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A study of word finding difficulties in Spanish speakers with temporal lobe epilepsy

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Temporal lobe epilepsy;
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Summary It is well established that naming deficits can be found in temporal lobe epilepsy (TLE). The aim of this study was to determine in Spanish speakers with pharmacoresistant TLE the characteristics of subjective naming difficulties and to examine performance in a definition task and a picture task in left TLE and right TLE. We observed that almost one-third of patients report frequent and severe word finding problems during spontaneous speech. In naming tests, our patients exhibited delayed times for finding words. Even if the target word was identified and semantically activated, there was difficulty with lexical access, which improved when a phonetic cue was given. Left TLE patients derived a lower benefit from phonetic cues in accessing words, even when the word is known and recognized semantically. These findings were not related to any demographic or clinical characteristics analyzed. The fact that the only weakly lateralized variable has been a lexical access facilitation measurement could support a lexical access hypothesis for naming deficits in TLE.

Introduction

Language assessment in medial temporal lobe epilepsy (TLE) patients plays an important role as a part of the cognitive presurgical evaluation. Word finding difficulties that interfere with daily life are frequently reported by epileptic patients whose seizures originate predominantly in the language-dominant cerebral hemisphere (Mayeux et al., 1980). Despite its apparent simplicity, this task recruits a complex set of mental representations and cognitive processes sustained by a network of brain regions (Damasio et al., 2004; Price et al., 2005). These have been described in detail in psycholinguistic models (Levelt, 1999).

In temporal lobe epilepsy, word finding difficulties were originally investigated with the classic test of confrontation naming, a task requiring patients to name aloud pictures of common objects (Kaplan et al., 1983). Most studies showed worse performance in TLE than in matched controls, while others did not detect significantly poorer performance in left TLE than in right TLE (Hermann et al., 1997, 1999; Saykin et al., 1995; Oddo et al., 2003). Hamberger et al. elicited patients' responses with oral descriptions instead of

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pictures, and this task has proved to be more sensitive than the picture task when it comes to detecting preoperational TLE language deficits (Hamberger and Tamny, 1999; Hamberger and Seidel, 2003; Bell et al., 2003).

In healthy speakers and in ischemic stroke patients, there is evidence indicating an association between word retrieval processes and posterior temporal sites (Hirsch et al., 2001; Price et al., 2006; Saccuman et al., 2006; Hillis et al., 2001, 2006). The neural basis of this deficit in TLE patients has been investigated using electrical cortical stimulation mapping. This technique is widely regarded as the gold standard for predicting postoperative functional impairment (Ojemann et al., 1989; Hamberger et al., 2005, 2007). These results are consistent with the prevalent view in temporal lobe surgery that word finding difficulties follow anterior temporal lobectomy (Bell et al., 2000; Schwarz et al., 2005; Drane et al., 2008). However, while TLE patients' difficulties in word retrieval (most clearly seen in the auditory naming task) are associated with more anterior temporal sites, in healthy and ischemic patients, word retrieval is associated with posterior temporal sites. This apparent discrepancy could be due to a fundamental reorganization of the language system specific to pharmacoresistant epilepsy (Devinsky et al., 1993; Hamberger et al., 2001). Alternatively, as another study suggested, it may indicate that epilepsy induces functional deafferentation between anterior temporal structures devoted to semantic processing and neocortical posterior temporal structures devoted to lexical processing (Trebuchon-Da Fonseca et al., 2009).

The aims of this study were to determine the characteristics of naming subjective difficulties in Spanish speakers with pharmacoresistant TLE and examine performance in definition and picture tasks in left and right TLE.

Methods

Participants

We studied 26 consecutive right-handed patients (P) with drug-resistant mesial TLE in whom the epileptogenic focus was clearly identified and localized to either the right or left hemisphere.

