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On a different *plane*:

Cross-language effects on the conceptual representations of within-language homonyms

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Abstract

We examined whether bilinguals' conceptual representation of homonyms in one language are influenced by meanings in the other. 117 Spanish-English bilinguals generated sentences for 62 English homonyms that were also cognates with Spanish and which shared at least one meaning with Spanish (e.g., plane*/plano*). Production probabilities for each meaning were calculated. A stepwise multiple regression revealed that whether a meaning was shared with Spanish or not accounted for a significant portion of the variance, even after entering production probabilities from published monolingual norms (Twilley et al., 1994). Homonyms classified as highly biased based on monolingual responses became less biased if the less frequent meaning was shared whereas balanced homonyms increased in polarization if the dominant meaning was shared. Results are discussed in terms of models of bilingual conceptual and lexical representation as well as theories of ambiguity resolution.

Introduction

Does proficiency in multiple languages alter the conceptual representations that underlie words for bilinguals? There is a vast body of research demonstrating that the languages of a bilingual are never completely turned off. Instead, whether a bilingual is reading, listening or speaking in a particular language both languages are active. The extent to which one language is active over another varies along a continuum according to the bilingual's surrounding linguistic context (Grosjean, 1997). This continual coactivation of the two languages may shape the underlying conceptual representations of words. For example, for an English monolingual speaker the word "arm" most often refers to a body part, and less often refers to "weapon". Consequently, a monolingual speaker is much more likely to think right away of the "body part" meaning. However, this might not be the case for a person who happens to be a proficient bilingual speaker of Spanish, since "arm" has a cognate translation in Spanish (*arma*) that can only mean "weapon". If a bilingual's languages are in continual interaction, it is possible for this less frequent meaning to actually become subjectively more dominant for the bilingual. One possible prediction is that, through cross-language interactions, it is possible for even a subordinate meaning (like the "weapon" meaning of arm) to become the more dominant, conceptually central meaning associated with a given word. Therefore, in the present study we hypothesized that the conceptual representations associated with ambiguous words for bilinguals may be altered through cross-language activation. We tested this hypothesis by presenting Spanish-English bilinguals with English homonyms that also happened to be cognates with Spanish (e.g., arm/arma) and asking them to

generate a sentence with the first meaning that came to mind. We predicted that homonym meanings that were shared with Spanish would be produced more frequently.

Models of bilingual conceptual memory

The prediction that cross-language coactivation can alter bilinguals' conceptual representations is supported by several models that converge on the assumption that conceptual representations are shared across languages (de Groot, 1992; Kroll & Stewart, 1994; Van Hell & de Groot, 1998). According to the Revised Hierarchical Model (RHM) (Kroll & Stewart, 1994), bilingual conceptual representations exist within a single, integrated store. The extent to which these concepts can be directly accessed from word-level (i.e. lexical) representations from either of a bilingual's languages will depend on developmental aspects of how that language was or is being acquired. Since participants in the present study were highly proficient Spanish-English bilinguals who had learned their second language (L2) at a fairly early age (in early childhood), the RHM would assume that, for these bilinguals, there are strong direct links between the lexical representations of English (the L2) and their underlying concepts, which are shared with the native language (L1), Spanish. In this way, the model would predict potentially strong cross-language influences on conceptual development.

The distributed feature model (DFM) (de Groot, 1992; Van Hell & de Groot, 1998) makes more specific assumptions regarding the nature of the conceptual overlap that exists across languages. According to this model, words across a bilingual's languages

activate a set of conceptual features that are distributed in conceptual space, allowing words to share subsets of conceptual features.

Within the context of the present study, the English word "arm" will activate conceptual features that are shared with its Spanish translation, "*arma*" that specifically relate to the shared "weapon" meaning. However, features that are more specific to language-unique meanings (i.e. the "body part" meaning of "arm" that does not exist in Spanish) are less likely to be shared. Kroll and de Groot (1997) postulated that certain conceptual features might be weighted differentially depending on whether they are central to the underlying concept or simply characteristic of that concept. In the present study, we made a similar prediction. More specifically, we hypothesized that conceptual features will be weighted differentially depending on whether they are shared across languages or not, with those that are shared being more heavily weighted. In this way, features that are shared will become stronger, more central features of the underlying concept in both the L1 and the L2. We are proposing that this alteration in weights develops through the continual coactivation of a bilingual's languages across time.

Several studies support the assumption that conceptual access for bilinguals is influenced by feature representations across languages. For example, Tokowicz and Kroll (2007) found that words with multiple translations were translated more slowly than words with a single translation. This suggests that the bilinguals were simultaneously activating the underlying conceptual feature representations from both

languages. The lack of a one-to-one correspondence in this feature overlap delayed translation.

There is also evidence that conceptual features across languages are activated even when bilinguals are not deliberately translating into their other language. In an all-English task, bilingual speakers of English and Hebrew rated unrelated English word pairs as more semantically similar if they happened to share a Hebrew translation (e.g., map and tablecloth are both translated as "*mapa*" in Hebrew) (Degani, Prior & Tokowicz, under review). The present study follows this line of inquiry by examining how shared conceptual features associated with L2 homonym words influence responses in an L2-exclusive sentence-generation task.

Until this point, we have focused our review on bilingual models of conceptual memory and representation. Also relevant to the present study are models of bilingual lexical representation. In order to complete the sentence-generation task implemented in the present study, bilinguals had to have first lexically accessed the target words. As discussed in the next section, research on bilingual lexical access demonstrates quite clearly that bilinguals activate lexical representations from both languages in parallel when recognizing words (often termed as *language non-selectivity*). We postulate that cross-language activation dynamics at both the lexical and conceptual level converge and drive cross-language influences on processing. Furthermore, since in the present study the target words were all cognates, which have a high degree of lexical form

overlap across languages, it is critical that we include lexical coactivation in our theoretical account.

