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ABSTRACT

The goal of the present study was to investigate whether competition resolution mechanisms are improved throughout a student's college years. For this purpose, I bilingual participants with a range in the number of college credits completed (e.g., freshmen to seniors) were recruited. Participants were presented with sentences that biased the less frequent, or subordinate meaning of an ambiguous word (e.g., novel, fast) (e.g., novel: something new; fast: to not eat). The ambiguous word was either a Spanish-English cognate (e.g., novel/novela) or a noncognate control (e.g., fast). These sentences were followed by target words that, on critical trials, were related to the contextually-irrelevant, dominant meaning (e.g., BOOK, SPEED). The participants' task was to decide whether the target word is related to the sentence (thus requiring a "no" response on critical trials). The results of the present study suggest that number of credits completed alone does not influence the development of lexical disambiguation skills. Instead, language proficiency and working memory capacity were found to be predictors of lexical competition resolution.

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1. INTRODUCTION

Acquiring a second language (L2) involves becoming fluent in several areas such as speaking, comprehension and reading. This research intends to examine the development of fluency in L2 reading. According to Segalowitz (2000), performance fluency can be defined as the speed, fluidity and accuracy of action. In this view, fluent L2 performance refers to speaking or reading as quickly in the second language as in the first, and doing so fluidly and without non-native like errors. On the other hand, a lack of fluency would refer to speaking or reading that is slower, more hesitant and that may include the type of errors not found in native-like speaking or reading. According to a slightly different perspective, fluency of speech can refer to the attainment of automatic procedural skill so that speech is automatic and does not need a great deal of attention or effort (Schimdt, 1992). In addition to speech, fluency is also manifested in reading. Favreau and Segalowitz (1983) examined whether, compared with first-language reading, slower second language reading is associated with reduced involvement of automatic processing during lexical access. They tested fluent English-French and French-English bilinguals who had either equal reading rate or unequal reading rate in the second language on a lexical decision task. Results showed that bilinguals with equal reading rate in first and second languages produced a pattern of reaction times that suggested automatic processing in both languages. On the other hand, bilinguals with unequal reading rate in the second language showed reaction time patterns of automatic processing only in their first language, but not the second.

The present study focused on how L2 fluency develops specifically in the domain of reading. Becoming a fluent L2 reader involves skills such as knowledge of L2 vocabulary, the transfer of L1 reading skills and the ability to select appropriate information for further processing. This last factor, selection of appropriate information, is thought to differentiate fluent from less fluent readers (Neumann, McCloskey & Felio, 1999), and is thought to involve two general mechanisms: facilitation and inhibition (Hasher & Zacks, 1988; Neumann & DeSchepper, 1992). Facilitation (also called enhancement) is important for the activation of appropriate information and inhibition is important for de-activating interfering, intrusive or inappropriate information.

Inhibition, also called suppression, has been implicated in studies of language processing. The ability to employ suppression as a general comprehension mechanism has been studied extensively by Gernsbacher and colleagues. These researchers have examined how variations in how efficiently readers can suppress irrelevant meanings of ambiguous words relate to individual differences in reading skill in (e.g.,Gernsbacher & Faust, 1995; Gernsbacher & Robertson, 1999; Gernsbacher, Varner & Faust, 1990). The proposed study will extend this body of work and will investigate whether suppression mechanisms are developed and improved for bilingual adults who are gaining additional L2 reading experiences.. Next, we will review monolingual research on lexical disambiguation and then review the nature of bilingual lexical activation.

1.1 Lexical disambiguation: within language studies

Words can vary in terms of the number of meanings they can refer to as well as the frequency in which these meanings are used. A critical question in the research has been whether all the potential meanings of a word are activated to the same degree. Competing theories have been presented to explain how the multiple meanings of ambiguous words are activated and then selected. These theories can be grouped into two classes, context-dependent and context-independent theories.

Context-dependent theories (Simpson, 1994) claim that the meaning of an ambiguous word will be influenced by a context that biases a particular meaning. On the other hand, context-independent theories suggest that the meaning of the ambiguous word is selected only after all other meanings have been accessed. The main difference between these two theories is that, in the former, top-down processes from the biasing context can directly affect word-based, bottom-up activation, thus allowing for selective access of the intended meaning. In the latter, all meanings are activated without the influence of context or word frequency and the correct meaning is chosen only after all of the meanings have been initially processed. The context-independent theories argue that there is initial non-selective access of all the meanings of an ambiguous word, therefore not allowing for selectivity (see Simpson, 1994 for a review).

As usually happens when two theories are opposite to each other, a third one is proposed that integrates aspects of both sides. In this case, the re-ordered access model, (Duffy, Morris, & Rayner, 1988) incorporates aspects from both classes of models. According to the re-ordered access model, the relative frequency of the meanings of an ambiguous word and the surrounding sentence context will influence which meaning becomes activated. In the experiments that led to the development of this model, readers' eye movements were recorded as they read sentences containing lexically ambiguous words. The ambiguous words were either equibiased words (two meanings equally frequent) (e.g., fast) or non-equibiased words (one meaning more dominant than the other) (e.g., fan). In half of the trials, the ambiguous words were preceded by a sentence that disambiguated the word, while in the remaining trials the disambiguating sentence followed the ambiguous word. The most interesting findings from this study pertain to the non-equibiased ambiguous words. When these words were preceded by a neutral context (disambiguating context after the ambiguous words), fixations were similar to the control, unambiguous words.

This suggests that the more dominant meaning of the word was activated early in processing, not allowing the subordinate meaning to compete for selection. However, when these same words were preceded by a disambiguating sentence that biased the subordinate meaning of the word, longer gaze durations were observed, compared to controls. This suggests that the provided disambiguating context allowed for the subordinate meaning to become activated earlier and to compete for selection with the dominant meaning. This effect is what has been called the subordinate bias effect.