Inclusion criteria were as follows: age 18–65 years of age, full-scale intellectual ability (FIQ $\geq$ 80), right-handedness, and TLE with hippocampal sclerosis or with other lesions (dysplasia, tumor localized in mesial area), identified by magnetic resonance image. A prolonged video-EEG monitoring was performed, and semiological and electrophysiological ictal changes allowed us to clearly localize and lateralize the seizure origin to medial temporal structures.

Patients were grouped according to the side of epileptogenic zone (left versus right). Seizure onset was left TLE in 13 P and right TLE in 13 P.

The control group (C) included a sample of 56 healthy subjects that attended the Epilepsy Center as patients' family members or friends. Individuals with a mini mental state examination score below 26, a history of learning disabilities, language problems, or neurological or psychiatric disorders were excluded from the control group. No significant differences were found between patients and controls with regard to sex, education, or age.

Both groups were also divided into two groups according to their educational level: equal or less than 10 years or more than 10 years of formal education.

All subjects gave their informed consent to participate in the study.

Tasks/measures

As part of their presurgical evaluation, each participant underwent a comprehensive neuropsychological battery used in our Epilepsy Center (Oddo et al., 2003) that included the following: the Weschler adult intelligence test (third edition), the Rey auditory verbal learning test (RAVLT), the Rey complex figure test, verbal fluency tasks (phonological and semantic), the digit span task, the trail making test and the Wisconsin card sorting test.

Once the neuropsychological battery was completed, the naming tests were administered in the following order: questionnaire, Boston naming test (BNT) and auditory naming test (ANT)

Questionnaire

A questionnaire was designed to address patients' perception about spontaneous speech difficulties and anomia (Lomlomdjian et al., 2009). A scale from 0 to 4 was defined to measure the frequency and functional impact of word finding problems, ranging from ''no word finding difficulties in conversational speech'' (0) to ''great difficulties with word finding'' (4) (Appendix A).

Boston naming test (BNT)

For the BNT, we used a version modified according to word frequencies in the Argentinian population (Allegri et al., 1997).

Auditory naming test (ANT)

The ANT (Hamberger and Tamny, 1999; Hamberger and Seidel, 2003) was adapted by our group to Spanish (Lomlomdjian et al., 2009). Morphological and syntactic language-specific differences were taken into account (Appendix A).

For both naming tests, we considered each one of the following standard scores independently:

Percentage correct answers = number of correct answers during the first 20 s, divided by the number of familiar (or known) words $\times$ 100.

Also we measured the mean time to find the correct answer in the first 20 s. For ANT items, the timing began at the end of the word description.

Percentage correct answers after a phonetic cue = is the number of correct answers after the phonemic cue, divided by the number of familiar (or known) words $\times$ 100. This measurement allowed us to observe the magnitude to the lexical access facilitation.

Percentage correct answers given as the first option = number of correct answers given as the first option in 20 s, divided by the number of familiar (or known) words $\times$ 100.

Statistical methods

Control and patients group were matched for age, sex and formal education.

Both the BNT and ANT performance results were compared between patients and controls using ANOVA test.

For each patient, the raw values of each of the cognitive tests in the neuropsychological battery were also normalized to a Z score and classified as ''deficit'' for Z values less than or equal to -2.

In a second stage, within-group analysis of all items studied was performed comparing patients with left TLE and right TLE using the Student's t-test for independent variables, chi-squared and logistic regression analysis.

The following variables were correlated: age, education, epilepsy duration, and NB results using the Pearson and Spearman correlation tests. Chi-squared and logistic regression analyses were used to evaluate associations between the questionnaire and naming tests.

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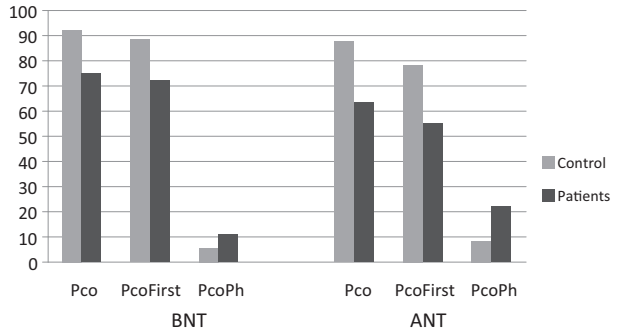

Fig. 1 Percentage of correct answers (Pco), percentage of correct answers given as first option (Pco first) and percentage of correct answers after a phonemic cue (PcoPh) for both visual (BNT) and auditory (ANT) naming tests, comparing control vs. patients group.