Bilingual lexical processing and language non-selectivity

To comprehend how words are represented in the bilingual mind, it is first necessary to understand how bilingual lexical access functions. Research on cross-language lexical activation has demonstrated that bilingual lexical access is non-selective (e.g., de Bruijn, Dijkstra, Chwilla, & Schriefers, 2001; de Groot & Nas, 1991; de Groot, Delmaar, & Lupker, 2000; Dijkstra, de Bruijn, Schriefers, & Brinke, 2000; Dijkstra, Timmermans, & Schriefers, 2000; Dijkstra & Van Hell, 2003; Duyck, Assche, Drieghe, & Hartsuiker, 2007; Gollan & Acenas, 2004; Kerkhofs, Dijkstra, Chwilla, & de Bruijn, 2006; Lemhöfer, Dijkstra, & Michel, 2004; Paulmann, Elston-Güttler, Gunter, & Kotz, 2006; Schwartz, Kroll, & Diaz, 2007; Schwartz & Arêas da Luz Fontes, 2008; Van Hell & Dijkstra, 2002; Van Heuven, Dijkstra, Grainger, & Schriefers, 2001; Von Studnitz & Green, 2002). Thus, when bilinguals are comprehending words in one language, lexical representations across their languages are simultaneously co-activated. The general strategy adopted across studies demonstrating non-selectivity has consisted of presenting bilinguals with words in one language that share some lexical property or properties with words from their other language. For example, cognates are words that are orthographically similar and share meaning across languages (e.g., piano/*piano* and arm/*arma* in English and Spanish). Processing time and accuracy for these words is then compared to control words that do not share any lexical property with the non-target language (e.g., pencil-lápiz). Any difference in these measures is interpreted as

reflecting cross-language lexical activation. Through this strategy, effects of cross-language activation have been observed across a wide variety of tasks such as single word recognition (Dijkstra, Van Jaarsveld, & Ten Brinke, 1998; Dijkstra, Grainger, & Van Heuven, 1999; Dijkstra et al., 2000; Dijkstra & Van Hell, 2003; Grainger & Beauvillain, 1987; Lemhöfer et al., 2004; Schwartz et al., 2007; Van Heuven et al., 2001), production tasks (Costa, Colome, Gómez, & Sebastián-Gallés, 2003; Costa, Santesteban, & Ivanova, 2006; Gollan & Acenas, 2004; Hermans, Bongaerts, De Bot, & Schreuder, 1998), and sentence comprehension tasks (Duyck et al., 2007; Elston-Güttler & Friederici, 2005; Elston-Güttler, Gunter, & Kotz, 2005; Schwartz & Kroll, 2006)); and through a variety of measures such as eye-movement monitoring (Duyck et al., 2007; Spivey & Marian, 1999) and ERPs (de Bruijn et al., 2001; Elston-Güttler et al., 2005; Kerkhofs et al., 2006).

These studies have also demonstrated that the nature and magnitude of cross-language lexical activation varies as a function of several factors such as the presence of a sentence context and the overall degree of lexical form and semantic overlap. More specifically, when words are presented in a semantically rich sentence, effects of cross-language activation are attenuated or even eliminated (Duyck et al., 2007; Schwartz & Kroll, 2006; Van Hell & de Groot, accepted). Effects of cross-language activation are also more robust when lexical form and semantic overlap is complete rather than partial. For example, the magnitude of cognate facilitation is greater when the orthographic and phonological overlap is greater across language (Duyck et al., 2007; Dijkstra et al., 1999; Schwartz et al., 2007).

A review of the literature suggests that semantic overlap is a particularly important modulator of cross-language activation effects. When semantics is shared, as is the case for cognates, effects of cross-language activation are quite robust. Cognate facilitation has been consistently observed across many single-word identification studies (Dijkstra et al., 1998; Dijkstra & Van Hell, 2003; Gollan, Forster, & Frost, 1997; Lemhöfer et al., 2004) and has also been shown to persist in sentence context (Duyck et al., 2007; Schwartz & Kroll, 2006). However, when semantics are not shared, as is the case for interlingual homographs, which only share form, effects of cross-language activation are not consistently observed (Dijkstra et al., 1998; Dijkstra et al., 2000; Schwartz & Kroll, 2006; Von Studnitz & Green, 2002).

Bilingual lexical activation is also sensitive to the degree to which semantic overlap of cross-language translations is complete or partial. Partial or incomplete semantic overlap is introduced when words in at least one of a bilingual's languages map onto more than one meaning (Tokowicz, Kroll, de Groot, & Van Hell, 2002). There are several studies demonstrating that bilinguals activate the multiple meanings of ambiguous words across their two languages and that a lack of a one-to-one correspondence amongst these meanings affects performance. For example, in an L2-exclusive lexical decision experiment, German-English bilinguals were presented with unrelated English prime-target word pairs. On critical trials, the pairs were actually both translations of a single German (L1) homonym (e.g., pine-jaw that both translate into *Kiefer* in German). The observed negative priming on target recognition

performance suggests that the bilinguals were activating the German translation resulting in competition between the two, alternative meanings (Elston-Güttler, Paulmann, & Kotz, 2005).

In yet another language-exclusive study, early, highly-proficient Spanish-English bilinguals read L2 sentences that biased the subordinate meaning of an L2 homonym that was either a cognate with Spanish for which the dominant meaning was shared across languages (e.g., novel/*novela*) or a noncognate (e.g., fast/*rápido*). On critical trials, the sentences were followed by a target word that was related in meaning to the contextually inappropriate and dominant meaning of the homonym (e.g., novel => BOOK; fast => SPEED). Participants were instructed to indicate whether the follow-up target word was related in meaning to the previous sentence (thus requiring a "no" response on critical trials). Significant inhibition was observed when the targets were related to the inappropriate, dominant meanings. More importantly, the magnitude of this cost was significantly greater when the previously presented English homonym was also a cognate with Spanish, indicating that competition from the dominant meaning was greater due to cross-language coactivation (Schwartz, Yeh & Shaw, 2008).

The present study

Thus, the emerging picture from existing literature is that, even when bilinguals are processing input from a single language, mental representations at the conceptual and lexical-semantic levels are co-activated across languages. Furthermore, when the words are semantically ambiguous, the multiple meanings are simultaneously coactivated,

even when the ambiguity exists in only one language. This, combined with the fact that the effects of cross-language activation are particularly robust when words have a high degree of lexical overlap, led us to hypothesize that bilinguals' conceptual representations associated with cognates in one language would be shaped by the existence of multiple meanings in the other language. We tested this hypothesis by asking Spanish-English bilinguals to generate sentences using English ambiguous words that also happened to be cognates with Spanish (e.g., arm/*arma*; type/*tip*o). We reasoned that in order to generate sentences one must access the conceptual representation of a word. We predicted that, even though the task was conducted entirely in English, meanings that were shared with Spanish would be provided more frequently in the generated sentences. This would be reflective of the greater involvement of that meaning in the bilingual's underlying conceptual representation of the word. We expected this effect to be particularly robust when the meanings shared with Spanish were infrequent in English.

It is important to note that this study is not concerned with the influence of regional differences in how words are used but rather our findings speak specifically to the influence of cross-language lexical activation on meaning generation. Therefore, we included in our design a comparison group of English speakers not proficient in Spanish but who were from the same surrounding region. Most studies demonstrating effects of cross-language activation have relied on word identification/comprehension tasks such as lexical decision or sentence reading in which effects unfold within 500 milliseconds or less. The present study used a production task in which, unlike

translation tasks, there was no requirement to deliberately activate the non-target language.

