RESEARCH ARTICLE

Turkish Journal of Psychiatry 2022;33(1):53-64

https://doi.org/10.5080/u25553

Effects of Age, Gender and Education on Phonemic and Semantic Verbal Fluency

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SUMMARY

Objective: The aim of this study was to obtain normative data for Verbal Fluency Test and investigate the effects of age, gender, and education on verbal fluency in native Turkish-speaking individuals.

Method: A pilot study was conducted to determine 3 letters with differing levels of difficulty for completing the phonemic fluency task. First names and animals were chosen for the semantic fluency task, and an alternating semantic task (first name-animal) was also used. In total, 415 participants (208 male and 207 female) were recruited and stratified based on the age and education levels.

Results: Level of education had a main effect on all verbal fluency tasks; people with higher education performed better. Age and gender were found to have no effect on phonemic verbal fluency. Only the < name production task was affected by gender, women performed better. Younger age groups produced more words in name generation and semantic alternating fluency tasks.

Conclusion: The effects of age, gender and education on verbal fluency are in accordance with many previous reports. Analysis of various errors were also conducted. Results for Turkish are presented and discussed in the light of literature.

Keywords: Verbal fluency test, Turkish language, normative study

INTRODUCTION

Verbal Fluency Tests (VFTs) are widely used for neuropsychological research and clinical assessment. VFTs measure the ability to produce words within a certain time period and within a particular category (Lezak 2012). Despite the many types of VFTs that have been proposed, there are generally two types of fluency measured: phonemic and semantic. Phonemic (lexical) fluency is defined as the ability to produce words beginning with a particular letter, whereas semantic fluency is the ability to produce words in a particular category (animals, kitchen tools, supermarket items, names of foods such as fruits and vegetables, first names) (Lezak 2012, Strauss et al. 2006).

VFTs are thought to measure various cognitive functions, including semantic memory, general language ability, attention, and complex attention (Aita et al. 2019, Lezak 2012, Ruff et al. 1997), information processing speed, and such executive functions as differentiating between relevant and irrelevant information, self-initiation and self-monitoring and inhibition of irrelevant responses (Baldo et al. 2001, Henry and Crawford 2004, Strauss et al. 2006). However semantic fluency is thought to depend more on the integrity of semantic stores and related to the temporal lobe structures while phonemic fluency relies primarily on lexical representations (Quaranta et al. 2019). Other than this distinction the two tasks are thought to reflect equal sensitivity to executive functions mentioned above (Henry and Crawford 2004).

VFT performance is negatively affected by many disorders, including depression (Akiyama et al. 2018), schizophrenia (Brebion et al. 2019), Parkinson's disease (Rosenthal et al

Received: 18.03.2020, **Accepted:** 10.12.2020, **Available Online Date:** 17.06.2021

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2016), Alzheimer's disease (St-Hilaire et al. 2016), and mild cognitive impairment (McDonnell et al. 2019). VFTs are reported to be helpful in the early diagnosis of the neurodegenerative disorders by showing the deterioration of semantic memory and the executive functions in the early phase of these disorders (McDonnell et al. 2019).

Demographic factors, such as age, level of education, and gender are also found to affect VFT performance. Generally, level of education and age are reported to substantially influence various fluency tasks, whereas reports on the effect of gender are less consistent. Level of education was reported to have a strong effect on verbal fluency by many researchers (Kosmidis et al. 2004, Loonstra et al. 2001, Ratcliff et al. 1998, Tombaugh et al. 1999, Van der Elst et al. 2006). The effect of age varies; age was reported to affect phonemic fluency by some researchers (Auriacombe et al. 2001, Brickman et al. 2005, Loonstra et al. 2001, Tombaugh et al. 1999) while other researchers have reported no such effect (Bolla et al. 1990, Parkin and Java 1999). Similarly, some researchers reported that age significantly affects semantic fluency (Brickman et al. 2005, Gladsjo et al. 1999, Mathuranath et al. 2003), whereas others reported that it does not (Henry and Phillips 2006). Most research shows that gender has no effect on VFT performance (Benito-Cuadrado et al. 2002, Mathuranath et al. 2003, Tombaugh et al. 1999, Troyer 2000), but some studies reported that it has a variable effect on phonemic and semantic fluency tasks (Capitani et al. 1998, Nogueira et al. 2016).

To date, many studies have provided VFT norms for different languages (Aziz et al. 2017), ethnicities (Ardila and Moreno 2001, Kave 2005, Khalil 2010, Kosmidis et al. 2004, Lee et al. 2004, Pena-Casanova et al. 2009, Tallberg et al. 2008, Van der Elst et al. 2006), and demographics (Khalil 2010, Loonstra et al. 2010, Ratcliff et al. 1998, Tombaugh et al. 1999). English-language VFTs have used various letters, including F, A, and S; and C, F, L, or P, R, W letters as alternative lists to prevent repetition/ learning effect (Ruff et al. 1996, Sumerall et al. 1997, Tombaugh et al. 1999). In general, these letters were chosen according to the difficulty levels as defined by the number of words beginning with each letter. Different letters defined according to the difficulty levels have been used for VFTs in different languages (Ardilla and Moreno 2001, Khalil 2010, Kosmidis et al. 2004, Van der Elst 2006, Aziz et al. 2017), but sometimes the same letters used for English language also have been used (Tallberg et al. 2008). For the semantic verbal fluency task many different categories have been chosen, including animals, fruits, vehicles, kitchen tools etc. The most commonly studied words are animals (Tombaugh et al. 1999). Linguistic factors, like the length of the words, and also cultural factors as familiarity with the tasks affect semantic fluency performance (Kempler et al. 1998, Ardila and Moreno 2001). Norms for semantic categories in different languages and cultures have also been published (Kave 2005, Khalil 2010, Kosmidis et al. 2004, Van der Elst 2006, Aziz et al. 2017). In Turkish language, Bingol et al. made a standardization study in 1994, and Tunçer made a dissertation thesis on the subject, but both studies were not published (Bingöl et al. 1994, Tunçer 2011).

