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Semantic and Phonological False Memories in Adults' First and Second Language

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Semantic and Phonological False Memories in Adults' First and Second Language

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Abstract

I explored second language acquisition in adults by examining false memories for semantically and phonologically related word lists in both the participants' first language and second language. I expected less proficient bilinguals who are initially acquiring their second language would make more phonological false memory errors, like children learning their first language. In contrast, I anticipated that more proficient bilinguals would make more semantic false memory errors in the DRM paradigm as the semantic stores for their two languages overlap more fully. Forty-one English-Spanish bilinguals (High Proficiency: $n = 17$; Low Proficiency: $n = 24$) completed a false memory task for semantically and phonologically related word lists in English and Spanish. The present study found that while the low proficiency group made more phonological than semantic errors in their second language when recalling studied lists as expected, the high proficiency bilinguals did not make more semantic than phonological errors in Spanish. Instead, both proficiency groups were much more prone to phonological than semantic errors regardless of whether they were remembering Spanish or English word lists. Additionally both groups made more false memory errors on Spanish than English lists. These results call into question whether there is in fact a phonological to semantic shift when acquiring a second language. Rather, they suggest that a second language may be mapped directly on to a first language, creating a pattern in which bilinguals are just as prone to make semantic false memories in a second language as in a first language.

Background

False Memory Paradigm

The DRM false memory paradigm (Deese, 1959; Roediger & McDermott, 1995) has been used to study false memories when recalling and recognizing semantically related word lists. In this paradigm, participants read different word lists comprised of 12 words, all of which are semantic associates of one specific critical lure, which is not presented. Consistently, participants recall and recognize the critical lure just as often as studied words. Subsequent research has sought to develop theories to explain this false memory phenomenon.

Three of the most prominent false memory theories are the fuzzy trace theory, the activation-monitoring theory, and the implicit-associative response theory. These theories were explained by Holliday and Weekes (2006). The fuzzy trace theory states that there are two distinct types of memory store; the verbatim memory store is the memory for the surface form of the word (the memory of the word's actual presentation) while the gist store is the memory for the concepts or elaborations a person produces as he or she works to encode that word for later recall. According to this theory, false memory for a non-presented critical lure occurs when a person relies on gist memory, rather than incorporating both gist and verbatim memory (Brainerd & Reyna, 1998). Activation-monitoring theory suggests that presenting a list of semantically associated words activates a network of related words. Thus, strong activation of this network by presenting a list of highly related words will result in increased false memory (Roediger & McDermott, 2000). Finally, the implicit associative response theory claims that false memories occur as a result of consciously or unconsciously producing the critical lure during presentation of the word list and of encoding it as if it were a studied word. According to this view, the critical lure would be remembered for both its semantic and surface properties and would be recalled just like a studied list word (Cabeza & Lennartson, 2005). While each of these theories has gained attention in the literature, the fuzzy trace theory is the most often cited and most strongly supported of the three.

False Memories in Children

The false memory paradigm has been used in past research to examine the development of language in children. Most research has come to the consensus that a child's language skills experience a shift from phonological processing to semantic with increasing age. Dewhurst and Robinson (2004) tested English speaking children aged 5, 8, and 11 on a variation of the DRM paradigm. Five lists were presented to the children, each with a common semantic theme. In addition, each word on the list had at least one rhyming word, which was not presented. They applied the fuzzy-trace theory to this particular paradigm, hypothesizing that young children would not form gist memories of the word lists because of their inattention to semantic information; conversely older children would. It could also be argued that, according to the activation-monitoring theory, young children have not yet developed the semantic networks to support spreading activation. Regardless, they assumed younger children would show more phonological false memories, but older children would show more semantic false memories, suggesting a developmental shift in language processing. In the end, results supported their hypothesis; 5-year-olds made significantly more phonological false memory errors than 8- and 11-year-olds, while 11-year-olds showed significantly more semantic false memory errors than 8- and 5-year-olds. The 8-year-olds tended to make an equal number of semantic and phonological false errors, suggesting that they were in the middle of the transition between phonological and semantic processing. In a similar study, Holliday and Weekes (2006) tested 8-, 11-, and 13-year-olds on semantically and phonologically related word lists. Once again, they found support for a developmental shift in language processing such that children produced more semantic false memories, but fewer phonological false memories, as age increased.

Second Language Acquisition

While the study of first language acquisition in children has garnered much attention, the study of second language acquisition has also become popular in recent years. Initial research with proficient bilinguals suggested that a second language (L2) is typically mapped onto the first language (L1) in the brain (Illes et al., 1999; Wilms et al., 2011; Yang, Tan & Li, 2011). As a result, the same brain areas activate when performing tasks in L2 as in L1. Yang, Tan and Li (2011) looked at the representations of nouns and verbs in the proficient Chinese-English bilingual brain. They found that, despite the profound differences between the two languages, the neural networks in L1 and L2 for nouns and verbs highly overlapped in the proficient bilingual. In other words, these participants processed nouns and verbs in both Chinese and English similarly. An additional study conducted by Wilms et al. (2011) also looked at noun and verb processing to study the organization of languages in the bilingual brain. They found that verb processing activated the same regions in the brain for both English and Spanish in highly proficient Spanish-English bilinguals. Finally, an fMRI study on English-Spanish bilinguals (Illes et al., 1999) found that during a semantic decision task in both English and Spanish, there was no notable difference in activation of brain regions between languages. Together, these studies support the idea that L1 and L2 share a common semantic store in the proficient bilingual's brain.

