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THE NATURE OF CROSS-LANGUAGE LEXICAL ACTIVATION IN SENTENCE CONTEXT: A PSYCHOLINGUISTIC INVESTIGATION

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ABSTRACT

The goal of the present study was to examine the cognitive nature of second language (L2) lexical processing in sentence context. Recent psycholinguistic research has provided evidence that bilingual lexical access is language non-selective in nature and that when bilinguals recognize words, information from both languages is activated in parallel. These non-selective findings have shaped current models of bilingual lexical activation and our understanding of how the bilingual lexicon is organized. However, these findings have been primarily based on isolated word recognition. Since bilinguals function in context-rich environments, it is important to understand to what degree information provided by context modulates language non-selectivity.

In the present study we examined the influence of sentence context by comparing bilinguals' lexical processes in out-of-context, and sentence-context tasks. Our goal was to determine whether the top-down process of L2 sentence comprehension interact directly with the bottom-up processes of lexical access and whether this interaction would constrain language non-selectivity. In the first set of experiments we examined bilinguals' L2 word recognition performance for language-ambiguous words (e.g., cognates and interlingual homographs) in two out-of-context tasks (word naming and lexical decision). These experiments replicated the effects of cross-language activation that have been observed in the literature. In the second set of experiments the same critical words were inserted in high constraint and low constraint sentences. The findings demonstrated that effects of language non-selective access persisted in low constraint sentences. This suggests that the language context provided by a sentence is not sufficient to constrain non-selectivity. However, in high constraint sentences the effects of cross-language activation were eliminated for bilinguals with relatively high L2 comprehension skills. The results suggest that sentence context can indeed constrain non-selectivity when there is sufficient semantic information and processing resources to efficiently suppress the non-target native language. Implications for current models of bilingual lexical access are discussed.

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Chapter 1

Introduction

From the primary grades through post-secondary education there is an increasing number of students whose first language is not English. For these students academic success requires not only oral proficiency in a second language (L2) but fluent reading skills as well. Yet, current research suggests that reading fluency in an L2 does not develop at the same rate as oral proficiency; even highly fluent bilinguals have considerably slower reading rates in their L2 (Favreau & Segalowitz, 1983).

How is the cognitive nature of L2 reading distinct from the native language (L1) and how might it account for decreased reading rate? There are at least two fundamental characteristics that distinguish L2 reading. First, basic word recognition processes may be slowed in L2 due to decreased familiarity and frequency of use of the language. Second, there is now abundant evidence from psycholinguistic research suggesting that bilinguals are not able to selectively turn off one of their languages (e.g., De Bruijn, Dijkstra, Chwilla, & Schriefers, 2001; De Groot & Nas, 1991; De Groot, Delmaar, & Lupker, 2000; Dijkstra, De Bruijn, Schriefers, & Brinke, 2000; Dijkstra, Grainger, & Van Heuven, 1999; Dijkstra, Van Jaarsveld, & Ten Brinke, 1998; Van Heuven, Dijkstra, & Grainger, 1998; Von Studnitz & Green, 2002). Therefore, L2 reading may pose a challenge for bilinguals due to the combined factors of slowed processing and cross-language interference.

What cognitive strategies are engaged that allow bilinguals to overcome these obstacles when reading in their L2? We know from within-language research that sentence-level, contextual information guides lexical access in the L1 (Morris, 1994; Simpson, Peterson, Casteel, & Burgess, 1989). Do bilinguals similarly make use of context when reading in their L2? Is this ability to use context moderated by individual differences in reading ability and L2 proficiency?

The goal of the present research was to provide a systematic examination of the reading process for adult late learners of a second language. This included an analysis of the factors that may impede performance and the cognitive strategies engaged to overcome them. This research adds to existing literature by providing a much-needed focus on the foundational processes of L2 reading, and examines word-based processes in combination with sentence-based processing. First, we summarize relevant literature from monolingual and bilingual investigations of lexical access out of context. These studies have provided consistent evidence that the multiple lexical representations of ambiguous words are activated in parallel. We then review research on lexical access in sentence context. Findings from those studies suggest that sentence context has a direct impact on the degree to which the multiple senses of ambiguous words become activated. Finally, we make predictions based on the monolingual sentence context studies of how sentence context might influence lexical access for bilinguals.

Monolingual lexical access out of context: Non-selective activation of ambiguous words

Readers are continuously confronted with lexical ambiguity. For example, when reading the following sentence frame, “We walked slowly into the room, worried that there were lots of bugs…" one might imagine annoying flies and mosquitoes. However, this interpretation would be erroneous if the sentence continued, "…that the government spies had planted in the walls". The English language is replete with such ambiguity. Furthermore, lexical ambiguity can occur at a number of levels, such as semantic (e.g., *bugs* can mean "insects" or "spying devices") and phonological (e.g., *lead* has two meanings as well as two pronunciations). Words that are polysemous (i.e., have multiple meanings) and have a single pronunciation are referred to as homonyms (e.g., *bugs*) and words that are polysemous and map on to more than one pronunciation are referred to as homographs (e.g., *lead*).

Despite the pervasiveness of lexical ambiguity, skilled readers are still able to quickly process words such as homonyms and homographs and integrate them into the text being read. This has led a number of researchers interested in the cognitive processes of reading to examine how polysemy is represented in the lexicon and how the multiple meanings of words become activated and ultimately selected. Researchers have been particularly interested in determining the extent to which readers automatically activate the multiple meanings of ambiguous words. In general, studies that have looked at the processing of ambiguous words out of context, such as in lexical decision, have found that recognition performance for homonyms are facilitated relative to unambiguous words (Gottlob, Goldinger, Stone, & Van Orden, 1999; Hino & Lupker, 1996; Pexman & Lupker, 1999; Rodd, Gaskell, & Marslen Wilson, 2002). The account given for this facilitation is that lexical access benefits from the multiple representations of the homonyms in the mental lexicon, which in turn suggests that the multiple meanings of ambiguous words are activated non-selectively, at least in tasks that do not require ambiguity resolution to make a response.

In the case of homonyms, multiple semantic representations map on to the same orthographic and phonological form. What happens when multiple meanings map on to different phonological representations, as they do with homographs? Gottlob et al. (1999) demonstrated that while homonyms (e.g., *spring*) were facilitated in naming and lexical decision, homographs (e.g., *lead*) were inhibited, suggesting that the two phonological representations were active and competing for selection. These results provided evidence that in addition to activation the multiple semantic representations of ambiguous words; readers also activate the corresponding phonological codes. One remarkable aspect of these results was that the effects of phonology were observed in lexical decision, which does not require that the words be pronounced and as a consequence phonology does not need to be specified in order to make a response.

Thus, the findings from out-of-context tasks provide evidence for non-selective activation of the multiple lexical representations of ambiguous words within a single language. What happens when the lexical ambiguity is cross-linguistic and the reader has proficiency in multiple languages? Does non-selective access similarly apply across multiple lexica? In the next section we report research on bilingual lexical processing out of context demonstrating non-selectivity across languages.

Bilingual lexical access out of context: Non-selective activation of ambiguous words across languages

Similar to monolingual research, the majority of studies on bilingual word recognition have demonstrated that out of context there is non-selective access of lexical information across a bilingual's two languages (De Bruijn et al., 2001; De Groot & Keijzer, 2000; Dijkstra, De Bruijn et al., 2000; Dijkstra et al., 1999; Dijkstra, Timmermans, & Schriefers, 2000; Dijkstra & Van Hell, 2003; Dijkstra et al., 1998; Gollan & Kroll, 2001; Jared & Kroll, 2001; Jared & Szucs, 2002; Kroll, Michael, Tokowicz, & Dufour, 2002; Marian, Spivey, & Hirsch, 2003; Miller & Kroll, 2002; Schwartz, Kroll, & Diaz, submitted; Talamas, Kroll, & Dufour, 1999; Van Hell, 1998; Van Hell & De Groot, 1998; Van Hell & Dijkstra, 2002; Van Heuven et al., 1998; Von Studnitz & Green, 2002). Furthermore, evidence of non-selectivity persists irrespective of the surrounding language context, task instructions or participant expectations to process one or multiple languages (Dijkstra, Timmermans et al., 2000; Dijkstra & Van Hell, 2003; Dijkstra et al., 1998; Van Hell & Dijkstra, 2002).

Also similar to monolingual research, the nature of the effects of non-selective activation depends on the relative match of the lexical codes (orthographic, phonological and semantic) across languages. For example, recognition of cognates, which are words that share orthography, phonology and semantics across languages (e.g., *piano* in English and Spanish) is consistently facilitated across a wide variety of tasks including translation (Kroll & Stewart, 1994); word association (Van Hell & De Groot, 1998) and lexical decision (Dijkstra et al., 1998). In contrast, findings regarding interlingual homographs, words that share form but not semantics (e.g., *fin* in Spanish means "end") have not been nearly as consistent. Some studies have demonstrated inhibitory effects associated with homograph status (Dijkstra et al., 1998; Jared & Szucs, 2002; Von Studnitz & Green, 2002), while others have failed to find any effects at all (Dijkstra et al., 1998; Gerard & Scarborough, 1989). Furthermore, the specific nature of homograph effects, whether they are inhibitory or facilitative in nature has varied as a consequence of differences in task demands, the salience of the non-target language, and the relative frequency of the homographs' lexical representations across languages (Dijkstra, De Bruijn et al., 2000; Dijkstra, Timmermans et al., 2000; Dijkstra et al., 1998).

