the derivative.

In the present report, data from the verbal (animal) fluency scores are reported, in addition to three subtest scores from the Wechsler Intelligence Scale for Children—fourth edition (WISC-IV, Wechsler, 2003). The WISC-IV subtest scores were obtained for two purposes: first, to ensure that the study sample, as a group, had average intelligence, and second, to determine if vocabulary level further predicted fluency scores in this low socioeconomic minority sample after age/educational level and gender were considered. The WISC-IV Manual (Wechsler, 2003) reports that the Vocabulary subtest score correlates +.91 with the Verbal Comprehension Index; Block Design correlates +.81 with the Perceptual Reasoning Index, and the Coding subtest correlates +.88 with the Processing Speed Index. Thus, the sum of these measures is a reasonable estimate of intellectual functioning using a test that has been standard on a national sample (Wechsler, 2003).

Previous studies have suggested that there is a small, but significant relationship between Verbal IQ and verbal fluency in TBI children (Verbal IQ correlated with verbal fluency, $r = 0.17$, $p = .02$, Levin et al., 2001). Similar findings have been reported in normally functioning children who

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are primarily white (96.7%) and of middle-class socioeconomic status, using the Peabody Picture Vocabulary Test-Revised Form ($r = .16$, $p = .05$, Halperin et al., 1989).

## Statistical Analyses

The sum of the age-corrected scaled scores from the Vocabulary, Block Design, and Coding tests of the WISC-IV were calculated for each child. Each child's level of performance on the animal fluency task was also calculated, and means and standard deviations obtained for children at different age ranges and grade levels. Analysis of variance on verbal fluency scores was conducted to determine the possible influence of age/grade level and gender on animal fluency scores. A similar analysis was conducted on the sum of the WISC-IV scaled scores. A regional normative table was established to illustrate the relationship of age/grade level to the number of animal names the children could produce within 60 seconds.

Hierarchical multiple regression analyses were performed using the Statistical Package of the Social Sciences, version 8.0 (SPSS; SPSS Inc., 1998). Predictor variables were entered into the equation in the following order: combined age range and grade level of the child (see Table 1 for grouping), the gender of the child, and the sum of the three WISC-IV scaled scores. The analysis was then repeated and the sum of the WISC-IV scaled scores replaced only with the Vocabulary subtest score to specifically determine the role of verbal fluency/vocabulary knowledge in predicting animal naming scores.

# RESULTS

## Demographic Findings

Sample sizes for each age/grade group ranged from 19 to 37 participants. As Table 1 illustrates, the sum of the three WISC-IV scaled scores was within the average range for each of the eight groups of children. The level of performance on the sum of the three WISC-IV scaled scores failed to reveal a group effect [$F(7,205) = 1.32$, $p = .23$]. A modest gender effect was found [$F(1,211) = 4.16$, $p = .04$]. Males obtained a mean Vocabulary + Block Design + Coding sum of 30.73 points ($SD = 4.66$) whereas females obtained a mean of 29.30 ($SD = 5.84$). No interaction effect was found [$F(7,205) = .90$, $p = .51$].

## Animal Fluency Scores

Analysis of variance revealed a strong age/grade group effect on animal fluency scores, $F(7,205) = 9.87$, $p = .01$. In general, younger children in lower grade levels produced fewer animal names than older children in higher grade levels (see Table 1). Using the Bonferroni correction to examine significant group differences revealed that Groups 1 (i.e., grade 1), 2 (i.e., grade 2), and 3 (i.e., grade 3) did not significantly differ from each other, but Group 1 (i.e., grade 1, mean age = 6.5 years) significantly differed from all other groups (i.e., grade 4 mean age = 9.4 years and higher). Group 2 (i.e., grade 2, mean age = 7.6 years) differed from Group 5 (i.e., grade 5, mean age = 10.5 years), 6 (i.e., grade 6, mean age = 11.6 years), and 8 (i.e., grade 8, mean age = 13.8 years). The same pattern was true for Group 3 (i.e., grade 3, mean age = 8.3 years). However, Group 4 (i.e., grade 4, mean age = 9.5 years) significantly differed only from Group 1. Groups 5, 6, and 8 only differed from Groups 1, 2, and 3, whereas Group 7 (i.e., grade 7, mean age = 12.3 years) differed only from Group 1.

A modest gender effect was found for the total number of animals named [$F(1,211) = 3.97$, $p = .05$], but there was not a significant interaction effect for age/grade group and gender [$F(7,205) = 1.60$, $p = .14$]. As a group, males generated 18.37 ($SD = 6.16$) words and females generated 16.38 ($SD = 4.64$) words.