Schwartz, Yeh & Shaw (accepted) have extended the subordinate bias effect to investigate lexical competition in bilinguals. In that study, a sentence biased the subordinate meaning of an ambiguous word in English that was either a cognate (e.g., novel/novela) or a non-cognate word with Spanish (e.g., fast). These sentences were followed by target words that, on critical trials were related to dominant, contextually-irrelevant meaning of the ambiguous word and participants were asked to decide if the follow-up target words were related to the sentence they had just read (thus requiring a "no" response). Participants exhibited longer reaction times (RTs) and error rates when the last word of the sentence was ambiguous and the follow-up target word was related to its dominant meaning. More interestingly, the relative cost of this ambiguity effect was greater when the ambiguous word was also a cognate with Spanish. This suggests that the contextually-irrelevant, dominant meaning received co-activation from both of the bilinguals' languages thus producing more interference.

While the re-ordered access model considers lexical and contextual factors of meaning selection, the structure-building framework (e.g., Gernsbacher, 1990, 1991, 1996, 1997; Gernsbacher & Faust, 1991a, 1991b, 1995) considers the role of individual differences in reading skill. According to this framework, individual differences in enhancement and suppression mechanisms are responsible for how much a sentence context aids in lexical selection. In this framework, enhancement helps in the construction of mental structures by activating the information necessary to create the initial foundation upon which a new structure will be created. Suppression in turn reduces the activation of irrelevant information. Gernsbacher and colleagues (1991) characterize more and less skilled readers in terms of enhancement and suppression mechanisms. Less skilled comprehenders show less efficient enhancement and suppression mechanisms, with the opposite pattern true for more skilled readers. For example, Gernsbacher, Varner, & Faust (1990) showed that less skilled readers have greater difficulty in suppressing the non-target meaning of ambiguous homonyms presented at the end of a sentence. For example, in the sentence “He dug with the **spade,**” less skilled readers have greater difficulty in suppressing the non-target meaning (e.g., “ace”) than more skilled comprehenders at long processing intervals (e.g., SOA’s of 1000 ms). The present study extended this paradigm to bilingual processing of lexical ambiguity.

1.2 Lexical disambiguation: across languages studies

The past ten years of cognitive/psycholinguistic research has shown that bilingual lexical access is non-selective (e.g., De Bruin et al., 2001; Dijkstra et al., 2000; Dijkstra & Van Hell, 2003; Gollan, Forster, & Frost, 1997; Jared & Kroll, 2001; Van Heuven, et al., 1998; Schwartz, Kroll, & Diaz, in press). Evidence comes from cognate facilitation studies (Dijkstra, A., Grainger, J., & Van Heuven, 1999; Gollan, Forster, & Frost, 1997; Kroll & Stewart, 1994), where bilinguals are faster to recognize a cognate such as “piano” than a control word, and from homograph inhibition studies (Jared & Szucs, 2002; Dijkstra, Van Jaarsveld, & Ten Brinke, 1998), where bilinguals are slower to recognize a homograph such as “fin” than a control word.

This means that, despite a bilingual's intentions to speak in only one language, both languages are activated in parallel. In other words, bilinguals deal with ambiguity within and across languages. If the two languages of a bilingual are activated simultaneously, and this activation persists even in sentence context, how is it that bilinguals eventually select the language appropriate lexical representation? For example, the word "novel" is a cognate with Spanish ("novela"). This means it has highly similar lexical form and the same meaning across both languages (a "book" or a "story"). However, in English, "novel" also means "new". If a Spanish-English bilingual encounters this word in a context biasing the "new" meaning, at what point is she/he able to select the appropriate meaning over the non-contextually relevant meaning shared with the L1?

One major limitation in this literature is that most of the research supporting cross-language non-selective activation has been done using isolated word recognition tasks such as lexical decision and word naming. We need to investigate how the presence of a context might facilitate lexical disambiguation.

The reliance on isolated word recognition tasks is problematic since in daily life words are usually encountered in a context, such as a sentence. Thus, research studying the effect of a sentence context in cross-language lexical access becomes an important question. A few recent studies have examined this issue (Elston-Güttler, 2000; Elston-Güttler, et al., 2005; Schwartz & Kroll, 2006; Van Hell, 1998). These studies taken together have shown one consistent finding: the simple presence of a sentence is not enough to eliminate non-selective, cross-language activation. For example, both Van Hell (1998) and Schwartz and Kroll (2006) observed cognate facilitation when these cognate words were embedded in low-constraint contexts. On the other hand, processing of the cognate targets appeared language selective when the sentence highly biased the meaning of the targets. In other words, the cognate facilitation found in low-constraint sentences was completely eliminated when the same words were embedded in high-constraint sentences.

In a recent study, Elston-Güttler, Paulmann & Kotz (2005) presented German-English participants with German homonyms translated into English to form prime-target pairs (*pine-jaw for Keifer*) to test whether the L1 caused interference in an all-L2 experiment. In Experiment 1, in which the prime-target pairs were presented in isolation, the pattern of performance reflected reversed priming effects for low-proficiency learners. The authors argued that such results suggest that the two translations of a homonym are connected by inhibitory connections in the mental lexicon. The ERP N200 effects also obtained in Experiment 1 gave support to this idea since these were found very early, between 100 and 200 ms and were found in the absence of N400 effects. The authors argued that the presence of N200 priming in the absence of N400 priming implicates that interference from L1 occurs in form of orthographic interference as opposed to semantic.