Dijkstra, Grainger and Van Heuven (1998) tested for potential differential effects of shared orthography, phonology and semantics for Dutch-English bilinguals. They found that in progressive de-masking and lexical decision tasks in English, Dutch-English bilinguals' reaction times to words that either shared orthography (O) or orthography and semantics (SOP, SO) were facilitated. However, shared phonology (P) produced different effects. Reaction times to words that only shared phonology (P) were *inhibited* and words that shared a combination of phonology and either orthography (OP) or semantics (SP) did not produce reliable differences in reaction times. The authors account for the differential effects of phonology and orthography by pointing out that while it is possible to find words across languages that share identical orthography, it is not possible to find this same type of identical overlap in phonology.

In a recent study, Schwartz et al. (submitted) found further evidence that bilingual lexical processing of ambiguous words, specifically cognates, is influenced by the relative match in orthographic and phonological codes across languages. In that study, English-Spanish bilinguals named cognates (e.g., *piano*) and non-cognate control words (e.g., *lapiz/pencil*) in their L1 and L2. The cognates were classified according to the relative orthographic and phonological similarity across English and Spanish. To illustrate, the English-Spanish cognate *base* maps on to very distinct pronunciations ([bas] vs. [báse]) and was classified as +O-P, whereas *piano* is pronounced much more similarly ([piæ'nou] vs [pi'a'no]) and was classified as +O-P. The authors predicted that in the presence of highly similar orthography (e.g., *piano*/*piano*; *base*/*base*) the activation of the cross-language phonological representations would be particularly strong. When these representations were more distinct (e.g., [bas] vs. [báse]) the resulting competition would inhibit performance. The findings supported this prediction, the +O+P cognates (e.g., *piano*) were named faster and more accurately than the +O-P cognates (e.g., *base*) in both the L1 and L2 of the participants. This suggested that not only is lexical access nonselective across bilinguals' two languages, but that the subtle interactions between the codes activated determine the manner in which cross-language competition is manifest.

A model of bilingual word recognition

As the brief review of studies on bilingual lexical access suggests, when bilinguals recognize words, they appear to activate information in parallel in their two languages in a non-selective way. The Bilingual Interactive Activation model (BIA) proposed by Dijkstra and Van Heuven (1998), has been used to model these nonselective results. The BIA is a network model of bilingual visual word recognition and is based on the McClelland and Rumelhart (1988) model for monolingual visual word recognition. The BIA model consists of four layers of nodes; the feature, letter, word (or lexical) and language layers (see Figure **1-1**). Starting at the feature level, individual features send activation to matching letter nodes. Letter nodes in turn send activation to words at the word level that contain the letters in the correct position, and inhibition to words that have the letters in the wrong position. The word layer consists of two integrated lexica, one for each of a bilingual's languages. Activated words within each lexicon send activation to the corresponding language node while at the same time sending inhibition to other, competing words both within the same lexicon and across to the other lexicon. Word recognition is achieved when a word's activation level surpasses a certain recognition threshold. Finally, language nodes operate by collecting activation from all words in the corresponding lexicon while sending inhibition to the other, competing lexicon.

A critical assumption of the BIA model is that the early stages of word recognition are based on exclusively, stimulus-driven, bottom-up processes which are unaffected by information from any surrounding linguistic context. It is this bottom-up processing which allows the model to account for the non-selective results reported in prior studies.

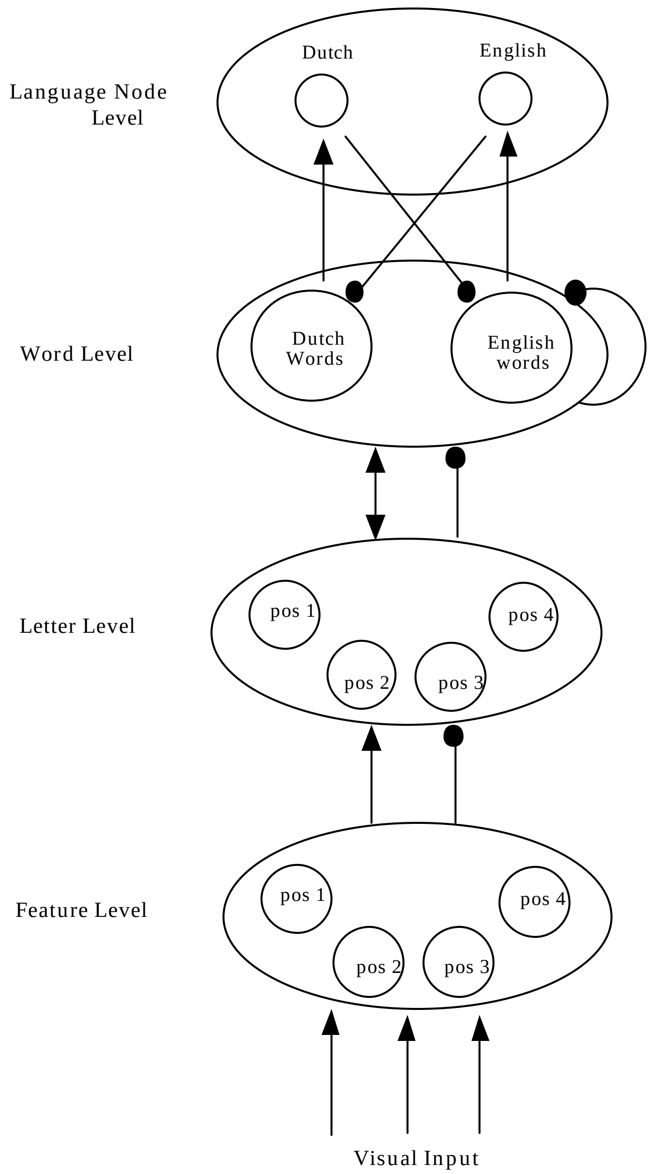

Figure **1-1**

The Bilingual Interactive Activation model (Dijkstra & Van Heuven, 1998)

It should be noted that the BIA is an orthographically-based model and does not include phonological and semantic representations. As evident in the studies reviewed earlier, the effects of language interaction are influenced by cross-language phonological and semantic representations. Recently the BIA has been updated to include both phonological and semantic representations (see Figure **1-2**). As in the BIA, the BIA+ assumes that lexical information from a bilingual's two languages are represented in an integrated lexicon, in which there is language non-selective activation. Thus, the critical assumption is still that in the initial stages of lexical access, there is bottom-up, non-selective activation of lexical information across a bilingual's languages and this non-selectivity is impenetrable from influences outside of the lexicon.

A critical difference between the earlier BIA and the newer BIA+ is that the latter model incorporates a distinction between a word identification system (the lexicon) and a task/decision system. The authors propose that the task/decision system is affected by extra-linguistic factors such as task demands and participant expectations, which in turn can influence the output of the word identification system. The word identification system, on the other hand is directly affected only by linguistic factors such as lexical, syntactic and semantic information. By including both of these systems, the authors can accommodate the wide range of evidence for language non-selectivity and the more specific differences that arise across different experiments, tasks, and contexts.

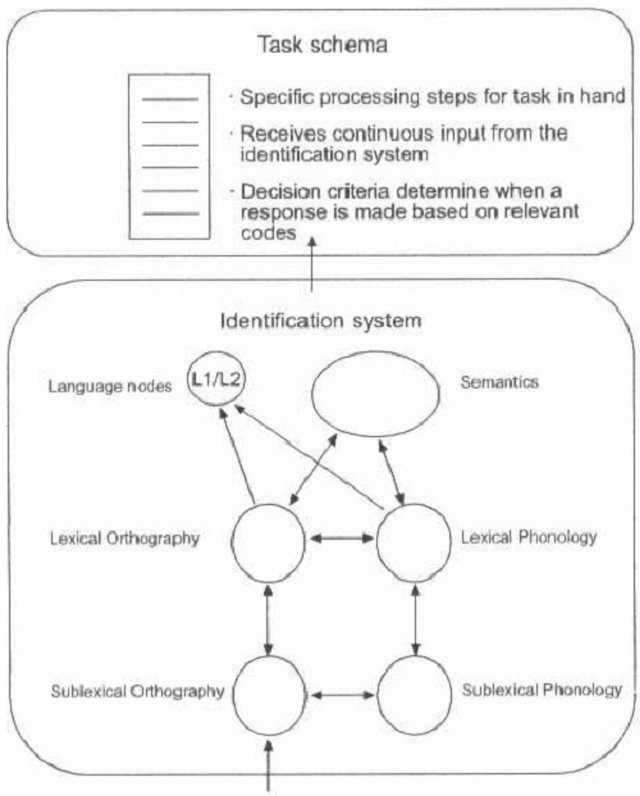

Figure **1-2**

The BIA+ model (Dijkstra & Van Heuven, 2002)

A final distinction between the BIA and BIA+ is that the language nodes are included in the lexicon. These nodes act as language tags, or representations of language membership. They do not directly affect the relative activation of words within a given language, and act solely as an additional representational layer. This architecture therefore assumes that the language membership of the input string does not constrain non-selectivity.

