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## **CATALAN ADAPTATION AND NORMALIZATION OF NEUROPSYCHOLOGICAL INSTRUMENTS**

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## 1. Abstract

Neuropsychological assessment is crucial for the diagnosis and management of patients suffering from neurodegenerative diseases. There are several factors that impact cognitive performance, which is usually measured by means of neuropsychological tests. The effect of age, education and sex is well known, as well as the language in which the assessment is performed. Language issues could question the validity of the results. In order to know the actual cognitive performance of a subject, he should be explored with tests that are adapted to, and not only translated into, his language. These tests must have also appropriate normative data. Most neuropsychological tests come from the English-speaking countries. Although some have been adapted and standardized in Spanish, there is a lack of adapted Catalan tests with appropriate norms. Aims of this study are twofold: first, to translate the most widely used cognitive tools both in the clinical field and in the research field into Catalan. Those with verbal content will be adapted taking account of psycholinguistic variables (word length, frequency, familiarity etc.). Second, we obtained normative data of the adapted tests in a sample of 401 Catalan-speakers aged between 18 to 90 years old, distributed throughout the territory where Catalan is spoken and their dialectal variants (Central Catalan, North-western, Balearic and Valencian) to create normative data. The effect of sociodemographic and linguistic variables was studied. Normative tables and adjustments for sociodemographic variables have been developed to be available to clinicians that assess Catalan-speakers in Catalan. These results improve the diagnosis and management of neuropsychological assessment in our environment.

## 2. Results

**1. Neuronorma.cat (NN.CAT) protocol in Catalan.** We have developed a Catalan version, including dialectal varieties, of the most widely used neuropsychological tests Neuronorma.cat protocol (NN.CAT), after translation of protocols, materials, instructions and correction without important linguistic variations. Besides the tests with verbal content being translated into Catalan and its dialects, some items have been adapted to match their original versions or Spanish versions, taking into account linguistic variables such as length, frequency, familiarity, and imaginativeness. This has given rise to some psycholinguistic variations in the Catalan final version compared to

the original version tests (Buschke, 1984, Kaplan, Goodglass & Weintraub, 1983) or compared to the Spanish adaptation (Pena et al., 2009) (Table 1). In some cases, adaptation has also led to linguistic differences among the different Catalan dialectal versions (Table 2).

**Table 1.** Semantic categories stimuli of FCSRT in different versions (original English, Catalan and Spanish)

<b>Original version</b>		<b>Spanish version</b>		<b>Catalan version (central Catalan dialect)</b>	
<b>Semantic clue</b>	<b>Stimuli</b>	<b>Semantic clue</b>	<b>Stimuli</b>	<b>Semantic clue</b>	<b>Stimuli</b>
Bird	Owl	Ave	Cuervo	Ocell	Corb
For Carrying	Basket	Material de lectura	Enciclopedia	Material de lectura	Enciclopèdia
Vegetable	Onion	Verdura	Apio	Verdura	Api
Worn on feet	Skates	Calzado	Alpargatas	Calçat	Espardenyes
Dessert	Cake	Reptil	Caimán	Reptil	Camaleó
For Smoking	Pipe	Material de construcción	Mármol	Material de construcció	Marbre
Jewellery	Watch	Piedra preciosa	Turquesa	Pedra preciosa	Turquesa
Kind of building	Cabin	Edificio	Piso	Edifici	Pis
Furniture	Desk	Mueble	Escritorio	Moble	Calaixera
Transportation	Train	Vehiculo	Autocar	Vehicle	Autocar
Tool	Axe	Herramienta	Hoz	Eina	Falç
Musical instrument	Guitar	Instrumento musical	Armónica	Instrument musical	Violí
Kitchen appliance	Toaster	Utensilio de cocina	Colador	Utensili de cuina	Colador
Sport equipment	Racket	Deporte	Gimnasia	Esport	Gimnàstica
Kind of plant	Cactus	Planta	Jazmín	Planta	Romaní
Part of ship	Anchor	Tipo de barco	Pesquero	Tipus de vaixell	Pesquer

