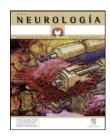# NEUROLOGÍA

ORIGINAL ARTICLE

Spanish normative studies in young adults (*NEURONORMA* young adults project): Norms for verbal fluency tests[☆]

M. Casals-Coll[a], G. Sánchez-Benavides[a], M. Quintana[a], R.M. Manero[b], T. Rognoni[a], L. Calvo[a], R. Palomo[a], F. Aranciva[a], F. Tamayo[a], J. Peña-Casanova[b,*]

[a] *Grupo de Neurología de la Conducta y Demencias, Programa de Neurociencias, Instituto de Investigación Hospital del Mar (IMIM), Barcelona, Spain*
[b] *Sección de Neurología de la Conducta y Demencias, Servicio de Neurología, Hospital del Mar, Barcelona, Spain*

Abstract
Introduction: Lexical fluency tests are frequently used in clinical practice to assess language and executive function.
Objective: As part of the Spanish normative studies project in young adults (*NEURONORMA* young adults), we provide age- and education-adjusted normative data for 3 semantic fluency tasks (animals, fruits and vegetables, and kitchen tools), three formal lexical fluency tasks (words beginning with P, M and R), three excluded-letter fluency tasks (words excluding A, E and S) and a verb fluency task.
Material and methods: The sample consisted of 179 participants who are cognitively normal and range in age from 18 to 49 years. Tables are provided to convert raw scores to scaled scores. Age- and education-adjusted scores are provided by applying linear regression techniques.
Results: The results show that education impacted most of the verbal fluency test scores, with no effect related to age and only minimal effects related to sex.
Conclusions: The norms obtained will be extremely useful in the clinical evaluation of young Spanish adults.
© 2011 Sociedad Española de Neurología. Published by Elsevier España, S.L. All rights reserved.

Estudios normativos españoles en población adulta joven (proyecto NEURONORMA jóvenes): normas para los test de fluencia verbal

Resumen
Introducción: Los test de fluencia verbal se utilizan con frecuencia en la práctica clínica con el fin de explorar el lenguaje y las funciones ejecutivas.
Objetivo: En el presente estudio, como parte de los estudios normativos españoles del proyecto NEURONORMA jóvenes, se aportan datos normativos ajustados por edad y escolaridad para

3 tareas de fluencia semántica (animales, frutas y verduras, y utensilios de cocina), 3 tareas de fluencia formal (palabras que empiezan por P, M, y R), 3 tareas de fluencia de letra excluida (palabras que no contienen A, E, y S) y una tarea de fluencia de verbos.

Material y métodos: La muestra está formada por 179 participantes, cognitivamente normales, de entre 18 y 49 años de edad. Se aportan tablas para convertir las puntuaciones brutas en escalares y tablas para realizar los ajustes pertinentes por edad y escolaridad a partir de regresiones lineales.

Resultados: Los resultados obtenidos muestran la influencia de la escolaridad para la mayoría de los test de fluencia verbal, escaso efecto de la edad y mínimo efecto del género.

Conclusiones: Las normas obtenidas aportan datos de gran utilidad clínica para la evaluación de población adulta joven española.

Introduction

The primary objective of the NEURONORMA project (NN) is to collect normative data for frequently used neuropsychological tests in an adult population older than 49.[1] The present study (NEURONORMA young adults [NNy]) collects normative data from an adult population aged 49 and younger using the same tests. The general characteristics of this study are described in another article.[2]

Our article, within the framework of the project mentioned above, presents normative data from young adult subjects (aged 18—49) on 10 verbal fluency (VF) tests: 3 semantic fluency tasks (SVF) for animals, fruits/vegetables and kitchen tools; 6 formal fluency tasks (FVF); 3 initial letter tasks (ILF); 3 excluded letter tasks (ELF) and a verb fluency task (VVF). This last is a new test which we have added to the neuropsychological test battery used in the NN project.