Since the lexical identification system in the BIA+ is hypothesized to be affected by linguistic context, Dijkstra and Van Heuven (2002) propose that the presence of a sentence context can constrain the degree to which effects of non-selectivity are observed and can even directly affect what information becomes activated in the non-target language. The authors further suggest that researchers should examine whether the language of the sentence context, in and of itself, is sufficient to constrain non-selective activation. In this thesis we address this issue specifically by examining how the effects of cross-language activation are modulated by the presence of sentences that vary in their semantic constraint. The overarching theoretical question of interest is whether the top-down processes of sentence comprehension interact with the bottom-up, non-selective processes of bilingual lexical access. Before discussing the goals and hypotheses of the present study, it is essential to first review theories and models of monolingual sentence processing, especially since many of these studies have focused specifically on the issue of whether sentence context constrains lexical access in monolinguals.

Monolingual lexical processing in sentence context

In the previous sections we reviewed a number of studies that provide consistent evidence that lexical access entails the parallel activation of the multiple senses of ambiguous words. However, in everyday use, words are most often encountered in a meaningful context and not in isolation. Does the presence of a meaningful context circumvent non-selective activation? In other words, can information activated top-down from semantics influence the bottom-up processes of lexical access? There is general agreement that context aids in interpretation of ambiguous words. However, what is still debated is the point at which selection of the appropriate meaning takes place and how early in the process of lexical access context can exert its effect. Can context exert an effect on lexical access early and prevent the activation of the non-relevant representation, thus allowing for selective access? Or are the effects of context late and restricted to post lexical access checking and integration processes?

The research generally suggests that context can influence lexical access, however how early this influence occurs depends on several factors including the semantic constraint of the sentence, the relative dominance of the alternative meanings of the word, and the similarity of their pronunciations (Duffy, Morris, & Rayner, 1988; Simpson, 1994; Tabossi, 1988; Tabossi, Colombo, & Job, 1987). We next review some of the most prominent accounts of sentence context effects.

Accounts of sentence context can be divided into two classes, context-independent and context-dependent. According to context-dependent accounts, the conceptual representations of sentences that readers build have an early influence on lexical access. Thus, language processing is seen as being highly interactive, such that lexical knowledge, world knowledge and the semantic and syntactic information provided by a sentence interact with the bottom-up processes that drive lexical access. This account is based on the finding that words are processed faster when they are embedded in a congruent sentence context than a neutral or incongruent context (Simpson et al., 1989; Stanovich & West, 1979). For example, the word “ducks” would be processed faster in a congruent sentence context such as “Ana loves to go to the pond and feed bread to the ducks” relative to a neutral context, “Ana saw some ducks” or an incongruent context, “This dissertation was written by some ducks.”.

While such evidence does suggest early influences of sentence context, it has been argued that these effects could have occurred after the word had already been accessed or they could have been due to intra-lexical priming between words in the sentences (e.g., the word “pond” can prime the word “duck”). It has therefore been argued by proponents of the context-independent account that the multiple meanings of ambiguous words are initially activated, without any influence from context and the eventual selection of the appropriate meaning occurs only after the word has been accessed (Hogaboam & Perfetti, 1975; Onifer & Swinney, 1981; Swinney, 1979).

In a classic study, Swinney (1979) had participants listen to auditorily presented sentences containing lexical ambiguities (e.g., *bugs*) such as “Rumor had it that for years the government building had been plagued with problems. The man was not surprised when he found several spiders, roaches and other **bugs** in the corner of the room.” At the offset of the ambiguous words participants performed a visual lexical decision on target words that were either related to the context appropriate interpretation of the ambiguous word, (e.g., *ant*), or related to the inappropriate meaning (e.g., *spy*) or were completely unrelated (e.g., *sew*). Participants responses to the words relating to the contextually appropriate and inappropriate meaning were both facilitated, suggesting that the multiple meanings of “bugs” were activated irrespective of contextual constraint. Findings such as those from Swinney (1979) have been interpreted as strong evidence for modular theories of language. If the multiple meanings of ambiguous words are activated, irrespective of context, this would mean that the bottom-up lexical processes that lead to their activation are autonomous from top-down processing.

More recently, however, researchers have directly addressed the arguments that the evidence supporting early influences of sentence context were due to either intra-lexical priming and/or post lexical processing. For example, Simpson et al. (1989) tested the assumption that effects of sentence context were due to intra-lexical priming between associatively related words such as “chairs” and “table”. Participants read visually presented sentences and named target words out loud. On critical trials the to-be-named target words (e.g., *table*) were preceded by an associatively related prime (e.g., *chairs*). The authors manipulated whether these words were presented in a normal sentence context (e.g., “John bought new *chairs* to go with his new *table*”) or a scrambled context (e.g., “Four with to *chairs* his go John new bought *table*”). They reasoned that if speeded lexical access of the target words (e.g., *table*) were due solely to intra-lexical priming, than naming latencies should have been equally fast for targets, irrespective of whether they were embedded in normal or scrambled sentences. In contrast, if contextual priming was indeed due to the higher level, semantic information of the sentences, than priming should have only been observed in the normal sentence conditions. The results showed significant priming for targets, only when they were embedded in normal sentences.

The authors noted that the lack of priming in the scrambled sentence condition could have been due to difficulties associated with reading a sentence that lacked any syntactic cohesion. Therefore, in a second experiment the scrambled sentences were replaced with sentences that followed English syntax, but did not make sense (e.g., “The *author* tried many whispers on his back *book*”). Once again there was significant priming for targets only when they were embedded in normal sentences. These findings, overall, provided a strong argument against the claim that effects of priming in sentence context were due solely to intra-lexical, associative priming.

Our understanding of the influences of sentence context on lexical access has been further strengthened through the use of new methodologies, including eye-movement tracking and neurocognitive methods such as the recording of event-related potentials (ERP). There have been a large number of studies that have used eye-movement recording (Binder & Morris, 1995; Dopkins, Morris, & Rayner, 1992; Duffy et al., 1988; Folk & Morris, 1995; Morris, 1994; Morris & Binder, 2001; Morris & Folk, 2000; Morris, Rayner, & Pollatsek, 1990; Rayner & Morris, 1991; Simpson, 1994).

There are several advantages associated with the use of eye tracking. For example, there is no requirement for participants to make responses, such as naming or lexical decision on target words, which are secondary to the process of reading, which makes the task more reflective of natural reading (Morris, 1994). The recorded eye movements are considered to be more sensitive to the on-line lexical processing that occurs during sentence comprehension, relative to naming latencies and lexical decision responses (Simpson, 1994).

Furthermore, multiple aspects of the eye-movement record can be analyzed, which to some extent, can be mapped on to different stages of lexical access and integration. First fixation duration and gaze duration are two measures that are consistently reported across studies. First fixation duration is the duration of the first fixation on a word, irrespective of other fixations made at a later point. Gaze duration is the sum of all fixations made on a word before the eyes proceed to another word (Rayner, 1988). Although eye-movement researchers have been hesitant to make a commitment regarding what aspects of the eye-movement record reflect what specific processes (Rayner, Sereno, Morris, & Schmauder, 1989), there is some general agreement that initial fixations are more reflective of processes of lexical access while gaze duration includes processes that occur post- lexical access.

Using eye tracking methodology, Morris (1994) examined whether initial lexical access is influenced by message level information provided by a sentence context. To do this, she manipulated the congruency of the agent in a sentence with the object of its action, while keeping the lexical content and syntactic complexity of the sentences constant. For example, in the sentence “The gardener talked as the barber trimmed the mustache after lunch” the agent (barber) is congruent with the object of its action (moustache). In contrast, in the sentence “The gardener talked to the barber and trimmed the mustache after lunch” the agent is “gardener” which is not congruent with trimming mustaches. If lexical access is influenced by message-level information of sentences, longer durations should be observed for the word “mustache” in the incongruent relative to the congruent sentences. The resulting pattern in the initial fixation and gaze duration data supported this prediction. The findings from this study demonstrated not only that sentence context influences lexical access, but also that even more subtle aspects of the sentence’s message can exert an effect.

In a related series of studies, Duffy and her colleagues also used eye-movement tracking to shed light on how the relative frequency of an ambiguous word’s multiple meanings interact with sentence context (Duffy, Kambe, & Rayner, 2001; Duffy et al., 1988; Rayner, Binder, & Duffy, 1999; Rayner & Duffy, 1986). In one study (Duffy et al., 1988) they compared eye fixations for two types of ambiguous words; words for which the frequency of the multiple meanings was similar (balanced words) (e.g., *bark*) and words for which one of the meanings was of a much higher frequency (biased words) (e.g., *port*). These words were presented in either neutral sentences, sentences that biased the dominant meaning, or sentences that biased the subordinate meaning.

When balanced words were presented in neutral sentences, fixations were longer relative to control words, suggesting that the two equally-likely meanings were competing for activation. When the same words were presented in a disambiguating context the inhibitory effects disappeared, suggesting that the additional semantic information provided by the sentence allowed for early selection of the appropriate meaning.

