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The Predictive Nature of Age and Gender in the Verbal Fluency Test in the Greek Cypriot Children: Normative Data

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Abstract

Objective: The Children's Verbal Fluency test (VF) is a neuropsychological test that measures executive function, vocabulary storage, and speed of mental processing. It has been increasingly used in the assessment of children in neurological and psychiatric disorders such as Batten disease, frontal lobe epilepsy, cerebellar tumor, Attention-Deficit Hyperactivity Disorder (ADHD) and dyslexia. However, there is a paucity of studies presenting normative data. The aim of the present study was to provide normative data for the children's verbal fluency test in the Cypriot population and to test the criterion validity of the children's VF in children with ADHD.

Method: A total of 749 native Cypriot children aged 7-16 years, recruited from various public schools across the island, took part in the study. Exclusion criteria involved the existence of neurological, psychiatric, cardiological and metabolic diseases and native language other than Greek.

Results: Age but not gender was found to be an important factor for the interpretation of scores in the verbal fluency variables. Older children produced more words in both, semantic and phonemic fluency test compared to younger children. Also, the test seemed to discriminate the clinical group of children exhibiting ADHD in semantic verbal fluency as compared to pair-matched controls.

Conclusions: Children's verbal fluency test is a promising tool for the measurement of executive function in the Cypriot population. Further research is needed in children diagnosed with various neurological and psychiatric diseases in order to estimate the validity of the children's verbal fluency in other clinical populations.

Keywords: Normative data; Verbal fluency; Greek language

Introduction

The Verbal Fluency test (VF) measures the subject's ability to generate words in a specific amount of time (usually 60 seconds) and within a certain category [1]. Across cognitive domains, the test measures executive function, vocabulary storage and speeded mental processing [2].

The historical roots of the VF test involve participants to write as many words as possible starting with the letter S in a specific time [3]. Oral versions of the test may be also parts of a battery of tests like the Multilingual Aphasia examination Battery [1] or the Delis-Kaplan Executive Functions System [4]. The most common categories used, are the semantic and phonemic categories.

In semantic VF, animals [5-16], fruits and vegetables [5,6,8,10,12,16,17], items of a supermarket [18], types of transportation [19], tools and clothing [20], and furniture [4] have been used.

In phonemic VF, different letters of the alphabet have been used depending on the native languages of the participants [5,6,8,11-15,21-24]. There is only one study in the Greek language which measured semantic VF using animals, fruits and objects and phonemic VF using the letters A, S, and X [25].

In the last 15 years, there were a number of normative studies of the VF test in children using the same logic as in adults. The children's VF test has been normed in Dutch, Swedish, Finnish, Italian, Chinese, Cameroonian, and American with Hispanic origin populations [26-32]. The number of participants ranged from 125 children [30] to 464 children [27]. Except for age, other methodological differences between these studies involved differences in grades of education, and the use of either batteries of tests or only single tests in every study. In our opinion, only one study measured the children's VF in 1-year intervals of age (3-12 years) [26]. So, there is a great need for normative studies in different languages across a shortened age range and to employ a larger number of healthy children.

In the children's VF test, age was found to be associated with a better scoring in semantic fluency [26,28-32] and phonemic fluency [26,29-31]. However, the effect of gender on VF performance is unclear. Some studies have shown that boys at ages 8, 9, and 12 performed better than girls in the semantic fluency test [26] while the opposite happens in the phonemic fluency test [26]. Other studies did not find differences [29,30] or found marginal effects [28]. The children's VF test was also correlated with other language measures such as vocabulary and sentence repetition [33].

The children's VF test has been used with other neuropsychological tests to measure executive function in neurological and psychiatric disorders like Batten disease [33], frontal lobe epilepsy [34], cerebellar tumor [35], Attention-Deficit Hyperactivity Disorder (ADHD) alone

[36,37], dyslexia alone [38] or ADHD with dyslexia [39]. Lower scores of the children's VF test were found in the clinical groups as compared to controls except in one study where no differences between ADHD children and controls were found in semantic and phonemic VF [37].