Subsequent research involving developing bilinguals suggests that the idea of overlapping language stores is not indicative of the whole picture. While the study by Illes et al. (1999) found a common semantic neural system for L1 and L2, the authors also acknowledged the possibility that this occurred as proficiency increased. In other words, the brain regions involved in processing L2 semantics may become more like those used for processing L1 semantics as a bilingual becomes more proficient in L2. In a series of studies, researchers further explored this concept. One study by Alvarez, Holcomb, and Grainger (2003) looked at beginning bilinguals and their within-language and between-language repetition effects. They found that within-language repetitions resulted in more priming than between-language repetitions. They also found that priming effects were larger and occurred faster when the prime word was in L2 and the target word in L1, than when the prime word was in L1 and the target in L2. These results suggest that in beginning bilinguals, there is some overlap of language representation in the brain, as evidenced by the presence of between-language priming effects. However, their results also suggest that the two languages do not completely overlap given that the within-language priming was greater than between-language priming. In an additional study by Geyer, Holcomb, Midgley and Grainger (2011) looked again at priming of between-language and within-language words for proficient Russian-English bilinguals. They found that the priming effects from L2 to L1 and L1 to L2 were equivalent, meaning that for these proficient bilinguals, there was significant overlap of L1 and L2. Geyer et al. (2011) suggest that Alvarez et al. (2003) found different patterns of within-language priming effects than did Geyer et al. (2011) because Alvarez et al. (2003) tested less proficient bilinguals. This provides evidence that as proficiency increases so does the overlap in representations of the two languages in the brain.

False Memory in Bilinguals

By studying false memory in bilinguals, second language acquisition can be better understood, but thus far little research has been done to combine the study of second language acquisition and false memories. One study conducted by Marmolejo, Dilberto-Macaluso, and Altarriba (2009) looked at proficient Spanish-English bilinguals, but whose dominant language was actually English, their L2. Participants in this study heard DRM word lists, presented either in Spanish or English, which were each followed by a written recall test in either the same language or different language as the presented list, and finally a written recognition test in either the same or different language. This study found the least amount of false recall in the Spanish-Spanish condition, but equivalent false recognition rates in both the Spanish-Spanish and English-English conditions. They also found that false memory for critical non-presented lures was higher in the between-language condition than the within-language condition but that the language of encoding was the most important predictor of the rate of false memories. False recognition of critical lures was higher in the dominant language English condition than the less dominant Spanish language, suggesting that more semantic false memories occur in L2 as proficiency increases. However, these researchers only looked at semantic false memories and did not examine phonological false memories.

A study by Sahlin, Harding, and Seamon (2005) employed a similar test on highly proficient English-Spanish bilinguals. They wanted to test the two major language acquisition theories: whether languages are stored in language-specific stores or whether they have separate lexical stores but common semantic stores. Consistent with Marmolejo et al. (2009), Sahlin et al. (2005) found that false memories were more common in L1 than L2. Additionally, they discovered that false recognition for critical lures was greater in same-language conditions than different-language conditions, although false memories occurred in both contexts. These findings suggest that the participants relied more on gist memory when moving between two languages, but focus more on the precise lexical representation when processing words within one language. The fact that false memories crossed languages supports the theory that L1 and L2 share semantic stores. Again, these researchers only examined semantic, not phonological, false memory errors.

Goals and Hypothesis

The present study aims to expand this previous literature on false memories in bilinguals by looking at not only semantic false memory errors, but also phonological false memory errors. Based on the results of past studies of second language acquisition, I believe that there is a shift during second language acquisition such that less proficient learners initially have separate semantic and lexical stores, but as proficiency increases, the semantic stores for their two languages begin to overlap. As a result, I hypothesize that less proficient bilinguals who are initially acquiring their second language will make more phonological false memory errors, like children learning their first language. In contrast, I anticipate that more proficient bilinguals will make more semantic false memory errors in the DRM paradigm as the semantic stores for their two languages overlap more fully.

Method

Participants

All participants were Butler undergraduate students (*n* = 41). I recruited students from introductory psychology courses as well as from upper-level Spanish courses. Participants either received extra credit in their psychology class or were entered into a drawing for a gift card in return for their participation. All participants were primary English speakers with Spanish as their second language. Participants were classified as either less proficient (*n* = 24) or more proficient (*n* = 17) English/Spanish bilinguals based on a proficiency test taken at the end of the study. The two proficiency groups were statistically equivalent in age, years of education, and gender distribution (all ps > .05). See Table 1.

Materials

<u>Demographic Form:</u> Participants filled out a questionnaire consisting of questions about age, gender, class rank, and ethnicity.

<u>Word Lists</u>: Participants listened to eight pre-recorded word lists. The lists were presented in a randomly determined but fixed order. Each list included 9 words. The lists were either in English or Spanish and consisted either of semantically-related or phonologically-related words. See Appendix A for the word lists.

<u>Recognition Tasks:</u> The recognition tasks were also presented in an auditory format. Participants listened to the recognition lists immediately following the 2-minute recall task. The recognition lists consisted of 12 words—six studied list words and six distraction words. Of the six distraction words, two were phonological associates, two were semantic associates, and two were unrelated to words on the studied list. See

Appendix A for the target (marked with a "(T)" on the list) and distractor words (specified under each list).

Proficiency Test: I randomly chose six words from each of the Spanish lists used in the study for the proficiency test. The participants were asked to define each word in English to the best of their ability. See the underlined words on the Spanish lists in Appendix A for words used on the proficiency test.

Design

Based on scores from the proficiency test, my study has one between-subjects independent variable—proficiency. In addition, my study has two within-subjects independent variables: list language and list type. I investigated two different dependent variables: correct recall and errors.