Method

Participants

A total of 178 students from the University of Texas at El Paso were recruited through the Psychology pool and participated in the experiment. One participant did not finish the experiment; therefore, producing a sample size of 177. All participants filled out a Language History Questionnaire (LHQ). This questionnaire assessed their language background and abilities in English and Spanish. Participants self-reported their speaking, reading, comprehension and speech skills in both English and Spanish. They also reported how often they communicated in English and Spanish, with eight possible choices, ranging from daily to less than once or twice a year. Responses were numerically coded for later analyses such that a response of "daily use" was given the highest numerical value (8) and "less than once or twice a year" was given the lowest numerical value (1). In a similar way, participants were asked to report the diversity of contexts in which they used the two languages. Five contexts were listed on the questionnaire (home/family, school, friends, work and media). Responses were once again numerically translated by tallying the number of contexts that each participant marked (thus ranging from 0 to 5). Based on responses on the LHQ a total of 117 participants were identified as being proficient bilingual participants.

As noted earlier, the premise of the present study is that the observed differences in meaning frequency were due to cross-language activation and not simply a function of regional differences in how the partial cognates are used. Since this study was conducted in a highly bilingual, bi-cultural, border community in which words may come to be used differently due to loan shifts between the two languages, it was of particular importance that we rule out this possibility. We reasoned that the ideal control group would be participants who were living in the same bilingual, bi-cultural community, but who were not proficient Spanish speakers. We therefore identified participants from the initial pool whose Spanish proficiency was too low to be included in the proficient bilingual sample. Therefore 21 participants' whose mean Spanish proficiency rating was less than five and who reported no use of Spanish in the home were identified as a local control group (see Table 1 for a summary of LHQ data for all participants).

Bilingual participants

Our initial criterion for classifying a participant as being a proficient bilingual was that their mean self-assessed proficiency rating in the two languages had to be at least five on a scale of one to ten. However, due to the high Spanish proficiency of the local population, participants tended to rate their proficiency in Spanish low. Therefore, participants who rated their Spanish slightly lower than 4 (e.g., 4.0 – 4.9) but who also reported learning Spanish before the age of five and using Spanish on a daily basis were also classified as being bilingual and included in the analyses.

The bilingual participants reported learning English at a later age (M= 4.5 years) than Spanish (M= 3.2 years), t (116) = 2.54, p<.01. Nonetheless, their average proficiency self-ratings (averaged across reading, writing, speaking and listening comprehension) were higher in English (M=9.2) than Spanish (M=7.5), t (116) = 7.68, p<.001. In addition, participants reported using English more frequently than Spanish t (115) = 4.27, p<.001, and in more contexts than Spanish t (116) = 6.35, p<.001, suggesting that English had become their dominant language. However, since Spanish was the first language acquired, in this paper we refer to it as the L1. Thus, bilinguals in the present study had become L2- dominant.

(Insert Table 1 about here)

Local control group

On average, local control group participants rated their Spanish proficiency very low (M = 2.6) and their English proficiency almost at ceiling (M = 9.4), t (20) = 22.56, p<.001. These participants reported learning Spanish (M = 12.5) at a much later age than English (M = 3.3), t (18) = -5.95, p<.001. It is important to note that it is almost impossible to identify participants who live in this bilingual region and have absolutely no exposure to Spanish. Therefore, a portion of these local control participants (n = 2) reported being exposed to Spanish at age five or earlier. It is not uncommon in this region to be exposed to Spanish early on in the home (for example through relatives) but then later not go on to become a proficient speaker of the language. The remaining 19 participants in this sub-sample were exposed to Spanish later (three between ages

eight and ten, and the remaining 14 in adolescence). Two participants reported never actually having learned Spanish, but did report using the language and provided proficiency ratings. Overall, participants in the local control group reported using Spanish on a monthly basis, while using English on a daily basis, t (19) = 9.53, p<.001.

Comparison between groups

The local control group rated their Spanish skills (M= 2.6) significantly lower than the bilingual group (M=7.5), t (136) = -10.13, p<.001. Overall, the local control participants also reported using Spanish far less frequently (once a month on average) than the bilingual participants who reported daily use, t (134) = -10.53, p<.001. In addition, the local control group reported learning Spanish (M = 12.5) much later than the bilingual group (M = 3.2), t (134) = 11.32, p<.001. In terms of English proficiency, the two groups reported equivalent skills, t (136) = .775, p=.440. In addition, both groups learned English at about the same age, t (136) = -1.53, p=.129, and reported using English on a daily basis, t (136) = 1.08, p=.218.

Monolingual group

In the present study monolingual response data were obtained from Twilley, et al., (1994). This dataset was chosen for several reasons. First, these norms are widely cited in psycholinguistic literature. Second, the authors of this study ensured that all participants were monolingual. For these two reasons the dataset is considered to be representative of English monolingual's response to homonyms. Third, this study

included a report of all necessary statistics to perform an in-depth analysis (e.g., U values are reported for each item).

Task and Materials

Sentence generation task

Participants were given a set of English ambiguous words that had very similar orthography with Spanish and had at least one meaning shared with Spanish (i.e. a cognate). These words were presented on an excel sheet on a computer screen and participants were asked to write one sentence for each of these words. There were no requirements regarding the length of the sentences.

Stimulus words

Previously normed English ambiguous words were selected from Twilley, Dixon, Taylor and Clark (1994) in which the relative frequencies of ambiguous words' multiple meanings provided by English monolingual speakers are reported. Only words that were cognates with Spanish, having high orthographic similarity and having at least one meaning shared with Spanish, (from this point referred to as "partial cognates") were selected to be included in the study as judged by an initial rater. This produced an initial set of 78 partial cognates. Two additional bilingual raters from the surrounding region reviewed the set of partial cognates and classified which meanings they felt were shared and which were not shared. For a subset of 16 of the initial set of words, agreement could not be reached on which meanings were shared. This disagreement stemmed from variation in regional uses of the words and these 16 words were excluded from the analyses leaving a total pool of 62 words.

Based on Twilley et al. (1994), the ambiguous words differed in polarization status and were either biased (with one meaning given 70% or more of the time) (N= 27) or balanced (N= 35) (with no single meaning given more than 70% of the time) (see Table 2). Amongst the biased ambiguous words, eight had the dominant meaning shared with Spanish (e.g., the "herbal" meaning of plant/*planta*) and 11 had the subordinate meaning shared with Spanish (the "weapon" meaning of arm/*arma*). Eight biased words had both dominant and subordinate meanings shared. Amongst the balanced partial cognates, 17 had only one meaning shared with Spanish (check=money=*cheque*) and 18 had more than one meaning shared with Spanish (i.e. model=occupation or type=*modelo*).

(Insert Table 2 about here)

Procedure

As participants arrived at the lab, they were greeted in English and asked to sign an informed consent form. After agreeing to participate, the participant was taken to an individual testing room where he or she was seated in front of a computer. The researcher then explained the sentence generation task, in which participants were asked to write one sentence for each of the words presented on an excel sheet. Participants were instructed to use the words as they were given. For example, no inflections were allowed. In addition, if the participants did not know a word, they were instructed to leave that space blank. There were no requirements for sentence length. Participants had about 45 minutes to complete the task. At the end of the experiment,

participants received a debriefing form that explained more about the study. They were also given an opportunity to ask questions about the study. All participants received course credit for their participation.