However, of more interest for the proposed study are the findings from Experiment 2, in which the same materials were presented in a sentence context. The prime word was presented as the last word of the sentence, followed by the target word. In this case, the sentence biased either the dominant or subordinate meaning of the German homonym, and the target was always related to the meaning that was not biased by the sentence. Again, low-proficiency learners showed strong overall reversed priming effects in the ERP (100-250 ms) and reaction time data. This time though, high-proficiency learners showed no reversed priming on either measure. The authors concluded that the ERP and reaction time effects observed by low-proficiency learners in sentence context make a strong case for a highly integrated lexicon linked at the word form level and a fundamentally non-selective word-recognition system. Also, the authors propose that the N200 effects suggest that inhibitory mechanisms may be at play in the L1 influence on L2.

In another study, German-English bilinguals performed an L2 lexical decision in which sentences ended in interlingual homographs (e.g. bald) and followed by a target that reflected the German meaning of the homograph (e.g. soon) (Elston-Guttler, Gunter & Kotz, 2005) . The authors manipulated global language context by manipulating the language of the movie watched by the participants prior to completing the task. Priming effects were only observed for participants that saw the German version of the film (the non-target L1), and only during the first half of the experiment. The authors suggested that during the first half of the experiment there still existed some residual information from L1 as the system attempts to zoom into the new L2 language setting. However with time and additional L2 input the system is able to behave selectively, eliminating L1 influence.

In contrast to these results, Paulmann, Elston-Guttler, Gunter & Kotz (2006) using the same materials, manipulation and block design, but in an all single word experiment, found significant ERP and RT priming effects of first-language meanings in the all-L2 experiment. In that case, showing support for nonselective access theory of bilingual word recognition.

1.3 Bilingual lexical/language inhibition

Previous research suggests that lexical suppression, as described by Gernsbacher and colleagues, is also an operative mechanism in bilingual processing. For example, in a seminal study, Meuter & Allport (1999) provided evidence for language-level suppression in a language switching task. In that study, participants were asked to name numerals in either their first or second language, unpredictably. Response latency on switch trials was slower than on nonswitch trials. However, more interestingly, the switch cost was asymmetrical, such that a greater cost was observed when participants switched from L_2 to L_1. This finding suggests that naming in the second language requires inhibiting or suppressing of the stronger competing first language.

Green (1998) further instantiates inhibitory control mechanisms in his Inhibitory Control Model (ICM). According to this model, bilingual language control is achieved through the implementation of language task schemas. Language task schemas exert control within the bilingual lexicon by activating and inhibiting lexical nodes (i.e., word representations) on the basis of their associated language tags (e.g., “perro” would have a Spanish language tag; “dog” would have an English language tag). Task schemas also exert control through the suppression of competing task schemas. For example, when the task goal is to name an object in L1, the L1 task schema assumes control of lexical selection processes by activating lexical representations with L1 tags and by suppressing the L2 task schema (which, in turn, serves to inhibit lexical representations with L2 tags). As such, the ICM specifies two types of inhibition: inhibition of schemas that operate outside of the lexicon and inhibition of lexical representations within the bilingual lexicon. An important feature of the ICM is that inhibition is proposed to be reactive and proportional such that the more non-target lexical representations become activated initially; the stronger those representations are then inhibited.

Although Green’s (1998) model seems more appropriate to language switching tasks, inhibition of the non-target language must also be achieved in tasks which implement only one of the bilingual’s languages. If bilinguals’ lexical access is non-selective, than information from both languages are activated in any given language-related task. In that case, one must be able to inhibit information from the non-target language that has been activated. Although there are several pieces of converging evidence for the role of inhibition/suppression in language processing, it is important to point out that there is disagreement in the literature as to whether models need assume the existence of suppression per se to account for existing data (e.g., Gorfein, 2000; Finkbeiner, Almeida, Janssen, Caramazza, 2006; McDaniel, 2004; McNamara &; Perfetti, 2001).

The present study will focus specifically on whether the mechanisms of activation and competition resolution develop in adult L2 readers. It is hypothesized that, through the reading experiences of the college years, these cognitive mechanisms are highly practiced and can improve, to perhaps native-like fluency. Therefore, in this study we predict that, with increasing reading exposure, the overall pattern of reading performance will reflect more efficient lexical activation and competition resolution, both within and across languages.

1.4 The present study

The goal of the present study was to investigate whether the cognitive cost due to lexical competition decreases for adult L2 readers as they gain increased reading experiences. In other words, we wanted to see if efficiency in lexical resolution, particularly concerning lexical ambiguity, could account for the gain in L2 reading ability demonstrated by bilingual college students as they advance in their college years.

The present study tested this hypothesis by extending the paradigm developed by Gernsbacher and colleagues (1991) to bilingual reading. More specifically, bilinguals were presented with English sentence frames, that on critical trials ended in an ambiguous word that was either a cognate (e.g., novel) or a noncognate (e.g., fast). For those sentences ending in an ambiguous word, the sentential context biased the subordinate meaning (e.g., novel: something new; fast: not eating). These sentences were then followed by a target word and participants were asked to decide whether that target word was related to the meaning of the preceding sentence. On critical trials the target was related to the contextually irrelevant, dominant meaning of the ambiguous word (e.g., “BOOK”; “SPEED”), thus requiring a “no” response.

We hypothesized that when the critical prime word was an unambiguous cognate, it would facilitate responding whereas when it was an ambiguous cognate it would interfere with responding due to coactivation of the shared, dominant meaning. We further hypothesized that the number of credits completed in college study would predict the degree of cognate facilitation and cognate interference demonstrated by the participants. In other words, more reading exposure that comes with college years, would predict how much cognate facilitation and cognate interference students experience when reading in their L2, although dominant language. In order to examine whether processes of lexical resolution would improve with reading experience, bilingual students were recruited from different level courses (e.g., intro to upper level courses).