Procedure

After giving informed consent, participants completed a demographic form. Next, participants were presented with 8 auditory, pre-recorded word lists. After each list was presented, the participants completed a one-minute distraction task (working on a Sudoku puzzle) immediately followed by recall of the word list. During recall, they had two minutes to write down as many of the words as they could remember from the list previously heard. Then, following each recall task, they completed an auditory recognition task. They heard a list of 12 words, and were asked to circle "yes" or "no" for each word to indicate whether they had heard it on the list. At the end of the study, participants completed a proficiency test. This was a Spanish vocabulary test that consisted of 24 Spanish words.

Results

Analyses

I performed a 2 (list language: Spanish vs. English) x 2 (list type: semantically-related vs. phonologically-related) x 2 (proficiency group: high vs. low) mixed model analysis of variance for true positives on both the free recall and recognition portions of the memory tests. In addition, I added error type (semantic, phonological, unrelated) as an independent variable when examining errors on recall and recognition measures. Whenever significant interaction effects emerged, I ran follow-up simple main effect (for two-way interactions) or simple interaction effect (for three-way interactions) analyses. In all cases, I adjusted my critical p-value using the Bonferroni correction (.05 / number of follow-up analyses) to protect against a Type I error.

Recall

True Positives. I analyzed true positives on the recall task across the two list languages, two list types, and two proficiency groups. See Table 2. Although the three-way interaction failed to reach significance ($F\ (1, 39) = .09, p > .05$), I did find two two-way interactions. First, a significant interaction between list language and proficiency group emerged, $F\ (1, 39) = 13.53, p < .001$. See Figure 1. Simple main effect analyses revealed that the high proficiency group (HP) freely recalled more Spanish words than the low proficiency (LP) group ($t\ (39) = 3.44, p = .001$), but the two groups performed equivalently in their free recall of English lists, $t\ (39) = .62, p > .025$. Second, I found a significant interaction between list language and list type, $F\ (1, 39) = 5.01, p < .05$. See Figure 2. Follow-up analyses indicated that participants recalled Spanish words from phonological lists better than those from semantic lists (F (1, 40) = 16.05, $p < .001$), but list type had no effect on recall in English, F (1, 40) = .54, $p > .025$.

Errors. I analyzed recall errors across the two list languages, two list types, two proficiency groups, and three error types. See Table 3. The four-way interaction did not reach significance (F (2, 38) = 1.16, $p > .05$), but all three three-way interactions were significant or near significant. I found a significant three-way interaction between list language, error type, and proficiency group, F (2, 38) = 5.37, $p < .01$. See Figure 3. To follow up on this three-way interaction, I ran separate list language by error type analyses for each proficiency group. For the LP group, a significant two-way interaction emerged between list language and error type, F (2, 22) = 13.20, $p < .001$. The LP group made an equal number of free recall semantic errors in English and Spanish (t (23) = .21, $p > .008$), but were more likely to make phonological and unrelated free recall errors in Spanish than in English (phonological: t (23) = 6.49, $p < .001$; unrelated: t (23) = .4.31, $p < .001$). For the HP group, only the main effect of error type reached significance, F (2, 15) = 13.28, $p < .001$. This group made more phonological than semantic errors overall, but made a similar number of each error type regardless of whether they were recalling English or Spanish lists, F (2, 15) = .72, $p > .025$.

In the primary analysis, I also found a near-significant three-way interaction between list language, list type, and proficiency group, F (1, 39) = 3.28, $p = .08$. See Figure 4. Again, I ran separate list language by list type analyses for each proficiency group to follow up on this interaction. For the LP group there was a main effect of list language such that LP participants tended to make more errors in Spanish than in English regardless of list type, F (1, 23) = 33.83, $p < .001$. There was also a main effect of list type, $F(1, 23) = 8.20$, $p < .01$; the LP group tended to make more errors on phonological lists than on semantic lists. Although the HP group also made more errors on the phonological lists than the semantic lists, the main effect was not significant for the HP group after the Bonferroni correction, and no other effects reached significance in this follow-up analysis.

The third three-way interaction that emerged from the primary analysis was a near-significant interaction between list language, list type and error type, $F(2, 38) = 2.79$, $p = .07$. See Figure 5. To follow up on this effect, I ran a list type by error type ANOVA separately for each language. There was a significant interaction between list type and error type for both Spanish and English lists (Spanish: $F(2, 39) = 27.54$, $p < .001$; English: $F(2, 39) = 25.74$, $p < .001$). Regardless of language, semantic errors were more common on semantic lists than on phonological lists (Spanish: $t(40) = 3.89$, $p < .001$; English: $t(40) = 4.88$, $p < .001$), and phonological errors were more common on phonological lists than semantic lists (Spanish: $t(40) = 6.14$, $p < .001$; English: $t(40) = 6.99$, $p < .001$). Unrelated errors were more common on Spanish semantic lists than Spanish phonological lists ($t(40) = 4.09$, $p < .001$); however there was no difference in the occurrence of unrelated errors across phonological and semantic English lists where unrelated errors almost never occurred, $t(40) = .00$, $p = 1$.

Recognition

True Positives. Just as for recall, I analyzed true positives on the recognition task across the two list languages, two list types, and two proficiency groups. See Table 2. Similar to recall, the three-way interaction also failed to reach significance for recognition, $F(1, 39) = 2.16$, $p > .05$. However, I again found a significant interaction between list language and list type, $F(1, 39) = 3.98$, $p = .05$. See Figure 6. Follow-up simple main effect analyses indicated that, comparable to the recall task, there was a list type effect for Spanish lists such that participants performed better on the Spanish phonological lists than the Spanish semantic lists, $F(1, 40) = 7.74$, $p < .01$. However, there was no difference in performance between phonological lists and semantic lists in English, $F(1, 40) = .02$, $p > .025$.