The opposite pattern was observed for the biased words. When those words were presented in neutral context fixations were similar to controls, suggesting that the highly dominant meaning was automatically activated and since the frequency of the subordinate meaning was comparably lower, it did not compete for activation. When the same biased words were presented in sentences biasing the *subordinate* meaning, strong inhibitory effects emerged. They reasoned that the additional semantic support of the subordinate meaning provided by the sentence allowed this meaning to become activated within the same window of time as the dominant meaning. The resulting competition delayed fixations.

Duffy and colleagues referred to this phenomenon as the “subordinate bias effect” and it has served as the cornerstone of their recent theory of lexical processing in sentence context, the “reordered access model” (see Duffy et al., 2001). One of the major claims of this model is that the extent to which the multiple meanings of an ambiguous word compete is dependent on the relative time course of their activation. When the alternative meanings become active within the same window of time the resulting competition will delay lexical access. The time course of activation, in turn depends on the relative frequency of the alternative meanings and the contextual support provided by the sentence. Thus, initial word access is not immune to the effects of sentential context. It is called the “reordered access model” because the major stipulation is that, in the absence of a biasing context, the relative frequency of the alternative meanings determines the order (or relative speed) of their activation. However, a strong biasing context can reorder this activation.

The reordered access model has received support from a number of eye-movement studies as well as from a recent ERP study (Sereno, Brewer, & O'Donnell, 2003). It has been called a hybrid model in that it incorporates both context dependent and context independent mechanisms of lexical access in sentences. Several researchers agree that the best interpretation of the existing evidence is that access to the multiple meanings of ambiguous words is determined by an interaction between frequency and sentence context (Altarriba & Gianico, 2003; Altarriba, Kroll, Sholl, & Rayner, 1996; Rayner & Frazier, 1989; Simpson, Krueger, Kang, & Elofson, 1994; Tabossi et al., 1987).

Proposed mechanisms of sentence context effects

The generation of feature restrictions

We now turn to a description of some of the proposed mechanisms through which sentence context is hypothesized to exert its effects. According to Schwanenflugel and colleagues (Schwanenflugel, 1991; Schwanenflugel & LaCount, 1988; Schwanenflugel & Shoben, 1985) sentence constraint influences lexical activation through a set of feature restrictions that readers generate as they comprehend sentences. With increasing constraint, an increasing number of restrictions are generated. Lexical entries that conflict with these constrictions are inhibited. For example, when reading the sentence “The tired mother gave her dirty child a ___” a number of features are generated such as something that cleans, that a mother can give to her child, etc. Facilitation will be shown only for words that match all of these features, such as “bath”. In low constraint sentences far fewer features are generated. For example, for the sentence, “Tim reached into his pocket for the ___” a few features are generated, including something that is small, and often found in pockets. In this case facilitation would be observed for multiple words, such as keys, or a lighter or a wallet.

A critical prediction of this feature restriction account is that in high constraint sentences, inhibition should be observed for plausible but unexpected words. For example, for the sentence “The landlord was faced with a strike by the ___”, “tenants “ is the expected completion. However, the synonym “residents” would also be compatible with the context, yet due to its lower frequency of use in such a context, it would be an unexpected completion. If readers do indeed generate numerous and specific feature restrictions when reading high constraint sentences, then performance should be inhibited when they encounter such unexpected words. Whereas for low constraint sentences, facilitation should be observed for a broader range of words. Schwanenflugel and La Count (1988) observed this pattern precisely. After reading low constraint sentences, participants’ lexical decision latencies on both expected and unexpected target words were facilitated. After reading high constraint sentences, on the other hand, facilitation was only observed for the expected completions.

Individual differences in suppression skill

When studying lexical processing in sentence context, it is essential to consider factors related to individual differences in reading skill. We know from a large body of research that there is great variability in people's ability to efficiently decode text and integrate information from text into a coherent mental representation (Carpenter, Miyake, & Just, 1994; Daneman, 1991; Haenggi & Perfetti, 1992; Herdman & LeFevre, 1992; Perfetti, 1985, 1988, 1994, 1997; Perfetti & Hart, 2001; Rieben & Perfetti, 1991). According to the structure building framework, proposed by Gernsbacher and colleagues (Gernsbacher, 1990, 1991, 1996, 1997a, 1997b, 1997c; Gernsbacher & Faust, 1991a, 1991b, 1995; Gernsbacher & Jescheniak, 1995), the extent to which sentence context aids in lexical selection is dependent upon individual differences in two, general cognitive mechanisms, enhancement and suppression. Within this framework, the goal of sentence comprehension is to build mental structures that represent the text being read. These structures are built through a combination of enhancement of relative information and suppression of irrelevant information. Enhancement aids in the construction of mental structures by activating the information necessary to create the initial foundation upon which new structures will be created. Suppression works by reducing the activation of irrelevant information. Low comprehension performers are characterized by less efficient enhancement and suppression mechanisms. Therefore, these readers have an increased difficulty in activating information to build an initial representation of text as well as suppressing contextually irrelevant information, which remains active for a longer period of time. It is important to note that, according to this framework, low comprehension performers are just as sensitive to the information provided by context as high comprehension performers, indeed they are often more reliant on this information since they are less efficient at creating initial structures (Gernsbacher & Faust, 1991a). The problem lies within the inefficiency with which they use this information to construct mental representations (see Gernsbacher & St John, 2001).

Several studies have provided support for this model (Gernsbacher & Faust, 1991a; Gernsbacher, Varner, & Faust, 1990). In these studies, the general approach has been to present more and low comprehension performers (as indicated by their performance on standardized comprehension tests) with sentences ending in ambiguous words such as homonyms (e.g., *spade*) and homophones (e.g., *patients*/*patience*). After presentation of the sentence, participants decided whether a target word was congruent with the meaning of that sentence. On critical trials the target word was either related to the context appropriate meaning of the ambiguous word or related to the context inappropriate meaning. For example, the sentence “He dug with the spade” was followed by either the target word “shovel” (context appropriate) or “ace” (context inappropriate). The targets were presented either immediately after the sentence (100 milliseconds) or after a short delay (one second). In the immediate presentation both more and low comprehension performers took longer to reject the target word that was related to the contextually inappropriate meaning. After a one second delay, only the low comprehension performers still showed this difficulty, suggesting that they were not able to suppress the irrelevant meaning as quickly as the high comprehension performers (Gernsbacher et al., 1990).

Similar results have been found for homophones (Gernsbacher & Faust, 1991a). When presented with the sentence “He had lots of patients” low comprehension performers had more difficulty rejecting the homophonically related target word, "calm" after a one second delay. This suggests that low comprehension performers are also less efficient at suppressing incorrect lexical forms as well as irrelevant semantics.

The two proposed mechanisms of sentence context effects summarized here are not mutually exclusive. Indeed, it seems likely that they are interrelated. That is, the ability to generate quality feature restrictions, that adequately reflect the semantic information of a sentence, might be dependent on readers' ability to efficiently suppress irrelevant information. If irrelevant information is not quickly suppressed, this can lead to the generation of incorrect feature restrictions, thus limiting the overall quality of the mental representation of the sentence. In the present thesis we demonstrate that the concepts of feature restriction and suppression skill can be extended to understanding the nature of cross-language interactions in sentence context (see the discussion sections of Chapters 5 and 6 and the general discussion in Chapter 7).

Bilingual lexical processing in sentence context

Decreased automaticity in L2 lexical access

Since the reading tasks in the present experiments were performed exclusively in participants' L2, it is important to describe general characteristics of reading in a second language. The goal of reading is to construct a meaningful, mental representation of text. In order to build this representation readers need to coordinate multiple low level processes (e.g., word recognition, lexical access) with higher level, more complex processes (e.g., sentence comprehension, textual integration). From this perspective it seems surprising that reading proceeds smoothly without completely tapping cognitive resources. Of course what gives skilled readers this illusion of smooth reading is the ability to engage in highly efficient and, to some degree, automatic processes that allow for quick word identification and syntactic analysis.

One way for skilled readers to fully appreciate the complexity of reading is to have them read in a less dominant language. Research on reading in a second language has shown that even highly fluent bilinguals with impeccable reading skills in their first language show marked decreases in reading speed in their less dominant language (the average reading rate in L2 is between 60-70% that of L1 reading) (Favreau, 1983)

This slower reading rate is likely due at least partially, to decreased automaticity in lexical and syntactic processing. Fluent reading depends on highly automatic processes of lexical access. Research on reading in a second language has shown that these lexical processes are far less automatic, even for fairly balanced bilinguals. For example, Favreau and Segalowitz (1983) compared associative priming effects for two groups of bilinguals; one group read equally fast in both languages while the other group read at a significantly slower pace in L2. In a primed lexical decision task the slower readers showed semantic priming effects in their L2 only at a long interval, whereas the equal reading rate bilinguals showed significant semantic priming at both short and long intervals. Thus, the faster L2 readers activated semantic information at an earlier interval than the slower readers. This suggests that one factor contributing to slower reading rates in L2 is less automatic access to lexical information such as semantics.