Another important prediction was that working memory capacity would be a predictor of lexical ambiguity resolution. Miyake, Just and Carpenter (1994) have demonstrated that resolving lexical ambiguity is related to working memory capacity such that high-span and even mid-span readers are able to hold both meanings of an ambiguous word which are available up to the time of disambiguation. Low-span readers on the other hand showed great ambiguity effects suggesting that they were not able to hold more than one meaning available.

We also predicted that proficiency variables in the two languages, such as self-ratings, would account for increased efficiency in lexical resolution. For example, we expected that Spanish proficiency would be a predictor of cognate interference because taking into account that English is the dominant language, it should be Spanish proficiency that causes interference when reading in the L2. In other words, higher Spanish proficiency would lead to greater cognate interference.

2. METHOD

2.1 Participants

Two hundred and thirty five undergraduate students from the University of Texas at El Paso were recruited from Introduction to Psychology and upper level Psychology courses. Only participants whose responses on the Language History Questionnaire (LHQ) reflected proficiency in both English and Spanish were included in the analyses (see the Results section for more details regarding these criteria). This led to an exclusion of 67 participants, a rate of 28%. Data from two participants was lost due to a computer malfunction. Therefore, the final group of Spanish-English bilingual students consisted of 166 participants.

Table 1. Language experiences, digit spans and self-assessed proficiency ratings of the Spanish-English bilingual participants (n=166). Self-assessed ratings based on a scale 1-10

Age Acquired English (years)	5.3	
Age Acquired Spanish (years)	3.3	
Digit Span English	5.6	
Digit Span Spanish	5.5	
	Self-assessed ratings[1]	
Skill	English (L2)	Spanish (L1)
Reading	9.1	7.3
Writing	9.0	6.4
Speaking	9.2	7.7
Listening	9.4	7.1
Mean rating	**9.2**	**7.4**

2.2 Tasks and Materials

2.2.1 Semantic verification task. The main task participants completed in the study was the Semantic Verification Task. In this task, participants were presented with a sentence frame missing the last word (e.g., *He is an original thinker and all of his ideas are exciting and*_______). Participants then pressed the middle key of a response box when they were ready to read the last word of that sentence, the prime word (e.g. *novel*), which was followed by the target word (e.g. NEW) after an SOA of 1250 milliseconds (ms). Finally, participants were asked to make a decision as to whether the target word was related to the meaning of the previously presented sentence by pressing the "yes" or "no" keys on a response box. An equal number of "yes" and "no" trials were included in the stimulus list. All prime words were presented in lowercase letters while target words were presented in uppercase letters.

2.2.2 Stimulus words. There were four groups of critical English prime words, which were based on an orthogonal manipulation of ambiguity and cognate status relative to Spanish: ambiguous-cognates, ambiguous-noncognates, unambiguous-cognates and unambiguous-noncognates. Prime words were matched for frequency and length across cognate status within the semantic ambiguity condition. In other words, ambiguous cognate primes were matched with ambiguous noncognate primes, while unambiguous cognates were matched with unambiguous noncognates.

Table 2. Example of word manipulation. Critical words were matched in length and frequency

Condition	Critical word	Translation equivalent	F	Word length
Cognate/ambiguous	habit	hábito	106.9	5.1
Noncog./ambiguous	school	escuela	104.6	5.0
Cognate/unambiguous	poet	poeta	80.7	5.9
Noncog./unambiguous	happy	feliz	78.8	6.0

2.2.3 Stimulus sentences. Materials consisted of 160 sentences. Half of these sentences were critical trials that required a "no" response. The other half was filler trials and required a "yes" response. Each sentence frame was presented on the computer screen with the last word missing. The word that was missing, our prime words, were from one of four conditions: ambiguous-cognate, ambiguous-noncognate, unambiguous-cognate and unambiguous-noncognate or a filler word for "yes" trials (see Table 3 for examples). The prime words were always the last word of the sentence followed by the target word. In the ambiguous critical trials, the meaning of the sentence biased the subordinate meaning of the ambiguous word (e.g., novel – NEW). In the case of the unambiguous, control trials, the target was a word not related to the meaning of the sentence. In both cases, the correct answer was "no." For the filler trials, the target words were related to the meaning of the sentence and require a "yes" response. Critical and filler sentences were matched on length. Furthermore to ensure that the presence of an ambiguous word would not cue a "no" response filler trials also included ambiguous prime words.

Table 3. Example of stimulus sentences on critical trials

Condition	
Ambiguous cognate	The nun was never seen in any type of clothing other than her habit.
Ambiguous noncognate	The scuba diver admired all of the fish in the school.

2.2.4 Digit span task. In the Digit Span task, participants heard a sequence of numbers in a series that increased from three to eight digits and were asked to recall these numbers in order after each trial. There were two trials of each length of digits and after participants heard each of the trials, they were given as much time as they needed to recall the numbers and to type them in the space provided after the trial.

Participants completed two versions of the Digit Span task, one in English and one in Spanish. The only difference between the two was that in the Spanish version the numbers were said in Spanish. However, instructions to the task were in English.