Results

Control group

A total of 56 right-handed subjects were evaluated. The questionnaire showed that 10% of control subjects reported having sporadic anomia, while no one reported either frequent or important word finding problems (questionnaire score > 2). None of the subjects presented with deficits in the BNT or ANT. When comparing the two naming test scores across all variables, we observed that all subjects obtained slightly lower mean scores on the ANT than on the BNT, suggesting a higher task difficulty (Table 2, Fig. 1).

We observed significantly higher performance scores in each variable for both tasks in the high education level group.

Patients group (P)

Twenty-six drug-resistant TLE patients were studied (12 male, 14 female); seizure onset was left TLE and right TLE for 13 subjects in each group. The mean age was 37.6 (minimum 19, maximum 62), the mean epilepsy onset was 11.2 ± 7.7 years old, and the mean illness duration was 26.3 (SD 12.3) years. All patients were undergoing treatment with multiple antiepileptic drugs (2—3 drugs), one of which was topiramate in four cases per group. No statistical differences were found between left TLE and right TLE patients in age, sex, education, epilepsy onset and duration, and antiepileptic drugs. Demographics and clinical data are shown in Table 1.

Average performance in the neuropsychological battery is reported in Table 1. There was no difference in performance between left TLE and right TLE, except in verbal memory (RAVLT test), in which left TLE patients had significantly poorer performance on a verbal list learning curve, post-interference recall and recognition tasks (Table 1).

Questionnaire

Twenty-seven percent (26.9%) of P reported word finding problems having a functional impact on spontaneous speech (score ≥ 3). This finding was higher in the left TLE group (8 vs. 6 in right TLE), however this difference was not significant.

We observed a correlation between this observation and pathological results on naming tests, 71% P for BNT and even though not show statistical signification, it was higher 85.7% P for ANT.

Naming tests

BNT: We observed significantly lower performance in each sub-item of the BNT in patients compared to controls ($p < 0.000$), except for the time score, in which only

Table 1 Demographic clinical and NB evaluation data in Left TLE vs. Right TLE.

	Left TLE $n = 13$	Right TLE $n = 13$	Student's *t*-test P
Age	40.7 (19—62)	34.6 (21—54)	NS
Gender	M 5, F 8	M 7, F 6	NS
Education (years)	10.0 (2.7)	12.1 (3.6)	NS
Epilepsy onset (age)	10 (9.3)	12.5 (6.2)	NS
Illness duration (years)	31.28 (12.4)	20.8 (12.07)	NS
Number of AEDS	3 (2—3)	2 (—2 to 3)	NS
Full scale IQ	88.0 (12.27)	93.62 (11.42)	NS
Verbal IQ	90.46 (11.11)	93.30 (14.04)	NS
Procedural IQ	89 (11.75)	93.69 (12.73)	NS
Phonological fluency (Z)	—1.54 (.88)	—1.38 (1.11)	NS
Semantic fluency (Z)	—1.13 (.90)	—1.39 (1.18)	NS
Digit span (Z)	—0.69 (1.49)	0.60 (.48)	NS
RAVLT list A1 (Z)	—1.13 (.98)	—0.80 (1.11)	NS
RAVLT total A 1—5 (Z)	—1.66 (.7)	—0.46 (1.21)	.008
RAVLT 6 (post-interference) (Z)	—1.59 (.87)	—0.77 (.89)	.035
RAVLT delayed recall (Z)	—1.59 (.87)	—0.80 (1.15)	NS
RAVLT recognition (Z)	—.11 (1.04)	0.60 (.48)	.037

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Table 2 Boston naming test (BNT) and auditory naming test (ANT) in control group vs. patients group and left TLE vs. right TLE.

