

## Supplementary Materials Online

**Table S1. Stimulus Material**

*Stimulus Material Used in the Training Tasks*

Spanish words	Vimmi words	Semantic "yes"	Semantic "no"	Lexical "yes"	Lexical "no"
oso (bear)	miresado	animals	body	s	m
perro (dog)	fukepa	animals	body	p	f
caballo (horse)	bati	animals	fruits	b	t
cabra (goat)	doba	animals	fruits	b	d
burro (donkey)	boreda	animals	kitchen	o	a
ratón (mouse)	fesuti	animals	kitchen	t	f
cebra (zebra)	dirube	animals	music	b	d
cerdo (pork/pig)	wepuda	animals	music	d	p
conejo (rabbit)	ean	animals	vehicles	e	a
gato (cat)	geloro	animals	vehicles	o	e
cabeza (head)	urabe	body	animals	b	r
dedo (finger)	detu	body	animals	d	t
labio (lip)	bikute	body	fruits	b	t
pierna (leg)	ganuma	body	fruits	n	g
nariz (nose)	seza	body	kitchen	a	e
ojo (eye)	kadonega	body	kitchen	o	e
brazo (arm)	zuowe	body	music	o	u
mano (hand)	wari	body	music	a	i
oreja (ear)	iol	body	vehicles	o	i
pie (foot)	furome	body	vehicles	e	o

manzana (apple)	nobani	fruits	animals	n	b
naranja (orange)	wubonige	fruits	animals	n	b
cereza (cherry)	loeke	fruits	body	e	o
fresa (strawberry)	toari	fruits	body	a	o
limón (lemon)	tofitá	fruits	kitchen	i	a
piña (pineapple)	deschoga	fruits	kitchen	a	o
pera (pear)	pigemola	fruits	music	p	l
plátano (banana)	raone	fruits	music	n	r
sandía (watermelon)	peabe	fruits	vehicles	a	e
uva (grape)	lodefawi	fruits	vehicles	a	e
salero (salt shaker)	kiale	kitchen	animals	l	k
sartén (frying pan)	mulogite	kitchen	animals	t	m
cuchara (spoon)	gitu	kitchen	body	u	i
cuchillo (knife)	ruzanego	kitchen	body	u	e
taza (cup)	tedo	kitchen	fruits	t	d
vaso (glass)	esepo	kitchen	fruits	s	p
cazo (dipper)	zagido	kitchen	music	a	i
copa (wineglass)	lofuse	kitchen	music	o	e
frigorífico (fridge)	mogra	kitchen	vehicles	o	a
tenedor (fork)	pukoni	kitchen	vehicles	o	i
arpa (harp)	fapro	music	animals	p	f
campana (bell)	lamube	music	animals	m	l
trompeta (trumpet)	mapusebo	music	body	m	s
violín (violin)	koludi	music	body	l	d

flauta (flute)	lefu	music	fruits	f	l
trompa (horn)	pabezi	music	fruits	p	b
acordeón (accordion)	dikemori	music	kitchen	e	i
guitarra (guitar)	foine	music	kitchen	i	e
piano (piano)	ratube	music	vehicles	a	e
tambor (drum)	lasi	music	vehicles	a	i
avión (plane)	lenope	vehicles	animals	n	p
barco (boat)	beropuga	vehicles	animals	b	p
camión (lorry)	pewo	vehicles	body	o	e
carrito (shopping cart)	tanedila	vehicles	body	i	e
bicicleta (bicycle)	paltra	vehicles	fruits	t	p
moto (motorbike)	mofire	vehicles	fruits	m	f
coche (car)	tizo	vehicles	kitchen	o	i
helicóptero (helicopter)	uteli	vehicles	kitchen	i	u
autobús (bus)	brido	vehicles	music	o	i
tren (train)	dra	vehicles	music	r	d

---

*Note.* Spanish words (English translation in brackets) and Vimmi words used in the study. Semantic “yes”: the Vimmi word denotes an exemplar of the semantic category. Semantic “no”: the Vimmi word refers to an exemplar from another semantic category. Lexical “yes”: the grapheme is part of the Spanish translation of the Vimmi word. Lexical “no”: the grapheme is not part of the Spanish translation of the Vimmi word. Music: Musical instruments, Body: Body parts, Kitchen: Kitchen utensils.