**Table 2.** Classification of differences after adaptation among dialectal varieties of Catalan

Central			Balearic	North-Western	South- Western	
Barcelona	Girona	Tarragona	Palma de Mallorca	Lleida	Castelló	València
Mini-Mental State Examination -MMSE- (Folstein et al., 1976)						
<b>FORQUILLA</b>			FORQUETA		FORQUETA	
<b>PLÀTAN</b>				PLÀTANO		
Free and Cued Selective Reminding Test –FIRST- Versión A (Buschke, 1984)						
<b>OCELL - CORB</b>			AUCELL		PARDAL	
<b>VERDURA - API</b>			ÀPIT	ÀPIT		
<b>MATERIAL DE CONSTRUCCIÓ - MARBRE*</b>			CIMENT		CIMENT	
<b>VEHICLE - AUTOCAR</b>				AUTOBÚS	AUTOBÚS	
<b>EINA - FALÇ</b>			FAUÇ		CORBELLA	
<b>ESPORT - GIMNÀSTICA</b>			GIMNÀSSIA	GIMNÀSIA		
<b>PLANTA - ROMANÍ</b>					ROMER	
STROOP TEST (Golden, 1978)						
<b>Verd - blau - vermell</b>				Verd - blau - roig	Verd - blau - roig	
Boston Naming Test (Kaplan, Goodglass & Weintraub, 1983)						
<b>XIULET</b> bufar - xiulet - cinta mètrica - xiular			<b>SIULET</b> bufar - siulet - cinta mètrica - siular	XIULET - <b>PITO</b> bufar - xiulet- cinta mètrica - xiular		
<b>TISORES</b> ganivet - alicates - tisores - tallar			<b>ESTISORES - ESTIDORES</b> guinavet - alicates - estisores - tallar	<b>ESTISORES</b> ganivet - alicates - estisores - tallar	<b>ESTISORES</b> ganivet - alicates - estisores - tallar	
<b>PINTA</b> pèl - pinta - rascllet - raspall			PINTA pèl- pinta - rastell - raspall		PINTA pèl- pinta - rastell - raspall	
<b>FLOR</b> jardí - flor - sor - arbre			<b>ESTISORES</b> guinavet - alicates - estisores - tallar		FLOR jardí - flor - cor - arbre	
<b>RASPALL DE DENTS</b> raspall de dents - fil dental - dents - pasta de dents				<b>RESPALL DE DENTS</b> respall de dents - fil dental - dents - pasta de dents		
<b>ESCOMBRA</b> Fregona- raspall - escombrar - escombra			GRANERA fregona - raspall - agranar - granera	ESCOMBRA - <b>GRANERA</b> fregona- raspall -	GRANERA fregona - raspall - agranar - granera	

		escombrar - escombra	
<b>POP</b> Calamar- pop - pou - fantasma			POLP calamar - <b>polp</b> - pou - fantasma
<b>BOLET</b> paraigua - bolet - barret - menjar	BOLET- <b>ESCLATASANGS</b> Paraigua - bolet - <b>capell</b> - menjar		
<b>CAMELL</b> camell - ase - desert - canell		CAMELL camell <b>ruc</b> - desert - canell	
<b>MÀSCARA</b> carnaval - màscara - cara - pallasso	<b>CARETA</b> carnaval - <b>careta</b> - cara - pallasso		<b>CARASSETA</b> carnaval - <b>carassetta</b> - cara - pallasso
<b>MAGDALENA</b> galeta - galena - magdalena - gelat	MAGDALENA <b>galleta</b> - galena - magdalena - gelat		
<b>CARGOL</b> cargol - llimac - closca - carbó	<b>CARAGOL</b> <b>caragol</b> - llimac - closca - carbó		<b>CARAGOL</b> <b>caragol</b> - <b>bavosa</b> - closca - carbó
<b>CANOA</b> cànon - canoa - balsa - rem	<b>CÀNOVA</b> cànon- <b>cànova</b> balsa - rem		CANOA cànon - canoa - <b>bassa</b> - rem
<b>GLA</b> glà - boina - castanya - roure	<b>AGLÀ</b> <b>aglà</b> - boina - castanya - roure	<b>AGLÀ</b> <b>aglà</b> - boina - castanya - roure	<b>BELLOTA</b> <b>bellota</b> - boina - castanya - roure
<b>IGLÚ</b> cabana esquimal - rusc - iglú - casa de gel	IGLÚ cabana esquimal - <b>caera</b> - iglú - casa de gel		IGLÚ <b>cabanya esquimal</b> - <b>colmena</b> - iglú - casa de gel
<b>XANQUES</b> Crosses - xanques - bastons - esclops			XANQUES crosses - xanques - bastons - <b>socs</b>
<b>ESCALES MECÀNIQUES</b> Ascensor - escales mecàniques - funda de guitarra- esglaons	ESCALES MECÀNIQUES ascensor - escales mecàniques - funda de guitarra- <b>escalons</b>		ESCALES MECÀNIQUES ascensor - escales mecàniques - funda de guitarra- <b>escalons</b>
<b>PICAPORTA*</b> picaporta - mànec - pom -	<b>BAULA</b> <b>baula</b> - mànec -		<b>PICAPORT</b> <b>picaport</b> - mànec -