Besides phonemic and semantic fluency tests, alternating fluency tests are reported to be more challenging on executive functions and cognitive flexibility, especially following the order and inhibition of the irrelevant responses are needed during these tests (Nogueria et al. 2016, Birn et al. 2010).

The verbal fluency literature emphasizes the importance of adapting VFTs to specific language and cultures before extensive use. VFTs are widely used tests that evaluate a broad network of cognitive functions including semantic memory, attention and executive tests, which is administered in a relatively short time and used in both clinical practice and research studies for supporting the diagnosis of neurodegenerative disorders and attention and hyperactivity disorders; adaptation to our language and norm study is important. The primary aim of the present study was to adapt VFTs-phonemic fluency (letters), semantic fluency (first names and animals), and semantic alternating fluency (alternating between first names and animals)-for use with native Turkish-speaking individuals, and to obtain normative data for age, gender, and level of education. Additional aims were to investigate the effects of age, gender, and level of education on verbal fluency performance and to create a list of alternate letters for testing phonemic fluency.

METHODS

Participants

This study has included 2 phases: a pilot study for determining the letters to be used in the phonemic fluency study and the main study for all the fluency tasks. Different samples were used for the 2 studies.

The main study included 415 voluntary participants (207 female and 208 male) aged 15-85 years. The participants were composed of the healthy relatives of the patients, social environment of the hospital personnel and other volunteers. Level of education (years) ranged between 5 and 22 years and at least a primary school graduation was the inclusion criterion. The level of education groups (5-8 years: primary and middle school, 9-11 years: high school, and ≥12 years: university) correspond to the cut-off points of the first, second, and third levels of the Turkish education system. All the participants were native Turkish speakers, and none received financial compensation for participating.

A detailed report, including demographic data, medical and psychiatric history, and the use of prescribed medications was obtained from each participant. Any person with

a known psychiatric disorder (except a history of depression or anxiety disorders, completion of pharmacologic treatment ≥6 months earlier, and currently symptom free) or neurologic disease, history of head trauma, substance use or abuse, and current use of psychiatric medications were excluded from the study.

Tests and Procedure

The study protocol was approved by the Hacettepe University Ethics Committee (No: HEK 12/105-17) and all the participants provided written informed consent. Phonemic and semantic verbal fluency tests were used to evaluate the verbal fluency in the study.

Phonemic Fluency: First a pilot study was conducted in collaboration with the Department of Linguistics of Ankara University to determine the letters to be used for the phonemic fluency task. The pilot study included 15 participants who were not in the main study.

Three levels of difficulty for phonemic fluency were defined in the pilot study based on the produced number of words beginning with each letter. The less the number of the words beginning with a letter, it means the more difficult to produce words with that letter. The aim of the pilot study was to determine 3 letters with an increasing level of difficulty based on the estimated number of words beginning with each letter and also to develop a substitute letter list for every level.

The Word Frequency Dictionary of Written Turkish (Göz 2003) was used to determine the number of words that could be produced using each letter. For this purpose, the contents of the dictionary were transferred to an Excel file and the number of words beginning with each letter was calculated. All the letters were divided into 3 groups based on the frequency of words beginning with each letter: the most frequent, second most frequent, and least frequent. In the Turkish language there are 2 types of vowels: *a, o, u*, and ı (back vowels) and *e, ö, ü,* and *i* (front vowels). From these only *a* and *e* were included in the study, as most Turks cannot discriminate between other vowels (like o and ö, u and ü use instead of each other) and could switch to a categorically wrong word. Similarly, *c* and *ç,* and *m* and *n* were excluded from the letter list to prevent possible confusion.

Each participant in the pilot study was asked to produce as many words as possible with each letter of the alphabet except the above mentioned vowels and letters within 1 minute. The 3 letter groups were determined based on the number of words they produced. These letters were compared with the data in the *Word Frequency Dictionary of Written Turkish,* and the letters discordant on the verbal and written words produced were excluded from the study. The letters determined and related findings are presented in the results section.

The phonemic fluency tests were administered first, and a standard instruction was used for each participant. The beginning part of the instruction is as follows: "I will give you a letter and one minute time. In this time, I would like you to say as many words as you can starting with this particular letter. But these words cannot be first names, city and country names, and numbers".

Instructions for the phonemic tasks used in the present study differs in some ways from those used by numerous other studies. The term "proper names" was not used in the instruction, in consideration that many participants, especially those with a low level of education, might not have understood the term and instead explaining generally what "proper name" means was preferred: "the words you produce cannot be first names, country or city names, and numbers". In Turkish language agglutination is used extensively to produce new words from root words, verbs, and nouns. Many Turkish words are produced via application of derivative suffixes to a core set of vocabulary. We did not warn the participants about production of words using suffixes. The rationale was that this would be time consuming and, more importantly, could result in unnecessary attention to warnings and interfere with the production of words due to inhibition. Thus, an instruction that is overly verbose and complex was avoided in this study.

Semantic Fluency: Semantic fluency was tested using 3 subtests: production of a list of first names (NAMES) within 1 minute, a list of animals (ANIMALS) within 1 minute, and production of a list alternating between NAMES and ANIMALS (semantic alternating fluency (ALTERNATION) within 1 minute. ALTERNATION task performance is thought to reflect a different/more difficult skill, including complex attention, inhibition of impulses, switching between categories, and tracking. In order to prevent the sequencing effect, the letters of phonemic task were administered in a counterbalanced order. After the completion of phonemic task, semantic tasks were administered in different orders for each participant, and alternation task was always administered after the semantic tasks. All the test materials were administered face to face to the participants during a session at their home or in the researcher's office.