Errors. Just as for recall, I analyzed recognition errors across the two list languages, two list types, two proficiency groups, and three error types. See Table 4. The four-way interaction did not reach significance ($F(2, 38) = 1.52$, $p > .05$), but two of the three-way interactions did. First, I found a significant interaction between list language, list type, and proficiency group ($F(1, 39) = 6.20$, $p < .05$). See Figure 7. The follow-up list language by list type analysis for the LP group resulted in a main effect of list language. The LP group made more errors in Spanish than English regardless of list type, $F(1, 23) = 11.72$, $p < .01$. For the HP group, there was a significant interaction between list language and list type in the follow-up analysis, $F(1, 16) = 8.46$, $p = .01$; HP participants made more errors on the phonological lists than semantic lists in Spanish ($F(1, 16) = 14.22$, $p < .01$), but there was no significant difference in the number of errors across semantic and phonological English lists, $F(1, 16) = .86$, $p > .0125$.

In the primary analysis I found a significant interaction between list language, list type, and error type, $F(2, 38) = 5.63$, $p < .01$. In the follow-up simple interaction effects analysis for both Spanish lists and English lists, a list type by error type interaction emerged (Spanish: $F(2, 39) = 28.55$, $p < .001$; English: $F(2, 39) = 22.03$, $p < .001$). See Figure 8. Identical to recall, semantic recognition errors were more common on semantic lists than phonological lists across both languages (Spanish: t (40) = 5.78, $p < .001$; English: t (40) = 6.65, $p < .001$). Similarly, phonological errors were more common on phonological lists than semantic lists across both languages (Spanish: t (40) = 6.53, $p < .001$; English: t (40) = 4.68, $p < .001$). Unlike the results for recall errors, on the recognition test, the prevalence of unrelated errors did not depend on list type for either Spanish (Spanish: t (40) = 2.24, $p > .008$) or English (t (40) = 1.00, $p > .008$) lists.

Discussion

In conducting this study, I sought to find evidence for a proficiency-based shift in the processing of a second language such that a less proficient English-Spanish bilingual would make more phonological errors (similar to a child learning a first language) and a more proficient bilingual would make more semantic errors (similar to an adult) in a false memory paradigm.

First, I found that proficiency impacted overall performance on memory tests. Not surprisingly, the HP group freely recalled more Spanish words than the LP group. There was no significant difference between the two groups' performances on the English lists however, indicating that the two proficiency groups did not simply differ in their overall memory skills.

Consistent with expectations and with the primary hypothesis of the study, my LP group made more phonological than semantic false memory errors in their second language when recalling studied lists. However, contrary to my hypothesis, the HP bilinguals did not make more semantic than phonological errors in Spanish. In fact, both proficiency groups were much more prone to phonological than semantic errors regardless of whether they were remembering Spanish or English word lists. This result expands on past studies that have exclusively focused on semantic false memories in bilinguals (Marmolejo et al., 2009; Sahlin et al., 2005). One possible explanation for the prevalence of phonological errors in my study was the inclusion of phonologically related word lists. When faced with lists of phonologically related words, rather than producing phonological false memories, the participants may have simply guessed rhyming words when recalling the word lists. However, this does not fully explain the overall pattern of results because phonological errors were fairly common even on semantic lists, particularly in Spanish. Thus, in L2, participants were creating phonological false memories even when the lists were semantically related. These results indicate that future studies should continue to include phonologically related word lists in order to further explore phonological false memories rather than solely focusing on semantic false memory errors in bilinguals.

When I looked in more depth at the effect of semantically-related versus phonologically-related word lists on false memories, both proficiency groups were more susceptible to false memory errors on semantic lists in Spanish than English. This result suggests that my English-Spanish bilinguals had a strong semantic network in Spanish, supporting the contention that their Spanish semantic network is mapped onto their English semantic network. This finding is consistent with three past studies that found evidence for an overlapping semantic store in L1 and L2 (Illes et al., 1999; Wilms et al., 2011; Yang et al., 2011), but calls into question the theory that semantic networks overlap only as proficiency increases (Alvarez et al., 2003; Geyer et al., 2011). Instead I found false memories on semantic lists regardless of proficiency. The number of false memory errors made by my developing bilinguals was similar to that of my proficient bilinguals, suggesting that both groups have mapped their second language onto their first language in the brain. Thus, second language acquisition may not involve a phonological to semantic shift similar to what children experience when learning their first language (Dewhurst & Robinson, 2004; Holliday & Weekes, 2006). Instead, bilinguals at all proficiency levels demonstrate similar types of false memories across both of their languages given that L2 is mapped onto L1, which already experienced that shift in processing.

The higher rate of false memory errors on semantic lists in Spanish than English contradicts the two past studies that have examined false memories in bilinguals, both of which found more false memory errors in L1 than L2 (Marmolejo et al., 2009; Sahlin et al., 2005). However, my results fit well with the fuzzy trace theory. The higher rate of false memory errors in Spanish than English might be due to the participants having a stronger memory for specific lexical representations in English than Spanish leading to fewer false memory errors. Participants might have formed both verbatim and gist memories for the words in English leading to more accurate memory of the words. On the other hand, they might have formed only gist memories for Spanish words, which, as Holliday and Weekes (2006) found with children would lead to increased false memories.

