LEXICAL CATEGORY DIFFERENCES IN BILINGUAL PICTURE NAMING: IMPLICATIONS FOR MODELS OF LEXICAL REPRESENTATION

**Supplementary Table 1.** Stimuli used in Experiment 2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **IPNP ID** | **English name** | **English log freq/million** | **Spanish name** | **Spanish log freq/million** |
| **Low Frequency Nouns** | |  |  |  |
| obj007 | antlers | -0.04 | cuernos | 2.44 |
| obj010 | fishtank | -0.10 | pecera | 1.81 |
| obj035 | beard | 1.14 | barba | 2.75 |
| obj063 | broom | 0.73 | escoba | 2.28 |
| obj067 | butterfly | 0.87 | mariposa | 2.45 |
| obj085 | castle | 1.33 | castillo | 2.95 |
| obj087 | celery | 0.29 | apio | 1.77 |
| obj102 | clown | 1.34 | payaso | 2.92 |
| obj116 | cross | 1.36 | cruz | 2.95 |
| obj117 | crown | 1.13 | corona | 2.74 |
| obj130 | dolphin | 0.84 | delfín | 2.14 |
| obj147 | eskimo | 0.18 | esquimal | 1.71 |
| obj151 | feather | 1.10 | pluma | 2.66 |
| obj155 | fireman | 0.71 | bombero | 2.43 |
| obj160 | flashlight | 0.85 | lámpara | 2.63 |
| obj191 | brush | 0.87 | cepillo | 2.60 |
| obj193 | hammer | 1.07 | martillo | 2.70 |
| obj221 | jar | 1.02 | frasco | 2.54 |
| obj223 | jumprope | -0.19 | cuerda | 2.99 |
| obj232 | ladle | -0.09 | cucharón | 1.34 |
| obj235 | lawnmower | 0.24 | podadora | 1.38 |
| obj258 | mask | 1.39 | máscara | 2.92 |
| obj264 | mixer | 0.16 | batidora | 1.34 |
| obj275 | mushroom | 0.70 | hongo | 2.12 |
| obj286 | octopus | 0.29 | pulpo | 1.91 |
| obj295 | palmtree | 0.21 | palmera | 1.71 |
| obj318 | piggybank | -0.13 | alcancía | 1.48 |
| obj325 | pitchfork | -0.07 | trinche | 0.70 |
| obj332 | popcorn | 0.87 | palomitas | 2.52 |
| obj333 | popsicle | 0.31 | paleta | 2.01 |
| obj344 | raccoon | 0.29 | mapache | 2.03 |
| obj362 | rollingpin | -0.70 | rodillo | 1.43 |
| obj372 | sailboat | 0.26 | velero | 1.88 |
| obj379 | scarf | 0.68 | bufanda | 2.23 |
| obj380 | scissors | 0.83 | tijeras | 2.46 |
| obj395 | shovel | 0.87 | pala | 2.43 |
| obj398 | skateboard | 0.31 | patineta | 1.92 |
| obj403 | sled | -0.74 | trineo | 2.25 |
| obj416 | spider | 1.17 | araña | 2.80 |
| obj421 | statue | 1.10 | estatua | 2.67 |
| obj441 | teapot | -0.02 | cafetera | 2.11 |
| obj451 | thimble | -0.47 | dedal | 1.08 |
| obj459 | tomato | 1.02 | tomate | 2.62 |
| obj481 | unicycle | -0.66 | monociclo | 0.48 |
| obj482 | vacuum | 0.73 | aspiradora | 2.31 |
| obj484 | vest | 0.83 | chaleco | 2.50 |
| obj502 | wheat | 0.76 | trigo | 2.32 |
| obj504 | wheelbarrow | -0.17 | carretilla | 1.88 |
| obj509 | windmill | 0.24 | molino | 2.12 |
| obj514 | wolf | 1.39 | lobo | 3.00 |
|  |  |  |  |  |
| **High Frequency Nouns** | |  |  |  |
| obj011 | arm | 2.10 | brazo | 3.37 |
| obj022 | bag | 2.09 | bolsa | 3.49 |
| obj037 | bed | 2.30 | cama | 3.87 |
| obj048 | boat | 2.04 | barco | 3.55 |
| obj049 | bomb | 1.80 | bomba | 3.52 |
| obj053 | bottle | 1.81 | botella | 3.25 |
| obj056 | box | 2.01 | caja | 3.67 |
| obj062 | bridge | 1.69 | puente | 3.23 |
| obj065 | bus | 1.88 | camión | 3.42 |
| obj071 | cake | 1.71 | pastel | 3.36 |
| obj073 | camera | 1.88 | cámara | 3.62 |
| obj086 | cat | 1.94 | gato | 3.35 |
| obj089 | chair | 1.77 | silla | 3.36 |
| obj090 | cheese | 1.61 | queso | 3.29 |
| obj095 | church | 1.86 | iglesia | 3.54 |
| obj097 | city | 2.26 | ciudad | 4.04 |
| obj127 | doctor | 2.48 | doctor | 3.88 |
| obj128 | dog | 2.40 | perro | 3.84 |
| obj132 | door | 2.52 | puerta | 4.14 |
| obj135 | dress | 1.87 | vestido | 3.53 |
| obj153 | finger | 1.85 | dedo | 3.28 |
| obj154 | fire | 2.23 | fuego | 3.74 |
| obj162 | floor | 2.04 | piso | 3.62 |
| obj166 | foot | 2.28 | pie | 3.63 |
| obj177 | ghost | 1.71 | fantasma | 3.21 |
| obj189 | gun | 2.44 | pistola | 3.37 |
| obj190 | hair | 2.21 | cabello | 3.48 |
| obj195 | hand | 2.70 | mano | 4.03 |
| obj201 | heart | 2.43 | corazón | 4.02 |
| obj211 | horse | 2.13 | caballo | 3.41 |
| obj226 | king | 2.13 | rey | 3.68 |
| obj237 | leg | 2.06 | pierna | 3.33 |
| obj240 | letter | 2.09 | carta | 3.58 |
| obj267 | moon | 1.72 | luna | 3.44 |
| obj278 | neck | 1.80 | cuello | 3.37 |
| obj283 | nose | 1.88 | nariz | 3.35 |
| obj342 | queen | 1.78 | reina | 3.41 |
| obj345 | radio | 1.90 | radio | 3.49 |
| obj355 | ring | 1.93 | anillo | 3.40 |
| obj391 | boat | 2.04 | barco | 3.55 |
| obj392 | shirt | 1.75 | camisa | 3.28 |
| obj413 | soldier | 1.83 | soldado | 3.35 |