The present study aims to provide normative data about the children's VF test in the Cypriot population (Greek language with a Cypriot dialect). Relationships between the number of words in either, semantic fluency or phonemic fluency with age and gender are investigated. Further examinations involve the criterion validity of the test in participants diagnosed with ADHD.

Methods

Participants

Children were recruited from the four main cities (Nicosia, Limassol, Larnaca and Pafos) and 10 public schools across the island of Cyprus (sample of convenience). The estimated population of children educated in the primary and secondary education in Cyprus is 117,767 [40]. The normative sample consisted of 749 community dwelling Caucasian native Cypriot children (Greek language with a Cypriot dialect) aged 7-16 years old. The sample included 302 males (40%) and 447 females (60%). The majority of the children (n=661) were right handed (88%). The sample was divided in 10 age groups (7-16 years) in yearly intervals.

All parents of the children informed about the scope of the study, voluntarily participated and signed the informed consent form. The local ethics committee reviewed and approved the consent form.

Initial screening included a structured interview with the parents based on a short medical history form, including biographical data and the exclusion criteria. Participants were excluded from the study if they had been diagnosed with psychiatric, cardiological, metabolic, neurological diseases and their native language was other than Greek. Additionally, participants were excluded if the mother had a history of alcoholism and drug abuse during pregnancy. Finally, factors such as premature birth, low birth weight, hearing loss, visual problems and abnormality in fine-motor movements were also taken into consideration. Two hundred and twenty eight participants were excluded from the study (total initial sample, n=977). The number of excluded children included low birth weight (85 children), native language other than Greek (59 children), cardiological/metabolic diseases (51 children) and Attention Deficit Hyperactivity Disorder (ADHD)/learning disabilities (33 children). The present study is a part of another study which investigated normative data of the Children Color Trails Test (CCTT) in a Cypriot sample of children [41].

Thirty four children diagnosed with ADHD according to DSM-IV criteria [42] by a local child psychiatrist were pair-matched to 34 healthy children derived from our sample. The healthy children were selected to be +/- 2 months of age and having the same gender with the clinical group. No specific subtype of dyslexia was reported by the child psychiatrist. The ADHD group was seen in the European University Clinic (EUC) for speech and hearing disorders and followed the same procedure as the healthy children for the assessment of verbal fluency.

Materials

The children's VF test was administered to the participants in the Greek language according to the test guidelines [1,25]. First, participants produced as many different words as possible in semantic categories such as animals, fruits, and objects [25]. After this, the participants generated as many different words starting with the Greek letters X (Chi), S (Sigma), and A (Alpha). According to Kosmidis et al. [25] the ratio of the aforementioned letters relative to the total number of words in the Greek dictionary, corresponds to the ratio of words F, A, S in the English dictionary. More specifically, the researcher announced each category and the participant generated as many words as possible in 60 seconds trials. The total number of words in either, semantic or phonemic VF, were calculated. Excluded words involved repetitions or variations of previously given words, items irrelevant to the semantic category or letters other than X, S, and A.

Procedure

The interview took place in the house of every participant except for the clinical groups in whom the interview and the subsequent assessment took place in the EUC speech and hearing clinic. The completion of the history form was followed by the CCTT administration and the children's VF test. During administration all variables were recorded.

Statistical analysis

Descriptive analysis involved means and standard deviations of all variables followed by multiple regression analyses ("enter" method in SPSS). The multiple regression analyses were used to investigate the relationships of age and gender (predictors) with the generated number of words in either, semantic or phonemic categories. We also examined the sensitivity of the children's VF test by comparing one group of participants diagnosed with ADHD vs. a pair-matched group of healthy controls (in age and gender).