Another possible explanation is that the higher rate of false memory errors in Spanish than English could reflect the participants simply translating the Spanish word lists into English rather than remembering the words in Spanish. If this were the case, participants would actually be using their English semantic network during recall and recognition and the false memory errors documented in my study would be similar to the between-language errors found in the Sahlin et. al. (2005) study. Although I recruited students who claimed to be proficient in Spanish, my participants may not have been proficient enough in Spanish to attempt remembering the words in Spanish. On average, the HP group barely scored above 50% on the Spanish vocabulary proficiency test. Their limited proficiency was also evident in their performance on the recall memory tests. While they performed better than the LP group, they still did not perform equally in English and Spanish. This suggests that they were not equally proficient in L1 and L2. This lack in proficiency might have hindered even the HP group from forming a gist memory, as the fuzzy trace theory would suggest (Holliday & Weekes, 2006). Future research endeavors might reach beyond the Butler community in order to find more proficient English-Spanish bilinguals. By creating a stronger polarity between low proficiency and high proficiency participants, different types of false memories might emerge between the two groups. In fact, in this case a higher number of semantic errors relative to phonological errors might emerge in the HP group as originally hypothesized.

Ultimately, I did not find evidence to support my hypothesis, and this could be attributable to multiple factors. Beyond potential proficiency issues, a small sample size might have limited my ability to detect some interaction effects. Many of my results neared significance. Had I tested a larger sample, some of these might have reached significance. Future studies should include a larger sample to assure that a lack of statistical power does not interfere with documenting meaningful results.

Also, the proficiency test might have been an inaccurate or unreliable measure of the participants' actual proficiency, causing the proficiency groups in my study to be an invalid representation of their actual level of bilingualism. Future researchers could develop a more accurate proficiency test to place participants into more meaningful proficiency groups.

In summary, the lack of support for my hypothesis might in fact indicate that there is no phonological to semantic shift when acquiring a second language as I had anticipated, or might reflect the lack of proficiency in my English-Spanish bilinguals. However, my results do fit with fuzzy race theory and, to the extent they are valid, better support findings by Tan and Li (2011), Wilms et al. (2011), and Illes et al. (1999), which suggest L2 is mapped on to L1, creating a pattern in which bilinguals are just as prone to make semantic false memories in L2 as in L1.

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Appendix A

Word Lists

English Semantic 1

Hill (T)
Valley (T)
Climb (T)
Summit
Top
Peak
Plain (T)
Glacier (T)
Goat (T)

Distractors: Mountain (S), Rock (S), Cop (P), Streak (P), Fence (U), House (U)

English Semantic 2

Nurse
Sick
Lawyer (T)
Medicine (T)
Hospital (T)
Dentist (T)
Physician
Office (T)
Stethoscope (T)

Distractors: Clinic (S), Doctor (S), Purse (P), Trick (P), Curtain (U), Father (U)

English Phonological 1

Pail
Tail (T)
Bail (T)
Nail
Mail (T)
Kale (T)
Flail
Whale (T)
Fail (T)

Distractors: Bucket (S), Hammer (S), Rail (P), Snail (P), Shadow (U), Elbow (U)

English Phonological 2

Sake (T)
Awake (T)
Make
Lake
Fake (T)
Cake
Flake (T)
Shake (T)
Take (T)

Distractors: Pond (S), Batter (S), Ache (P), Rake (P), Moon (U), Flower (U)

Appendix A (continued)

Spanish Semantic 1:

Cama
Descanso (T)
Despierto
Cansado (T)
Sueño (T)
Estela (T)
Letargo
Ronquido (T)
Siesta (T)

Distractors: Dormir (S), Noche (S), Concierto (P), Llama (P), Regalo (U), Edificio (U)

Spanish Semantic 2

Jarro (T)
Platillo (T)
Té
Tapa (T)
Jugo (T)
Café
Paja (T)
Sopa
Bebida (T)

Distractors: Vaso (S), Taza (S), Fé (P), Ropa (P), Pelota (U), Suelo (U)

Spanish Phonological 1

Mata
Rata (T)
Piñata (T)
Corbata (T)
Lata
Trata (T)
Bata (T)
Nata
Chata (T)

Distractors: Crema (S), Arbusto (S), Gata (P), Pata (P), Canasta (U), Iglesia (U)

Spanish Phonological 2

Cana (T)
Lana (T)
Gana
Rana (T)
Banana
Gitana (T)
Llana (T)
Cubana
Manzana (T)

Distractors: Plátano (S), Deseo (S), Pana (P), Sana (P), Contenta (U), Silla (U)

Note: T=Target, S=Semantic distractor, P=Phonological distractor, U=Unrelated distractor; Underlined words represent those participants defined on the Spanish proficiency test.

Table 1

Mean (SD) for Demographics and Proficiency Scores by Proficiency Group

	Low Proficiency *N* = 24	High Proficiency *N* = 17
Age	19.75 (1.42)	19.18 (1.38)
Gender (% F)	75	82
Ethnicity (% Caucasian)	100	76
Proficiency Score	9.21 (1.59)	13.88 (1.87)

Table 2

Mean (SD) Correct Recall and Recognition by List Language, List Type, and Proficiency Group

List Language and Type	Low Proficiency *N* = 24	High Proficiency *N* = 17
	Recall	
Spanish Semantic	3.90 (0.92)	4.97 (1.43)
Spanish Phonological	4.58 (1.14)	5.79 (1.41)
English Semantic	6.71 (1.01)	6.74 (0.92)
English Phonological	6.71 (0.98)	7.03 (1.24)
	Recognition	
Spanish Semantic	4.81 (0.87)	5.18 (0.58)
Spanish Phonological	5.29 (0.49)	5.44 (0.63)
English Semantic	5.56 (0.43)	5.44 (0.63)
English Phonological	5.46 (0.55)	5.62 (0.49)