VF tests provide data about the subject's attention, short-term memory, ability to begin and maintain verbal production, mental flexibility, response inhibition capacity, mental processing speed, and semantic memory.[3] They are widely used for both research and neuropsychological examinations since they are both easy to administer and sensitive to a wide variety of cognitive dysfunctions.[4—6]

VF tests are numerous and available in multiple versions that appear in some compilations of neuropsychological tests.[4,7,8] Many neuropsychological test batteries include a VF test. Most versions evaluate production of words pertaining to a set grammatical category in the period of 1 minute. The most common categories of FV tests are semantic (animals) and formal (initial letter).

Benton developed the first oral version of the FVF test[9]; its most recent version is the Controlled Oral Word Association Test (COWAT).[5] While there is currently no consensus on which version is the most appropriate for studying FVF, the most commonly employed test of ILF in English uses the letters F, A, and S. Crawford et al.[10] developed another type of FVF task, excluded letter fluency, which Shores et al.[11] used to gather normative data for young adults.

A wide array of categories has been proposed for studying SVF: animals, fruits and vegetables, kitchen tools, items in a supermarket, or personal names. The most widely studied category is names of animals.[12]

The VVF, developed by Piatt et al., studies production of words in the verb category. The same researchers also provided normative data for both the elderly[13,14] and young adults.[15]

Several normative studies have shown how sociodemographic factors affect performance on VF tests. Specifically, scores show significant age and education effects.[16—22] Tombaugh et al.[12] concluded that FVF is more sensitive to education, while the SVF is more sensitive to age. Other studies have described a positive relationship between verbal intelligence and FV in older adults.[23—25]

Whether or not there is a sex effect on the number of words generated in VF tasks is a matter for debate. While most studies show only minimal evidence of a sex effect for these tasks, other studies have found sex to be significantly correlated with SVF.[16,26] A meta-analysis carried out by Loonstra et al.[19] concluded that there was a clear sex effect on the COWAT test.

Most studies in the literature describe an ethnicity effect on VF.[17,27] However, other studies, such as the one by Kempler et al.,[28] attribute differences in performance to linguistic issues and not to any effect of ethnicity per se.

Other factors, such as bilingualism or the geographic region, may also influence performance on VF tasks.[29]

Benton et al.[5] considered ranges of frequencies for letters in Spanish in order to develop a multilingual test battery to test for aphasia, the Multilingual Aphasia Examination. Many Spanish-language neuropsychological test batteries include VF tasks.[30—33] Furthermore, numerous studies provide normative data in Spanish.[34—42] Artiola et al.[31] proposed using the letters P, M, and R for the FVF task in order to minimise language effects. Other studies have compared results from bilingual and non-bilingual Spanish speakers on tasks in English and Spanish.[16,27,43] Researchers recently proposed a standard method for administering the VF test in Spanish.[44]

To date, many normalisation studies for VF tasks have focused on age and sex effects in adults older than 50 (see Mitrushina et al.[8]). On the other hand, some studies warn against applying validated normative data from adults over 50 in younger subjects, given that the impact of sociodemographic variables changes throughout the subject's lifetime.[21] Results from numerous studies stress the need for normative data appropriate for studying VF in the young adult population. The purpose of our study is to present an initial description of performance on formal, semantic, and verb VF tasks in a young adult population in a specific cultural and linguistic context.

Material and methods

Subjects

Recruitment methods and sample characteristics have already been described in another article.[2] To summarise, we recruited 179 white subjects who had been educated in Spain and were either native Spanish speakers or bilinguals. The sample was stratified by age and educational level. None of the subjects presented cognitive disorders; scores on the Mini-Mental State Examination (MMSE)[45,46] were ≥24 and scores on the Memory Impairment Screen (MIS)[47,48] were ≥4.

Neuropsychological measurements

We followed the neuropsychological protocol established for the NN project.[34] All tests were administered according to the procedures published in their manuals.

Below, we describe the specific methods for administering each of the VF tests.

Semantic fluency. Test makes use of 3 semantic categories: animals, fruits and vegetables, and kitchen tools. Subjects are allowed 60 seconds to provide answers for each category. They received the instructions described in the Barcelona test manual.[32] Only correct responses were counted; we did not list incorrect responses or repeated answers, including words for the 2 sexes of the same species unless the root words were etymologically different (an example in English would be 'stallion' and 'mare'). Variant words for the same animal species were also eliminated, as well as generic terms in cases in which the subject named more than 1 animal corresponding to a generic group (for example, if the subject named both 'bird' and 'canary', only 'canary' was counted). Electrical appliances were excluded from the 'kitchen tools' category.