Naming task	Variables	Control Mean (SD)	Patients Mean (SD)	ANOVA *p*	Left TLE Mean (SD)	Right TLE Mean (SD)	Student's *t*-test *p*
BNT	Pco	92.14 (5.51)	75.11 (13.34)	0.000	71.49 (16.18)	78.72 (8.98)	NS
	PcoFirst	88.20 (6.14)	72.23 (13.57)	0.000	70.65 (15.41)	73.82 (12.16)	NS
	PcoPh	5.54 (4.48)	11.24 (5.18)	0.000	11.12 (5.17)	11.36 (5.40)	NS
	CoTime	1.89 (0.78)	1.95 (0.91)	NS	2.02 (.95)	1.85 (.92)	NS
ANT	Pco	87.59 (8.64)	63.53 (16.61)	0.000	59.68 (17.51)	67.38 (15.36)	NS
	PcoFirst	78.46 (11.13)	55.20 (15.82)	0.000	54.17 (16.23)	57.62 (16.55)	NS
	PcoPh	8.19 (6.41)	22.39 (11.11)	0.000	19.21 (6.45)	25.57 (13.92)	NS
	CoTime	2.49 (0.83)	4.46 (2.00)	0.000	4.59 (2.36)	4.29 (1.51)	NS

Pco: percentage of correct answers, PcoFirst: percentage of correct answers given as first option, PcoPh: percentage of correct answers after a phonemic cue, CoTime: mean time to find the correct word.

correct answers were taken in account. The time score would be higher for patients if the incorrect, post-facilitation or unfamiliar words were included. Patients gave fewer correct answers (P mean 75.11 SD 13.3 vs. C mean 92.14 SD 5.5), including correct answers given as a first attempt (P mean 72.23 SD 13.6 vs. C mean 88.2 SD 6.1). When the identification of the target word was correct, as indicated by subjects responding with semantically related words, a clear benefit was obtained from a phonetic cue, which facilitated lexical access and led to an increase in correct answers (correct answers after a phonetic cue mean 11.24 SD 5.1 vs. C mean 5.54 SD 4.5). No education bias advantage was observed in BNT test performance (Table 2) (Fig. 1).

ANT: Patient performance was significantly poorer than that of the control group in every test variable ($p < 0.000$). We found that patients produced fewer total correct answers (P mean 63.5 SD 16.6 vs. C mean 87.6 SD 8.6) and fewer correct answers given as first option (P mean 55.2 SD 15.8 vs. C mean 78.5 SD 11.1) as well as an increase in the time to find the correct answer (P 4.5 s vs. C 2.5 s). As described for the BNT, when the identification of the target word was correct, a clear benefit was obtained from a phonetic cue, with an increase in correct answers (correct answer after a phonetic cue, P mean 22.39 SD 11.1 vs. C mean 8.19 SD 6.4) (Table 2) (Fig. 1).

Left TLE vs. right TLE performance on naming tasks: Despite the absence of statistically significant differences between left TLE and right TLE groups on mean scores in both BNT and ANT tests, left TLE patient performance was worse (10—15% lower scores). Left TLE patients showed a lower benefit from phonetic cues even when responding to known and semantically recognized words, specially for the ANT (left 19.21% P vs. right 25.57% P). No correlation was found between the performance on naming tests and the neuropsychological battery. No evidence was found in favor of contributions from education, age, gender, epilepsy onset, or illness duration.

Discussion

It is well established that naming deficits are associated with TLE, regardless of other normal language functions. The exact nature of this association is still unknown, though some hypotheses have attempted to explain these linguistic deficits. In chronic TLE, structural and cognitive impairment could extend beyond the mesiobasal areas (Luders et al., 1991). Recently, Trebuchon-Da Fonseca et al. demonstrated a correlation between anomia and PET scans in a population with TLE. The correlation involved cortical areas extending far beyond the mesiobasal temporal region (Trebuchon-Da Fonseca et al., 2009).