<b>estrep</b>	<b>maneta</b> - estrep		<b>maneta</b> - estrep
<b>PELICÀ</b> pingüí - ocell - pelicà - gavina	PELICÀ pingüí - <b>aucell</b> - pelicà - gavina		PELICÀ pingüí - <b>pardal</b> - pelicà - gavina
<b>MORRIÓ - BOÇ</b> arnès - marró - morrió - pistolera		MORRIÓ - <b>BOÇAL</b> arnès marró - morrió - pistolera	<b>BOÇ</b> arnès - <b>bocí</b> - <b>boç</b> - pistolera
<b>BALDA*</b> porta - cadenat - balda - passador	<b>BIULÓ</b> porta - cadenat - <b>biuló</b> - passador		BALDA porta- cadenat - <b>pestell</b> - passador
<b>PERGAMÍ</b> manuscrit - pergamí - escriptura - papir	<b>PLEGAMÍ</b> manuscrit- <b>plegamí</b> - escriptura - papir		
<b>EMBUT</b> filtre- embut - got - sifó	EMBUT filtre- embut - <b>tassó</b> - sifó		
<b>ACORDIÓ</b> acordió - gaita- porta plegable - piano	ACORDIÓ acordió - <b>xeremia</b> - porta plegable - piano		
<b>SOGA*</b> botxí - llaç - sogà - corda	<b>CORDA</b> botxí - llaç - <b>corda</b> - <b>amarra</b>		
<b>ESPÀRREC</b> bròquil- branca - carxofa - espàrrec			<b>ESPÀRREC</b> <b>bròcoli</b> - branca - carxofa - <b>espàrrec</b>
<b>PINCES</b> pinces- tenalles - taüt - alicates	PINCES Pinces- <b>estenalles</b> - <b>baül</b> - alicates		PINCES pinces- <b>estenalles</b> - taüt- alicates
<b>PÈRGOLA</b> heura - pèrgola - cavallet - gelosia			PÈRGOLA <b>hedra</b> - pèrgola - cavallet - gelosia
<b>ÀBAC</b> boles - xines - àbac - joc	ÀBAC <b>bolles</b> - xines - àbac - joc		

## **2. Sociodemographic characteristics of the experimental sample and standardization of NN.CAT in Catalan-speaking population and its dialectal varieties.**

We have obtained the first normative data from native Catalan inhabitants of Catalonia, Balearic Islands and Valencia, whose native tongue is standard Catalan or any of its dialects. The demographic characteristics and its sample distribution indicate that the study sample comprises 401 people (191 men and 210 women) who speak Catalan as their dominant language and live in Barcelona (140), Girona (32), Tarragona (50) where Central Catalan is spoken; in Lleida and Andorra (65) where north-western Catalan is spoken; Palma de Mallorca (45) where Balearic is spoken; and finally Castellon de la Plana (16) and Valencia (53) where Valencian is spoken. A homogeneous sample distribution is observed.

### **2.1. Impact of sociodemographic variables on the performance of the tests.**

We have studied the effect of demographic variables (age and education) on the performance of the neuropsychological tests in Catalan (Table 3). To study the effect of age and education variables on the performance of neuropsychological tests in Catalan, a Pearson correlation between variables was run. The result of this analysis indicates, in line with the published results in previous studies (Peña-Casanova et al., 2009, 2012), that there is a negative impact of age on performance in all the neuropsychological tests (the performance worsens by age) except in the semantic verbal fluency "fruits and vegetables" test. We have also observed a positive effect of educational level on the performance of all neuropsychological tests administered in Catalan. Thus, these results suggest that the raw scores gathered from these tests should be adjusted by these two variables in order to obtain the real performance from the assessed study participants and to make an appropriate valuation of the cognitive state.