In another study differences in speed of lexical access were again compared for equal and slower reading rate bilinguals (Segalowitz & Hebert, 1994). This time, however, the authors were specifically interested in the access of phonological information. In a sentence verification task English-French bilinguals were presented with a set of sentences in L1 and in L2. The critical materials consisted of sentences containing a homophonic target word which was either congruent or incongruent with the sentence's meaning (e.g. "*She noticed the* ***fair/fare*** *weather outside*.") The faster reading rate bilinguals showed interference only when the incongruent homophone was present. The slower reading rate bilinguals, on the other hand, showed an increase in reaction time and errors for the homophones, irrespective of congruency. This suggests that bilinguals who read more slowly in their L2 may be less efficient in how they process phonological information.

Cross-language lexical activation

As described earlier, there is a great deal of evidence demonstrating that bilinguals activate lexical information non-selectively from both of their languages during word recognition. Does this cross language lexical activation similarly apply for bilingual reading in context? Or does the presence of sentence context constrain non-selectivity? One possibility is that the presence of a sentence context, in and of itself, is sufficient to eliminate activation in the non-target language. Another possibility is that sentence context cannot eliminate non-selectivity and that cross-language interactions occur irrespective of sentence constraint. A third alternative falls somewhere between these two extremes, in that context may constrain some aspects of cross-language activation but not others.

There have been very few studies that have examined cross-language influences on bilingual lexical processing in sentence context. In the studies that will be summarized here, there is converging evidence that effects of cross-language interaction are most likely to be observed when the critical words share semantic links across languages (e.g. translation equivalents and cognates).

Frenck-Mestre and Pynte (1996) examined whether syntactic parsing in L2 would be influenced by lexical level information from the L1. Across languages, certain words are a source of extra-syntactic cues that aid parsing. For example, in English certain verbs can only be followed by a single argument (e.g., *rejected*) while others allow for more than one (e.g., *obey*). The authors found that the English-French bilinguals had more difficulty processing sentences that contained verbs with conflicting syntactic constraints across their two languages, suggesting that the L1 translation of the verb was active.

Although not originally designed to test the parallel activation hypothesis, a study by Altarriba et al. (1996) examined the extent to which cross-language semantic and lexical features are generated when bilingual participants read high constraint sentences. They monitored the eye-movements of Spanish-English bilinguals as they read high and low constraint sentences in English. On half of the trials, one word in each sentence was a code-switched word from the non-target language, Spanish (e.g., He wanted to deposit all of his *dinero* (money) in the credit union). Critically, this code switched word was either a high frequency word or a low frequency word in Spanish.

Analyses of the first fixation durations on the code-switched words revealed an interaction between sentence constraint and word frequency, such that fixations were delayed in high constraint sentences when the code-switched word was of a high lexical frequency. This suggests that the participants generated both semantic and lexical level feature restrictions when reading high constraint sentences. That is, when presented with the high frequency, code-switched word (e.g., *dinero*), processing was inhibited because the word met all of the semantic but not the lexical feature restrictions.

The next two studies provided even more direct evidence that lexical representations from the non-target language do become active in sentence context and that the extent of this activation is greatest for words that are semantically linked across languages. Elston-Güttler (2000) examined the degree to which bilinguals' lexical representations in the L2 were independent from representations in the L1. In a primed lexical decision task she presented highly proficient German-English bilinguals with L2 words whose translation equivalent in the L1 was polysemous. For example, the English word "clap" translates into German as "klatchen". "Klatchen" in German can either mean "clap" or "gossip". In the present thesis we refer such words as "partial cognates". The basis for this term is that there is one cognate meaning (e.g., *clap*) and one homographic meaning (e.g., *gossip*). For half of the participants the partial cognates were preceded by single word primes [e.g., *clap* (prime word) => *gossip* (target)] and for the other half they were preceded by a sentence context [e.g., "After the wonderful performance the audience began to *clap*. => *gossip*].

The author reasoned that if L2 lexical representations were fully independent from L1 representations, no priming would be observed between *clap* and *gossip* either in the single word prime condition or in the sentence prime condition. On the other hand, if bilinguals activate the non-target lexical form through the shared semantic links, priming should be observed in both contexts. The results showed consistent priming between "clap" and "gossip" in both the single word and sentence prime conditions. The implication is that L1 lexical forms were activated, even in a highly constraining sentence context.

In another experiment Elston-Güttler (2000) tested whether similar cross-language interactions would be observed for interlingual homographs, which lack a semantic link (e.g., *chef* in German means "boss"). This time there was significant homograph priming only in the single word prime condition. The priming effects disappeared in sentence context. Together the results from the two experiments suggest that lexical entries from the non-target L1 do become active during sentence comprehension, however only for words that share semantics.

Using a similar sentence context priming paradigm, Van Hell (1998) observed similar cross-language interactions for Dutch-English cognates in sentence context. Unlike Elston-Güttler (2000) she also manipulated sentence constraint. Highly proficient Dutch-English bilinguals read visually presented sentences in their L2, English. The location of the target word was marked with three dashes (e.g., "A green --- and a yellow banana lay on the fruit dish"). After four seconds, the sentence disappeared and the target word appeared (e.g., *apple*). Another group of Dutch-English bilinguals were presented with the cognates in a standard lexical decision task (no primes were included). Responses to cognate were strongly facilitated both in the standard lexical decision task and in low constraint sentences. In high constraint sentences, however, cognate facilitation disappeared. These results provided converging evidence that lexical information from the non-target L1 becomes active during sentence comprehension.

However, the results further suggested that the relative constraint of the sentence modulates the degree of this cross-language interaction.

One difference between Elston-Güttler (2000) and Van Hell (1998) is that in the former case, effects of cross-language priming were observed in high constraint sentences (all of the sentences in Elston-Güttler's experiment were high constraint), where as in the latter case the effects were observed only in low constraint sentences. This discrepancy could be due to differences in the methodology employed, in the Elston-Güttler study there was one word in each sentence (e.g., *clap*), which was always a sentence final word, and which, in and of itself, could have primed the target (e.g., *gossip*). Another difference was that the two studies focused on different types of cross-language competitors, in one case partial cognates and in the other case, cognates.

The present investigation

The present thesis investigates cross-language interaction during L2 reading. The experiments reported here extend previous findings by including a range of critical words that are ambiguous across languages and by examining the manner in which they are recognized in and out of context.

Dijkstra and Van Heuven (2002) suggested that sentence context could potentially have a direct impact on cross-language activation through increased activation of semantics. This would predict that effects of non-selective activation could potentially be eliminated in a constraining context. However, the authors do not specify the constraint conditions that would need to be satisfied for this to occur. One possibility is that only a high constraint sentence context will modulate non-selectivity. Furthermore, given the authors' assumption that language membership of word stimuli is not sufficient to constrain non-selectivity, effects of cross-language activation should persist in a low-constraint sentence context.

The findings reported in this thesis support both predictions. Effects of cross-language activation persisted in low constraint sentences. In high constraint sentences these effects were eliminated. However, the BIA+ model does not fully specify the mechanism through which sentence context exerts its effect or the conditions in which this effect is most likely to be observed. In the present thesis we provide evidence that the effects of sentence context on bilingual lexical access is dependent on both sentential constraint and the L2 comprehension performance of the bilingual. Before turning to these results, we provide an overview of the methodology and specific predictions in Chapter 2.

Chapter 2

General Approach

The fundamental question addressed in the present study was whether cross-language activation in bilingual lexical processing could be directly affected by the top-down processes of sentence comprehension. To examine this question, lexically ambiguous words [e.g., interlingual homographs (*fin*, meaning "end" in Spanish), cognates (*piano*)] were presented in sentence context. If the presence of a sentence context does not affect non-selectivity at all, then processing of the language ambiguous words should reflect effects of cross-language activation and these effects should resemble those observed out of context. On the other hand, if the presence of sentence context allows for language-selective processing, then processing of ambiguous words should not reflect effects of cross-language interaction and performance for these items should be similar to non-ambiguous control words. A third alternative falls somewhere between these two extremes, in that context may constrain some aspects of cross-language activation but only when the lexical system is provided with sufficiently detailed semantic information. For this reason we included a sentence constraint manipulation in which the critical words were embedded in high constraint or low constraint sentences. For example bilinguals were presented with sentences like the following (critical words are in bold):

(a) For dessert we had a slice of apple **pie** with ice-cream.

(b) After years in the theater his dream of becoming an **actor** was fulfilled.

(c)She was buried in a **grave** next to her beloved godson

In example (a) the critical word is an interlingual homograph, a word that has identical lexical form across English and Spanish but corresponds to two different meanings (*fin* in Spanish means “end”). In (b) the critical word is a cognate, a word with both identical lexical form and shared meaning. Finally in (c) the critical word is what will be referred in this thesis as a “partial cognate”. Similar to a cognate, a partial cognate also has identical lexical form and a shared meaning (*grave* in English and Spanish means “serious”). What distinguishes a partial cognate, however is the existence of another meaning that is not shred across languages (*grave* in English also means a place of burial, this meaning does not exist in Spanish.)

From the above examples it is clear that careful selection of the critical items was important. The critical items had to be matched with control items in terms of word length, lexical frequency and onset. Furthermore, we needed to ensure that these critical items, when presented in isolation, would produce the same type of non-selective results which have been repeatedly observed in the literature. Finally, we had to ensure that the high constraint sentences were indeed more semantically constraining than the low constraint sentences. Therefore, before the experimental phase of the present study we completed a set of norming procedures, described in Appendices A and B.