**Table S2. Statistics of Material***Characteristics of the Stimuli Used in the Study*

	Mean	SD
Spanish words		
Length	5.68	1.71
Frequency	38.90	61.80
Orthographic neighbourhood	3.36	5.00
AoA	2.47	0.74
Word familiarity	4.16	2.89
Word manipulability	3.36	0.97
Word typicality	4.50	0.47
Word imageability	4.00	2.98
Word concreteness	4.10	2.86
Vimmi words		
Length	5.66	1.45
Orthographic neighbourhood	1.11	2.24
Shared graphemes	2.11	0.97
Shared graphemes (positional)	0.50	0.67
Pictures		
Visual complexity	2.59	0.82
Image agreement	3.94	0.51
Image variability	2.38	0.67
Picture-name agreement	88.2	15.0

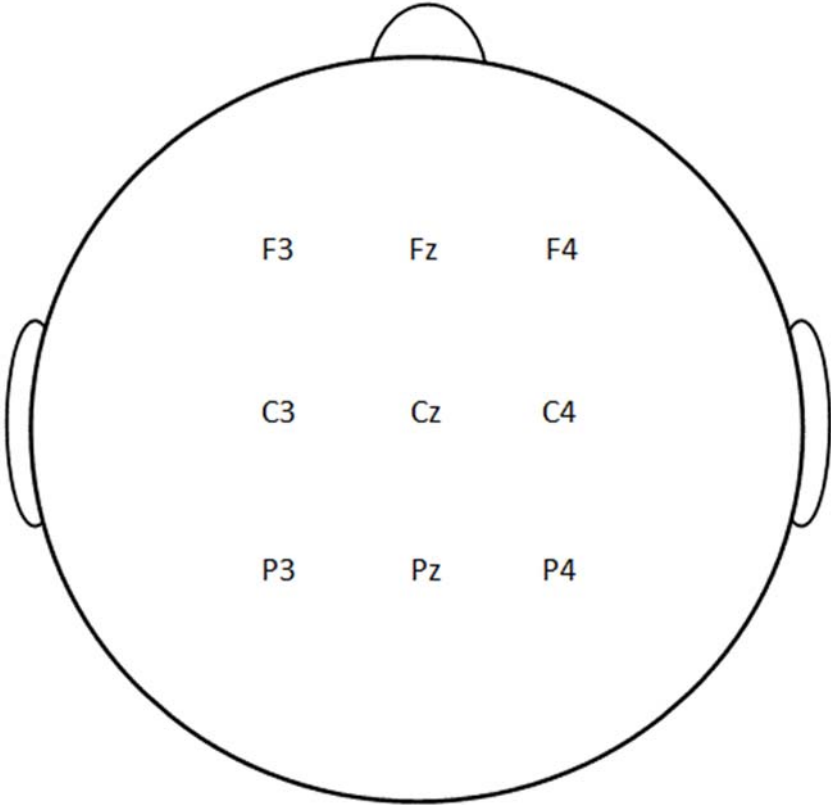
*Note.* Lexical characteristics of words and visual properties of pictures used in the study.

*Length:* Number of graphemes of the word. *Frequency:* Spanish word frequency per one million