**Table 3.** Correlation of sociodemographic variables (age and education) and performance obtained in the neuropsychological tests

Neuropsychological tests in Catalan	Age		Education	
	<i>r</i>	<i>P Value</i>	<i>r</i>	<i>P Value</i>
Direct digits	-.286	.000*	.295	.000*
Reverse digits	-.389	.000*	.369	.000*
Boston	-.292	.000*	.372	.000*
TOKEN	-.466	.000*	.337	.000*
FCSRT Record Free 1 <sup>st</sup> attempt	-.409	.000*	.318	.000*
FCSRT Record Free Total	-.628	.000*	.400	.000*
FCSRT Record Total	-.366	.000*	.333	.000*
FCSRT Record free delayed	-.519	.000*	.363	.000*
FCSRT Record delayed Total	-.272	.000*	.248	.000*
Stroop reading	-.421	.000*	.466	.000*
Stroop colour	-.487	.000*	.350	.000*
Stroop reading-colour	-.522	.000*	.323	.000*
Semantic verbal fluency "animals"	-.350	.000*	.306	.001*
Semantic verbal fluency "fruits and vegetables"	-.064	.508	.208	.030*
Semantic verbal fluency "kitchen utensils "	-.343	.000*	.338	.000*
Formal verbal fluency "p"	-.352	.000*	.351	.000*
Formal verbal fluency "m"	-.258	.006*	.265	.005*
Formal verbal fluency "r"	-.231	.015*	.345	.000*

**Note.** \* = Significant difference ( $P < 0.05$ ),  $r$  = Pearson correlation

**2.2. Standardization of NN.CAT.** We have obtained normative data from a Catalan speaking population through the administration of neuropsychological tests, which have been translated and adapted into Catalan and its dialectal varieties (Neuronorma.cat). To assure an appropriate interpretation of the neuropsychological test takers' performance, we have used reference data (Table 4). When gathering the data from the study sample, we have taken into account the impact of the sociodemographic variables, age and education, according to the study sample's distribution (table 5). The sample has been properly stratified in different groups, so that it is representative of the Catalan-speaking studied population.



**3. Impact of linguistic variables studied in the NN.CAT.** We have studied the influence of bilingualism (unbalanced bilingual with Catalan as the dominant language vs balanced bilingual) and switching (which measures the lack of awareness of the alternating use of languages and dialects). To study the effect of these linguistic variables, first we have studied the differences between bilingual groups according to different quantitative variables of switching (global and specific), using a non-parametric Mann-Whitney test. The results (Table 6) show significant differences in switching (global switching trend to Spanish and contextual switching), between unbalanced and balanced bilingual subjects. These data show a higher prevalence of switching among the balanced bilingual group compared to the unbalanced bilingual group, in consensus with published data in previous scientific literature (Rodríguez-Fornells et al., 2012).

**3.1. The effect of bilingualism.** The effect of bilingualism on the performance of neuropsychological tests has been studied. Differences between bilingual groups were evaluated by the performance obtained in the Stroop test in Catalan. Results confirm a positive impact of bilingualism on the interference task of the Stroop test (reading-coloured;  $P = 0.005$ ), which measures the ability to inhibit automatic responses and therefore control over the switching tendency. The results indicate that the better performance of this group (bilingual balanced) in this task is consistent with studies which explain that the frequent use of inhibitory networks can increase efficiency in this process (Festman et al., 2010; Lehman-Blake et al., 2015; Li et al., 2015).