Evaluation of The Performance and Scoring: Every word produced according to the instructions was scored as 1 point. Some geographic names such as the names of a lake or mountain, and brand names used like a common name (selpak) in our language were accepted as correct and scored.

In this study error types in the word production were also analyzed by statistical methods. For scoring purposes, a new error type in phonemic category was defined: "production error", which is the production of a new word using a suffix, resulting in a very similar meaning to the main word. During calculation of the total number of words produced by each

participant those words with similar meanings (production errors) were not included in the scoring. For example, words produced with suffixes that conveyed a different meaning, such as *göz* (eye) and *gözlemek* (to observe), were accepted as valid, whereas *gözlük* (eye-glass) and *gözlüklü* (a person who wears eye-glasses) were not accepted as two distinct words; instead *gözlük* was accepted as a word production and *gözlüklü* was accepted as a production error. Other types of errors were also defined for all the fluency tasks, including repetition error (repeating the same word without acknowledging), perseveration error (repeating the word more than two times), category error (saying words mentioned in the instructions, such as first names, city, country names, and numbers, and use of other letters (for example Ş instead of *S*) in phonemic fluency; and saying words other than animals or first names in the semantic fluency task); and alternation error (saying ≥2 names or animals consecutively) in alternation fluency task.

As a result, the general criteria for scoring phonemic fluency was as follows: only correct answers were added to the total word production count. Repetition errors, category errors, and production errors were scored and analyzed separately. Words that sound the same but differ in meaning were accepted as valid (yüz-yüz-yüzme), as were slang words. For the semantic fluency task repetition and category errors were defined with exception of production error, and for ANIMALS supra-ordinations were not accepted if they followed or preceded a specific animal name (for example, if a participant said fish and later said salmon or vice versa, only salmon was accepted as a word production).

Statistics

SPSS v.16.0 for Windows was used for all analyses (SPSS, Inc., Chicago, IL, USA). Frequency distributions and homogeneity of variances were analyzed and analyses indicated that assumptions of parametric tests have been met. Normative data based on age, gender, and level of education are presented as descriptive statistics. The effect of age, gender, and level of education on all phonemic and semantic fluency categories were investigated using 6X2X3 factor analyses of variance (ANOVA). Errors were also examined and the groups making error and with no errors were compared by using student t-test for independent groups. The factors determining the making of errors or not were determined using logistic regression analyses. Pearson correlation coefficients were computed to determine correlations within and between tasks. Cronbach alpha coefficients were computed to show the internal consistency of two phonemic fluency lists S+A+Z (total score) and D+E+V (total score). The paired samples t-test and Student's t-test were used to examine the difference of mean scores of these two lists.

RESULTS

Results of The Pilot Study

In the pilot study the letters S, A and Z were chosen as the first list in a descending order of the production numbers. Correlation analysis was done to create an alternative list and the letters with the highest correlation coefficients with *S, A*, and *Z* were chosen. The highest correlations were as follows:

S letter (mean number of the produced words=16.6, SD=3.17) and *D* letter (mean number of the produced words=16.7, SD=4.5): r=0.79 (p=0.01); *A* letter (mean number of the produced words =14.3, SD=4.1) and *E* letter (mean number of the produced words =13.5, SD=3.8): r=0.62 (p<0.05); *Z* letter (mean number of the produced words =11.3, SD=3.3) and *V* letter (mean number of the produced words =11.7, SD=3.5): r=0.66 (p<0.01). As such two identical lists to be used as alternative for each other were created: S, A and Z list and the alternative one D, E and V list.

The study included 415 participants (207 female and 208 male). Participants were divided to the 6 age groups (15-24, 25-34, 35-44, 45-54, 55-64, 65 years old and above) as every group including at least 30 male and 30 female participants; and also 3 educational levels (5-8 years, 9-11 years, 12 years and above) as every group including at least 60 male and 60 females. No difference was found between females (Mean=10.87, SD=4.06 years) and males (Mean=11.32, SD=3.82 years) regarding levels of education ($t_{(410)}$=0.25, p=0.67).

Effects of Age, Gender, and Level of Education on Phonemic Fluency

The participants' age and educational levels are presented in Table 1. No difference was found between the groups regarding the age and education levels ($X^2_{(10)}$=8.53, p=0.58).

Table 1. Age and Level of Education of The Participants (Mean ± SD)

Variables	Group	Mean ± SD
Age (Years)	15-24 (42 Female, 46 Male)	20.0 ± 2.7
	25-34 (33 Female, 36 Male)	30.3 ± 3.0
	35-44 (36 Female, 30 Male)	40.1 ± 2.9
	45-54 (32 Female, 35 Male)	48.8 ± 2.7
	55-64 (34 Female, 31 Male)	59.1 ± 2.9
	≥65 (30 Female, 30 Male)	71.4 ± 5.8
Level of Education (Years)	5-8 (66 Female, 61 Male)	6.4 ± 1.5
	9-11 (62 Female, 66 Male)	10.8 ± 0.6
	≥12 (79 Female, 81 Male)	15.1 ± 2.1

Table 2. Mean Number of Produced Words in The Phonemic (Letter) Fluency Task (Mean ± SD)