Formal VF with a set initial letter. Subjects were asked to name as many words starting with a specific letter as possible in 60 seconds. Subjects performed the task for the letters P, M, and R. These letters were used in the same way as we describe in NN,[34] and were chosen because they are well-suited to the Spanish lexicon (unlike F, A, and S).[31] Proper names and derivative words were not permitted.

Formal VF with a set excluded letter. Subjects were asked to name as many words as possible not containing a specific letter in 60 seconds. Excluded letters were A, E, and S, as stated in the NN project.[34] Proper names and words derived from previous answers were not permitted.

Verb fluency. Subjects were asked to name as many verbs or 'action words' as possible during 60 seconds. Different verbal forms of the same action were not counted (to cite an equivalent English example, answering 'sing' and 'singing' would count as a single answer).

Statistical analysis

A uniform statistical analysis was carried out for all neuropsychological tests included in the project due to its role as a co-normalisation study. The procedure can be summarised as follows: (a) we calculated the cumulative frequencies of the raw scores on all the VF tests. Percentile ranges were assigned to raw scores according to their position within the distribution. Percentile ranges were then converted to NSS (NEURONORMA Scaled Scores) ranging from 2 to 18. This conversion of raw scores produces an approximation of a normal distribution (mean ± standard deviation: 10 ± 3) that permits use of linear regression models; (b) NSS correlation coefficients (r) and coefficients of determination (R^2) were determined for age, years of education, and sex for each of the VF tests. Adjustments were applied only to those variables with a percentage of explained variance exceeding 5% and a statistically significant coefficient of regression. (c) The NSS was adjusted for age, education, and sex according to the following formula: $NSS_{A\&E\&S} = NSS - (\beta_1 \times [age - 35] + \beta_2 \times [education - 13] + \beta_3 \times sex)$, using the regression coefficient (β) from this analysis as the basis for adjusting for age and education. The resulting value was truncated to the next lower integer.

Results

Table 1 displays the array of frequencies of raw scores for the entire group aged 18 to 49, with the corresponding scaled scores and percentile ranks. To use the table, we select the patient's raw score for each test and identify the corresponding NSS and the percentile rank.

Based on the NSS, and given a normal distribution for the sample, we calculated the correlation coefficient (r) and coefficient of determination (R^2), which are shown in Table 2. The variable 'education' explained a large part of the variance on most of the VF tests: animals (10.2%), fruits/vegetables (10%); initial letter 'P' (8.1%) and 'M' (10.8%); excluded letter 'A' (10.8%), 'E' (9.6%), and 'S' (8.3%); and verbs (18.7%). This was not the case for initial letter 'R' and kitchen tools, for which the percentage of variance explained by education was less than 5%. Age explained 6.7% of the variance in performance on the SVF test for fruits/vegetables and 6.6% of the variance for initial letter 'R'. There was no significant age effect on any of the other tests. No sex differences were observed for any of the VF tests.

Multiple regression coefficients were used to adjust for age and education by using the formula for $NSS_{A\&E}$. Based on these data, we created age and education adjustment tables which doctors can use to adjust scores (Tables 3–5). Tables 3 and 4 are used by selecting the variable 'years of education' or 'age' on the top row in order to ascertain the correction to be applied to the NSS for each test. Table 5 is used by selecting the variables 'age' from the top row and 'years of education' from the left column to determine the correction to apply to the score.

Discussion

The main objective of our study was to obtain normative data from young Spanish adults completing a wide range of VF tests as part of a co-normalisation project for neuropsychological testing tools. The methodology is described in another article.

Table 1 Scalar scores and percentiles corresponding to the verbal fluency tests.