2.3 Procedure

When 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 first task was the Semantic Verification task. Instructions were presented on the computer screen as well as orally. The participant had a chance to complete 20 practice trials with feedback from the experimenter. Once the participant was ready to continue he or she pressed the middle key on the response box and a fixation point appeared on the middle of the screen. The task was self-paced, so whenever the participant was ready he or she could press the middle key on the response box to see the next sentence. The sentence frame was then presented on the screen. The sentence always had the last word missing. To see the last word, participants pressed the response box when they were ready. The last word (prime word) was then presented for 250ms, followed by a blank screen for 1000ms, which was then followed by a target word presented in all capital letters. The participant was then required to make a decision as to whether that target word was related to the meaning of the sentence previously read. “yes” responses were made with a right-hand key press and “no” responses with a left-hand key press on a response box. After the response was made another fixation point appeared on the screen and the participant had to press the space bar to see the next sentence and so on. This continued for 160 trials until the task was complete.

After finishing the Semantic Verification task, participants completed the English version of the digit span task. Again, instructions were presented on a computer screen as well as orally. Participants were instructed to listen to all digits on each trial, to remember them in order and then type them on the space provided after each trial. The first trial consisted of three digits and it increased consistently by one digit until it reached nine digits. Digits ranged from one to nine and were randomized for every trial. Repetition of digits was allowed, such that participants could hear a trial such as “3477.”

The next task was the Spanish version of the digit span task. Instructions to this task were the same as for the English version. The only difference between the two versions is that in the Spanish version, the digits ranged from one to eight. This difference in the two versions of the tasks was due to a mistake made in the scripting of the experiment. However, we corrected the error by bringing digits in the English version down to eight. Please refer to the results section for more information on this issue.

Finally, participants completed the language history questionnaire. This questionnaire assesses 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 and the contexts in which they speak each of the languages.

At the end of the experiment, participants received a debriefing form that explained them more about the study. They were also given an opportunity to ask questions about the study.

3. RESULTS

3.1 Language history questionnaire data

Data from the language history questionnaire (LHQ) are summarized in Table 1. Our initial criterion for classifying a participant as being a Spanish-English 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 reported learning Spanish before the age of five and reported using Spanish on a daily basis were also classified as being bilingual and included in the analyses.

Participants reported learning Spanish at an earlier age (M=3.3 years) than English (M=5.3 years), $t(1,160) = 4.38$, $p<.01$. Nevertheless, their average proficiency self-ratings (averaged across reading, writing, speaking and listening comprehension) were higher in English (M=9.2) than Spanish (M=7.4), $t(1,162) = 9.63$, $p<.01$, and they reported using English more frequently than Spanish $t(1,163) = 5.32$, $p<.01$, suggesting they had become more dominant in English.

3.2 Digit span data

The digit span for each participant was calculated by counting the number of total consecutive digits recalled without error. For example, if a participant recalled up to five digits and incorrectly recalled the following sixth digit, his or her span was identified as five. Due to an experimental running error in the English digit span task participants were presented with up to nine digits, whereas in the Spanish digit span task the list only went up to eight. In order to compare these two digit spans, we re-coded participants' English span, such that the highest possible number of digits recalled was eight. This change was made for only one participant who had correctly recalled all nine digits. Furthermore, this participant was monolingual and not included in further analyses. Participants showed equivalent digit span for English (M=5.6) and Spanish (M=5.5), $t(1,159) = 1.20$, $p>.05$.

3.3 Semantic verification task

3.3.1 Data trimming procedures. Mean RT for each participant for correct trials was calculated. RTs that were either faster than 500ms or slower than 5000 ms were counted as outliers and excluded from analyses. Participants with filler RTs of 2000ms or higher were also excluded. Any participant who had an error rate greater than 30% on the critical trials was also excluded from further analyses. An average error rate for the critical trials was calculated by averaging across the three critical conditions. This excluded participants who missed 80% or more on any of the three conditions. All these conditions led to an exclusion of 14.4% of trials.

3.3.2 Correlation analysis. Cognate facilitation and cognate interference effects scores were calculated for both RTs and error rates. Cognate facilitation effects scores were calculated by subtracting unambiguous cognate scores from unambiguous non-cognate scores. Cognate interference effects, on the other hand, were calculated by subtracting ambiguous non-cognate scores from ambiguous cognate scores. This procedure was repeated for each participant for both RT's and error rates.

Pearson product-moment correlation coefficients were computed for the two cognate facilitation effect scores, the two cognate interference effect scores, the number of credits completed, as well as many proficiency variables (e.g., age of acquisition, reading proficiency, added self-rated proficiency) in both English and Spanish and digit span scores also in both languages. In addition, an English proficiency score and a Spanish proficiency scores were created by adding the self-reported ratings (reading, writing, speaking and comprehension) of each participant. These scores allow for a more comprehensive view of participants' proficiency. From now on, we will refer to the added self-rated proficiency solely as English ability and Spanish ability.

Table 4. Correlations between the four dependent variables and all the independent variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
Cognate interference RT	---												
Cognate interference error	-.070	---											
Cognate facilitation RT	.112	-.001	---										
Cognate facilitation error	.078	.083	-.002	---									
Sum English	-.005	-.093	.191*	.007	---								
Sum Spanish	.020	.229**	.018	.183*	-.241**	---							
English digit span	.014	.191*	.003	.010	-.053	-.116	---						
Spanish digit span	.019	-.126	-.008	.016	.006	.019	.191*	---					
Number of credits	.040	-.024	.161	.018	.095	.037	.018	-.051	---				
Spanish reading	.043	.207*	.032	.197*	-.187*	.912**	-.115	.062	.042	---			
AoA Spanish	.099	-.171*	-.030	-.039	.095	-.238**	-.047	-.034	-.139	-.168	---		
English reading	-.006	-.080	.184*	-.009	.881**	-.149	-.055	-.029	.151	-.092	.083	---	
AoA English	-.041	.112	-.144	.122	-.390**	.565**	-.068	-.004	.042	.513**	-.209*	-.264**	---

* Correlation is significant at the 0.01 level (2-tailed).
** Correlation is significant at the 0.05 level (2-tailed).