Results

The mean age of the sample was 134.58 months (11.22 years) (SD=32.49), and the mean education 5.57 years (SD=2.70). The mean score of the total sample for semantic VF was 31.51 words (SD=8.94), and for phonemic VF, 19.76 words (SD=8.17). The mean score of the female subgroup for semantic VF was 31.52 words (SD=8.66), and for phonemic VF was 20.05 (SD=8.12). The mean score of the male subgroup for semantic VF was 31.55 words (SD=9.34), and for phonemic VF was 19.34 (SD=8.26). Table 1 shows normative data for each of the 10 age groups and Figure 1 shows the percentile scores for the semantic VF and the phonemic VF test.

To investigate the predictive nature of demographic variables (age and gender) on the semantic and phonemic VF, a multiple regression analysis was used. Significant associations of age were found with the number of words produced during semantic and phonemic VF. Our model accounted for 32.9% of the variation in the semantic VF and 36.4% of the variation in the phonemic VF. Gender did not contribute to the scores of both semantic and phonemic verbal fluencies. Table 2 shows the results of the multiple regression analysis for semantic and phonemic verbal fluencies.

The investigation of the criterion validity showed that the ADHD group exhibited significantly lower performance than the control group in semantic verbal fluency while no differences between these groups were found in phonemic verbal fluency. Table 3 shows the results of the independent samples T test (in age and education) and the results of the Mann-Whitney test in semantic and phonemic VF.

	n	Semantic Verbal Fluency	Phonemic Verbal Fluency
7-7.11 years	71	22.27 (5.93)	12.70 (5.49)
8.0-8.11 years	122	25.50 (5.84)	14.25 (5.05)
9-9.11 years	104	29.57 (6.90)	16.95 (5.48)
10.0-10.11 years	90	31.06 (6.53)	18.89 (6.22)
11.0-11.11 years	99	33.69 (7.12)	20.54 (5.62)
12.0-12.11 years	46	34.89 (8.07)	23.13 (7.63)
13.0-13.11 years	77	33.61 (8.34)	22.25 (7.79)
14.0-14.11 years	50	37.66 (9.39)	24.80 (8.31)
15.0-15.11 years	36	40.89 (7.78)	29.20 (6.76)
16.0-16.11 years	54	40.05 (8.29)	29.58 (8.70)

Table 1: Means of the number of words and their standard deviations for all Verbal Fluency variables.

Predictor variables	Predicted variables		
	Standardized Beta	t value	p value
Semantic Verbal Fluency ANOVA (regression) F2,746=184.159 p=0.000, Adjusted R^2=0.329			
Age	.574	19.152	0.000
Gender	-.044	-1.461	0.145
Phonemic Verbal Fluency ANOVA (regression) F2,706=214.812 p=0.000, Adjusted R^2=0.364			
Age	0.604	20.711	0.000
Gender	0.017	0.575	0.565

Table 2: Contribution of age and gender to the semantic and phonemic verbal fluencies.

	Control group n=34	ADHD group n=34	Statistical testing	p value
Age (months)	126.97 (28.57)	126.71 (28.50)	t=.038	p=.970
Education (yrs)	4.94 (2.32)	4.94 (2.39)	t=.000	p=1.00
Semantic VF	32.12 (8.58)	27.58 (11.05)	U=377.500	p=.021
Phonemic VF	18.91 (6.45)	15.67 (7.43)	U=426.000	p=.090

Table 3: Results of the Mann-Whitney test comparing the performance of ADHD and dyslexia groups as compared to two pair-matched control participants.