NSS	Percentile ranges	Semantic			Formal						Verbs
		Animals	Fruits/vegetables	Kitchen tools	Initial letter			Excluded letter			
					P	F	R	A	E	S	
2	<1	1—11	1—10	1—6	1—6	1—4	4	1—2	1—5	1—6	1—8
3	1	12—13	—	7	7	5	5	3	6	7	9
4	2	14	11	8	8	6	6	—	7	8—9	—
5	3—5	15—16	12	9—10	9—10	7	7	4	—	10	10—11
6	6—10	17	13—14	11	11	8	8	5	8	11	12—14
7	11—18	18—19	15—16	12	12	9	9—10	6	9	12—13	15—16
8	19—28	20	17—18	13	13	10—11	11	7	10	14	17—18
9	29—40	21—22	19	14	14—15	12—13	12	8—9	11—12	15—16	19—20
10	41—59	23—24	20—21	15—16	16—18	14—15	13—14	10—11	13—14	17—19	21—23
11	60—71	25—26	22	17	19	16—17	15—16	12	15	20—21	24
12	72—81	27—28	23—24	18—19	20—21	18	17	13—14	16	22—23	25—26
13	82—89	29—30	25	20	22	19—20	18—19	15—16	17	24—25	27—29
14	90—94	31	26—28	21	23—24	21—22	20	17	18—19	26—28	30—34
15	95—97	32—33	29	22—24	25—26	23—24	21—22	18—19	20—21	29—30	35—37
16	98	34—36	30	25	27	25	23	20—21	22	31—32	38—39
17	99	37	31—32	26	28—29	26—27	24	22—27	23—25	33—35	40—45
18	>99	>37	>32	>26	>29	>27	>24	>27	>25	>35	>45
Number of subjects	178	178	178	178	179	179	178	179	178	177	

SS: scalar scores.

Table 2 Correlation coefficients (r) and coefficients of determination (R^2) of the scaled scores by age, education, and sex.

	Age (years)		Education (years)		Sex	
	r	R^2	r	R^2	r	R^2
Animals	0.114	0.013	0.320[b]	0.102[c]	−0.131	0.017
Fruits/vegetables	0.258[b]	0.067[c]	0.317[b]	0.100[c]	0.161[a]	0.026
Kitchen tools	0.164[a]	0.027	0.152[a]	0.023	0.133	0.018
Initial letter 'P'	0.165[a]	0.027	0.284[b]	0.081[c]	0.059	0.003
Initial letter 'M'	0.166[a]	0.027	0.329[b]	0.108[c]	0.091	0.008
Initial letter 'R'	0.256[b]	0.066[c]	0.185[a]	0.034	−0.072	0.005
Excluded letter 'A'	0.185[a]	0.034	0.328[b]	0.108[c]	−0.117	0.014
Excluded letter 'E'	0.002	0.000	0.310[b]	0.096[c]	−0.010	0.000
Excluded letter 'S'	−0.045	0.002	0.288[b]	0.083[c]	−0.058	0.003
Verbs	−0.027	0.001	0.432[b]	0.187[c]	−0.002	0.000

[a] Correlation significant at a level of .05 (bilateral).
[b] Correlation significant at a level of .01 (bilateral).
[c] $R^2 \geq 0.05$.

Table 3 Education-adjusted table for verbal fluency tests.

	Education (years)												
	8	9	10	11	12	13	14	15	16	17	18	19	20
Animals[a]	+1	+1	0	0	0	0	0	0	0	−1	−1	−1	−1
Initial letter 'P'[b]	+1	0	0	0	0	0	0	0	0	0	−1	−1	−1
Initial letter 'M'[c]	+1	+1	0	0	0	0	0	0	0	−1	−1	−1	−1
Excluded letter 'A'[d]	+1	+1	0	0	0	0	0	0	0	−1	−1	−1	−1
Excluded letter 'E'[e]	+1	0	0	0	0	0	0	0	0	0	−1	−1	−1
Excluded letter 'S'[f]	+1	0	0	0	0	0	0	0	0	0	−1	−1	−1
Verbs[g]	+1	+1	+1	0	0	0	0	0	−1	−1	−1	−1	−1

[a] $\beta = 0.271$.
[b] $\beta = 0.232$.
[c] $\beta = 0.255$.
[d] $\beta = 0.263$.
[e] $\beta = 0.241$.
[f] $\beta = 0.237$.
[g] $\beta = 0.355$.