The procedures in Appendix A were designed to confirm that the cognates, homographs and partial cognates met the semantic criteria of their classification. For example, we confirmed that the homographs did not share any semantics across languages and that the partial cognates had one cognate meaning that was shared, and one homographic meaning that was not shared. The procedures described in Appendix B provided a measure of the relative constraint differences between the two sentence context conditions[1].

Participants

Four groups of bilinguals were recruited in the present study; two groups of Spanish-English bilinguals and two groups of English-Spanish bilinguals. The bilinguals consisted mostly of university students who had completed several years of formal instruction in their second language. In general, the native Spanish speakers started L2 formal instruction in late childhood, around ten years of age and had been studying the language for about 12 years. The native English speakers started their L2 instruction in early adolescence, around 13 years of age and had been studying the language for about seven years. Although there was some variability, the L2 proficiency of the four participant groups was comparable.

Materials

Three, critical word types were examined in the present study, cognates (e.g., *piano*), homographs (e.g., *fin*) and partial cognates (e.g., *grave*). The cognates were drawn from a larger, previously normed set of materials used in prior studies conducted

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[1] Due to time constraints regarding data collection in Spain the sentence cloze norming procedures were completed after the actual sentence experiments had been completed. Thus, it was not possible to use the ratings from the these procedures to exclude poor sentence items.

in our laboratory (Schwartz, Kroll, & Diaz, submitted). These cognate were further classified as being either more phonologically similar (+P) (e.g., *piano;* [pi.æ.no] in English, [pja.no] in Spanish) or less phonologically similar (-P) (e.g., *base*; [bejs]in English, [ba.se] in Spanish). These phonological ratings were based on subjective ratings of monolingual English speakers, who listened to each member of the cognate pairs and assessed on a scale of one to seven, how similar the pair of cognates sounded.

The homographs and partial cognates were selected from the Dictionary of Spanish false cognates (Prado, 1993). Norming procedures were carried out to ensure that, (1) the homographs and partial cognates had high lexical form similarity, (2) the homographs did not share any meanings across English and Spanish and, (3) the partial cognates shared only one meaning (see Appendix A). The partial cognates were further classified according to the language of their polysemy (e.g., *grave* is polysemous in English and *real* is polysemous in Spanish).

Out-of-context experiments

The experimental phase of the present study was divided into two parts (see Table **2-1**). During the first part, the critical word items selected from the norming procedures and matched control word items were presented in two, out-of-context tasks, word naming and lexical decision. Two out-of-context experiments were completed. Experiment 1 was conducted in Spain with native Spanish speakers who were relatively proficient in English. Experiment 2 was conducted in the United States with native

English speakers whose proficiency in their second language, Spanish, was comparable to that of the native Spanish speakers.

These out-of-context experiments served two purposes. First, they provided an out-of-context control for the later, sentence context experiments. Second, they provided an opportunity to test some additional assumptions and conditions not addressed in previous out-of-context studies of bilingual lexical processing. We manipulated the cross-language phonological similarity of the critical cognate items. Based on a recent study from our lab we expected naming performance to be facilitated for cognates with high phonological similarity (the +P cognates) (e.g., *piano*) and inhibited for cognates with low phonological similarity (the –P cognates) (e.g., *base*). We were also interested in whether this sensitivity to cross-language phonological match would also be manifest in lexical decision. To the extent that phonological codes are automatically activated during lexical access, we expected to observe greater facilitation for the +P cognates relative to the –P cognates.

As discussed in the introduction, previous findings regarding the effect of interlingual homograph status have been mixed. By including a within-participants design, in which the same bilinguals named subsets of the homograph items in naming and lexical decision, we hoped to provide additional insight regarding the conditions under which effects of homograph status are most likely to be observed. We predicted that in lexical decision, homograph status would either facilitate performance or have no effect at all, since decision responses could be made on the basis of general lexical activity. In naming, on the other hand, we expected to observe inhibitory effects associated with homograph status since naming requires that phonology be fully specified.

We also included partial cognates to examine whether imperfect semantic overlap would modulate the facilitative effects typically observed for cognates. We predicted that the existence of a non-shared homographic meaning (e.g., the “burial place” meaning of *grave* and the “royal” meaning of *real*) would attenuate facilitation due to competition at the semantic level. We report the findings from the out-of-context experiments in Chapters 3 and 4 for the native Spanish speakers and the native English speakers, respectively.

Table 2-1

Schematic overview of the four experiments

Part one: Out-of-context experiments

Experiment	Participants	Tasks	Independent variables	Dependent variables
Experiment 1	Spanish-English bilinguals	English naming English lexical decision	task word type	naming latency and error rates lexical decision latency and error rates
Experiment 2	English-Spanish bilinguals	Spanish naming Spanish lexical decision	task word type	naming latency and error rates lexical decision latency and error rates

Part two: Sentence-context experiments

Experiment	Participants	Tasks	Independent variables	Dependent variables
Experiment 3	Spanish-English bilinguals	English sentence processing (RSVP)	word type sentence constraint comprehension performance	naming latency and error rates
Experiment 4	English-Spanish bilinguals	Spanish sentence processing (RSVP)	word type sentence constraint comprehension perforamnce	naming latency and error rates

Sentence context experiments

The second part of the experimental phase consisted of two sentence-context experiments (Experiments 3 and 4). The same critical word stimuli used in the out-of – context experiments were inserted into high and low constraint sentences (see Table **2-2**). Sentence constraint was operationalized as the degree of semantic support of the target word provided by the sentence preceding its presentation.

Experiment 3 was conducted in Spain with native Spanish speakers who were relatively proficient in English and Experiment 4 was conducted in the United States with native English speakers who were relatively proficient in Spanish. The overarching goal of these two experiments was to examine whether the presence of sentence context would modify the nature of the effects of cross-language activation observed in the out-of-context experiments.

We predicted that in low constraint sentences effects of cross-language activation would persist. In high constraint sentences we expected to observe either attenuation or elimination of these effects. For example, we expected that cognate facilitation effects would persist in low constraint sentence context. We also predicted that, if effects of homograph status persisted in sentence context, they would be inhibitory in nature due to the competition between the two alternative semantic representations across languages.

In the sentence context experiments we also manipulated whether the partial cognates were embedded in sentences that biased the shared cognate meaning (e.g., the "serious" meaning of *grave* and the "authentic" meaning of *real*) or in sentences that biased the L2-specific homograph meaning (e.g., the "burial place" meaning of *grave* for a native Spanish speaker and the "royal" meaning of *real* for a native English speaker). We predicted that lexical processing of the partial cognates would be inhibited when these were embedded in sentences that biased the non-shared homographic meaning because the more dominant, L1 meaning would compete for selection.

Table 2-2

Example sentence stimuli used in Experiments 3 and 4 (Spanish sentences in parentheses)

	High constraint	Low constraint
Cognate	In the car my friend and I listened to the songs on the **radio** and sang along.	My friend wanted to know if the **radio** we bought came with a warranty.
	(Escuchamos las canciones que pusieron por la **radio** y las cantábamos juntas.)	(El gato estaba escondido detrás de la **radio** en el salón.)
Partial-cognate	In the cemetery we walked past the **grave** where my aunt was buried.	We walked around until we found the **grave** where my aunt was buried.
	(En el palacio viven el rey y otros miembros de la familia **real** de este país.)	(He vivido mucho tiempo en esta ciudad y aun no he visto la familia **real** en persona.)
Homograph	From the beach we could see the shark's **fin** pass through the water.	We were all a little nervous as we watched the large **fin** of the shark go through the water.
	(Cada nochevieja miles de neoyorquinos van a celebrar el **fin** del año bebiendo champán.)	(Vamos a la casa de mi suegra porque es el **fin** de año y van hacer una gran fiesta.)

Unlike the Van Hell (1998) and Elston-Güttler (2000) studies, sentences in the present experiments were presented via rapid serial visual presentation (RSVP). The RSVP procedure consists of presenting sentences, one word at a time, at a relatively fast rate (250 milliseconds). One word (the target word) in each sentence is named out loud. This methodology was chosen for a number of reasons. First, previous studies have demonstrated the sensitivity of this method to lexical factors (Altarriba et al., 1996). Second, in an effort to make the reading task as similar as possible to "normal" reading, we wanted to avoid the inclusion of non-words, which would be necessary if we were to incorporate lexical decision into the task. Third, the relatively fast pace of presentation limited the likelihood that participants would directly translate the target words. Finally, by using RSVP, the actual L1 lexical competitor (whether it be a translation equivalent or its form-related competitor) was never included in the sentence stimuli, thus creating a more stringent test of the strength of lexical non-selectivity in sentence context.

To ensure that participants were attending to the meaning of the sentences being read on 20% of the trials sentences were followed by comprehension questions. When analyzing participants' overall performance on these questions it became apparent that there was considerable variability in participants' ability to answer these questions. We therefore included general comprehension performance as an additional independent variable.