Table 3

Mean (SD) Recall Error Types by List Language, List Type, and Proficiency Group

List Language and Type	Low Proficiency *N* = 24			High Proficiency *N* = 17		
	Semantic	Phonological	Unrelated	Semantic	Phonological	Unrelated
Spanish Semantic	.38 (.50)	.67 (.46)	.31 (.36)	.26 (.31)	.29 (.36)	.23 (.50)
Spanish Phonological	.08 (.41)	1.56 (.95)	.02 (.10)	.00 (.00)	.82 (.58)	.00 (.00)
English Semantic	.46 (.51)	.04 (.14)	.02 (.12)	.26 (.31)	.02 (.12)	.02 (.12)
English Phonological	.04 (.20)	.94 (.78)	.00 (.00)	.00 (.00)	1.09 (1.05)	.06 (.17)

Table 4

Mean (SD) Recognition Error Types by List Language, List Type, and Proficiency Group

List Language and Type	Low Proficiency N = 24			High Proficiency N = 17		
	Semantic	Phonological	Unrelated	Semantic	Phonological	Unrelated
Spanish Semantic	.38 (.34)	.46 (.44)	.23 (.33)	.32 (.43)	.21 (.25)	.00 (.00)
Spanish Phonological	.02 (.10)	.98 (.54)	.04 (.14)	.00 (.00)	.97 (.57)	.03 (.12)
English Semantic	.52 (.48)	.13 (.22)	.02 (.10)	.50 (.53)	.18 (.35)	.00 (.00)
English Phonological	.00 (.00)	.69 (.51)	.00 (.00)	.00 (.00)	.53 (.67)	00 (.00)

Figure 1

Correct Recall Score by List Language and Proficiency Group (n=41)

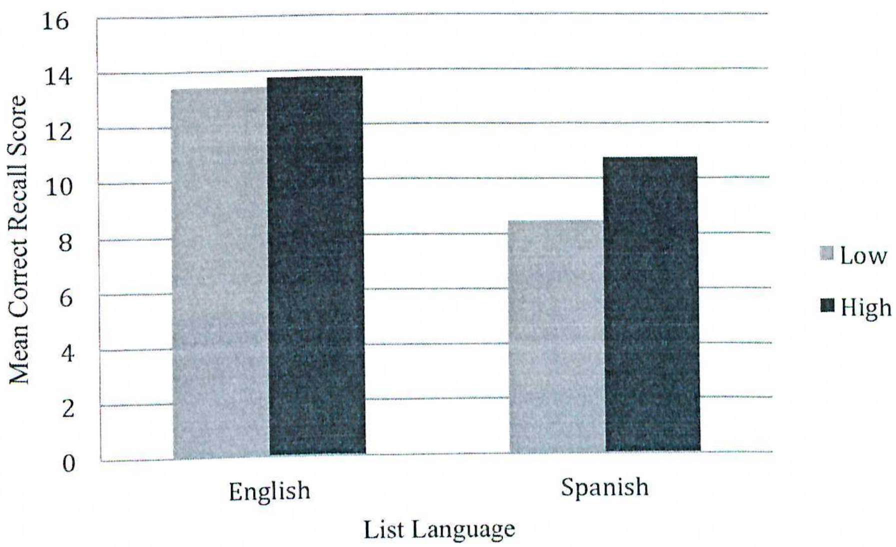

Figure 2

Correct Recall Score by List Language and List Type (n=41)

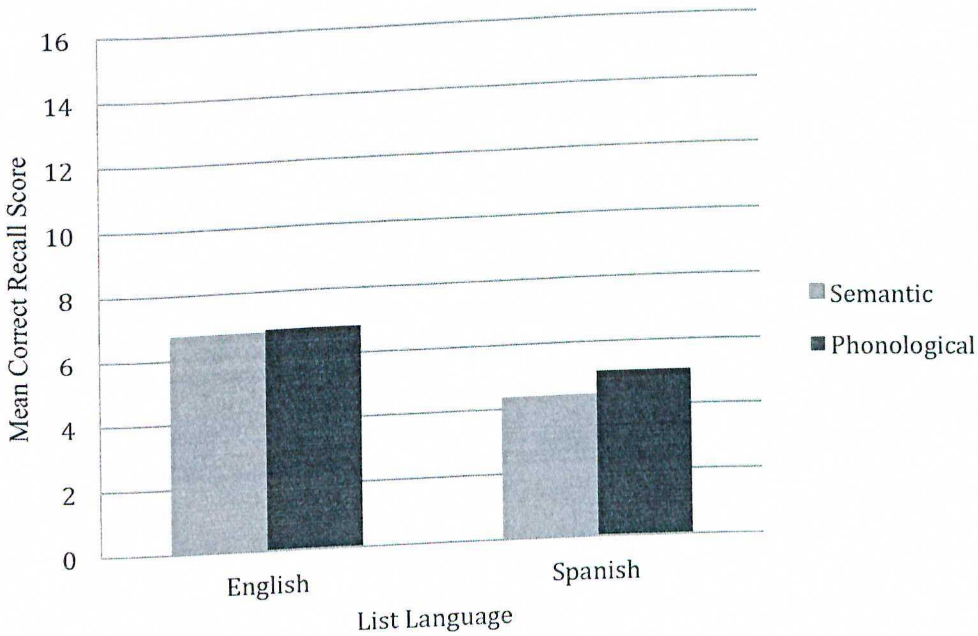

Figure 3

Recall Errors by List Language, Error Type, and Proficiency Group (n=41)