Data coding procedures

Data were number coded based on which meaning of the ambiguous word was biased by the participant generated sentence. For example, given the word "arm", if the participant wrote: "I fell from the tree and broke my arm," it received a "1" coding for the meaning "body part." On the other hand, if the sentence read: "The soldier fired his arm in the battle field," it received a "1" coding for the meaning "weapon". Two research assistants worked on coding with the investigator. The primary author and one of the research assistants independently read all sentences for agreement in the coding. For 95% of the sentences, agreement was reached about which meanings of the partial cognate was being biased in the sentence. For the remaining 5% of sentences, agreement was reached after discussion between the author and the research assistant.

Results and Discussion

Word level analyses

Following Twilley et al. (1994), an index of ambiguity was calculated for each partial cognate using the formula: $U = \Sigma^{n}_{i=1} p_i \log_2(1/p_i)$. In this formula, n refers to the number of different meanings provided for a given partial cognate and p_i is the proportion of responses given to meaning i. Thus, a higher U value reflects a greater degree of ambiguity due to either the existence of many meanings and/or the lack of any single

meaning being dominant. In our analyses, we also made a distinction between biased and balanced partial cognates. A meaning that is given infrequently by monolinguals (a subordinate meaning) may be given more frequently by bilinguals if it is shared, through a cognate, with their other language. This would lead to an overall reduction in the polarization of the word. Conversely, if it is the more frequent or dominant meaning that is shared with Spanish, it is unlikely to significantly change the overall U value of the word since it is already highly biased.

To assess whether bilinguals' knowledge of Spanish increased the overall perceived ambiguity of the partial cognates and whether this would vary as a function of the partial cognates' polarization status a 3 (bilingual status: Bilingual, monolingual or local control) X 2 (Cognate polarization: biased or balanced) Mixed ANOVA was conducted. For the ANOVA analysis, the within group variable was the source of the U values; one derived from the published, monolingual responses of Twilley et al. (1994), and the other two from the bilingual and local control groups recruited in the present study. The between-groups variable was polarization status. Although the main effect of group was not significant, F_2[1] (1, 60) =.355, MS = .041, p= .554, it was qualified by a significant interaction with polarization status, F_2 (1, 60) =8.84, MS = 1.024, p<.01. The pattern of means from the above interaction suggested that most of the variation in the responses occurred for the biased partial cognates. Follow-up paired sample t-tests performed with a Bonferroni correction confirmed that the ranges in U values for the monolingual and bilingual groups differed significantly [t_2 (26) = - 2.51, p < .05]. This

[1] Note that participants only provided one meaning for each word and it is not possible to provide a measure of meaning dominance for words within participants. Thus, it is logistically impossible to perform analyses by participants (F_1); all analyses are by items (F_2).

difference reflected the higher U values in the bilingual responses (M = .78) relative to monolingual responses (M = .56), thus supporting our hypothesis that bilinguals perceive biased partial cognates with greater ambiguity than monolinguals. However, another t-test comparing the U values of the bilingual group with those of the local control group recruited from the same bilingual region (M = .81) was not significant [t_2 (26) = - .429, $p > .05$]. Therefore, it remained unclear whether the difference between the U values generated from the bilinguals in the present study and those reported in the Twilley et al., (1994) study was strictly regional. More specifically, the increased U values for the bilinguals may have simply reflected an increased tendency to use meanings in the Southwestern U.S. that are not commonly used in Canada. Alternatively, the differences could have been due to a combination of both regional differences and cross-language activity, a distinction that cannot be made at the word level. To more directly assess whether bilinguals' perception of the ambiguous words was being specifically affected by cross-language activation of shared meanings, we performed a set of analyses on the production probabilities of the meanings themselves.

Meaning level analyses

The major hypothesis of the present study is that bilinguals activate the meaning representations from both of their languages even when operating in a single language and that this activation would influence the frequency with which certain meanings are given in a sentence generation task. We therefore conducted a series of analyses on the production probabilities of the meanings provided by the bilinguals and compared these to those provided by monolingual respondents as reported by Twilley et al., (1994).

Overall, the database of 62 partial cognates contained 142 meanings, 93 of which were shared with Spanish and 49 were not shared. Our first question was whether our database of meanings would have a different proportion of meanings classified as dominant, subordinate or mid-range relative to the monolingual database. Based on the assumption that proficient bilinguals were activating the shared meanings of the set of partial cognates, we predicted that a higher percentage of the meanings provided by the bilinguals would meet criterion for being dominant (given 70% of the time or more). We first classified all the meanings according to the monolingual responses reported by Twilley et al. (1994) for a monolingual group and then again according to both the bilingual and local control responses of the present study. Meanings that were provided 70% of the time or more were classified as "dominant"; 30% or less as "subordinate" and all others were classified as "mid-range". Table 3 summarizes the percentage of meanings in each of these three categories for the monolingual, bilingual and local control responses. An examination of this table reveals that a higher percentage of the meanings provided by the bilinguals met criterion for being dominant (26%) relative to those provided by monolinguals (19%). It is interesting to note that the percentage of meanings classified as being subordinate was identical across the two populations (47%) (see Table 3). Thus, the difference in the distribution of the meanings across the three categories was due to mid-range meanings becoming dominant range in the bilingual responses.

(Insert Table 3 about here)

However, the relative difference between the percentage of meanings classified as dominant for the bilingual versus local control participants was much smaller (26% versus 23%) (see Table 3). To more directly test our hypothesis that differences in meaning production probability were due to activation of shared meanings, and not an extraneous factor such as regional differences in language use, we further classified the meanings according to whether they were shared with Spanish or not. We then performed an ANOVA directly contrasting the production probabilities of the meanings provided by the proficient bilinguals with those provided by the local control group.

A 2 (Shared status: shared or not shared) X 2 (Production probability: derived from proficient bilinguals versus non-proficient comparison group) within-items ANOVA was performed, treating the meaning production probabilities as the random factor. This analysis revealed a significant interaction between the two factors, F_2 (1, 140) = 5.50, MSE = 1.73, p <.05, with production probabilities derived from the proficient bilingual group showing a greater increase in probability when these were shared with Spanish (an increase from 0.36 for non-shared meanings to 0.44 for shared meanings) than those observed for the local control group (0.40 for non-shared meanings and 0.42 for shared meanings). Follow-up one-tailed[2] t-tests revealed that the increase in probability for the bilingual group approached significance, t_2 (140) = 1.4, p = .08, whereas the increase for the local control group did not, t_2 (140) = 0.3, p = .39 This interaction provided important converging evidence supporting our hypothesis that increases in the

[2] We had an a priori, theoretically driven prediction of the direction of the effect

production probabilities of meanings shared across English and Spanish were indeed due to cross-language activation and not regional differences in word use.