**Table 4.** Descriptive statistics scores on neuropsychological tests distributed by age and education

<b>Group</b>	<b>Direct digits</b>	<b>Reverse digits</b>	<b>Boston Naming Test</b>	<b>Token Test</b>	<b>FIRST Record free 1<sup>st</sup> attempt</b>	<b>FIRST Record free total</b>	<b>FIRST Record total</b>	<b>FIRST Record free delayed</b>	<b>FIRST Record Delayed Total</b>	<b>Stroop reading</b>	<b>Stroop colour</b>	<b>Stroop reading-colour</b>
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
<b>1</b>	6.32 (0.24)	4.57 (0.24)	48.70 (0.92)	34.59 (0.50)	7.82 (0.57)	29.96 (1.44)	43.36 (1.33)	11.29 (0.67)	14.68 (0.60)	94.64 (2.41)	71.50 (2.64)	47.43 (2.46)
<b>2</b>	5.92 (0.13)	4.72 (0.17)	50.36 (0.92)	35.32 (0.16)	8.25 (0.38)	32.14 (0.88)	44.53 (0.89)	11.61 (0.54)	14.61 (0.46)	96.14 (1.94)	69.33 (2.13)	51.92 (1.84)
<b>3</b>	6.50 (0.19)	4.97 (0.15)	52.45 (0.74)	35.41 (0.17)	8.63 (0.36)	32.57 (1.01)	44.48 (0.91)	12.15 (0.46)	14.73 (0.44)	94.33 (2.31)	74.74 (2.14)	52.26 (1.97)
<b>4</b>	6.05 (0.29)	4.47 (0.22)	51.89 (0.94)	35.29 (0.18)	8.11 (0.59)	29.37 (1.49)	42.79 (1.44)	10.00 (0.95)	14.00 (0.75)	90.47 (2.64)	65.56 (2.23)	47.50 (2.93)
<b>5</b>	5.92 (0.19)	4.80 (0.22)	51.40 (0.61)	35.33 (0.19)	8.08 (0.48)	27.65 (1.31)	42.46 (1.05)	10.38 (0.57)	14.65 (0.51)	98.12 (2.07)	69.07 (2.65)	48.27 (1.97)
<b>6</b>	6.61 (0.33)	5.22 (0.34)	53.72 (0.80)	35.44 (0.28)	7.67 (0.49)	30.56 (1.53)	44.78 (0.68)	12.33 (0.75)	15.44 (0.27)	96.39 (3.36)	71.50 (3.11)	52.83 (2.16)
<b>7</b>	5.69 (0.47)	3.92 (0.33)	51.08 (1.14)	33.19 (0.73)	4.23 (0.54)	19.76 (1.84)	35.92 (3.09)	7.46 (1.25)	12.15 (1.56)	71.38 (5.09)	60.23 (4.89)	39.31 (2.30)
<b>8</b>	5.28 (0.22)	4.12 (0.23)	49.61 (0.95)	34.36 (0.46)	6.44 (0.43)	24.56 (1.15)	42.48 (1.24)	9.00 (0.67)	14.12 (0.62)	82.20 (3.37)	60.00 (2.54)	38.84 (2.24)
<b>9</b>	6.03 (0.20)	4.47 (0.24)	54.25 (0.54)	34.69 (0.25)	7.06 (0.48)	26.74 (1.37)	42.42 (1.29)	9.90 (0.77)	13.58 (0.82)	94.94 (2.16)	72.06 (2.64)	46.50 (2.25)

<b>10</b>	6.19 (0.16)	4.42 (0.18)	53.56 (0.63)	34.99 (0.25)	8.49 (1.22)	28.83 (0.76)	43.95 (0.94)	10.81 (0.53)	14.75 (0.51)	95.89 (2.15)	67.97 (2.23)	47.94 (2.73)
<b>11</b>	4.64 (0.29)	2.88 (0.27)	43.63 (1.74)	31.53 (0.89)	4.13 (0.46)	17.40 (1.34)	35.20 (2.39)	5.08 (0.90)	11.17 (1.37)	64.53 (4.36)	49.12 (2.71)	32.99 (2.61)
<b>12</b>	5.56 (0.28)	3.31 (0.19)	49.06 (0.77)	32.47 (0.66)	4.44 (0.39)	18.50 (1.19)	35.63 (2.13)	5.75 (0.84)	11.56 (1.25)	75.25 (3.21)	54.75 (2.59)	30.81 (2.59)
<b>13</b>	5.94 (0.25)	4.19 (0.24)	50.93 (1.34)	32.75 (0.49)	5.73 (0.58)	24.20 (1.46)	42.07 (1.81)	9.14 (0.89)	13.64 (0.94)	87.19 (3.57)	53.75 (2.59)	33.69 (3.24)
<b>14</b>	6.00 (0.23)	4.38 (0.19)	51.95 (0.78)	33.64 (0.44)	6.05 (0.51)	23.47 (1.34)	42.00 (1.04)	9.00 (0.70)	14.24 (0.50)	96.62 (2.02)	55.50 (2.96)	38.91 (2.08)
<b>15</b>	5.11 (0.27)	2.89 (0.17)	44.28 (2.00)	31.09 (1.06)	3.47 (0.40)	12.76 (1.57)	30.41 (2.91)	3.93 (1.01)	9.40 (1.39)	71.91 (5.15)	65.24 (2.78)	27.87 (3.06)
<b>16</b>	4.92 (0.29)	3.42 (0.26)	41.83 (2.56)	30.79 (0.93)	3.17 (0.66)	14.00 (2.27)	32.17 (2.90)	5.67 (0.84)	11.08 (1.69)	75.19 (7.48)	41.87 (2.77)	34.20 (4.08)
<b>17</b>	5.18 (0.32)	3.81 (0.35)	45.18 (1.77)	31.73 (1.05)	3.60 (0.34)	15.20 (1.77)	37.70 (2.08)	4.33 (0.50)	12.89 (0.65)	72.63 (2.64)	53.80 (4.70)	27.36 (3.00)
<b>18</b>	6.80 (0.44)	4.50 (0.48)	45.00 (2.62)	33.33 (0.68)	5.20 (0.69)	19.40 (2.20)	37.30 (2.36)	6.11 (0.95)	12.22 (1.14)	67.97 (2.23)	48.18 (3.32)	25.19 (3.24)