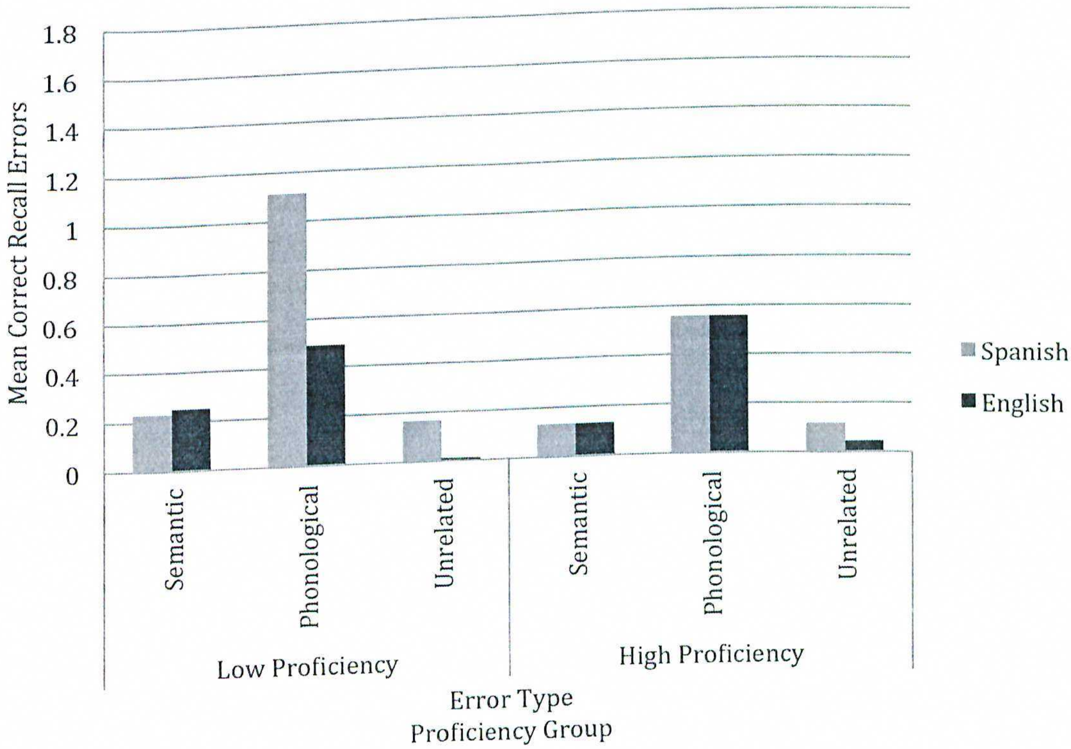

Figure 4

Recall Errors by List Language, List Type, and Proficiency Group (n=41)

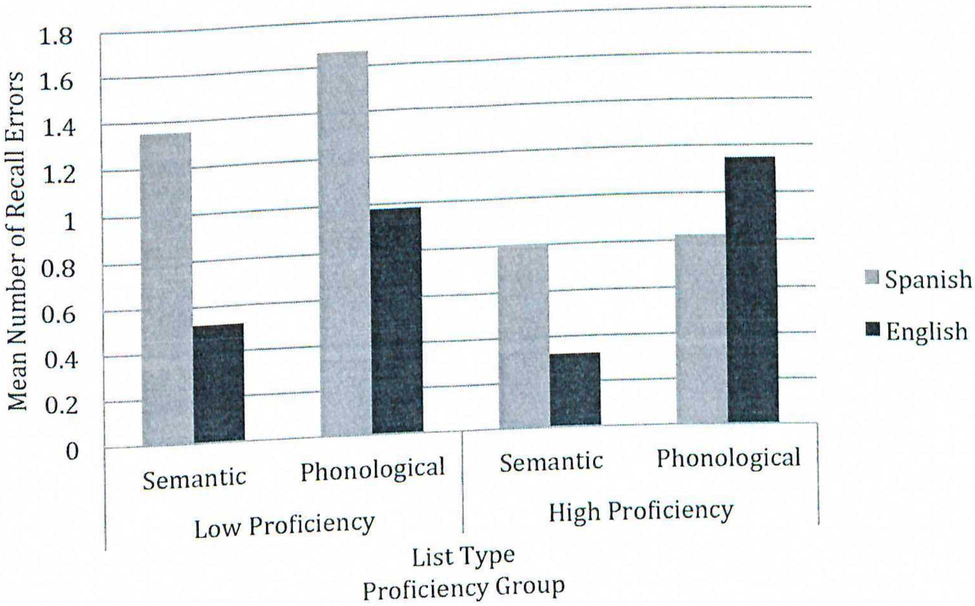

Figure 5

Recall Errors by List Language, List Type, and Error Type (n=41)