The present study showed that almost one-third of patients with TLE report frequent and severe word finding problems during spontaneous speech. In most patients, these problems could be correlated with deficits in both naming tests, with poorer performance in the ANT than the BNT, although this difference was not statistically significant. Our patients showed delayed times in finding words in ANT naming tests, significantly longer than those for BNT. Probably due to different attentional executive and linguistic processes that are needed to a proper oral comprehension as auditory task could represent major inner complexity than visual task. Even when the target word was identified and semantically activated, there was difficulty in lexical access that was improved when a phonetic cue was given. It has been suggested that sequential processing stages and different cognitive systems are involved during the naming process: object recognition and identifi-

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cation (perceptual), access (retrieval from semantic store and name activation) (semantic), and production of the correct name or response generation (lexical-phonemic) (DeLeon et al., 2007). In addition to analyzing the percentage of correct answers and response time, we also compared answer accuracy (correct answers given as the first option) and distinguished lexical access (correct answer after phonetic cue) from semantic and lexical storage processes. The hypothesis that TLE naming deficits could be due to lexical access problems is supported by our observation of the higher benefit that the patient group obtained from phonetic cues compared to the control group, which brought their performance to near-normal levels. The percentage of correct answers given after a phonetic cue was the only variable showing weak association with epileptogenic zone side. Left TLE patients showed a lower benefit from phonetic cues that suggests a difference on lexical-phonemic stage probably specific to the left hemisphere. Regarding qualitative measurements based on naming error types in visual confrontation naming tests, some studies showed that left TLE individuals were more likely to make paraphasic errors, especially in phonemic-literal type naming confrontation tasks (interictal and postictal) compared with right TLE individuals, while semantic type could be found in both groups (Rohrer et al., 2008). This suggests that the lexical-phonemic stage is specific to left (or language dominant) hemisphere processing and is thus more capable to lateralize the epileptic zone. Trebuchon-Da Fonseca et al. suggested that the anomia is due to lexical retrieval difficulty in the lexical-phonemic stage and is associated with a temporal lobe network, within which the left posterior and basal areas play a crucial role while more anterior bilateral temporal areas may be associated with semantic processing. These findings were explained as a functional deafferentation between anterior (semantic) and neocortical posterior temporal (lexical processing) structures due to epileptic disorganization (Trebuchon-Da Fonseca et al., 2009).

Examining naming ability could have a lateralization value as long as thorough evaluations explore quantitative and qualitatively each stage of naming process. Further investigation is needed to evaluate post-surgery cortical reorganization changes on naming process and guide cognitive rehabilitation methods.

Although several studies have been performed using auditory naming tests for TLE evaluation (Hamberger and Tamny, 1999; Hamberger and Seidel, 2003; Hamberger et al., 2005), our study is the first conducted in Spanish. Contrary to previous studies (Hamberger and Tamny, 1999; Hamberger et al., 2005) that showed that auditory naming tasks were more impaired in left hemisphere (language dominant) TLE compared to visual naming tests, as in other work (Trebuchon-Da Fonseca et al., 2009), we did not find a significant difference between left TLE and right TLE. However, performance on the auditory naming task was worse in right TLE vs. controls, and left TLE vs. right TLE.

These findings were not related to any of demographic or clinical patient characteristics, and no correlation was found with performance in the neuropsychological battery.

One limitation of our study is the relatively small sample size. Only drug-resistant surgery candidates were included, and multi-drug therapeutic schemes could interfere with cognitive performance. A further limitation is that response times were measured with a stopwatch instead of using more precise computerized methods.

The fact that the only variable showing lateralization was response to lexical access facilitation is supportive of a lexical access hypothesis in naming impairments in TLE.

Appendix A.

Questionnaire

Do you have any trouble in finding the word you want to say?

Do you need to use gestures, explanations or synonyms to replace words you could not say?

Do you feel you have a word on the tip of the tongue, and you know it but you cannot say it?

Mark 0 for this question if this does not happen to you.