Table 4 Age-adjusted and education-adjusted table corresponding to the verbal fluency test for initial letter 'R'.[a]

Age (years)		
18−22	23−47	48−49
+1	0	−1

[a] $\beta = 0.077$.

Results show a clear education effect on 8 of the VF tests (animals, fruits/vegetables, initial letters 'P' and 'M', all excluded letter tests, and verbs). This was not found for kitchen tools and initial letter 'R'. The education effect was the most marked for the VF tasks for initial letter 'M', excluded letter 'A', and the VVF tests. These results are consistent with a large majority of normative studies which have found a significant education effect on FVF and SVF test results.[8,16−19,22,25−30,49−51] The fact that the education effect is more marked for listing verbs and naming words beginning with 'M' or not containing 'A' may indicate that higher cultural and educational levels[4,11,12] (a better knowledge of the grammar and spelling of the language in question) aid in performing these tasks. These results support the hypothesis that this type of fluency test is more sensitive for detecting executive function disorders.[11,12] Our results are also consonant with results from the Tombaugh et al.[12] study that describes education as being better than age at predicting performance on VF tests.

Performances on only 2 of the VF tests (fruits/vegetables and the initial letter 'R' tests) displayed an age effect. There were no significant age differences for the rest of the tests. These results do not coincide with generic conclusions from prior studies that describe decreasing VF with increasing age,[16−22] while they do coincide with other studies that found no significant differences.[23] In contrast, the relationship observed between age and the SVF test for fruits/vegetables and the ILF test for 'R' was opposite to that found in the studies indicated above. In our study, age had a positive effect and was associated with better performance on those tests. The positive effect of age on test performance may be linked to our sample characteristics, including the age range studied (<50 years). Subjects in this age group have not begun to experience any type of

Table 5   Age-adjusted and education-adjusted table for the verbal fluency test for naming fruits and vegetables.

Education (years)[b]	Age[a]																															
	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
8	+2	+2	+2	+2	+2	+2	+2	+2	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	0	0	0	0	0	0	0	0	0	0	0
9	+2	+2	+2	+2	+2	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	+2	+2	+2	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	+1	+1	+1	+1	+1	+1	+1	+1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	+1	+1	+1	+1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	-1	-1	-1
14	+1	+1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-2	-2	-2	-2	-2	-2	-2
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-2	-2	-2	-2	-2	-2	-2	-2
19	0	0	0	0	0	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2
20	0	0	0	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2

[a] $\beta = 0.076$.
[b] $\beta = 0.258$.

age-related decline, which takes place after middle age. The more limited capacity to name fruits and vegetables among younger subjects could reflect poorer knowledge of vocabulary in this specific semantic field. This could be due to the changes in eating and consumption habits that have taken place over the last few decades. Results from this study may support other studies concluding that performance on the FVF test peaks between the ages of 30 and 39 and begins to decline in middle age.[8,12,17,18,21,26,28,52,53] They may also support research by Chan and Poon[54] who observed a peak in performance between the ages of 19 and 30 with declining scores as age increased. However, our findings do not coincide with prior studies that observed a decline in scores beginning at the age of 20.[8] Neither did we observe a stronger relationship between age and SVF than between age and FVF as some authors have proposed.[12,17,18]

No significant sex effects on performance were detected for any of the VF tests in our group. We find conflicting data regarding the influence of this variable on VF tests (please refer to the review by Mitrushina et al.[8]). The results obtained in our study support those concluding that there is no sex effect on performance on VF tests.[12,23]

With regard to studies published in Spanish using adult subjects younger than 50, our results with regard to the effect of education on VF support findings by Buriel et al.[37] and Villodre et al.[55] However, we did find a different age effect for some of the ELF tests and the SVF test for animal names.

Compared to results from the NN study for the group of adults over 50,[34] our study revealed different age effects. This is probably due to the effects of ageing on performance on VF tests which begin to appear in middle-aged subjects. Findings for education were similar, as education had the same effect on performance in both groups.