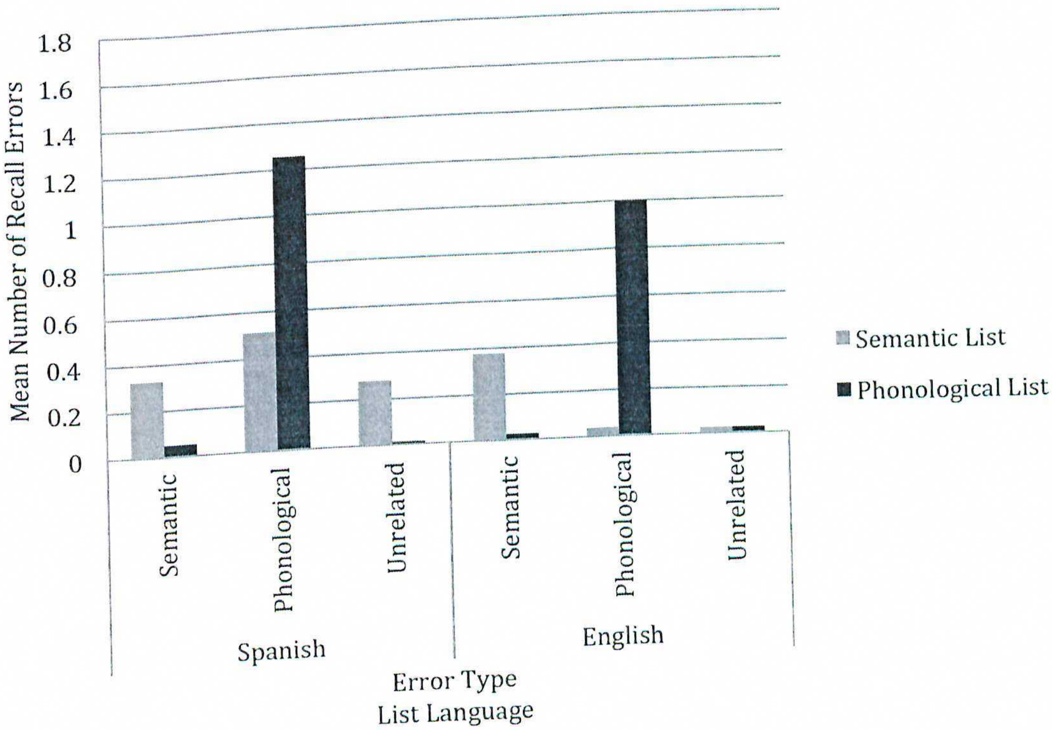

Figure 6

Correct Recognition Score by List Language and List Type (n=41)

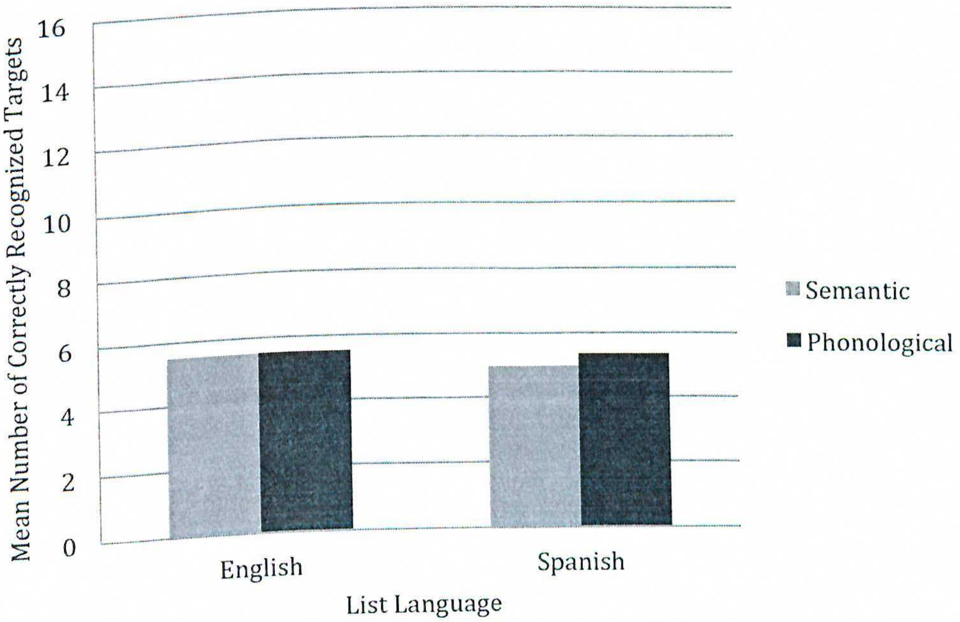

Figure 7

Recognition Errors by List Language, List Type, and Proficiency Group (n=41)

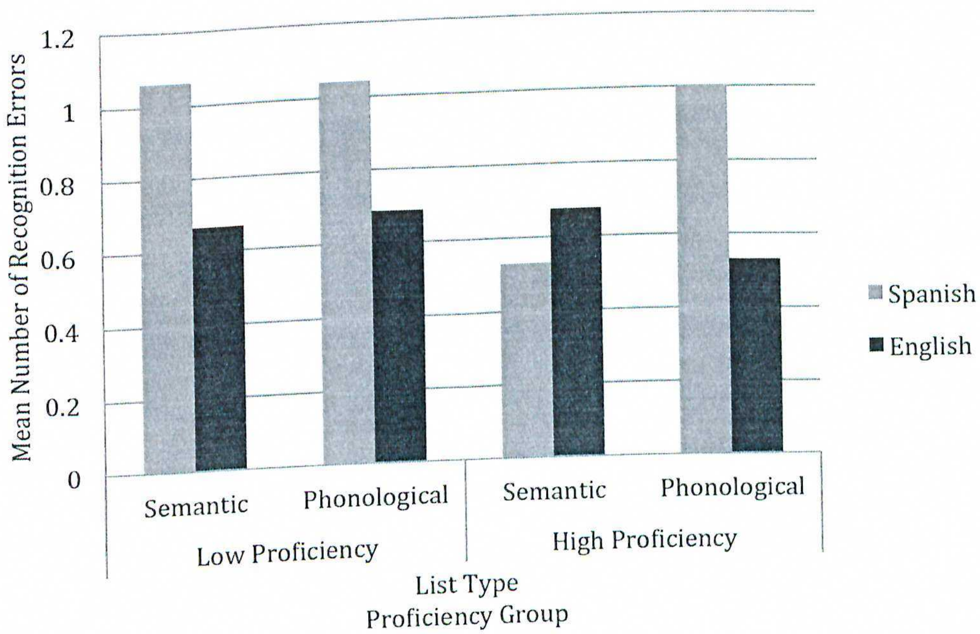

Figure 8

Recognition Errors by List Language, List Type, and Error Type (n=41)