In a final set of regression analyses we sought to assess the relative contribution of cross-language activation of shared meanings relative to other factors. More specifically, we wanted to determine whether cross-language activation would still have a significant impact on the production probabilities of meanings, even after controlling for the expected probability of a meaning based on established, monolingual norms. A stepwise multiple regression was used because in this analysis the independent variables are entered one at a time, which allows us to understand the percentage of variability in the dependent variable that can be accounted for by each of the independent variables. Monolingual probabilities from Twilley et al (1994) and "shared" status were used as predictors in the model. "Shared" status was coded as either a "1" (shared) or "0" (not shared). Regression analyses and t-tests are both based on the general linear model; therefore, it is appropriate to include discontinuous variables as independent variables in the model. We expected that "shared" status would be a significant predictor reflecting the influence of Spanish on the bilingual based responses

Therefore, in the first model we entered monolingual probability which significantly accounted for 30% of variance in bilingual probability, F (1,140) =61.44, p<.01. By adding "shared" status to the second model, the percentage of variance explained significantly increased by 4%, F (1,139) =8.31, p<.01. In addition, both monolingual

probability (t (139) =8.37, p<.01) and "shared" status (t (139) =2.88, p<.01) were significant predictors of bilingual probability, further demonstrating the influence of Spanish on the bilingual based responses. This regression analysis demonstrated that cross-language activation of shared meanings is an important determinant of how readily a meaning is activated, since it accounted for a significant portion of variance, even after entering monolingual frequencies.

(Insert Table 4 here)

The same regression analysis was performed on the production probabilities from the non- proficient comparison group (see Table 4b). In this case we predicted that "shared status" would not be a significant predictor of the meaning frequencies. In the first model we entered monolingual probability which significantly accounted for 24% of variance in bilingual probability, F (1,140) =44.66, p<.01. Adding "shared" status to the second model did not increase the amount of variance explained by the model, F (1,139) =1.57, p=.212, thus demonstrating that whether a meaning is shared with Spanish did not influence the probability that a meaning was given by this non-proficient group. In addition, only the monolingual probability reported by Twilley et al (1994) (t (139) =6.80, p<.01) was a significant predictor of the probability based on responses from this non-proficient group. "Shared" status (t (139) =1.25, p=.212) was not a significant predictor reflecting the absence of Spanish influence on the probability of meanings given by this subset of participants.

General Discussion

The findings from the present study supported the hypothesis that bilinguals' underlying conceptual representation associated with cognates in one language is shaped by the existence of multiple meanings in the other language. Specifically, cognate meanings that were shared with Spanish were provided more frequently than meanings not shared in an all-English sentence-generation task. In fact, six meanings initially classified as subordinate according to monolingual responses became dominant based on bilingual responses and all of these were shared with Spanish. Thus, similar to the previous finding that bilinguals prefer to give a cognate translation when one exists (Prior, MacWhinney & Kroll, 2007), in the present study bilinguals preferred giving the shared meaning (or cognate meaning) of an ambiguous word over a non-shared meaning (or homographic meaning). The fact that shared meanings were produced more often also suggests that their existence influenced the underlying conceptual representations. This is compatible with the finding from Degani et al (2008), in which shared translations in the non-target language influenced perceived similarity of word pairs from the target language. One limitation that must be acknowledged in the present study is that participants only saw cognate words, which could have prompted them to perform the task in bilingual mode, instead of in English-only mode (Grosjean, 1997). However, it should be noted that more recent studies have demonstrated that the bottom-up nature of cross language activation is not significantly influenced by bilingual mode (e.g., Dijkstra & Van Hell, 2003; Van Hell & Dijkstra, 2002). In fact current models of bilingual lexical representation assume that such factors only exert an

indirect influence on processing (Dijkstra & Van Heuven, 2002). Another possible limitation is that participants only saw ambiguous words. Here, there is a possibility that participants noticed that all words were ambiguous and gave more subordinate meanings. However, we do not believe this was the case because, as noted earlier, bilinguals did not provide more subordinate meanings compared to dominant meanings. As data presented in table 3 suggested, bilinguals provided as many subordinate meanings as monolinguals did.

An important aspect of the present study is that it demonstrates the influence of cross-language lexical activation in a task that goes beyond simple word identification. In the sentence generation task participants must think deeply about each word and what it means to them, thus probing into cross-language influences on a conceptual level. Furthermore, the influence of cross-language activation was observed in a language-pure task in which the knowledge of Spanish was not referenced. Follow-up studies should use a set of control, ambiguous-noncognates which would enable a more direct comparison of how proficiency in multiple languages influences the perception of ambiguous cognates relative to noncognates. The inclusion of noncognate ambiguous words would also help elucidate the role that lexical form similarity (such as orthographic overlap) plays in increasing the influence of the non-target language.

Implications for models of bilingual conceptual and lexical memory

The present findings are consistent with the major assumptions of the RHM (Kroll & Stewart, 1994) and the DFM (de Groot, 1992). Both models assume strong, direct links between lexical representations and concepts for highly proficient bilinguals. Therefore,

both would predict influences of L1 conceptual information on L2 processing such as those observed in the present study. According to the RHM, the cross-language connections between lexical representations and conceptual representations in the bilinguals' memory representation are asymmetric. In other words, concepts in bilingual memory are shared across languages but ease of access to these concepts depends on the direction of activation flow (whether it be from the L1 or from the L2).

In the present study we cannot easily disentangle effects of eased access to sub-features of concepts versus enhanced representations of these features. We assume that ease of access to certain features of a concept (such as those corresponding to a particular meaning of a homonym) is also modified through the coactivation of languages. Consequently, as access to these sub-features of concepts becomes facilitated their representational weight becomes strengthened through time, making them a more prominent aspect of the conceptual representation.

The present findings also extend the DFM by revealing a specific way in which bilingual conceptual representations come to be modified. More specifically, we have seen evidence that bilingual's concepts of homonyms are at least partially shaped by which meanings are shared across their two languages. When a particular meaning is shared, its associated features become more heavily weighted, thereby making that meaning a more central aspect of the word's concept.