As reported in Chapters 5 and 6, the influence of sentence context on cross-language activation effects interacted with individual differences in comprehension performance. In Chapter 7 we discuss the overall pattern of findings from the four experiments and relate them to the BIA+ model. We also describe the possible mechanisms through which sentence context exerts its effect on bilingual lexical access. Finally, we conclude by delineating remaining questions and suggesting directions for future research.

Chapter 3

Experiment 1: Cross-language lexical activation for Spanish-English bilinguals in out-of-context tasks

Predictions

The over-arching goal of this experiment was to replicate effects of cross-language activation that have been observed in bilingual word recognition. Since similar critical conditions have been implemented (i.e., cognates and interlingual homographs) in past research, predictions could be made based on findings from those studies.

Cognates

Cognates are words across languages that have both high form similarity (orthographic and to some extent phonological) as well as semantic overlap (e.g., *piano* in Spanish and English). A number of studies have reported facilitative effects associated with cognate status in a variety of tasks including lexical decision (Dijkstra, et al., 1999; Dijkstra, et al., 1998) translation (Kroll & Stewart, 1994) and word association (Van Hell & Dijkstra, 2002). This general finding of facilitation is not surprising since cognates have both semantic and form overlap. However, more recent studies have demonstrated that more subtle aspects of cognates' lexical codes can moderate this facilitation. For example, in an English lexical decision task performed by Dutch-English bilinguals, Dijkstra et al. (1999) observed inhibition for cognates that were phonologically dissimilar. This suggests that even for lexically transparent items mismatches in lexical code can slow access. In a later naming study (Schwartz, et al., submitted) similar effects of phonological match were observed. In that study, cognate naming latencies were a function of the more subtle match between the orthographic and phonological codes across the English-Spanish bilinguals' two languages. When the orthographic and phonological codes were highly similar across languages (e.g., *piano*), the standard cognate facilitation was observed. When the phonological codes were more distinct (e.g., *base*), however, naming latencies were delayed.

In the present experiment we manipulated the degree of phonological match of the cognate items. We therefore predicted that we would observe cognate facilitation in lexical decision and naming, however, only when the orthographic and phonological codes across English and Spanish were highly similar.

Homographs

Interlingual homographs are words that across languages have high orthographic similarity (and as a consequence phonological similarity) but no meaning overlap at all (e.g., *pan* in Spanish means "bread"). Prior findings with interlingual homographs have been mixed. The overall pattern across studies suggests that whether homograph status facilitates or inhibits performance is a function of the characteristics of the task and stimulus list employed (see Dijkstra et al., 1998 for a discussion). In general, when both languages are present in the task, consistent homograph effects are observed. For example, when distractor words from the non-target language are included in the stimulus list of a language-specific lexical decision task (thus requiring a "no" response), strong *inhibitory* effects are observed. When these same words are presented in a language general lexical decision task (participants respond "yes" to any word from either language), strong *facilitative* effects are observed (Dijkstra et al., 1998). Furthermore, in naming, homograph status has been found to inhibit performance, even in the L1 (Jared & Szucs, 2002).

When both languages are not clearly present in the task the findings have been more mixed. A couple of studies failed to observe any effects of homograph status in a standard lexical decision task (Dijkstra et al., 1998; Gerard & Scarborough, 1989); while other studies have found homograph inhibitory effects (Von Studnitz & Green, 2002).

One potential reason for the discrepancy relates to differences in the participants' bilingualism and language environment. In the Von Studnitz and Green study the participants were German-English bilinguals, living in their L2 environment (England). In the other reported studies the bilingual participants were immersed in their L1 cultures.

Such differences across studies in participant languages and linguistic environments make it difficult to draw any strong conclusions regarding the effects of interlingual homograph status in bilingual lexical access. For this reason, in the present study we implemented a within-participants design in which the same group of bilinguals performed both lexical decision and naming on different, counterbalanced, subsets of homograph materials. This allowed us to hold factors related to the participants' bilingualism constant while varying the task.

In the present experiment, distractor words from the non-target L1 were not included in the lexical decision task. We therefore predicted that homograph status would not inhibit performance. Indeed, we expected that homograph status might actually facilitate performance since half of the actual words on a given list (requiring a "yes" response) were also words in the non-target language (e.g., cognates and homographs), and therefore participants could rely on general activation across the two languages.

We predicted the opposite for naming. In order to correctly name a homograph, participants needed to select language-specific phonology. Therefore in the naming task participants would not be able to rely on overall lexical transparency. This, combined with the high proportion of items that were words in both languages, should lead to homograph inhibition.

Partial cognates

Partial cognates are words across languages that have highly similar form overlap and one shared meaning. What distinguishes partial cognates from true cognates is the existence of another, unshared, homographic, meaning (e.g., *grave* in English and Spanish means "serious" [the cognate meaning] but only in English does it also mean "burial place" [the homograph meaning]). Relatively little research has examined how polysemy affects bilingual lexical access. In a recent study on translation Tokowicz, (2001) examined how the existence of multiple translations affected translation performance (e.g., the polysemous English word *glas*s translates into two words in Spanish; *vidrio*, as in the material of glass; and *vaso*, as in something to drink out of). She found that the usual translation advantage observed for concrete words relative to abstract words persisted only when words had multiple translations. When the concrete and abstract words had only one translation, the concreteness advantage disappeared. This suggests that in a translation task, bilinguals access the multiple meanings of the words they are translating.

To the best of the author's knowledge, only one study has examined the effect of polysemy in bilingual lexical access during comprehension. Elston-Güttler (2000) had highly proficient German-English bilinguals perform a lexical decision on target words in their L2, English. For one group of participants, the lexical decision was primed by a single word, while for another group the lexical decision was primed by a sentence-final word. On critical trials, the primes consisted of words whose translations were polysemous in the non-target L1 (e.g. *clap* translated into German as *klatschen* can mean either "applause" or "gossip"). The participants then performed a lexical decision on a word that was either the L1 alternative meaning of the polysemous word (e.g., *gossip*) or a completely unrelated word (see Table **3-3** for an example). The lexical decision latencies were facilitated for the critical targets that were translations of the non-target, L1- specific alternative meaning (e.g., *gossip*) in both the single word-prime condition and the sentence-prime condition. This suggests that bilinguals activated the multiple meanings of the polysemous words in a language non-selective way, both in and out of sentence context.

Table 3-3

Example of critical stimuli from Elston-Güttler (2000)

Type of trial	Test sentence	Critical target	Control target
Single word prime	clap	gossip	shoe
Sentence prime	After the wonderful performance the audience began to *clap*.	gossip	shoe

The studies reviewed here suggest that during comprehension, bilinguals non-selectively access the multiple meanings of words across their two languages. The focus in the present experiment was on words that in addition to being polysemous, had high form similarity and one shared meaning (e.g., *grave*). We predicted that this high degree of lexical overlap would enhance access to cross-language lexical representations and that this cross-language activation would be reflected in facilitated latency and accuracy performance. We manipulated an additional variable, the language of polysemy of the partial cognates. Half of the partial cognates were polysemous in the participants' L1, Spanish (e.g., *real*: "authentic" is the cognate meaning, "royal" is the homograph meaning) and the other half were polysemous in English (e.g., *grave:* "serious" is the cognate meaning and "burial place" is the homograph meaning). We wanted to examine whether the predicted facilitation would be moderated by the language of polysemy in the out-of-context tasks. We predicted that when the partial cognates were polysemous in the non-target L1, performance would be slower and more error prone relative to when the partial cognates were polysemous in the target L2. This prediction was based on the assumption that the existence of multiple meanings in the non-target L1 would make it more difficult to suppress its non-target L1 lexical representation.

Method

Participants

Twenty-five participants from the University of Valencia, Spain completed the experiment. All participants were paid for their participation. Of these 25, two were excluded because they had an L1 other than Spanish. Another two participants were excluded due to computer failure and one was excluded because of very low English proficiency (the average self-assessed rating was less than four). The remaining 21 participants were native speakers of Spanish proficient in English.

Materials

A set of 104 critical English words comprised the critical materials. These critical words consisted of 42 cognates (*e.g., piano*); 24 homographs (e.g., *pan*) and 38 partial cognates (e.g., *grave*). A different number of items were selected in each condition in order to meet specific selection criteria, such as word frequency and length matching. For each critical word a control word was selected which was matched in terms of word frequency, word length, and when possible, phonological onset

The cognate items were selected from a previous study in which the phonological similarity of their cross-language pronunciations was normed. In that study, monolingual

English speakers listened to recordings of English-Spanish bilinguals pronouncing each member of the cognate pair. They then rated how similar they perceived the pronunciations to be on a scale of one to seven (Schwartz et al., submitted). Fifty cognates were then classified as being either more phonologically similar (+P) (e.g., *piano;* [pi.æ.no] in English, [pja.no] in Spanish) or less phonologically similar (-P) (e.g., *base*; [bejs] in English, [ba.se] in Spanish). In the present study 42 cognates (22 +p, 20 –P) were selected from that original set of 50 so that they were as closely matched to controls as possible in both conditions the (see Table **3-4**). It is important to note that phonological ratings were obtained for the cognates only, and we did not have such ratings for the homographs and partial cognates, described below. This is because the three critical word types (i.e. cognates, homographs and partial cognates) were included as a way of systematically manipulating semantic match across languages.