| obj431 | sun | 1.85 | sol | 3.56 |
| obj437 | table | 2.08 | mesa | 3.66 |
| obj447 | tv | 2.02 | televisión | 3.38 |
| obj467 | train | 1.94 | tren | 3.47 |
| obj469 | tree | 1.99 | árbol | 3.34 |
| obj472 | truck | 1.93 | camión | 3.42 |
| obj510 | window | 2.05 | ventana | 3.48 |
| obj515 | woman | 2.65 | mujer | 4.34 |
|  |  |  |  |  |
| **Low Frequency Verbs** | |  |  |  |
| act014 | bark | 0.74 | ladrar | 1.90 |
| act020 | bow | 1.31 | saludar | 2.74 |
| act025 | buckle | 0.70 | abrochar | 1.26 |
| act027 | bury | 1.32 | enterrar | 2.54 |
| act032 | carve | 0.49 | esculpir | 1.26 |
| act189 | carve | 0.49 | esculpir | 1.26 |
| act037 | chew | 0.96 | morder | 2.34 |
| act038 | clap | 0.67 | aplaudir | 1.79 |
| act043 | comb | 0.78 | peinar | 1.49 |
| act045 | conduct | 1.05 | dirigir | 2.76 |
| act047 | cough | 0.94 | toser | 1.62 |
| act221 | cough | 0.94 | toser | 1.62 |
| act053 | curl | 0.37 | peinarse | 1.00 |
| act056 | decorate | 0.36 | decorar | 1.99 |
| act001 | dive | 1.11 | clavarse | 0.48 |
| act062 | drip | 0.71 | gotear | 1.23 |
| act066 | drip | 0.71 | gotear | 1.23 |
| act086 | drip | 0.71 | experimentar | 2.49 |
| act074 | erase | 0.79 | borrar | 2.58 |
| act249 | frost | 0.68 | decorar | 1.99 |
| act098 | glue | 0.77 | pegar | 2.52 |
| act103 | grind | 0.57 | guardar | 3.00 |
| act107 | hatch | 1.11 | nacer | 2.61 |
| act111 | howl | 0.31 | aullar | 1.36 |
| act188 | itch | 0.62 | rascar | 1.48 |
| act120 | kneel | 0.73 | hincar | 0.78 |
| act122 | knit | 0.28 | tejer | 1.78 |
| act134 | magnify | -0.23 | observar | 2.61 |
| act141 | meditate | 0.01 | meditar | 1.88 |
| act146 | mix | 1.21 | batir | 1.83 |
| act150 | operate | 1.13 | operar | 2.53 |
| act153 | peel | 0.73 | pelar | 1.78 |
| act154 | pet | 1.30 | acariciar | 1.79 |
| act156 | pinch | 0.79 | pellizcar | 1.15 |
| act159 | plow | 0.27 | arar | 1.20 |
| act183 | sail | 1.14 | navegar | 2.51 |
| act184 | salute | 0.86 | saludar | 2.74 |
| act195 | sharpen | 0.05 | afilar | 1.23 |
| act196 | shave | 1.14 | rasurar | 1.20 |
| act197 | shave | 1.14 | rasurar | 1.20 |
| act198 | shine | 1.31 | alumbrar | 1.08 |
| act205 | skate | 0.77 | patinar | 2.29 |
| act214 | sneeze | 0.47 | toser | 1.62 |
| act215 | snow | 1.50 | nevar | 1.69 |
| act226 | stack | 0.79 | acomodar | 1.92 |
| act230 | stir | 0.77 | batir | 1.83 |
| act231 | strain | 0.85 | escurrir | 1.00 |
| act254 | wade | 1.22 | nadar | 3.01 |
| act273 | yawn | 0.00 | bostezar | 0.90 |
| act275 | zip | 0.88 | abrochar | 1.26 |
| **High Frequency Verbs** | |  |  |  |
| act015 | beg | 1.71 | pedir | 3.48 |
| act048 | count | 1.95 | contar | 3.42 |
| act174 | count | 1.95 | contar | 3.42 |
| act051 | cross | 1.74 | caminar | 3.41 |
| act052 | cry | 1.82 | llorar | 3.30 |
| act095 | cry | 1.82 | llorar | 3.30 |
| act055 | dance | 2.17 | bailar | 3.46 |
| act002 | drink | 2.39 | tomar | 4.03 |
| act067 | drive | 2.19 | manejar | 3.28 |
| act072 | eat | 2.40 | comer | 3.91 |
| act080 | fall | 2.07 | caer | 3.28 |
| act083 | fight | 2.30 | pelear | 3.37 |
| act084 | file | 1.64 | buscar | 3.85 |
| act176 | fix | 1.94 | arreglar | 3.37 |
| act009 | fly | 1.93 | volar | 3.39 |
| act090 | fly | 1.93 | volar | 3.39 |
| act092 | follow | 2.09 | caminar | 3.41 |
| act123 | knock | 1.81 | tocar | 3.42 |
| act130 | listen | 2.74 | escuchar | 3.57 |
| act133 | look | 3.29 | mirar | 3.48 |
| act144 | mine | 2.40 | trabajar | 3.99 |
| act149 | open | 2.51 | abrir | 3.43 |
| act028 | pay | 2.41 | comprar | 3.67 |
| act044 | play | 2.55 | tocar | 3.42 |
| act158 | play | 2.55 | tocar | 3.42 |
| act173 | read | 2.38 | leer | 3.49 |
| act182 | run | 2.54 | correr | 3.40 |
| act177 | save | 2.21 | salvar | 3.51 |
| act190 | sell | 1.96 | vender | 3.32 |
| act207 | sleep | 2.36 | dormir | 3.86 |
| act228 | steal | 1.73 | robar | 3.27 |
| act244 | talk | 2.93 | hablar | 4.52 |
| act245 | think | 3.43 | pensar | 3.99 |
| act252 | type | 1.78 | escribir | 3.44 |
| act256 | wait | 2.92 | esperar | 3.86 |
| act008 | walk | 2.33 | caminar | 3.41 |
| act257 | walk | 2.33 | caminar | 3.41 |
| act258 | wash | 1.61 | llorar | 3.30 |
| act259 | watch | 2.52 | ver | 4.66 |
| act011 | win | 2.13 | ganar | 3.69 |
| act266 | win | 2.13 | ganar | 3.69 |
| act269 | wish | 2.37 | pensar | 3.99 |
| act064 | write | 2.10 | escribir | 3.44 |
| act272 | write | 2.10 | escribir | 3.44 |