A more recent version of the DFM, the Distributed Lexical/Conceptual Feature Model (DLCFM) (Van Hell & de Groot, 1998) provides a specific mechanism through which

shifts at the conceptual level occur for bilinguals which is compatible with the present findings. This model assumes distributed feature representations at both the lexical and conceptual levels. In this way, a single word is actually represented by a pattern of activated lexical and conceptual features that are distributed in representational space. Activation patterns for different words can partially overlap and this overlap will be greater as a function of the overall lexical and/or conceptual similarity. When the model is presented with a stimulus word input it will settle on a pattern of activation that best matches that input, thereby "recognizing" or "retrieving" the word. Activation then continues to flow to other patterns of activation that correspond to other similar words. Within the context of the present study, when a Spanish-English bilingual encounters the English word "arm" the resulting pattern of activation overlaps greatly with that of the Spanish word "*arma*". The features within this pattern of activation that correspond to the shared meaning of the two words at the lexical level consequently provide greater coactivation of the underlying feature representations at the conceptual level. Over time, these specific features become more heavily weighted and activated more strongly upon presentation of either "arm" or "*arma*".

Implications for lexical ambiguity resolution

The present findings also speak to more general issues of how bilingualism influences the perception of lexical ambiguity. Although in the present study the U values from bilingual and monolingual responses did not differ significantly across the entire pool of partial cognates, when biased and balanced words were analyzed separately, different results emerged. For instance, the bilingual U values for the biased words

were higher indicating less polarization and higher perceived ambiguity. Thus, for bilinguals the presence of shared meanings across languages can increase the ambiguity of words within a language. This has important implications in terms of understanding differences in lexical fluency and comprehension for bilinguals. For example, even highly proficient bilinguals have slower reading rates in their less dominant language relative to their dominant language (Favreau & Segalowitz, 1982) and researchers are still exploring the reasons behind this difference. Some factors that contribute to this difference in fluency have been identified such as decreased lexical automaticity in the L2 (Favreau & Segalowitz, 1983; Frenck-Mestre & Pynte, 1996; Kotz & Elston-Güttler, 2004), costs due to cue competition (MacWhinney, 1997) and higher working memory demands (Cheung & Lin, 2005; Costa, Santesteban, & Ivanova, 2006; Harrington, 1992). The finding from the present study reveals increased lexical ambiguity as another factor that can slow reading fluency in a less dominant language. Indeed, since participants in the present study were reading in their second, but more dominant language, it seems that increases in lexical ambiguity that are introduced through the existence of multiple languages, can reduce speed irrespective of relative dominance. As mentioned in the Introduction, Schwartz et al (2008) recently observed increased slowing in performance for L2 homonyms that were also cognates in an on-line, fast-paced psycholinguistic task.

The fact that cross-language activation dynamics can alter the relative polarization of a homonym is critical for extending existing theories of ambiguity resolution to bilingualism. The Re-ordered Access Model (RAM) is a well-supported monolingual

model of how readers resolve lexical ambiguity, particularly in sentence context (Duffy, Morris, & Rayner, 1988). According to the model, the extent to which the multiple meanings of a homonym compete is dependent on the relative time-course of their activation. In the absence of a biasing context, the relative frequency of the alternative meanings determines the order (or relative speed) of their activation. However, a strong biasing context can reorder this activation. To understand how the relative frequency of the alternative meanings interacts with context, consider two types of homonyms: balanced and biased. Balanced homonyms have meanings with a similar likelihood or frequency of use (e.g., fan). Biased homonyms, on the other hand, contain one meaning that is far more frequent or likely (e.g., novel). In a neutral context, balanced homonyms take longer to process than biased ones or unambiguous controls. This is because the two, equally likely meanings compete for selection. For the biased words, this competition does not occur because the subordinate meaning is not activated early enough. In a biasing context, this pattern is reversed. Balanced words take less time than biased or unambiguous controls because the target meaning is activated early enough to bypass competition with the alternative. Biased words however, take longer to process if the context biases the subordinate meaning. This is because the preceding context boosts the activation of the subordinate meaning, allowing it to compete with the dominant meanings. This effect has been referred to as the "subordinate bias effect" (SBE) (Rayner, Pacht, & Duffy, 1994). In order to fully extend this model to bilingual reading, cross-language activation of shared meanings needs to be added as an additional factor affecting the relative time-course of meaning activation. The fact that in the present study when a subordinate meaning was shared

across languages it was produced more frequently demonstrates that shared subordinate meanings are activated more strongly. Therefore, during comprehension shared subordinate meanings may be activated early enough to compete with more dominant meanings, even in the absence of a biasing context.

Conclusions

The evidence presented in this study highly suggests that, indeed, proficiency in multiple languages alters the way bilinguals conceptualize words. It is possible that through this continuous cross-language activation certain meanings can become more frequent and thus alter bilinguals' concepts of words. The results from the present study clearly show that knowledge of Spanish alters the way bilinguals provide meanings in English to partial cognates with Spanish. This is central evidence of the effects of cross-language activation in the daily lives of bilingual students and it should be taken into consideration by teachers, especially those in the ESL programs. It is important for teachers to understand that Spanish will still be active in an all-English environment and this co-activation of the two languages will shape how bilinguals come to conceptualize words in the target language. Curricular goals should be planned in a way that allows for the interaction of two languages as a means to enhanced understanding of the target language.

References

Cheung, H., & Lin, A. M. Y. (2005). Differentiating between automatic and strategic control processes: Toward A model of cognitive mobilization in bilingual reading. *Psychologia: An International Journal of Psychology in the Orient, 48*(1), 39-53.

Costa, A., Colome, À, Gómez, O., & Sebastián-Gallés, N. (2003). Another look at cross-language competition in bilingual speech production: Lexical and phonological factors. *Bilingualism: Language and Cognition, 6*, 167-179.

Costa, A., Santesteban, M., & Ivanova, I. (2006). How do highly proficient bilinguals control their lexicalization process? Inhibitory and language-specific selection mechanisms are both functional. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 32*, 1057-1074.

de Bruijn, E. R. A., Dijkstra, T., Chwilla, D. J., & Schriefers, H. J. (2001). Language context effects on interlingual homograph recognition: Evidence from event-related potentials and response times in semantic priming. *Bilingualism: Language and Cognition, 4*(2), 155-168.

Degani, T., Prior, A., & Tokowicz, N. (2008). *Bidirectional semantic transfer: The effect of sharing a translation*. Manuscript under revision.

de Groot, A. M.B. (1992). Determinants of word translation. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 18*(5), 1001-1018.

de Groot, A. M. B., & Nas, G. L. (1991). Lexical representation of cognates and noncognates in compound bilinguals. *Journal of Memory and Language, 30*(1), 90-123.

de Groot, A. M. B., Delmaar, P., & Lupker, S. J. (2000). The processing of interlexical homographs in translation recognition and lexical decision: Support for non-selective access to bilingual memory. *Quarterly Journal of Experimental Psychology: Human Experimental Psychology, 53A*(2), 397-428.

Dijkstra, T., De Bruijn, E., Schriefers, H., & Brinke, S. T. (2000). More on interlingual homograph recognition: Language intermixing versus explicitness of instruction. *Bilingualism: Language and Cognition, 3*(1), 69-78.