We should mention that this is the first study presenting data for a wide range of VF tests (3 SVF, 3 ILF, 3 ELF, and 1 VVF) that were all administered to a single sample of adults younger than 50.

Conclusions

This study corroborates the effect of education on VF tasks and also highlights the minimal age and sex effects on performance of these tasks within the age range studied here.

This project provides normative data for VF in a younger population of Spanish adults. Our data have been processed in order to facilitate clinical diagnosis and permit analysis alongside other neuropsychological tests of all kinds.

Conflicts of interest

The authors have no conflicts of interest to declare.

References

1. Peña-Casanova J, Blesa R, Aguilar M, Gramunt-Fombuena N, Gómez-Ansón B, Oliva R, et al., for the Neuronorma Study Team. Spanish Multicenter Normative Studies (NEURONORMA project):

methods and sample characteristics. Arch Clin Neuropsychol 2009;24:307—19.

2. Peña-Casanova J, Casals-Coll M, Quintana M, Sánchez-Benavides G, Rognoni T, Calvo L, et al. Estudios normativos españoles en población adulta joven (proyecto NEURONORMA jóvenes): métodos y características de la muestra. Neurología. 2012, http://dx.doi.org/10.1016/j.nrl.2011.12.019.

3. Ruff RM, Light RH, Parker SB, Levin HS. The psychological construct of word fluency. Brain Lang. 1997;57:394—405.

4. Lezak MD, Howieson DB, Loring DW. Neuropsychological assessment. 4th ed. New York: Oxford University Press; 2004.

5. Benton A, Hamsher KS. Multilingual Aphasia Examination. Iowa City: University of Iowa; 1989.

6. Peña-Casanova J. Programa integrado de exploración neuropsicológica. In: Normalidad, semiología y patología neuropsicológicas. Barcelona: Masson; 1991.

7. Strauss E, Sherman EMS, Spreen O. A compendium of neuropsychological test. Administration, norms, and commentary. New York: Oxford University Press; 2006.

8. Mitrushina M, Boone KB, Razani J, D'Elia LF. Handbook of normative data for neuropsychological assessment. 2nd ed. New York: Oxford University Press; 2005.

9. Borkowski JG, Benton AL, Spreen O. Word fluency and brain damage. Neuropsychologia. 1967;5:135—40.

10. Crawford JR, Wright R, Bate A. Verbal, figural and ideational fluency in CHI. J Int Neuropsychol Soc. 1995;1:321 [abstract].

11. Shores EA, Carstairs JR, Crawford JR. Excluded letter fluency test (ELF): norms and test—retest reliability data for healthy young adults. Brain Impair. 2006;7:26—32.

12. Tombaugh TN, Kozak J, Rees L. Normative data stratified by age and education for two measures of verbal fluency: FAS and animal naming. Arch Clin Neuropsychol. 1999;14:167—77.

13. Piatt AL, Fields JA, Paolo AM, Tröster AI. Action (verb naming) fluency as an executive function measure: convergent and divergent evidence of validity. Neuropsychologia. 1999;37:1499—503.

14. Piatt AL, Fields JA, Paolo AM, Tröster AI. Action verbal fluency normative data for the elderly. Brain Lang. 2004;89:580—3.

15. Woods SP, Scott JC, Sires DA, Grant I, Heaton RK, Tröster AI, et al. Action (verb) fluency: test—retest reliability, normative standards, and construct validity. J Int Neuropsychol Soc. 2005;11:408—15.

16. Acevedo A, Loewenstein DA, Barker WW, Harwood DG, Luis C, Bravo M, et al. Category fluency test: normative data for English- and Spanish-speaking elderly. J Int Neuropsychol Soc. 2000;6:760—9.

17. Gladsjo JA, Schuman CC, Evans JD, Peavy GM, Miller SW, Heaton RK. Norms for letter and category fluency: demographic corrections for age, education, and ethnicity. Assessment. 1999;6:147—78.

18. Kavé G. Phonemic fluency, semantic fluency, and difference scores: normative data for adult Hebrew speakers. J Clin Exp Neuropsychol. 2005;27:690—9.