Contrary to what we expected, our variable of interest, number of credits, did not correlate with any of the cognate facilitation or cognate interference scores (cognate facilitation RT, r =.161, p>.05; cognate facilitation error rate, r =.018, p>.05; cognate interference RT, r =.040, p>.05 and cognate interference error rate, r = -.024, p>.05). There was only one correlation approaching significance, and that was with the cognate facilitation effect score RT

(p=.07). Thus, suggesting that years spent in college is not related to the degree of cognate facilitation or interference that bilingual readers experience.

However, the cognate effect scores did correlate with other variables. Cognate facilitation effect scores in RTs correlated positively with English reading (r =.184, p<.05) English ability (r =.191, p<.05), indicating that the higher English reading abilities and English proficiency, the greater the cognate facilitation effects observed in reaction times. Cognate facilitation effect scores in *error rates*, on the other hand, were correlated with *Spanish* proficiency variables. More specifically, Spanish reading (r =.197, p<.05) and Spanish ability (r =.183, p<.05) correlated positively with cognates facilitation effects in the error rates. Therefore, English and Spanish ability differentially affected responding on cognate trials: English ability had a more direct effect on speed of responding whereas Spanish ability had an effect on accuracy.

For the cognate interference effect scores in the RTs, none of the variables were correlated (all p's >.05). However, cognate interference effect scores in the error rates correlated negatively with age of acquisition of Spanish (r =-.171, p<.05) suggesting that the earlier participants learned Spanish, the more cognate interference experienced. Cognate interference effect scores in error rates also correlated positively with Spanish reading (r =.207, p<.05) and Spanish ability (r =. 229, p<.05). These correlations with Spanish proficiency measures suggest that increased proficiency in the L1, Spanish allowed for more robust activation of the non-target meaning shared with Spanish. Finally, cognate interference scores were also correlated with English digit span (r =. 191, p<.05), suggesting that higher verbal working memory in English produced greater cognate interference from the dominant meaning shared with Spanish.

3.3.3 Regression analyses. Four stepwise multiple regressions were conducted using each of the cognate effect scores (cognate facilitation RT, cognate facilitation error rate, cognate interference RT and cognate interference error rate) as the dependent variable.

In the first regression, we predicted cognate facilitation effects in the RT's. In the first model, we entered number of credits completed in college, which did not account for any variance in cognate facilitation effects in the RT's, F (1,115) =2.54, p>.05. Number of credits completed accounted for only 2.2% of variance in cognate facilitation effects in RT's and it was not significant. In the second model, we added language background variables such as English ability and Spanish ability. With these variables in the model, we increased the amount of variance explained by 6.3% (F (3,113) =3.49, p<.05). English ability (t =2.74, p<.01) was a significant predictor of cognate facilitation effects in the RT's. Spanish ability did not significantly contribute to the amount of variance explained.

Table 5. Stepwise regression predicting cognate facilitation in RT from number of credits and language proficiency variables (N=115)

Variable predicted	Step	R^2	Predictor	Standardized β	p
Cognate facilitation RT	1	.022	Number of credits	.147	.114
	2	.085	Number of credits	.122	.179
			Sum English	.255	.007
			Sum Spanish	.107	.252

In the second regression, we predicted cognate facilitation effects in the error rates. In the first model, we entered number of credits, which again did not account for any variance in cognate facilitation effects, F (1,115) =.023, p>.05. In the second model, we entered English ability and Spanish ability. However, adding these variables did not increase the amount of variance explained, F (3,113) =1.12, p>.05. In addition, none of our independent predictors contributed to the amount of variance explained by the model.

Table 6. Stepwise regression predicting cognate facilitation in error rates from number of credits and language proficiency variables (N=115)

Variable predicted	Step	R^2	Predictor	Standardized β	p
Cognate facilitation error rates	1	.000	Number of credits	.014	.881
	2	.029	Number of credits	.005	.957
			Sum Spanish	.174	.070
			Sum English	.031	.744

Cognate interference effects in RT's were predicted in the third regression analysis. Again, number of credits was entered in the first model and did not account for any variance in cognate interference effects in RT's, F (1,112) =.123, p>.05. In the second model, we entered the same English ability and Spanish ability scores as in the regressions predicting cognate facilitation effects. In addition, this time we also entered digit spans in both English and Spanish. The reason for entering these two variables is that language interference is thought to be highly linked to working memory capacity. Nonetheless, the second model was also not significant, thus not accounting for any variance in the cognate interference effects in RT's, F (5,108) =.187, p>.05. None of the predictors was significant.

Table 7. Stepwise regression predicting cognate interference in RT from number of credits, language proficiency variables and digit spans (N=112)

Variable predicted	Step	R^2	Predictor	Standardized β	*p*
Cognate interference RT	1	.001	Number of credits	.033	.726
	2	.009	Number of credits	.042	.663
			Sum Spanish	-.055	.579
			Sum English	-.065	.516
			Digit span Spanish	.040	.680
			Digit span English	.009	.928

Last, in the fourth regression we predicted cognate interference effects in error rates. As before, number of credits was entered first and once more did not account for any of the variance in cognate interference effects, F (1,112) =.053, p>.05. The same variables as before (English and Spanish ability and English and Spanish digit spans) were entered in the second model. With these variables in the model, we increased the amount of variance explained by 10%, F (5,108) =2.44, p<.05. Spanish ability (t =2.23, p<.05) and English digit span (t =2.54, p<.05) were significant predictors of cognate interference effects in the error rates. The remaining variables did not significantly contribute to the amount of variance explained. This suggests that, as we predicted, proficiency in Spanish influenced the degree to which cross-activation of the contextually irrelevant meaning interfered with processing. Furthermore, as in Miyake et al., (1994), working memory capacity in the dominant language was also a significant predictor of lexical disambiguation abilities.