words. *Orthographic neighbourhood*: Number of words that can be formed by substituting a single letter at any of the letter positions within the string. *Age of Acquisition*: the estimated age at which a word is acquired on a 7-point rating scale (0–2, 3–4, 5–6, 7–8, 9–10, 11–12, and 13 years or more). *Word familiarity*: the degree to which the concept denoted by the word is encountered in real life on a 5-point scale (1 = very unfamiliar, 5 = very familiar). *Word manipulability*: degree to which use of the human hand is necessary for the object denoted by the word to perform its function on a 5-point scale (1 = low manipulability, 5 = high manipulability). *Word typicality*: degree to which a concept denoted by a word is a representative exemplar of its category on a 5-point scale (1 = least typical, 5 = most typical). *Word imageability*: how easy it is for a word to arouse mental images on a 7-point scale (1 = low imageability, 7 = high imageability). *Word concreteness*: the degree to which the concept denoted by a word refers to a perceptible entity on a 7-point scale (1 = low concreteness, 7 = high concreteness). *Visual complexity*: of the pictures on a 5-point scale (1 = drawing very simple, 5 = drawing very complex). *Image agreement*: the degree to which the picture is similar to the real object depicted in the drawing on a 5-point scale (1 = low agreement, 5 = high agreement). *Image variability*: whether the name of the object evokes few or many different images on a 5-point scale (1 = few images, 5 = many images). *Picture-name agreement*: how close the picture matches the name given to the object in percentages (higher values, higher match).

**Figure S3. Scalp Distribution**

*Scalp Distribution of the Electrodes Selected for Analyses in the Study*



*Note.* Scalp distribution of the electrodes selected for analyses. Electrodes formed three columns in the left (F3, C3, P3), central (Fz, Cz, Pz), and right (F4, C4, P4) sides extending from the front to the back of the head.

#### **S4. Additional analyses.**

##### **Additional analyses. False discovery rate (FDR) corrections to control for false positive results**

False discovery rate (FDR) corrections were computed (Benjamini & Hochberg, 1995) to control for false positive results when multiple tests were conducted in our study. To this end, we first conducted pairwise comparisons in each spatial location and time window to examine the translation direction effect and the naming language effect in the lexical and semantic learning groups. Following the Benjamini-Hochberg procedure, the  $p$ -values associated with each comparison were ranked from lowest to highest where the smallest  $p$ -value had a rank of  $i = 1$  and the largest a value of  $i = 9$  (i.e., 9 electrodes in each time-window). Afterwards, the Benjamini-Hochberg critical value,  $(i/m)Q$ , was computed, where  $i$  was the rank,  $m$  the total number of comparisons, and  $Q$  the false discovery rate. The  $Q$  value was set at .15 following McDonald's recommendations (2014, p. 260,  $Q$  value between .10 and .20). According to the Benjamini-Hochberg procedure, the largest  $p$  value that has  $p < (i/m)Q$  is significant, and all of the  $p$  values smaller than it are also significant.

The results obtained in these analyses are reported in Table 1 & 2. The pattern of data after false discovery rate corrections was similar to that reported in text. Regarding the translation task (see Table 1), in the 150-300 ms time-window, pairwise comparisons revealed a significant translation direction effect in the semantic group (Pz location) and the lexical group (C4 location). We had no theoretical reasons to anticipate this effect in this early time window. However, these effects were not significant after FDR correction, indicating that they were false positive results. In the N400 time-window (300-500 ms), the semantic group showed the translation direction effect in centro-parietal locations (C4, Pz, Cz). Moreover, after FDR corrections, this effect was also found in the right parietal region (P4). However, in the lexical training group, the translation direction effect was shown in only one location (C4)

before and after FDR corrections. In line with the pattern of data reported in text, the outcomes after controlling for false positive results displayed a translation direction effect in the N400 time-window which was more widely distributed in the semantic group (centro-parietal regions in middle-line and right locations) than in the lexical group (C4 location). Finally, in the LPC time-window, the translation direction effect was widely distributed in both the semantic training group and the lexical group. In the lexical training group, FDR corrections revealed this effect in two additional locations (P4 and F3 locations).

In the picture-naming task (see Table 2), pairwise comparisons did not show significant naming language effects in the 150-250 ms time-window, neither in the semantic learning group nor in the lexical group. In the N400 time-window (250-400 ms), *t*-test comparisons revealed a naming language effect in the semantic group (C4 location) and the lexical group (Cz location). However, after FDR corrections, the naming language effect was significant in the semantic training group but not in the lexical group. Thus, the data after controlling for false positive results revealed a pattern of outcomes similar to that reported in the main text. The naming language modulated the N400 amplitude in the semantic group but not in the lexical group. Finally, in the late time window (400-700 ms), the amplitude of the LPC component was sensitive to the naming language in both training groups. This effect was widely distributed in the semantic group (F4, Pz, P3, C4 and Fz locations) and the lexical group (P3, F3, Pz). Furthermore, after FDR corrections, the effect was also significant in the Cz location for the semantic group and in C3 and F4 locations for the lexical group.