19. Loonstra AS, Tarlow AR, Sellers AH. COWAT metanorms across age, education, and gender. Appl Neuropsychol. 2001;8:161—6.

20. Lucas JA, Ivnik RJ, Smith GE, Bohac DL, Tangalos EG, Graff-Radford NR, et al. Mayo's older Americans normative studies: category fluency norms. J Clin Exp Neuropsychol. 1998;20:194—200.

21. Lucas JA, Ivnik RJ, Smith GE, Ferman TJ, Willis FB, Petersen RC, et al. Mayo's older African Americans normative studies: norms for Boston naming test, Controlled Oral Word Association, category fluency, animal naming, token test, wrat-3 reading, trail making test, Stroop test, and judgment of line orientation. Clin Neuropsychol. 2005;19:243—69.

22. Ivnik RJ, Malec JF, Smith GE, Tangalos EG, Petersen RC. Neuropsychological test norms above age 55: COWAT, BNT, MAE,
Token, WRAT-R, reading, AMNART, Stroop, TMT, and JLO. Clin Neuropsychol. 1996;10:262—78.

23. Cauthen NR. Verbal fluency: normative data. J Clin Psychol. 1978;34:126—9.

24. Bolla KI, Lindgren KN, Bonaccorsy C, Bleecker ML. Predictors of verbal fluency (FAS) in the healthy elderly. J Clin Psychol. 1990;46:623—8.

25. Steinberg BA, Bieliauskas LA, Smith GE, Ivnik RJ. Mayo's older Americans normative studies: age- and IQ-adjusted norms for the trail-making test, the Stroop test, and MAE Controlled Oral Word Association Test. Clin Neuropsychol. 2005;19:329—77.

26. Kosmidis MH, Vlahou CH, Panagiotaki P, Kiosseoglou P. The verbal fluency task in the Greek population: normative data, and clustering and switching strategies. J Int Neuropsychol Soc. 2004;10:164—72.

27. La Rue A, Romero LJ, Ortiz IE, Liang HC, Lindeman RD. Neuropsychological performance of Hispanic and non-Hispanic older adults: an epidemiologic survey. Clin Neuropsychol. 1999;13:474—86.

28. Kempler D, Teng EL, Dick M, Taussig IM, Davids DS. The effects of age, education and ethnicity on verbal fluency. J Int Neuropsychol Soc. 1998;4:531—8.

29. Rosselli M, Ardila A, Salvatierra J, Márquez M, Matos L, Weekes VA. A cross-linguistic comparison of verbal fluency test. Int J Neurosci. 2002;112:759—76.

30. Ardila A, Rosselli M, Puente M. Neuropsychological evaluation of the Spanish speaker. New York: Plenum Press; 1994.

31. Artiola L, Hermosillo D, Heaton R, Pardee RE. Manual de normas y procedimientos para la batería neuropsicológica en español. Tucson: m Press; 1999.

32. Peña-Casanova J. Programa integrado de exploración neuropsicológica. Manual. In: Test Barcelona. Barcelona: Masson; 1990.

33. Peña-Casanova J, Quiñones-Úbeda S, Gramunt-Fombuena N, Quintana-Aparicio M, Aguilar M, Badenes D, et al. Spanish multicenter normative studies (NEURONORMA project): norms for verbal fluency test. Arch Clin Neuropsychol. 2009;24:395—411.

34. Quiñones-Úbeda S. Desenvolupament, normalització i validació de la versió estàndard de la segona versió del Test Barcelona [tesi doctoral]. Barcelona: Universitat Ramon Llull; 2009.

35. Adrián JA, Hermoso P, Buiza JJ, Rodríguez-Parra MJ, González M. Estudio piloto de la validez, fiabilidad y valores de referencia normativos de la escala PRONEURO en adultos mayores sin alteraciones cognitivas. Neurología. 2008;23:275—87.

36. Benito-Cuadrado MM, Esteba-Castillo S, Böhm P, Cejudo-Bolívar J, Peña-Casanova J. Semantic verbal fluency of animals: a normative and predictive study in a Spanish population. J Clin Exp Neuropsychol. 2002;24:1117—22.