Table 8. Stepwise regression predicting cognate interference in error rates from number of credits, language proficiency variables and digit spans (N=112)

Variable predicted	Step	R^2	Predictor	Standardized β	*p*
Cognate interference error rates	1	.000	Number of credits	-.022	.819
	2	.101	Number of credits	-.037	.691
			Sum Spanish	.211	.028
			Sum English	-.025	.794
			Digit span Spanish	-.131	.162
			Digit span English	.239	.012

4. GENERAL DISCUSSION

In the present study, number of college credits did not correlate with any of the cognate facilitation or cognate interference scores as we had expected. This suggests that coursework completed per se is not the key factor in the further development of lexical disambiguation for highly proficient adult bilinguals. Instead, the present study suggests that other variables are critical factors in the efficiency of lexical disambiguation, such as language ability in the first and second language and working memory capacity in the second, dominant language.

These variables, language proficiency and working memory, were found to significantly influence the degree of interference and facilitation from Spanish. More specifically, increased language ability in Spanish was linked to greater cognate interference effects from Spanish. This conformed to our initial prediction that increased Spanish proficiency would lead to larger cross-language lexical effects. Therefore, in terms of extending the Re-ordered Access Model (RAM) to bilingualism, the present study suggests that cross-language lexical activation should be included as an extra factor which influences how multiple meanings of ambiguous words become activated and compete. Specifically, the present study suggests that increased proficiency in the non-target language influences the degree of cross-language activation, which in turn, influences how meanings compete and are further selected. Furthermore, proficiency in the more dominant language (English) was a predictor of cognate facilitation effects in the RT. We did not initially predict this effect and expected the opposite pattern. One possible interpretation for this effect is that in the absence of semantic ambiguity, increased ability in the target language allows readers to benefit from lexical transparency of cognates. This interpretation is compatible with existing bilingual research showing that L2 reading ability allows for greater lexical automaticity which allows for a greater set of lexical competitors to be co-activated (French-Mestre & Prince, 1997).

In terms of working memory capacity, findings from the present study suggest that working memory in the target language modulated the degree to which representations from the non-target language influenced lexical disambiguation. More specifically, English digit span was a significant predictor of cognate interference from Spanish. This result in itself is interesting because it supports previous research on the role of working memory in lexical disambiguation (Miyake et al., 1994). However, this result seems somewhat counterintuitive, as one might predict higher working memory capacity in the target language to be *inversely* related to the degree of interference experienced from the non-target language. A possible explanation for this finding is that high-span persons have more cognitive resources to initially activate more possible representations, including cross-linguistically, thus providing more initial lexical interference. In a study that investigated the role of study abroad experience and working memory capacity (WMC) on types of errors made during translation from first language to second language, Tokowicz, Michael and Kroll (2004) found that only high WMC learners made as many meaning errors (e. g. when individuals translate semantically related words instead of the target word) as non-response errors. They suggested that only high span learners were able to maintain multiple items in memory simultaneously, which allowed them to make these meaning errors. Again, in terms of a bilingual version of the RAM, working memory capacity should be incorporated as a factor as it influences the degree of activation from the non-target, shared meaning with the other language.

4.1 Future directions

One possible reason why our main hypothesis was not supported may have been due to the assumption that number of credits completed would be accompanied by increased reading exposure. Future research should include a reading habits measure which may provide a more precise and sensitive measure of reading experience and behavior. Indeed, findings from the present study suggest that reading measures are of particular relevance because self-rated reading abilities in English and Spanish correlated differently with cognate effects.

While previous research has documented the role that working memory plays in lexical disambiguation for monolinguals, the present study extends this work by examining bilinguals and ambiguity that extends across languages. We found that it is the span in the dominant language (English), not the first language (Spanish) that predicts cognate interference. This could be due to the fact that the task was done in English. In future research, we should conduct the same semantic verification task in Spanish to verify whether Spanish digit span will be a predictor. Another interesting factor to address in future research is the role of reading span in lexical disambiguation. Daneman and Carpenter (1980) have found that reading span, but not digit span, is correlated with reading comprehension. Therefore, it would be interesting to investigate whether reading span also correlates with lexical disambiguation.

4.2 Pedagogical implications

The present study has some pedagogical implications on programs to enhance reading and academic outcomes for non-native speakers. Specifically, this study recognizes the important role that individual differences in language proficiency and working memory capacity play in text processing. These factors might be of special importance and relevance when schools are designing curriculum for non-native learners. For example, school officials should create curriculum that focuses on increasing exposure to low frequency, ambiguous, complex words which boost the underlying lexical representations of these words. In turn, a strong lexical representation can serve as protection against low working memory resources.

LIST OF REFERENCES

Daneman, M. & Carpenter, P. A, (1980). Individual differences in working memory and reading. *Journal of Verbal Leraning and Verbal Behavior*, 19, 450-466.

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.

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

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.

Elston-Güttler, K. (2000). An enquiry into cross-languge differences in lexical-conceptual relationships and their effect on L2 lexical processing. University of CambridgeEditor).

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.

Faust, M. E., & Gernsbacher, M. A. (1996). Cerebral mechanisms for suppression of inappropriate information during sentence comprehension. *Brain and language, 53*(2), 234-259.

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

Finkbeiner, M., Almeida, J., Janssen, N. & Carramazza, A (2006). Lexical selection in bilingual speech production does not involve language suppression. *Journal of Experimental Psychology: Learning Memory and Cognition,* 32(5), 1075-1089.