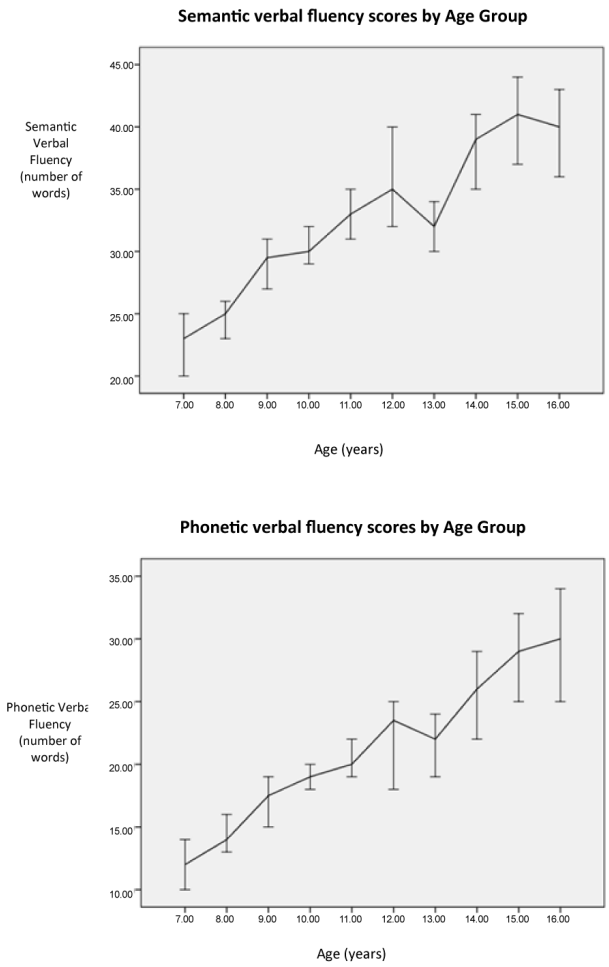

Figure 1: Percentiles across age groups (horizontal axis) and verbal fluency scores (vertical axis).

Discussion

The purpose of the present study was to provide normative data on the children's VF test in a Cypriot sample of 749 children aged 7-16 years.

The results showed that age is an essential variable to interpret the scores for the semantic and phonemic VF test. Older children with more years of education produced more words than younger children with less years of education. This trend was apparent in all age categories except the age of 12-12.11 where the number of participants was smaller (n=46) than the 13 years old participants. A weakness of the present study was the inequality of sample size among different subgroups. For example, the number of children aged 15.0-15.11 years (n=36) was almost 3 time smaller from the number of children aged 8.0-8.11 (n=122). The present data are in agreement with studies in different languages who found the effect of age in semantic VF [26,28-32] and phonemic VF [16,29-31].

Our results are in agreement with the results of other studies which showed no effect or marginal effect of gender on the number of words

in semantic and phonemic VF [28-30]. The only study which showed VF differences in gender was restricted to ages 8, 9, and 12 years [26].

In the present study, the semantic children's VF test was found to differentiate children with ADHD from pair-matched controls. There is a mixture of results in studies which searched the effect of verbal fluency in ADHD. For example, one study measured only the phonemic VF [39] while two other studies measured both semantic and phonemic VF [36,37]. Our results are in agreement with Puento-Rozo et al. [36] who found lower scores in semantic fluency in their sample. Methodological differences, e.g. differences in the type of ADHD among these studies may contribute to the differences in the results.

All the aforementioned studies included participants carefully selected not only based on the clinical diagnosis but also on variables such as IQ [36-39], socioeconomic status [39] and subtype of ADHD [37,39]. Due to its major emphasis on normative data, our study did not take into consideration factors such as subtype of ADHD, IQ and socioeconomic status.

The present study is among the few studies which provided normative data of the semantic and phonemic VF in a large sample of children (7-16 years old) and across a shortened age range (1 year intervals). Future studies are needed to relate our findings with factors such as IQ, socioeconomic status, vocabulary and in clinical populations such as traumatic brain injury, language disabilities, developmental delay, etc. Also, future studies may need to assess attention/speed of mental processing in a number of cognitive disorders such as traumatic brain injury (TBI), subtypes of ADHD, learning/language disabilities, hearing loss and developmental delay in Greek speaking children.

Disclosure Section

The authors have no financial conflicts of interest related to this work.

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