Age Groups (Years)	Level of Education (Years)			
	5-8	9-11	≥12	Total
S Letter				
15-24	7.00 ± 3.49	11.13 ± 3.45	15.82 ± 5.10	12.59 ± 5.66
25-34	6.81 ± 4.15	11.45 ± 4.94	15.85 ± 4.03	11.70 ± 5.71
35-44	8.73 ± 5.37	11.50 ± 4.97	15.50 ± 4.75	12.03 ± 5.72
45-54	7.73 ± 2.95	11.38 ± 3.99	13.13 ± 4.38	10.81 ± 4.41
55-64	7.71 ± 3.72	11.70 ± 6.01	13.10 ± 3.52	10.86 ± 5.07
≥65	8.95 ± 3.58	9.68 ± 3.67	13.75 ± 5.39	10.78 ± 4.73
Total	7.83 ± 3.96	11.17 ± 4.57	14.76 ± 4.72	
A Letter				
15-24	6.45 ± 3.15	11.43 ± 5.77	15.11 ± 4.80	12.18 ± 5.87
25-34	6.38 ± 2.48	9.55 ± 3.76	13.08 ± 3.99	9.91 ± 4.44
35-44	7.23 ± 4.12	11.35 ± 4.04	14.29 ± 5.43	11.05 ± 5.44
45-54	7.05 ± 3.08	9.76 ± 4.85	13.88 ± 4.62	10.34 ± 5.08
55-64	6.29 ± 3.02	10.57 ± 6.13	11.81 ± 4.01	9.58 ± 5.13
≥65	7.00 ± 4.07	9.58 ± 4.07	12.80 ± 4.76	9.75 ± 4.88
Total	6.74 ± 3.33	10.39 ± 4.87	13.75 ± 4.71	
Z Letter				
15-24	4.25 ± 2.24	6.04 ± 3.08	10.87 ± 3.49	8.10 ± 4.26
25-34	4.00 ± 2.45	7.73 ± 3.21	8.81 ± 2.40	7.00 ± 3.36
35-44	4.95 ± 2.36	7.35 ± 3.20	10.00 ± 3.22	7.52 ± 3.60
45-54	6.23 ± 2.51	7.67 ± 4.36	9.54 ± 3.89	7.87 ± 3.87
55-64	5.24 ± 2.53	7.96 ± 4.61	8.33 ± 2.42	7.20 ± 3.61
≥65	6.19 ± 2.82	6.89 ± 2.88	9.25 ± 3.54	7.43 ± 3.32
Total	5.16 ± 2.59	7.27 ± 3.63	9.67 ± 3.32	
D Letter				
15-24	6.35 ± 3.72	11.87 ± 5.06	14.53 ± 4.22	11.98 ± 5.40
25-34	6.43 ± 3.78	11.77 ± 4.92	14.31 ± 5.13	11.10 ± 5.67
35-44	7.82 ± 4.63	11.50 ± 5.53	14.54 ± 4.68	11.38 ± 5.62
45-54	8.45 ± 4.21	10.90 ± 4.98	13.50 ± 4.17	11.03 ± 4.86
55-64	7.67 ± 4.14	10.35 ± 6.13	12.62 ± 3.53	10.22 ± 5.12
≥65	7.62 ± 3.68	9.16 ± 4.55	12.50 ± 4.83	9.73 ± 4.77
Total	7.41 ± 4.04	10.96 ± 5.22	13.84 ± 4.45	
E Letter				
15-24	6.75 ± 2.71	8.91 ± 4.07	12.82 ± 4.05	10.42 ± 4.56
25-34	6.71 ± 2.90	9.27 ± 3.59	11.81 ± 4.39	9.45 ± 4.24
35-44	8.09 ± 3.44	10.60 ± 4.55	12.71 ± 4.43	10.53 ± 4.53
45-54	7.41 ± 2.87	9.43 ± 3.71	12.75 ± 3.90	9.96 ± 4.15
55-64	6.33 ± 3.38	9.96 ± 4.47	11.05 ± 3.64	9.14 ± 4.31
≥65	6.71 ± 3.08	8.11 ± 4.00	11.50 ± 4.44	8.75 ± 4.32
Total	7.02 ± 3.08	9.39 ± 4.07	12.23 ± 4.13	
V Letter				
15-24	4.35 ± 3.07	6.30 ± 4.08	9.80 ± 3.47	7.65 ± 4.21
25-34	4.43 ± 3.64	7.27 ± 3.73	9.15 ± 3.51	7.12 ± 4.07
35-44	4.77 ± 3.12	7.85 ± 3.56	9.42 ± 3.20	7.39 ± 3.79
45-54	5.14 ± 2.27	7.48 ± 4.31	8.29 ± 3.28	7.00 ± 3.58
55-64	4.48 ± 2.87	8.43 ± 4.52	8.90 ± 3.39	7.31 ± 4.14
≥65	5.24 ± 3.70	7.11 ± 2.54	10.05 ± 3.61	7.43 ± 3.85
Total	4.74 ± 3.10	7.41 ± 3.86	9.33 ± 3.41	

In order to determine the effects of age, gender, and level of education on the number of words produced 6X3X2 factor ANOVA analysis was conducted. According to the results, age and gender were found to have no statistically significant effect on the number of words produced with the letters S, A, Z, D, E and V. The findings showed that level of education had a statistically significant effect on all phonemic categories, as follows: for *S*[$F_{(2,379)}$=76.59, p<0.001, η^2=0.26], *A*[$F_{(2,379)}$=81.73, p<0.001, η^2=0.31], *Z*[$F_{(2,379)}$=64.66, p<0.001, η^2=0.24], *D*[$F_{(2,379)}$=63.23, p<0.001, η^2=0.25], *E*[$F_{(2,379)}$=61.26, p<0.001, η^2=0.25] and *V*[$F_{(2,379)}$=58.92, p<0.001, η^2=0.23]. An interaction effect of age and education level was found for the word production with Z letter [$F_{(10,379)}$=2.46, p<0.001, η^2=0.06], Otherwise no statistically significant effect was determined between the independent variables. The mean±SD number of words produced for each letter during the phonemic fluency task is presented in Table 2. As indicated below, as gender did not have a main effect on the number of words produced during the phonemic fluency task the results are presented without further division for gender.