37. Buriel Y, Gramunt N, Böhm P, Rodés E, Peña-Casanova J. Fluencia verbal. Estudio normativo piloto en una muestra española de adultos jóvenes (20 a 49 años). Neurología. 2004;19:153—9.

38. Carnero C, Lendinez A, Maestre J, Zunzunegui MV. Fluencia verbal semántica en pacientes neurológicos sin demencia y bajo nivel educativo. Rev Neurol. 1999;28:858—62.

39. Del Ser Quijano T, García de Yébenes MJ, Sánchez Sánchez F, Frades Payo B, Rodríguez Laso A, Bartolomé Martínez MP, et al. Evaluación cognitiva del anciano. Datos normativos de una muestra poblacional española de más de 70 años. Med Clin (Barc). 2004;122:727—40.

40. Perea MV, Ladera V, Rodríguez MA. Fluencia de verbos en personas mayores. Psicothema. 2005;2:263—6.

41. Rami L, Serradell M, Bosch B, Villar A, Molinuevo JL. Valores normativos de test de función cognitiva frontal para la población mayor de 60 años. Rev Neurol. 2007;45:268—71.

42. Ramírez M, Ostrosky-Solís F, Fernández A, Ardila-Ardila A. Fluidez verbal semántica en hispanohablantes: un análisis comparativo. Rev Neurol. 2005;41:463—8.

43. González HM, Mungas D, Haan MN. A semantic verbal fluency test for English- and Spanish-speaking older Mexican Americans. Arch Clin Neuropsychol. 2005;20:199—208.

44. Ostrosky-Solis F, Gutierrez AL, Flores MR, Ardila A. Same or different? Semantic verbal fluency across Spanish-speakers from different countries. Arch Clin Neuropsychol. 2007;22:367—77.

45. Blesa R, Pujol M, Aguilar M, Santacruz P, Bertrán-Serra I, Hernández G, et al. Clinical validity of the mini-mental state for Spanish speaking communities. Neuropsychologia. 2001;39:1150—7.

46. Folstein MF, Folstein SE, McHugh PR. Mini-mental state. A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res. 1975;12:189—98.

47. Böhm P, Peña-Casanova J, Manero RM, Terrón C, Gramunt N, Badenas S. Preliminary data on discriminative validity and normative data for a Spanish version of the Memory Impairment Screen (MIS). Int Psychogeriatr. 2003;15:249.

48. Buschke H, Kuslansky G, Katz M, Stewart WF, Sliwinski MJ, Eckholdt HM, et al. Screening for dementia with the Memory Impairment Screen. Neurology. 1999;52:231—8.

49. Brickman AM, Paul RH, Cohen RA, Williams LM, MacGregor KL, Jefferson AL, et al. Category and letter verbal fluency across the adult lifespan: relationship to EEG theta power. Arch Clin Neuropsychol. 2005;20:561—73.

50. Mack WJ, Teng E, Zheng L, Paz S, Chui H, Varma R. Category fluency in a Latino sample: associations with age, education, gender, and language. J Clin Exp Neuropsychol. 2005;27:591—8.

51. Mathuranath PS, George A, Cherian PJ, Alexander A, Sarma SG, Sarma PS. Effects of age, education and gender on verbal fluency. J Clin Exp Neuropsychol. 2005;25:1057—64.

52. Matute E, Rosselli M, Ardila A, Morales G. Verbal and nonverbal fluency in Spanish-speaking children. Dev Neuropsychol. 2004;26:647—60.

53. Riva D, Nichelli F, Devoti M. Developmental aspects of verbal fluency and confrontation naming in children. Brain Lang. 2000;71:267—84.

54. Chan AS, Poon MW. Performance of 7- to 95-year-old individuals in a Chinese version of the category fluency test. J Int Neuropsychol Soc. 1999;5:525—33.

55. Villodre R, Sánchez-Alfonso A, Brines L, Núñez AB, Chirivella J, Ferri J, et al. Fluencia verbal: estudio normativo piloto según estrategias de agrupación y saltos de palabras en población española de 20 a 49 años. Neurología. 2006;21:124—30.