Overall, the approach followed here, pairwise comparisons and subsequent control for false positive results, revealed a pattern of results similar to that reported in the main text. In addition, when this approach was conducted by adjusting the FDR correction to 18 comparisons per time-window (i.e., 9 locations for the semantic group along with 9 comparisons for the lexical group) the pattern of results was similar to that reported here.



**Table 1.** Translation Task. Translation Direction Effect Before/After FDR Corrections

R	E	$t(26)$	$p$	$p^{(u)}$	i/m	(i/m)Q	$p^{(c)}$	E	$t(26)$	$p$	$p^{(u)}$	i/m	(i/m)Q	$p^{(c)}$
Lexical Training							Semantic Training							
<b>150-300 ms Time-window</b>														
1	C4	-2.27	.031	*	0.11	0.017		Pz	-2.34	.027	*	0.11	0.017	
2	Fz	1.97	.060		0.22	0.033		P4	-1.45	.158		0.22	0.033	
3	P4	-1.23	.229		0.33	0.050		F4	1.31	.201		0.33	0.050	
4	Cz	-1.21	.236		0.44	0.067		C4	-0.94	.355		0.44	0.067	
5	F3	1.03	.313		0.56	0.083		Cz	-0.93	.358		0.56	0.083	
6	Pz	-0.84	.407		0.67	0.100		F3	-0.34	.731		0.67	0.100	
7	P3	-0.38	.705		0.78	0.117		Fz	-0.33	.739		0.78	0.117	
8	F4	0.23	.821		0.89	0.133		C3	0.28	.779		0.89	0.133	
9	C3	0.21	.837		1.00	0.150		P3	-0.27	.786		1.00	0.150	
<b>300-500 ms Time-window</b>														
1	C4	-4.34	.000	*	0.11	0.017	*	C4	-3.11	.005	*	0.11	0.017	*
2	Cz	-1.87	.073		0.22	0.033		Pz	-2.47	.020	*	0.22	0.033	*
3	Fz	1.39	.175		0.33	0.050		Cz	-2.12	.043	*	0.33	0.050	*
4	P4	-1.19	.245		0.44	0.067		P4	-1.94	.062		0.44	0.067	*
5	F3	0.97	.341		0.56	0.083		F4	0.72	.475		0.56	0.083	
6	P3	0.85	.403		0.67	0.100		P3	0.43	.669		0.67	0.100	
7	C3	0.54	.594		0.78	0.117		C3	-0.36	.717		0.78	0.117	
8	Pz	-0.46	.649		0.89	0.133		Fz	-0.26	.795		0.89	0.133	
9	F4	-0.28	.784		1.00	0.150		F3	0.24	.805		1.00	0.150	
<b>500-700 ms Time-window</b>														
1	C4	-4.03	.000	*	0.11	0.017	*	Fz	-4.26	.000	*	0.11	0.017	*
2	F4	-3.60	.001	*	0.22	0.033	*	F3	-3.58	.001	*	0.22	0.033	*
3	P3	3.56	.001	*	0.33	0.050	*	C4	-3.33	.003	*	0.33	0.050	*
4	Fz	-2.31	.029	*	0.44	0.067	*	C3	-2.90	.007	*	0.44	0.067	*
5	Cz	-2.30	.030	*	0.56	0.083	*	Cz	-2.53	.018	*	0.56	0.083	*
6	Pz	1.76	.090		0.67	0.100	*	P3	2.48	.020	*	0.67	0.100	*
7	P4	1.73	.095		0.78	0.117	*	F4	-2.24	.034	*	0.78	0.117	*
8	F3	-1.64	.112		0.89	0.133	*	Pz	1.49	.147		0.89	0.133	
9	C3	-1.47	.154		1.00	0.150		P4	1.45	.157		1.00	0.150	

**Note.** Abbreviations: R: Rank. E: Electrode.  $p^{(u)}$ : Uncorrected  $p$ -values in each pairwise comparison.  $p^{(c)}$ : Corrected  $p$ -values after corrections to control for false positive results. \*significant  $p$ -values.