All designated levels of education differed from one other based on post-hoc testing with Bonferroni correction. The number of produced words for each letter were found to be different in every education level from each other (p<0.05). For all the letters, the lowest education group (5-8 years) was found to produce the least words, the participants with 12 years and above education were found to produce the most words, and the number of words produced by the group with 9-11 years of education was found in between these 2 groups.

While the interaction effect between age and level of education for the letter Z was examined, for most age groups, performance increased as the level of education increased but at older ages this discrepancy tended to diminish. Only in the 55-64 age group performance of those with 9-11 years and ≥12 years of education did not differ.

Effects of Age, Gender, and Level of Education on Semantic Fluency

Names

Regarding the semantic fluency task, age [$F_{(5,379)}$=8.81, p<0.001, η^2=0.08], gender [$F_{(1,379)}$=21.22, p<0.001, η^2=0.04] and level of education [$F_{(2,379)}$=24.87, p<0.001, η^2=0.10] were found to have a statistically significant effect on the production of name generation. Interaction effects were not found significant. The mean ± SD number of words produced during the semantic fluency tasks and alternation task are presented in Table 3.

Post-hoc analysis showed that there were differences in the production of NAMES based on age; the 15-24 and 25-34 age groups were similar in they both produced most number of words, and the 55-64 and ≥65 age groups produced the

Table 3. The Mean Number of Produced Words for Semantic Fluency Tasks (Mean ± SD)

Age Groups (Years)	Level of Education (Years)						
Task	**5-8**		**9-11**		**≥12**		**Total**
	Female	**Male**	**Female**	**Male**	**Female**	**Male**	
First Names							
15-24	22.30 ± 5.21 n=10	24.6 ± 3.34 n=10	32.70 ± 5.88 n=10	28.46 ± 8.55 n=13	28.63 ± 5.20 n=22	31.91 ± 7.60 n=23	28.75 ± 7.07
25-34	24.30 ± 6.67 n=10	24.18 ± 6.24 n=11	29.64 ± 7.10 n=11	28.00 ± 5.80 n=11	32.83 ± 8.10 n=12	27.50 ± 6.47 n=14	27.86 ± 7.18
35-44	25.42 ± 4.32 n=12	23.30 ± 6.46 n=10	27.50 ± 5.15 n=10	27.10 ± 4.33 n=10	32.21 ± 5.49 n=14	26.20 ± 4.44 n=10	27.23 ± 5.70
45-54	25.92 ± 5.16 n=12	22.70 ± 5.21 n=10	27.00 ± 6.16 n=10	23.27 ± 3.82 n=11	30.50 ± 8.20 n=10	26.57 ± 6.81 n=14	25.99 ± 6.33
55-64	22.09 ± 5.05 n=11	19.80 ± 5.88 n=10	29.83 ± 9.81 n=12	22.55 ± 6.74 n=11	27.82 ± 6.42 n=11	24.10 ± 3.90 n=10	24.52 ± 7.31
≥65	21.91 ± 6.27 n=12	17.10 ± 5.11 n=9	23.22 ± 7.69 n=9	19.40 ± 3.20 n=10	27.80 ± 9.85 n=10	21.90 ± 8.54 n=10	21.87 ± 7.57
Total	23.73 ± 5.51	21.98 ± 5.90	28.47 ± 7.49	24.95 ± 6.55	29.92 ± 7.05	27.32 ± 7.33	
Animals							
15-24	14.20 ± 3.82	17.20 ± 2.49	21.70 ± 4.92	19.85 ± 6.04	21.82 ± 3.90	23.04 ± 3.62	20.44 ± 4.99
25-34	15.40 ± 3.13	19.18 ± 5.53	20.45 ± 4.80	21.82 ± 4.77	21.50 ± 4.68	20.79 ± 3.29	19.99 ± 4.74
35-44	16.83 ± 3.27	17.00 ± 4.62	20.00 ± 3.92	20.30 ± 5.25	24.00 ± 4.24	20.40 ± 3.89	19.92 ± 4.81
45-54	16.83 ± 3.19	18.60 ± 3.10	20.10 ± 4.43	21.10 ± 4.44	21.90 ± 3.80	21.30 ± 7.10	19.97 ± 4.87
55-64	16.91 ±5.63	15.10 ± 5.76	21.83 ± 6.28	18.45 ± 4.61	21.82 ± 5.55	20.60 ± 3.31	19.20 ± 5.70
≥65	17.36 ± 2.50	16.50 ± 5.30	17.90 ± 4.57	16.80 ± 4.66	21.30 ± 8.00	19.60 ± 4.97	18.23 ± 5.28
Total	16.32 ± 3.73	17.30 ± 4.66	20.42 ± 4.90	19.76 ± 5.11	22.10 ± 4.90	21.30 ± 4.55	
Alternation							
15-24	16.50 ± 3.17	18.60 ± 1.65	21.60 ± 4.40	20.92 ± 3.62	21.27 ± 3.10	23.35 ± 5.79	20.95 ± 4.52
25-34	16.30 ± 3.16	18.27 ± 4.08	21.45 ± 7.27	20.36 ± 4.37	21.83 ± 3.41	20.57 ± 4.52	19.91 ± 4.86
35-44	16.83 ± 4.00	17.80 ± 2.97	19.20 ± 3.36	18.50 ± 4.22	22.43 ± 5.15	20.70 ± 3.34	19.36 ± 4.33
45-54	17.50 ± 4.70	17.70 ± 3.10	20.10 ± 5.11	17.64 ± 3.35	19.80 ± 5.92	21.86 ± 5.05	19.19 ± 4.80
55-64	14.10 ± 4.32	13.30 ± 4.55	20.33 ± 6.44	18.36 ± 4.95	19.18 ± 4.02	17.80 ± 2.49	17.28 ± 5.20
≥65	14.91 ± 4.41	13.20 ± 3.12	15.44 ± 4.82	15.80 ± 2.62	20.40 ± 5.15	15.80 ± 5.31	15.92 ± 4.71
Total	16.05 ± 4.06	16.51 ± 3.98	19.81 ± 5.61	18.71 ± 4.15	20.97 ± 4.36	20.67 ± 5.30	

least number of words. Differences between age groups could be seen on Table 3.