Supplementary Table 2. Results of statistical analyses of picture naming accuracy for Experiment 2. p-values: \*\*\* < .001; \*\* >.01; \* < .05.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Coef β** | **SE (β)** | **t** |
| ***Picture Naming Accuracy*** |  |  |  |
| **Fixed effects: Language x Lexical Category** | |  |  |
| Intercept | 0.54 | 0.03 | 17.8\*\*\* |
| Lexical category (Verb) | 0.07 | 0.04 | 2\* |
| Language (Spanish) | 0.18 | 0.04 | 4.9\*\*\* |
| Lexical category x Language | 0.065 | 0.05 | 0.2 |
|  |  |  |  |
| ***Picture Naming Speed*** |  |  |  |
| **Fixed effects: Language x Lexical Category** | |  |  |
| Intercept | 1356.9 | 32.9 | 41.2\*\*\* |
| Lexical category (Verb) | 189.3 | 17.7 | 41.2\*\*\* |
| Language (Spanish) | 51.9 | 16.3 | 3.2\*\* |
| Lexical category x Language | 85.9 | 21.4 | 4\*\*\* |
|  |  |  |  |
| ***Translation Speed*** |  |  |  |
| ***Fixed effect: Lexical Category*** |  |  |  |
| Intercept | 1136 | 32.9 | 34.5\*\*\* |
| Lexical category (Verb) | 323 | 14.9 | 21.6\*\*\* |