Dijkstra, T., Grainger, J., & van Heuven, W. J. B. (1999). Recognition of cognates and interlingual homographs: The neglected role of phonology. *Journal of Memory and Language, 41*(4), 496-518.

Dijkstra, T., Timmermans, M., & Schriefers, H. (2000). On being blinded by your other language: Effects of task demands on interlingual homograph recognition. *Journal of Memory and Language, 42*(4), 445-464.

Dijkstra, T., & Van Heuven W. (2002). The architecture of the bilingual word recognition system: From identification to decision. Bilingualism: *Language and Cognition, 5*(3), 175-197.

Dijkstra, T., & Van Hell, J. G. (2003). Testing the language mode hypothesis using trilinguals. *International Journal of Bilingual Education and Bilingualism, 6*(1), 2-16.

Dijkstra, T., Van Jaarsveld, H., & Ten Brinke, S. (1998). Interlingual homograph recognition: Effects of task demands and language intermixing. *Bilingualism: Language and Cognition, 1*(1), 51-66.

Duffy, S. A., Morris, R. K., & Rayner, K. (1988). Lexical ambiguity and fixation times in reading. *Journal of Memory and Language, 27*(4), 429-446.

Duyck, W., Assche, E. V., Drieghe, D., & Hartsuiker, R. J. (2007). Visual word recognition by bilinguals in a sentence context: Evidence for nonselective lexical access. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 33*(4), 663-679.

Elston-Güttler, K. E., & Friederici, A. D. (2005). Native and L2 processing of homonyms in sentential context. *Journal of Memory and Language, 52*(2), 256-283.

Elston-Güttler, K. E., Gunter, T. C., & Kotz, S. A. (2005). Zooming into L2: Global language context and adjustment affect processing of interlingual homographs in sentences. *Cognitive Brain Research, 25*(1), 57-70.

Elston-Güttler, K. E., Paulmann, S., & Kotz, S. A. (2005). Who's in control? proficiency and L1 influence on L2 processing. *Journal of Cognitive Neuroscience, 17*(10), 1593-1610.

Favreau, M., & Segalowitz, N. S. (1983). Automatic and controlled processes in the first- and second-language reading of fluent bilinguals. *Memory and Cognition, 11*(6), 565-574.

Favreau, M., & Segalowitz, N. S. (1982). Second language reading in fluent bilinguals. *Applied Psycholinguistics, 3*(4), 329-341.

Frenck-Mestre, C., & Pynte, J. (1996). Syntactic ambiguity resolution while reading in second and native languages. *The Quarterly Journal of Experimental Psychology*, (50), 119-148.

Gollan, T. H., & Acenas, L. R. (2004). What is a TOT? cognate and translation effects on tip-of-the-tongue states in Spanish-English and Tagalog-English bilinguals. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 30*(1), 246-269.

Gollan, T. H., Forster, K. I., & Frost, R. (1997). Translation priming with different scripts: Masked priming with cognates and noncognates in Hebrew-English bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 23*, 1122-1139.

Grainger, J., & Beauvillain, C. (1987). Language blocking and lexical access in bilinguals. *Quarterly Journal of Experimental Psychology: Human Experimental Psychology*, *39*(2), 295-319.

Grosjean, F. (1997). Processing mixed language: Issues, findings and models. In: A.M.B. de Groot & J.F. Kroll (Eds), *Tutorials in bilingualism: Psycholinguistic perspectives* (pp. 225 254). Mahwah, NJ: Erlbaum Publishers.

Hermans, D., Bongaerts, T., De Bot, K., & Schreuder, R. (1998). Producing words in a foreign language: Can speakers prevent interference from their first language? *Bilingualism: Language & Cognition, 1*(3), 213-229.

Harrington, M. (1992). Working memory capacity as a constraint on L2 development. In R. J. Harris (Ed.), *Advances in psychology 83: Cognitive processing in bilinguals.* (pp. 123-135). North Holland: Elsevier Publishers.

Kerkhofs, R., Dijkstra, T., Chwilla, D. J., & de Bruijn, E. R. A. (2006). Testing a model for bilingual semantic priming with interlingual homographs: RT and N400 effects. *Brain Research, 1068*, 170-183.

Kotz, S. A., & Elston-Güttler, K. (2004). The role of proficiency on processing categorical and associative information in the L2 as revealed by reaction times and event-related brain potentials. *Journal of Neurolinguistics, 17*(2), 215-235.

Kroll, J. F., & Stewart, E. (1994). Category interference in translation and picture naming: Evidence for asymmetric connection between bilingual memory representations. *Journal of Memory and Language, 33*(2), 149-174.

Kroll, J.F. & de Groot, A.M.B. (1997). Lexical and conceptual memory in the bilingual: Mapping form to meaning in two languages. In: A.M.B. de Groot & J.F. Kroll (Eds), *Tutorials in bilingualism: Psycholinguistic perspectives* (pp. 169-200). Mahwah, NJ: Erlbaum Publishers.

Lemhöfer, K., Dijkstra, T., & Michel, M. C. (2004). Three languages, one ECHO: Cognate effects in trilingual word recognition. *Language and Cognitive Processes, 19*(5), 585-611.

MacWhinney, B. (1997). Second language acquisition and the competition model. In: A.M.B. de Groot & J.F. Kroll (Eds), *Tutorials in bilingualism: Psycholinguistic perspectives* (pp. 113-142). Mahwah, NJ: Erlbaum Publishers.

Paulmann, S., Elston-Guttler, K. E., Gunter, T. C., & Kotz, S. A. (2006). Is bilingual lexical access influenced by language context? *Neuroreport: For Rapid Communication of Neuroscience Research, 17*, 727-731.

Prior, A., MacWhinney, B., & Kroll, J. F. (2007). Translation norms for English and Spanish: The role of lexical variables, word class, and L2 proficiency in negotiating translation ambiguity. *Behavior Research Methods, 39*(4), 1029-1038.

Rayner, K., Pacht, J.M & Duffy, S.A. (1992). Effects of prior encounter and global discourse bias on the processing of lexically ambiguous words: Evidence from eye-fixations. *Journal of Memory and Language, 33*(4), 527-544.

Schwartz, A., & Arêas Da Luz Fontes, A. B. (2008). Cross-language mediated priming: Effects of context and lexical relationship. *Bilingualism: Language and Cognition, 11*(1), 95-110.

Schwartz, A. I., Kroll, J. F., & Diaz, M. (2007). Reading words in Spanish and English: Mapping orthography to phonology in two languages. *Language & Cognitive Processes, 22*(1), 106-129.

Schwartz, A. I., & Kroll, J. F. (2006). Bilingual lexical activation in sentence context. *Journal of Memory and Language, 55*, 197-212.

Schwartz, A. I., Yeh. L.H. & Shaw, M.P. (2008). Lexical representation of second language words: Implications for second language vocabulary acquisition and use. *The Mental Lexicon*, 3(3), 309-324.