Gender was found to have a significant effect on names production and females (Mean=27.52, SD=7.20) produced more names than males (Mean=24.99, SD=7.02). When the education effect examined, the first group with the lowest education level (5-8 years) produced fewer words than the other 2 levels of education groups (9-11 years, and ≥12 years) ($p<0.001$).

Animals

Only level of education had a main effect on the production of ANIMALS [$F_{(2,379)}= 36.18$, $p< 0.001$, $\eta^2=16.2$] while age and gender had no effect. No interaction effects were found. Post-hoc analysis showed that production of animals differed between all 3 levels of education groups ($P<0.05$); as the level of education increased the production of animals increased (Mean=16.76, SD=0.42; Mean=20.02, SD=0.14 and Mean=21.50, SD=0.38, for education levels respectively).

Alternation

With regard to the ALTERNATION task, age [$F_{(5, 379)}$=9.68, p<0.001, η^2=0.08] and level of education [$F_{(2,379)}$= 31.37, p<0.001, η^2=0.12] had a statistically significant main effect on the generation of words, whereas gender did not have both main and interaction effect (p=0.28). Bonferroni analysis showed that production numbers generally decreased with the decreasing education levels, the inter-group changes in performance can be tracked from Table 3. Post-hoc analysis for education groups showed that all levels of education groups were found to be different from one other, as the lowest education group had the lowest production and the highest education group had the highest production (Mean=16.25, SD=0.39; Mean=19.14, SD=0.39 and Mean=20.46, SD=0.36 for education levels respectively) (p<0.05).

As a conclusion level of education affected verbal fluency task performance and the performance increased as the level of education increased. The findings for gender and age were not as consistent. Only the production of NAMES was affected by gender favoring women. Age had an effect on NAMES generation and the ALTERNATION task but not on ANIMALS.

Analysis of Errors in Word Production

Three types of errors were analyzed in this study: repetition, category, and production. The effects of age, gender and education were examined on making error; the participants who made errors and who did not make any errors in every category were evaluated regarding age, gender and education using logistic regression analyses. The findings of logistic regression analyses are presented in Table 4.

A total repetition error score was computed for each letter, for *S+A+Z* total, and for the alternate list D+E+V total; regarding the similarity of the results for both lists, the results for the alternate list were not presented, but the findings for S, A and Z were presented in this article. The *S+A+Z* total score showed that 40% of the participants made no repetition errors; of the participants who made errors, 45.8% made one error, 25.7% made 2 errors, remaining made more than 2 errors. Participants who did not make errors and those who did were examined with logistic regression analysis, age and level of education were found to have an effect on making error, while gender was not. The participants who did not make errors were younger (Mean=39.71, SD=17.43) than those who did (Mean=45.42, SD=17.65), but had fewer years of education (Mean=10.36, SD=3.91 and Mean=11.63, SD=3.87, respectively).

A total category error score for *S+A+Z* was computed, which showed that 62.2% of the participants made no category errors. Of those that made errors 62% made one error, 19.8% made 2 errors and remaining made more than 2 errors. When participants who did not make errors and those who did were examined, age was found to have an effect on making error, while gender and level of education were not. Those who did not make errors were found to be younger than who did (Mean=39.96, SD=17.03 and Mean=48.25, SD=17.79, respectively).

In addition, production errors were also analyzed. Likewise due to the low number of production errors, a total production error score for *S+A+Z* was computed, which showed that 90.2% of the participants made no production errors. Of those who made errors 58% made only one error, 24% made 2 errors and the remaining made more than 2 errors. Those who did not make production errors and those who made were examined, age and level of education were found to have effect on making errors while gender was not.

Regarding the semantic fluency task, repetition and category error scores were defined and computed, and the participants who did and did not make errors were examined for the effects of age, gender and level of education on making errors with logistic regression analysis.

In all, 52.5% of the participants made no repetition errors on the NAMES production task. When those who did and did not make errors were examined, age was found to have a significant effect on making errors while gender and level of education were not. The participants who did not make errors were younger than those that did (Mean=40.59, SD=17.62 and Mean=45.87, SD=17.55, respectively). In total, 52% of the participants made no repetition errors on the ANIMALS production task. Those who did and did not make errors were examined with logistic regression, age was found to have effect on making error but gender and level of education were found to have no effect. Those who did not make errors were younger than those who did (Mean=40.20, SD=16.59 and Mean=46.24, SD=18.48, respectively).

Since 99.3% and 98.6% of the participants did not make category errors for NAMES and ANIMALS respectively, further analysis was not performed for these error types.

Regarding ALTERNATION task, 58.1% of the participants made no repetition errors. Those who did and did not make errors were examined, age, level of education and gender were found to have a statistically significant effect on making errors; women were found to make more repetition errors in this task. Due to the very low number of participants who made category errors (1.4%), no further analysis was performed in this error type.

In all, 71.3% of the participants produced no alternation errors during the alternating fluency task. Those who did and did not make errors were examined and age, gender and level of education were found to have no effect on alternation error.