For picture naming accuracy, generalized linear mixed model analysis with language (English, Spanish) and lexical category (noun, verb) as fixed effects and participants as random effects and intercept (for both fixed and random effects) and random slopes showed main effects of language and lexical category and no interaction. Participants were more accurate in English than in Spanish and also more accurate for nouns than for verbs (Supplemental Figure 1). For picture naming speed, the LME analysis with language (English, Spanish) and lexical category (noun, verb) as fixed effects and participants and items as random effects, including intercept for both fixed and random effects and random slopes was significant. There were significant effects of language, lexical category, and their interaction.

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**Effects of frequency and translatability on picture naming speed on Non-Cognate Stimuli in Experiment 2**

Given that the stimuli included some cognates (17 nouns, 11 verbs), the effects of frequency and translatability were examined by excluding the cognates.

*Translation Task:* Verbs (Mean (SE) = 1136.3 (32.8)) were translated faster than nouns (Mean (SE) = 1482.1 (33.4), *β* (noun) = 345.8, SE = 11.1, *p* < .001),).

*Picture Naming Task:* A 3-way LME with lexical category (noun, verb), frequency (low, high) and translatability (low, high) as fixed effects and participants and items as random effects. The intercept was included for both fixed and random effects. For Picture naming RTs, when language and lexical category were entered as fixed effects (random slope and random intercept, and participants as random effect), there was a main effect of language (*β* (noun) = -177.8, SE = 19.1, *p* < .001), a main effect of lexical category (*β* (English) = -48.6, SE = 18.4, *p* < .01) and an interaction between language and lexical category (*β* (noun, English) = -99.6, SE = 25.6, *p* < .001). This finding is the same as when all stimuli were included: verbs (Mean (SE) = 1324.5 (31.4)) were slower than nouns (Mean (SE) = 1096.8 (31.3), mean difference = 227.6 ms, SE = 12.8), Spanish naming (Mean (SE) = 1259.8 (31.5)) was slower than English naming (Mean (SE) = 1161.4 (31.2) mean difference = 98.4 ms, SE = 12.9), and the Spanish-English difference was smaller for verbs (mean difference = 48.5ms) than it was for nouns (mean difference = 148.2 ms).