**Note:** *M* = mean; *SD* = Standard Deviation

**Table 5.** Sample distribution according to age and education

Education (years)	Age				
	18-35	36-50	51-65	66-80	>80
Minimum (<8)			Group 7 (13)	Group 11 (18)	Group 15 (18)
Basic level (8-12 years)	Group 1 (28)	Group 4 (19)	Group 8 (27)	Group 12 (16)	Group 16 (12)
Medium level (12-15)	Group 2 (36)	Group 5 (26)	Group 9 (33)	Group 13 (16)	Group 17 (11)
Upper level (15-20)	Group 3 (41)	Group 6 (18)	Group 10 (37)	Group 14 (22)	Group 18 (10)

**Note.** Group (n)

**Table 6.** Correlative analysis between bilingual variables and tendency to switching.

	Non-balanced bilingual with Catalan predominance	Balanced bilingual TOTAL		<i>P- VALUE</i>
	Mean (SD)	Mean (SD)	Mean (SD)	
Switching total	27.27 (6.67)	29.33 (6.67)	27.9 (6.73)	0.011*
Tendency switching to Spanish	7.82 (2.84)	7.28 (2.89)	7.65 (2.87)	0.125
Tendency switching to Spanish	6.13 (2.46)	7.25 (2.83)	6.47 (2.63)	0.000*
Context switching	5.67 (2.59)	6.6 (2.92)	5.95 (2.73)	0.001*
Involuntary switching	7 (2.12)	7.1 (2.33)	7.03 (2.19)	0.583

**Note.** \* = Significant difference ( $P < 0.05$ )

**3.2. Effect of switching.** First we have compared the performance in the Stroop interference task (read-colour) test in Catalan and Spanish. Results, after a comparative analysis (Spearman correlation) between the performance obtained from the test in both languages, show a significant correlation between Catalan and Spanish tests (0781;  $p < 0.001$ ) and a positive effect of switching on the performance of the Stroop interference reading-collared task ( $p < 0.05$ ). These results suggest that the higher the score the greater is the tendency of switching this task when it is performed in Catalan, according to the data obtained in the previous analysis. Secondly, we analyzed the effect of bilingualism on the different performances obtained in the verbal fluency tests administered in Catalan and Spanish. The results show significant differences between (Catalan-Spanish) the semantic verbal fluency tasks "animals" ( $p = 0.010$ ) and "fruits and vegetables" ( $p = 0.013$ ). These differences change depending on the bilingual group, suggesting that the performance in these tests is higher when performed in the Spanish versions by the bilingual balanced group.

### 3. Relevance with possible future implications

Due to the lack of neuropsychological instruments available in Catalan, in clinical practice when there is a patient with L1 Catalan and not fluent in Spanish (L2), clinicians often have to assess by using Spanish neuropsychological test available and make an "online" translation to Catalan and then see performance by comparing the score obtained with Spanish reference standards. The lack to date of translations of content unified among clinicians and adjusted norms to the linguistic context in which they are applied could compromise the validity of the results and trigger biases (Uzzell, Ponton, & Ardila, 2007). With this project, the main neuropsychological instruments will be available in Catalan and its dialects, to enable clinicians the possibility to assess Catalan speakers in their language of choice, providing improved diagnostic quality of the evaluation in this population, and preserve the validity of the results without triggering bias. This project provides the standardized data in a reference population of the inhabitants of Catalonia, the Balearic Islands and Valencia, which speak mainly Catalan and its dialects, as indicated by the main authors (Lezak, et al., 2004; Strauss et al., 2006) and to avoid psychometric and diagnostic errors. The study confirms the effect of sociodemographic variables age and education already described in previous studies (Peña-Casanova 2009, 2012; Heaton, Ryan, Grant, & Matthews, 1996; Plitas & Plakiotis, 2010; Welsh-Bohm et al., 2009). Linguistic variables show an effect on the performance (bilingualism and switching) of neuropsychological tests (Rodriguez-Fornells et al., 2012; Ardila et al., 1994), implying a specific analysis of the scores obtained to know the actual patient's cognitive status of the evaluated patient.

### 4. Literature

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