Table 4. Effects of Age, Gender and Level of Education on Making Error in Different Types of Errors

	Beta	Standard error	Wald	p	OO	Confidence Interval (95%)
Error Types						
S+A+Z Total, Repetition Error						
Age	0.137	0.059	5.358	0.02*	1.15	1.02-1.29
Education level	0.421	0.126	11.233	0.02*	1.52	1.19-1.95
Gender	0.271	0.203	1.771	0.18	1.31	0.88-1.95
S+A+Z Total, Category Error						
Age	0.176	0.062	7.915	0.01*	1.19	1.06-1.35
Education level	-0.070	0.158	0.198	0.66	0.93	0.69-1.27
Gender	0.305	0.212	2.066	0.15	1.36	0.90-2.05
S+A+Z Total, Production Error						
Age	0.301	0.071	18.190	0.01*	1.35	1.18-1.55
Education level	-0.283	0.144	3.860	0.05	0.75	0.57-1.00
Gender	0.274	0.238	1.330	0.25	1.31	0.83-2.10
First Names, Repetition Error						
Age	0.160	0.061	6.840	0.01*	1.17	1.04-1.32
Education level	-0.191	0.127	2.264	0.13	0.83	0.64-1.06
Gender	0.032	0.210	0.023	0.88	1.03	0.68-1.56
Animals, Repetition Error						
Age	0.200	0.064	9.666	0.01*	1.22	1.08-1.39
Education level	-0.088	0.134	0.439	0.51	0.92	0.70-1.19
Gender	0.151	0.220	0.470	0.49	1.16	0.76-1.79
Alternation, Repetition Error						
Age	0.131	0.062	4.528	0.03*	1.14	1.01-1.29
Education level	0.441	0.132	11.222	0.01*	1.56	1.20-2.01
Gender	-0.577	0.213	7.348	0.01*	0.56	0.37-0.85
Alternation, Alternation Error						
Age	0.045	0.060	0.562	0.45	1.05	0.93- 1.18
Education level	-0.155	0.124	1.559	0.21	0.86	0.67-7-1.09
Gender	-0.065	0.205	0.101	0.75	0.94	0.63-1.40

OO: odds ratio, *p< 0.05

None of the participants made perseverative errors in our sample.

Consistency of Verbal Fluency Task Performance

Correlation coefficients were computed for all tasks. Correlation coefficients between phonemic fluency tasks are presented in Table 5 and correlations between phonemic and semantic tasks are presented in Table 6.

As seen from the tables, all the tasks were significantly correlated with each other. In terms of phonemic fluency scores, the number of words produced for *S, A,* and *Z* correlated with *S+A+Z* group total score; and *D, E,* and *V* scores correlated with the *D+E+V* group total score. Cronbach's alpha was .86 for both *S+A+Z* total group and *D+E+V* total group. Phonemic fluency total scores (*S+A+Z* and *D+E+V* group total scores) were significantly correlated with semantic fluency tasks' total scores.

In order to determine the differences in phonemic fluency performance using the primary letters (*S, A* and *Z*) and the alternate letters (*D, E* and *V*) the paired sample t test was used for *S-D, A-E*, and *Z-V* letter pairs, and the total *(S+A+Z)-(D+E+V)* pair. The mean number of *S* words produced was significantly higher than the mean number of *D* words ($t_{(414)}$=3.03, p=0.003), and the mean number of *A* words produced was significantly higher than the mean number

Table 5. Correlations Between the Letters for Phonemic Verbal Fluency Tests

	S	A	Z	D	E	V	S+A+Z	D+E+V
S	1	r=0.78*	r=0.70*	r=0.76*	r=0.74*	r=0.68*	r=0.92*	r=0.80*
A		1	r=0.75*	r=0.78*	r=0.77*	r=0.70*	r=0.94*	r=0.83*
Z			1	r=0.69*	r=0.70*	r=0.70*	r=0.87*	r=0.76*
D				1	r=0.78*	r=0.73*	r=0.82*	r=0.94*
E					1	r=0.70*	r=0.81*	r=0.91*
V						1	r=0.76*	r=0.88*
S+A+Z				.			1	r=0.87*
D+E+V								1

*p < 0.01

Table 6. Correlations Between The Total Scores Of Phonemic and Semantic Fluency Categories

	S+A+Z	D+E+V	Animals	Alternation
First Names	r=0.45*	r=0.47*	r=0.59*	r=0.65*
Animals	r=0.53*	r=0.54*	r=1.0	r=0.64*
Alternation	r=0.49*	r=0.51*	r=0.64*	r=1.0

*P < 0.01

of *E* words ($t_{(414)}$=4.85, p<0.001). There wasn't a significant difference between the number of *Z* and *V* words produced ($t_{(414)}$=1.50, p=0.13). The mean total number of *S+A+Z* words produced was significantly higher than the mean total number of *D+E+V* words ($t_{(414)}$= 5.02, p<0.001). The participants produced fewer words using the alternate letters.

DISCUSSION

In this study normative data for phonemic and semantic fluency in a Turkish-speaking sample were obtained. Age, gender and level of education effects on all fluency tasks were examined. Additionally, alternating fluency performance was measured, and different types of errors were analyzed according to participants' age, gender and level of education.

Phonemic fluency scores were lower in the present study than in studies on different languages, especially those conducted in the West, which may have been due to some cultural or linguistic factors (Ardila and Moreno 2001, Ostrosky-Solis et al. 2004). Many studies reported differences on verbal fluency production rates among different ethnic groups and languages (La Rue et al. 1999, Loewenstein et al. 1995, Roselli et al. 2002). It could be speculated that lack of familiarity with test taking conditions in our culture might have led to lower production. Another reason might be the lower repertory for vocabulary especially in lower educated groups in our country. Semantic fluency scores in the present study, however, were comparable with those of other studies and much higher than the present study's phonemic fluency scores. Overall, in the present study the word production rate during the semantic fluency task was consistent with earlier reports (Crowe 1998, Kave 2005, Ratcliff et al. 1998). The difference between phonemic and semantic fluency performance was reported also in other previous studies and was generally thought to reflect the differences in cognitive processes involved and word-search strategies used during the tasks (Kave 2005, Kozora and Cullum 1995, Troyer 2000).