Frenck-Mestre, C. & Prince, P. (1997). Second language autonomy. Journal of Memory and Language, 37(4), 481-501.

Gernsbacher, M. A. (1990). *Language comprehension as structure building*. Hillsdale, NJ, England: Lawrence Erlbaum Associates, Inc.

Gernsbacher, M. A. (1996). The structure-building framework: What it is, what it might also be, and why. In B. K. Britton (Ed.), *(1996). models of understanding text* (pp. 289-311). Hillsdale, NJ, England: Lawrence Erlbaum Associates, Inc.

Gernsbacher, M. A. (1997). Group differences in suppression skill. *Aging, Neuropsychology, and Cognition*, *4*(3), 175-184.

Gernsbacher, M. A., & Faust, M. (1991). The mechanism of suppression: A component of general comprehension skill. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *17*(2), 245-262.

Gernsbacher, M. A., & Robertson, R. R. W. (1999). The role of suppression in figurative language comprehension. *Journal of Pragmatics*, *31*(12), 1619-1630.

Gernsbacher, M. A., Varner, K. R., & Faust, M. E. (1990). Investigating differences in general comprehension skill. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *16*(3), 430-445.

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.

Gorfein, D. (2001) An activation-selection view of homograph disambiguation: A matter of emphasis? In D. S. Gorfein (Ed.) *On the consequences of meaning selection* (pp. 157-173). Washington, DC: APA Press.

Green, D. W. (1998). Mental control of the bilingual lexico-semantic system. *Bilingualism: Language and Cognition*, *1*(2), 67-81.

Hasher, L. & Zacks, R.T. (1988) Working memory, comprehension and aging: A review and a new view. In G. H. Bower (Ed.) *The psychology of learning and motivation*, Vol. 22 (pp. 193-225). San Diego, Ca: Academic Press.

Jared, D., & Kroll, J. F. (2001). Do bilinguals activate phonological representations in one or both of their languages when naming words? *Journal of Memory and Language, 44*(1), 2-31.

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.

Lu, C. & Proctor, R. W. (1995) The influence of irrelevant location information on performance: A review of the Simon and spatial Stroop effects. *Psychonomic Bulletin & Review,* 2(2), 174-207.

McNamara, D. S. & McDaniel, M. A. (2004) Suppressing irrelevant information: Knowledge of activation or inhibition? *Journal of Experimental Psychology: Learning, memory and cognition*, 30(2), 465-482.

Meuter, R. F. I., & Allport, A. (1999). Bilingual language switching in naming: Asymmetrical costs of language selection. *Journal of Memory & Language, 40*(1), 25-40.

Miyake, A., Just, A.M. & Carpenter, P. A. (1994) Working memory constrains on the resolution of lexical ambiguity: Maintaining multiple representations in neutral contexts. *Journal of Memory and Language,* 33, 175-202.

Neumann, E. & DeSchepper, B. G. (1992) An inbition based fan effect: Evidence from an active suppression mechanism in selective attention. *Canadian Journal of Psychology,* 46, 1-40.

Neumann, E., McCloskey, M.S., & Felio, A.C. (1999) Cross language positive priming disappears, negative priming does not: Evidence from two sources of selective inhibition. *Memory & Cognition*, 27, 1051-1063.

Perfetti, C. A. & Hart, L. (2001) The lexical basis of comprehension skill. In D. S. Gorfein (Ed.) *On the consequences of meaning selection* (pp. 157-173). Washington, DC: APA Press.

Segalowitz, N. (2000) Automaticity and attentional skill in fluent performance. In H. Riggenbach (Ed.) *Perspectives on Fluency*. (pp. 200-219) Ann Arbor, MI: University of Michigan Press.

Schimdt, R. (1992) Psychological mechanisms underlying second language fluency. *Studies of Second Language Acquisition*. 14, 357-385.

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

Schwartz, A. I. & Kroll, J. (2006) Bilingual lexical activation in sentence context. *Journal of Memory and Language*, 55(2), 197-212.

Schwartz, Shaw & Yeh (in preparation). First language influence on the reading process of second language.

Simpson, G. B. (1994). Context and the processing of ambiguous words. In M. A. Gernsbacher (Ed.), *Handbook of psycholinguistics* (pp. 359-374). San Diego, CA: Academic Press, Inc.

Stanovich, K. E., & West, R. F. (1981). The effect of sentence context on ongoing word recognition: Tests of a two-process theory. *Journal of Experimental Psychology: Human Perception and Performance, 7*(3), 658-672.

Tokowicz, N., Michael, E. B. & Kroll, J. F., (2004). The role of study abroad experience and working-memory capacity in the types of errors made during translation. *Bilingualism: Language and Cognition*, 7(3), 255-272.

Van Hell, J. G. (1998). *Cross-language processing and bilingual memory organization.* Unpublished dissertation, University of Amsterdam, Amsterdam, The Netherlands.

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.

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Grants and Awards

UTEP M-RISP Travel Award - University of Texas at El Paso, March 2008

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Increasing second language vocabulary acquisition in bilingual emergent readers through oral reading activities

Language attitudes and learning motivation for English and Spanish by Brazilians living in El Paso

Lexical ambiguity and language suppression in bilinguals: can the subordinate meaning of ambiguous words more strongly compete with the dominant meaning when the subordinate meaning is shared across languages (English and Spanish)?

Use of the Structure Strategy training to improve comprehension and recall of bilingual students at UTEP

Norming of ambiguous English-Spanish cognates

Development of lexical disambiguation mechanisms through reading experiences in the college years

The effectiveness of teaching English arts content in first language (Spanish) to newcomer high school students in local high schools

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