1. It happens occasionally but it is not sever enough to affect communication
2. It happens occasionally but does affect communication
3. It happens frequently but does not affect my communication too much.
4. It happens frequently and clearly affects my communication

Adaptation to Spanish of Boston naming test (BNT)

The administration of the test is based on the adaptation to the Argentinean population by Allegri et al. (1997), in which the stimulus order was changed according to the frequency of local word use.

Stimulus	Stimulus
1. Cama	31. Canoa
2. Arbol	32. Embudo
3. Lápiz	33. Zancos
4. Reloj	34. Compás
5. Tijera	35. Cactus
6. Peine	36. Pinzas
7. Flor	37. Hamaca
8. Martillo	38. Aguja
9. Escoba	39. Bozal
10. Zanahoria	40. Helado/magdalena
11. Percha	41. Cerradura
12. Corona	42. Rinoceronte
13. Regadera	43. Iglú
14. Termómetro	44. Ábaco
15. Camello/dromedario	45. Paleta
1. Cama	31. Canoa
2. Arbol	32. Embudo
3. Lápiz	33. Zancos
4. Reloj	34. Compás
5. Tijera	35. Cactus
6. Peine	36. Pinzas
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Stimulus	Stimulus
13. Regadera	43. Iglú
14. Termómetro	44. Ábaco
15. Camello/dromedario	45. Paleta

New nouns in bold.

Auditory naming test instructions

A pilot trial was first done evaluating 30 healthy controls using the original words. Based on subjects' performance and examiners' experience, we modified the test according to lexical (word) frequency, syntactic complexity, sentence length and difficulty level. Words with ambiguous meanings were excluded. Thirty-two auditory naming stimuli were translations of the original ANT items, and eighteen new nouns were included using modified dictionary definitions from the Spanish Royal Academy Dictionary 22nd edition and considering word frequency according to the Spanish Linguistic Units Frequency Dictionary (Alameda and Cuetos, 1995). The decision to replace 17 words was due to either low use frequency (e.g., moat, pretzel, flask), repetition of stimuli in the BNT (e.g., globe, igloo, abacus, volcano), compound words (toothbrush = cepillo de dientes, hourglass = reloj de arena) or ambiguity.

''I am going to read you a list of descriptions. After I have finished each of them, I will ask you to say the word you think I am describing as quickly as possible. If you cannot find the word you think is correct then say the first word that comes to mind while you try to find the correct response. If the answer you give me is not the correct one I will ask you to say another one. Every description defines only one word. Pay attention to the description because I will not be able to repeat it. Are you ready?''

The reading was required to be clear and slow enough to be understood and could not be repeated. After reading the description start the stopwatch to register the time to find the correct word. Register every answer. A maximum of 20 s will be given for answering correctly. Encourage the subject to produce words during the task. If the subject cannot provide the correct word, give the phonemic cue (the first syllable of the word) and give the subject another 10 s to answer. If the person is unable to find the word ask if they know what word we are talking about, asking for an example of use or other descriptions. Then say the correct answer and ask if they know that word to register the stimulus as familiar or not.