The present findings show that level of education was the only variable that had a significant effect on the word production, which is consistent with earlier studies conducted in different languages (Acevedo et al. 2000, Ardila and Moreno 2001, Brickman et al. 2005, Kave 2005, Mathuranath et al. 2003, Ostrosky-Solis et al. 2004, Ratcliff et al. 1998). Level of education had an effect both on phonemic and semantic fluency scores, as well as alternation fluency task.

Age was found to have no effect on phonemic fluency tasks in this study. This finding is in accordance with some of the previous studies (Bolla et al. 1990, Parkin and Java 1999). Bolla found that verbal intelligence was related to phonemic fluency performance while age and education were not, but in their sample education levels were high. Due to the nature of the relationship between age and level of education, separating their effects on verbal fluency performance can be very difficult. In Turkey legislation about compulsory education changes frequently and different cohorts are exposed to different legislations and regulations. Also, the chances for and the level of education are affected by many factors in our country. The rates of university graduates for the last decades are higher than the rates of 1950's (Tanrıkulu 2009). Also, few women had a university education in previous decades. Thus, older age groups with university education, especially older women may reflect a cohort with distinctive characteristics like higher socioeconomic status and higher intelligence etc. This may explain the absence of age effect on some of the tasks, higher educated elderly characteristics compensating for the age's effect on tasks.

Regarding semantic fluency, age, gender and level of education had a discriminatively different effect than they had

on phonemic fluency. NAMES production was affected by age, gender and level of education whereas ANIMALS production was affected only by level of education in the present study. The number of NAMES produced increased as the level of education increased but decreased with increasing age. The linguistic and semantic characteristics of common nouns (ANIMALS) and proper names (first NAMES in our study) appear to be distinct (Semenza 2006, Yasuda and Ono 1998). A category of common nouns contains a semantic hierarchy whereas proper nouns are devoid of a semantic network. Semantic fluency for common names has been hypothesized to be cue-dependent, thus minimizing the burden on executive verbal retrieval processes, while verbal fluency for proper nouns places a greater demand on executive verbal retrieval processes (Semenza 2006). It could be speculated that age effect emerges at more difficult tasks, and it is understandable that age has no effect on a relatively easy task such as ANIMALS. Cue-dependent tasks (ANIMALS) also requires intact semantic stores; so it can be concluded that in a well-chosen sample of healthy elderly group, semantic fluency (ANIMALS) is not affected by age; the results in our study reflects a well-chosen sample with intact semantic stores composed of healthy elderly individuals.

The alternation fluency task was affected by age and level of education like NAMES in the present study. Since alternation task always follows semantic tasks in our study, there might be a practice effect; due to this practice effect a similar pattern for age effect might have been observed. Also, alternation tasks require more executive strategies. Thus, the observed decrease with age in the rate of production during the ALTERNATION task as observed in NAMES production, might reflect the decrease in executive abilities with increasing age.

In the present study gender had no effect on phonemic fluency scores. Regarding semantic fluency tasks, gender had an effect on the production of NAMES —female participants produced more NAMES than the males- but had no effect on the production of ANIMALS. Gender has been the most inconsistent variable affecting VFT scores in different studies. Generally, a gender difference has not been observed in many studies (Chan and Poon 1999, Harrison et al. 2000, Lee et al. 2004, Tombaugh et al. 1999, Troyer 2000). However, Ruff et al. (1996) reported a significant gender effect on both phonemic and semantic fluency tasks, whereas Auriacombe et al. (2001) and Kosmidis et al. (2004) reported a modest effect on semantic fluency. Future studies are required to investigate the gender difference on fluency scores.

Types of errors in word production were also investigated in this study. Age, education and gender had no effect on any type of the errors. Gender has been found to have no effect on making error on all error types and in all fluency tasks except repetition errors in ALTERNATİON task. Age has been found to have a significant effect on all error types in all the fluency tasks including phonemic, semantic and alternation fluency; errors increased as the age increased. Level of education was also found to have an effect on many error types, the errors decreased as the level of education increased.

The repetition errors in all the fluency tasks were found to be related to the age. Avoiding repetition requires short-term task tracking. Task tracking, and suppressing repetition are all a part of working memory, which is an executive ability; it is well known that working memory is negatively affected by the age. Category errors in phonemic fluency tasks were also found to be related to age in our study; avoidance of this type of error necessitates such executive functions as working memory and suppression of irrelevant stimuli. Together with the other age-related effects on VFT error scores, it can be concluded that executive abilities are affected by increasing age and it is reflected on the performance of fluency tasks.

The present study has some limitations. Small sample size is one of the most important limitations. Also, most of the participants were living in urban areas. Future studies with larger sample sizes including subjects from suburban areas may reveal more information about performance on verbal fluency. Education and intelligence levels might be highly correlated; however, verbal intelligence levels might be an independent factor on verbal performance. General and verbal intelligence levels were not measured in this study due to practical difficulties. Therefore, future studies controlling verbal intelligence levels may reveal more precise results. Another limitation was the lack of cognitive evaluation of the elderly individuals with a screening test. However, all the elderly subjects were evaluated with a detailed psychiatric examination, and the individuals with intact daily functioning with no cognitive symptoms were included in the study.

In the present study alternation task was always administered after the semantic tasks. It should be kept in mind that the use of the same categories for both semantic and alternation tasks may produce practice effects. For clinical practice it is recommended to use these tests in the same order if investigators want to compare their results with our norms.

One of our aims was to create an alternative list for phonemic fluency. However, our results revealed that only Z and V letters could be used interchangeably. S and its alternative D, A and its alternative E letter produced different number of words, this might be due to the small sample size of the 15-subject pilot study. For future studies it is recommended to determine other valid letters for an alternative list.

To the best of our knowledge the present study is the first to present normative data for verbal fluency tasks in a Turkish sample. The normative data presented can be used to evaluate verbal fluency performance in native Turkish-speaking participants aged 15- 82 years, both genders, and with at least 5 years of education.

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