Spivey, M. J., & Marian, V. (1999). Cross talk between native and second languages: Partial activation of an irrelevant lexicon. *Psychological Science, 10*(3), 281-284.

Tokowicz, N., & Kroll, J. F. (2007). Number of meanings and concreteness: Consequences of ambiguity within and across languages. *Language and Cognitive Processes, 22*(5), 727-779.

Tokowicz, N., Kroll, J. F., de Groot, A. M. B., & Van Hell, J. G. (2002). Number-of-translation norms for Dutch-English translation pairs: A new tool for examining language production. *Behavior Research Methods, Instruments and Computers, 34*(3), 435-451.

Twilley, L.C., Dixon, P., Taylor, D. & Clark, K. (1994). University of Alberta norms of Relative meaning frequency for 566 homographs. *Memory & Cognition, 22 (1)*, 111-126.

Van Hell, J. G., & de Groot, A. M. B. (2008). Sentence context modulates visual word recognition and translation in bilinguals. *Acta Psychologica, 128*(3), 431-451.

Van Hell, J. G., & de Groot, A. M. B. (1998). Conceptual representation in bilingual memory: Effects of concreteness and cognate status in word association. *Bilingualism: Language and Cognition, 1*(3), 193-211.

Van Hell, J. G., & Dijkstra, T. (2002). Foreign language knowledge can influence native language performance in exclusively native contexts. *Psychonomic Bulletin and Review, 9*(4), 780-789.

Van Heuven, W. J. B., Dijkstra, T., Grainger, J., & Schriefers, H. (2001). Shared neighborhood effects in masked orthographic priming. *Psychonomic Bulletin and Review, 8*(1), 96-101.

Von Studnitz, R. E., & Green, D. (2002). Interlingual homograph interference in German-English bilinguals: Its modulation and locus of control. *Bilingualism: Language and Cognition, 5*(1), 1-23.

Table 1.

Language history background information and self-assessed proficiency ratings for English and Spanish for the proficient bilinguals (N= 117) and the local control group (N=21).

Language experiences	Proficient bilinguals	Local control group
Age Acquired English (years)	4.5	3.3
Age Acquired Spanish (years)	3.2	12.5
Frequency communicate in English[1]	7.9	8.0
Frequency communicate in Spanish	7.3	3.5

Self- assessed proficiency ratings[2]

	Proficient bilinguals		Local control group	
Skill	English	Spanish	English	Spanish
Reading	9.2	7.3	9.2	3.2
Writing	9.1	6.6	9.2	1.7
Speaking	9.2	7.9	9.5	2.9
Listening	9.4	8.3	9.8	3.3
Mean overall rating	**9.2**	**7.5**	**9.4**	**2.6**

1. Frequency rating ranged from one to eight.
2. Self-assessed proficiency ratings range on a scale from one to ten**.**

Table 2.

Example of stimulus words classified according to polarization of meanings shared with Spanish

Biased		Balanced	
Meaning shared with Spanish	Example word	Number of meanings shared with Spanish	Example word
subordinate	arm (arma) (n = 11)	one meaning	check (cheque) (n = 17)
dominant	novel (novela) (n = 8)	multiple meanings	model (modelo) (n = 18)
both	grain (grano) (n = 8)		

Table 3.

Percentage of meanings classified as dominant, mid-range or subordinate according to monolingual[1], bilingual, and local control group responses.

Classification	Monolingual responses	Bilingual responses	Local control group responses
Dominant	19%	26%	23%
Mid-range	34%	25%	32%
Subordinate	47%	47%	45%

1. From Twilley et al (1994).

Table 4.

Stepwise regression predicting meaning probability based on proficient bilingual responses (4a) and local control group responses (4b) from monolingual meaning probability (from Twilley et al., 1994) and shared status.

Variable predicted	Step	R^2	Predictor	Standardized β	*p*
Bilingual meaning probability	1	.305	Monolingual meaning probability	.552	.000
	2	.344	Monolingual meaning probability	.580	.000
			Shared status	.200	.005

Table 4b.

Variable predicted	Step	R^2	Predictor	Standardized β	*p*
Local control group meaning probability	1	.242	Monolingual meaning probability	.492	.000
	2	.250	Monolingual meaning probability	.505	.000
			Shared status	.093	.212

Appendix

Stimulus set

Stimulus Word	Spanish translation	Shared meaning	Number of shared meanings	Monolingual polarization
article	artículo	both	2	balanced
band	banda	both	2	balanced
bank	banco	both	2	biased
bar	barra	both	2	biased
bill	billete	both	2	balanced
cabinet	cabinete	both	2	biased
capital	capital	both	2	balanced
compact	compacto	both	2	balanced
company	compañia	both	2	balanced
deposit	depósito	both	2	biased
express	exprés	both	2	balanced
figure	figura	both	2	biased
firm	firme	both	2	biased
grain	grano	both	2	biased
interest	interés	both	2	balanced
model	modelo	both	2	balanced
mold	molde	both	3	balanced
operation	operación	both	2	biased
organ	organo	both	2	balanced
period	periodo	both	2	balanced
reflect	reflejar	both	2	balanced
reservation	reservación	both	2	biased
state	estado	both	2	biased
volume	volumen	both	2	balanced
admit	admitir	dominant	1	balanced
cape	capa	dominant	1	balanced
case	caso	dominant	1	balanced
course	curso	dominant	1	biased
digit	dígito	dominant	1	biased
mass	masa	dominant	1	balanced
novel	novela	dominant	1	biased

Stimulus Word	Spanish translation	Shared meaning	Number of shared meanings	Monolingual polarization
patient	paciente	dominant	1	biased
plant	planta	dominant	1	biased
racket	raqueta	dominant	1	biased
rare	rare	dominant	1	balanced
arm	arma	subordinate	1	biased
base	base	subordinate	2	balanced
cane	caña	subordinate	1	balanced
charge	carga	subordinate	1	balanced
check	cheque	subordinate	1	balanced
cycle	ciclo	subordinate	1	biased
fan	fan	subordinate	1	biased
fault	falta	subordinate	1	balanced
form	forma	subordinate	2	balanced
grace	gracia	subordinate	1	balanced
grave	grave	subordinate	1	biased
letter	letra	subordinate	1	balanced
mine	mina	subordinate	2	balanced
net	neto	subordinate	1	biased
panel	panel	subordinate	1	balanced
permit	permiter	subordinate	1	balanced
plane	plano	subordinate	1	biased
present	presente	subordinate	3	balanced
produce	produce	subordinate	1	biased
pupil	pupila	subordinate	1	balanced
race	raza	subordinate	1	biased
sentence	sentencia	subordinate	1	biased
term	término	subordinate	1	biased
terminal	terminal	subordinate	1	balanced
type	tipo	subordinate	1	balanced