## Prediction of Animal Fluency Scores in Socioeconomically Disadvantaged School-Age Children

Table 2 presents the findings of the hierarchical multiple regression analysis predicting animal fluency scores in this

**Table 1.** Characteristics of the study sample and their performance on selected subtests of the WISC-IV and an animal fluency task ($N = 213$)

| Group | Mean age (yrs) | Range (yrs) | Grade level | Males (no.) | Females (no.) | *n* | Sum of WISC-IV subtest scale scores: Mean | *SD* | Range | Animal Fluency Scores: Mean | *SD* | Range |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.5 | 6–7 | 1 | 5 | 18 | 23 | 29.91 | 5.83 | 16–44 | 12.09 | 3.04 | 7–18 |
| 2 | 7.6 | 7–8 | 2 | 9 | 13 | 22 | 27.59 | 5.25 | 16–38 | 14.50 | 5.33 | 8–31 |
| 3 | 8.3 | 8–9 | 3 | 8 | 17 | 25 | 30.12 | 6.41 | 17–44 | 14.56 | 5.24 | 6–27 |
| 4 | 9.4 | 9–10 | 4 | 15 | 19 | 34 | 29.88 | 3.87 | 24–40 | 16.82 | 3.61 | 10–25 |
| 5 | 10.5 | 10–11 | 5 | 10 | 21 | 31 | 29.39 | 6.05 | 18–42 | 18.81 | 4.81 | 10–30 |
| 6 | 11.6 | 11–12 | 6 | 8 | 11 | 19 | 31.95 | 4.36 | 25–40 | 20.79 | 5.11 | 13–31 |
| 7 | 12.3 | 12–13 | 7 | 10 | 12 | 22 | 30.23 | 5.87 | 17–41 | 18.82 | 5.61 | 10–33 |
| 8 | 13.5 | 13–14 | 8 | 18 | 19 | 37 | 30.08 | 5.53 | 19–43 | 19.73 | 4.75 | 10–31 |

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**Table 2.** Hierarchical multiple regression analysis predicting performance on an animal fluency task

| | $R$ | $R^2$ | $R^2$ Change | $F$ Change | Sig. $F$ Change | Beta | Beta Sig. | Variance Inflation Factor |
|---|---|---|---|---|---|---|---|---|
| Model 1 | | | | | | | | |
| Age range/Grade | .464 | .215 | .215 | 57.953 | .000 | .431 | .000 | 1.021 |
| Gender | .480 | .231 | .015 | 4.130 | .043 | –.092 | .118 | 1.032 |
| WISC-IV Sum of Vocabulary, Block Design and Coding subtests | .546 | .298 | .068 | 20.185 | .000 | .263 | .000 | 1.021 |
| Model 2 | | | | | | | | |
| Age range/Grade | .464 | .215 | .215 | 57.953 | .000 | .410 | .000 | 1.042 |
| Gender | .480 | .231 | .015 | 4.130 | .043 | –.075 | .214 | 1.059 |
| WISC-IV Vocabulary subtest | .537 | .288 | .057 | 16.862 | .000 | .249 | .000 | 1.076 |

sample. Age/grade level (i.e., group status) was the most powerful predictor, accounting for 21.5% of variability in scores. Gender contributed a marginal 1.5%, whereas the estimated intelligence level (i.e., the sum of the three WISC-IV scaled scores) contributed an additional 6.8%.

Recalculation of the same analysis, but replacing the sum of the three WISC-IV scaled scores with only the vocabulary scaled score produced highly similar findings. The vocabulary scaled score in and of itself accounted for 5.7% of additional variability.

Variance inflation factors for these variables were low, suggesting the absence of any significant multicollinearity (see Table 2).

## DISCUSSION

The present study provides regional (Southwest) normative data on 213 minority (primarily Hispanic) school-age children from low socioeconomic backgrounds on an animal fluency task. Their level of performance on this animal fluency task is not lower than what has been reported in primarily white children from middle class backgrounds in the United States (Halperin et al., 1989) or Canadian, English-speaking children (Regard et al., 1982). Also, the present normative findings are compatible with norms obtained from Italian children studied in the province of Milan (Riva et al., 2000). It should be noted that despite their minority status and socioeconomic background, all children in the present investigation were not requiring special education services and their estimated intellectual ability was within the average range. Thus, the children appear to be performing normally from an educational and level of intelligence point of view.

Whereas Ardila and Rosselli (1994) do report an age and socioeconomic interaction effect on semantic fluency scores for school-age children studied in Colombia, they noted that children from lower socioeconomic groups may have had less qualified teachers, were in larger classes, and had poor or non-existent school libraries. Thus, when the child has an impoverished educational experience, performance on semantic fluency tasks may in fact be negatively affected. A review of Ardila and Rosselli's (1994) data suggests that children from the lower socioeconomic classes generally performed poorer on every cognitive test that they were given. In the present study, it should be noted that the children had average performance on the Vocabulary, Block Design, and Coding subtests of the WISC-IV. They performed at a level comparable to national norms regarding knowledge of words, visuospatial ability, and speed of processing new information. The school district from which they came provided similar educational resources as other school districts within the greater Maricopa County (Phoenix) metropolitan area. Therefore, if the children have normal intelligence, it may not be the socioeconomic status of the child that accounts for poorer animal fluency scores, but the quality of their educational experience during these school-age years. In keeping with this observation, Ostrosky-Solis et al. (2007) recently reported that in Spanish-speaking adults lower level of education was negatively associated with semantic verbal fluency scores.

In the present study, the correlation between age range/grade also accounted for an expected range of the variability, as reported in other studies. The correlation between age range/grade level with the number of animal names produced in 60 seconds was $r = +.47$, accounting for 21.5% of the variability. Whereas the gender of the child exerted a mild effect, further analyses revealed that it is primarily the Vocabulary level of the child that added further predictive influence above and beyond the age/grade level of the child. Collectively, these findings would partially support Gasquoine's (1999) suggestion that differences reported between different ethnic groups on neuropsychological tests may reflect moderating variables such as the years of education, the quality of education, and the fluency level in a given language.

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