**Table 2.** Naming Task. Naming Language Effect Before/After FDR Corrections

R	E	$t(26)$	$p$	$p^{(u)}$	i/m	(i/m)Q	$p^{(c)}$	E	$t(26)$	$p$	$p^{(u)}$	i/m	(i/m)Q	$p^{(c)}$
Lexical Training							Semantic Training							
150-250 ms Time-window														
1	F4	1.12	.273		0.11	0.017		C3	1.52	.141		0.11	0.017	
2	P3	-1.07	.293		0.22	0.033		C4	0.95	.351		0.22	0.033	
3	Pz	-0.94	.358		0.33	0.050		Fz	-0.87	.395		0.33	0.050	
4	Cz	0.79	.435		0.44	0.067		F3	-0.68	.500		0.44	0.067	
5	C3	0.60	.552		0.56	0.083		Cz	0.56	.582		0.56	0.083	
6	C4	0.34	.739		0.67	0.100		Pz	0.37	.715		0.67	0.100	
7	F3	0.25	.802		0.78	0.117		F4	-0.28	.782		0.78	0.117	
8	P4	-0.08	.937		0.89	0.133		P4	0.19	.848		0.89	0.133	
9	Fz	-0.04	.965		1.00	0.150		P3	-0.08	.939		1.00	0.150	
250-400 ms Time-window														
1	Cz	2.49	.020	*	0.11	0.017		C4	2.93	.007	*	0.11	0.017	*
2	F3	-1.88	.071		0.22	0.033		Fz	-1.96	.061		0.22	0.033	
3	Fz	-1.54	.137		0.33	0.050		Cz	1.76	.090		0.33	0.050	
4	P4	1.26	.220		0.44	0.067		C3	1.47	.154		0.44	0.067	
5	P3	1.22	.234		0.56	0.083		F3	-1.45	.160		0.56	0.083	
6	Pz	0.94	.357		0.67	0.100		P3	-1.13	.268		0.67	0.100	
7	C3	0.77	.446		0.78	0.117		Pz	0.87	.391		0.78	0.117	
8	F4	-0.52	.607		0.89	0.133		P4	0.71	.485		0.89	0.133	
9	C4	0.43	.669		1.00	0.150		F4	-0.47	.640		1.00	0.150	
400-700 ms Time-window														
1	P3	-2.30	.030	*	0.11	0.017	*	F4	2.90	.007	*	0.11	0.017	*
2	F3	2.27	.032	*	0.22	0.033	*	Pz	-2.75	.011	*	0.22	0.033	*
3	Pz	-2.14	.042	*	0.33	0.050	*	P3	-2.41	.023	*	0.33	0.050	*
4	C3	1.96	.060		0.44	0.067	*	C4	2.31	.029	*	0.44	0.067	*
5	F4	1.91	.068		0.56	0.083	*	Fz	2.19	.038	*	0.56	0.083	*
6	P4	-1.66	.110		0.67	0.100		Cz	1.96	.060		0.67	0.100	*
7	Cz	0.96	.344		0.78	0.117		C3	1.27	.216		0.78	0.117	
8	C4	0.82	.421		0.89	0.133		F3	1.08	.289		0.89	0.133	
9	Fz	0.78	.441		1.00	0.150		P4	-1.00	.326		1.00	0.150	

**Note.** Abbreviations: R: Rank. E: Electrode.  $p^{(u)}$ : Uncorrected  $p$ -values in each pairwise comparison.  $p^{(c)}$ : Corrected  $p$ -values after corrections to control for false positive results. \*significant  $p$ -values.