Adaptation to Spanish of auditory naming test

Original word	Adaptation	Definición
1. Wrinkle	Arruga	Pliegue que se hace en la piel por efecto de la edad
2. Picnic	**Campamento**	Lugar al aire libre donde las personas se alojan en carpas
3. Globe	**Mapa**	Representación geográfica a escala de un lugar
4. Temperature	Temperatura	Lo que se mide con un termómetro cuando la gente está enferma
5. Witch	Bruja	Mujer que practica magia negra
6. House	Casa	Estructura en la que viven personas
7. City	Ciudad	Espacio geográfico en el que viven muchas personas, poblado grande o metrópolis
8. Friend	Amigo	Persona no familiar con la que se mantiene una relación de afecto y confianza
9. Artist	Artista	Persona que realiza obras de arte.
10. Team	Equipo	Grupo de personas que participande un juego o competencia
11. Chapter	Capítulo	Partes en las que esta dividido un libro
12. Rifle	Rifle/escopeta	Arma de fuego, larga, que se apoya en el hombro
13. Atmosphere	Atmósfera	Capa de aire que rodea el planeta
14. Beach	Playa	Lugar con arena a lo largo de una costa
15. Desk	Escritorio	Tipo de mesa donde las personas se sientan a leer o escribir usado en oficinas
16. Scale	Balanza	Objeto utilizado para pesar elementos o cosas
17. Volunteer	Voluntario	Persona que ayuda sin obtener beneficios económicos a cambio
18. Pencil	Lápiz	Instrumento de madera y gráfito, que sirve para dibujar
19. Envelope	Sobre	Elemento de papel en el que se pone una carta y estampilla
20. Compass	***Paraguas***	Objeto portátil y plegable para resguardarse de la lluvia
21. Sole	Suela	Parte del calzado que toca el piso; hecha de cuero o goma
22. Gas	Combustible/nafta	Lo que necesita el motor de un auto para funcionar
23. Wreath	Moño	Lazo de cintas para decorar un regalo
24. Bachelor	Soltero	Hombre que no está casado
25. Stroller	Cochecito	Vehículo pequeño con forma de cuna que transporta a los bebes
26. Nap	Siesta	Breve periodo de sueño después del mediodía
27. Apron	Delantal	Prenda para proteger la ropa cuando se cocina
28. Toothbrush	***Cepillo***	Elemento con cerdas para arreglarse el cabello
29. Marrow	***Pulmón***	Órgano de la respiración del ser humano
30. Palette	***Espejo***	Cristal en el que se refleja la imagen de los objetos
31. Flask	***Termo***	Recipiente que conserva la temperatura de los líquidos

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Original word	Adaptation	Definición
32. Chalk	Tiza	Elemento utilizado para escribir en el pizarrón
33. Yoke	***Montura***	Tipo de silla usada para cabalgar
34. Volcano	***Trueno***	Sonido intenso en el cielo provocado por un rayo
35. Mosquito	Mosquito	Insecto volador que produce un zumbido y deja picaduras
36. Quiz	Encuesta	Conjunto de preguntas destinadas a averiguar opiniones
37. Crust	***Cáscara***	Cubierta exterior de los huevos y varias frutas
38. Hanger	Percha	Elemento de madera o metal en el que se cuelga ropa
39. Scissors	Tijera	Instrumento compuesto de dos hojas de acero que sirve para cortar cosas
40. Duplex	***Colmena***	Lugar construido por las abejas para vivir
41. Abacus	***Bicicleta***	Vehículo de dos ruedas a pedales
42. Igloo	***Congreso***	Edificio donde los diputados votan leyes
43. Chameleon	Camaleón	Lagarto pequeño con capacidad para cambiar de color
44. Octagon	Octágono	Figura de 8 lados
45. Pretzel	***Tomate***	Fruto rojo y redondo usado en ensaladas y salsas
46. Moat	***Cimientos***	Base de concreto sobre el que se construye un edificio
47. Hourglass	***Himno***	Composición musical que identifica a una nación o país
48. Tutu	***Detective***	Policía entrenado para hacer investigaciones
49. Spatula	Espátula	Utensilio usado para mover los panqueques y tortillas
50. Zodiac	***Horóscopo***	Predicción del futuro basada en los signos del zodíaco

New nouns in bold.

Scoring for both tests

Answer type. Accurate answers registered during the first 20 s are considered correct answers (R+). If they can produce the correct word within 10 s after the phonemic cue, this is considered correct after phonemic cue (Ph+). If they cannot say the word but recognize it as familiar (F), then the response will be scored as incorrect (R−). On the other hand ANT if it is not recognized as part of their lexical store then will be scored as unknown (U).

Scoring. Percentage correct answers = total (R+)/total (F) × 100; percentage of correct answers after phonemic cue = total (Ph+)/total (F) × 100; percentage correct answers given as the first option = total (R+) as first option/total (F) × 100.

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