Table 3-4

Examples of stimuli used in Experiment 1 and their lexical characteristics

	Critical words			Controls		
Condition	Example	English Frequency[1]	Length	Example	English Frequency[1]	Length
Cognates						
+P	band	41.9	6.2	bond	40.0	6.3
-P	acre	38.6	5.8	anger	37.0	6.0
Partial cognates						
Polysemous in English	grave	78.1	5.7	gift	76.6	5.5
Polysemous in Spanish	real	77.4	5.2	round	74.0	5.6
Homographs	pan	40.0	4.2	pen	39.0	4.4

1. (Kucera & Francis, 1967)

The homographs and partial cognates were initially selected from the Lexesp Electronic Database (Sebastián-Galles, Martí Antonín, Carreiras Valiña & Cuetos Vega, 2000) and the Dictionary of Spanish False Cognates (Prado, 1993). The homographs (*e.g., pan*) and partial cognates (*e.g., grave*) were selected through a variety of norming procedures to ensure that they indeed met the respective criteria of form and meaning overlap (see Appendix A for a description of these procedures). Thirty-two of the original 45 homographs normed and 38 of the original 59 partial cognates normed were selected. Partial cognates were further distinguished based on the language in which they are polysemous. For example, the partial cognate *real* is polysemous in Spanish (meaning both "authentic" and "royal"), while the partial cognate *grave* is polysemous in English (meaning both "serious" and "burial place").

For each critical condition a control condition was created. These control conditions were created through an item-by-item match in which every critical word was paired with an English control word matched on word frequency in English, word length and, when possible, phonological onset.

An additional set of non-words was constructed to be used in the lexical decision task. The non-words were pronounceable letter strings created by changing one or two letters from an actual English word (*e.g., garrons*). The materials were divided into two lists (A and B). Each participant was presented with one list for naming and the other list for lexical decision, the order of which was counterbalanced. In the naming task, words were presented in random order. In the lexical decision task, words and non-word stimuli were also presented in random order. Examples of the word stimuli are presented in Table 2.1 along with their lexical properties.

Procedure

Participants were recruited through announcements that were posted across the University campus. When they arrived at the lab they were greeted in English (L2). After completing an informed consent form (which was written in Spanish to ensure that the experimental description was clear), participants were seated in front of a laptop computer. They first completed the naming task. Instructions were presented on the laptop LCD display in English. These instructions were read to the participants out-loud. They were instructed to name each word, in English, as quickly and as accurately as possible. If they did not know a word they were instructed to make their best guess in pronunciation. Clarifications were given in Spanish when needed. Participants then completed 10 practice trials. Following practice the experimenter left the room. The naming session was tape recorded and reaction times were recorded in milliseconds by the computer.

In the naming task, each trial was initiated by the presentation of a fixation point (“+”) in the center of the screen. This fixation remained on the screen until the participant pressed a key on the response box. A word was then presented on the screen and disappeared after the participant made a spoken response into the microphone or until 2000 milliseconds (ms) had elapsed.

After completing the naming task, the experimenter entered the room and set up the lexical decision task on the laptop computer. Instructions were once again presented on the screen in English and clarifications were provided in Spanish when needed. Participants were instructed that they would see letter strings presented, one at a time, in the middle of the computer screen. They were told to decide as quickly and as accurately as possible whether each letter string formed an actual word or not in English by pressing the appropriate key on the response box. If they were unsure they were told to guess.

Participants completed 10 practice trials before the experimental phase began. After practice the experimenter left the room.

In the lexical decision task, each trial was initiated by the presentation of a fixation point ("+") in the center of the screen. This fixation remained on the screen until the participant pressed the center key on the response box. A word or non-word was then presented on the screen and disappeared after the participant made a key response or until 3000 ms had elapsed. Participants pressed the left-most key to indicate "no" for non-words and they pressed the right most key to indicate "yes" for words.

After completing the lexical decision task, participants completed a language history questionnaire (LHQ) in which they were asked to self-assess their proficiency in reading, writing, speaking and listening in English and Spanish on a scale of one to ten. They also reported any immersion experiences they had in English-speaking countries as well as their familiarity and proficiency with languages other than English and Spanish. The entire experimental procedure was completed in approximately 40 minutes.

Results and Discussion

General approach

Data from the three critical word types (cognates, homographs and partial cognates) and the two tasks (naming and lexical decision) were analyzed and discussed in a variety of ways. First, each condition was analyzed separately to test for general effects of cross-language activation. These per condition analyses were necessary given the constraints of item matching. For each word in each condition a control word, matched on lexical frequency and word length was selected. It was not possible to find a single set of control words that would adequately match the lexical characteristics of the items across all three of the critical word types. In these per condition analyses task was included as an independent variable[2], which allowed us to address the question of how effects of cross-language activation were modulated by task demands (e.g., was cognate facilitation reduced in naming relative to lexical decision?).

Throughout this thesis we performed analyses using both participants (F1) and items (F2) as random factors. It has been argued that F2 analyses are not necessary when proper item matching and counterbalancing have been performed and that F1 analyses are the appropriate statistic (Raaijmakers, Schrijnemakers, & Gremmen, 1999). By including F2 analyses we were able to examine additional item-related factors, such as frequency, phonological onset, etc. Although care was taken to match critical and control items, it is not possible to control for al potentially relevant factors a priori.

For each critical word type we also report analyses of monolingual control data obtained from an on-line database (Balota, Cortes, Hutchison, Neely, Simpson & Treiman, 2002) to ensure that the bilingual results were indeed a function of the bilingualism of the participants rather than some un-accounted for factor. Finally, when relevant, post-hoc analyses were performed to answer additional questions. Before

[2] We recognized that lexical decision responses and naming responses are limited in the degree to which they can be directly compared, particularly since the lexical decision data included in these comparisons consisted of only “yes” trials, which represents half of the task. However, we were less concerned with questions of task-specific processing and more interested in cross-language interactions across the two tasks.

turning to these analyses, data from the language history questionnaires completed by the participants are summarized.

Language history questionnaire data

Data from the language history questionnaire are shown in Table **3-5**. The participants' ages ranged from 18 to 31, with a mean age of 24.5 years. On average they had been studying English for twelve years, starting at around the age of ten. Of the 21 participants, 13 reported having high proficiency in Valenciano as well as in Spanish and English. Of these 13, four considered themselves native speakers of Valenciano. Thus, the majority of the participants were trilingual, with proficiency in Spanish, English and Valenciano. It should be noted that Valenciano is more similar to Spanish than it is to English. It is therefore unlikely that their proficiency in Valenciano would affect English lexical processing differentially. Their self-assessed ratings indicated that although they considered themselves relatively proficient in English (mean rating= 6.3) they were dominant in Spanish (mean rating= 9.6).

Table 3-5

Language experiences and self-assessed proficiency ratings of the Spanish-English bilingual participants (n=21) of Experiment 1

Age (years)	23.5	
Length of English study (years)	12.1	
Length of immersion in an English-speaking country (months)	4.1	
Mean lexical decision latency (ms)	712	
Mean naming latency (ms)	588	
	Self-assessed ratings[1]	
	English (L2)	Spanish (L1)
Reading	6.8	9.6
Writing	6.0	9.4
Speaking	5.9	9.6
Listening	6.4	9.7
Mean rating	**6.3**	**9.6**

1. Based on a scale of 1-10

Analyses per condition

Data trimming procedures

Lexical decision

Mean reaction times (RTs) for correct trials were calculated for each participant in each condition. RTs that were faster than 300 ms or slower than 3000 ms were counted as outliers and excluded from the analyses. RTs that were more than 2.5 standard deviations above or below the participants mean RT were also considered outliers and eliminated from analyses. The standard deviation cut-offs were calculated separately for the words and non-words. These data trimming procedures led to an exclusion of 2% of all trials.

Naming

Two research assistants were trained by the principal investigator to code the accuracy of participants' spoken responses. After a two week training phase, the two research assistants independently coded the same subset of participant responses. A comparison of these ratings demonstrated that the inter-rater reliability exceeded the 95% criterion.

Mean RT's for correct trials were calculated for each individual in each condition. RT's that were either faster than 200 ms or slower than 2000 ms were counted as outliers and excluded from the analyses. RT's that were more than 2.5 standard deviations above or below the participants mean RT were also considered outliers and eliminated from analyses. This led to an exclusion of 1.3% of the data.

Overall analyses

Overall latency analysis

Paired t-tests revealed that latencies were significantly faster in naming than in lexical decision, and this difference was significant, t_1 (1, 20) = 5.21, $p < .001$. This latency difference was expected and it has been consistently observed in past studies (Forster & Chambers, 1973; Seidenberg, Waters, Barnes, & Tanenhaus, 1984). In the lexical decision task, participants were faster making "yes" responses to actual English words (mean RT= 698 ms) than they were to making "no" responses to the non-words (mean RT= 832 ms); t_1 (1, 20) = 5.91, $p<.001$.

Overall error analyses

The overall accuracy for lexical decision and naming was highly similar (19.1% error rate in lexical decision and 19.8% error rate in naming). This difference was not statistically significant (p value > .05). In the lexical decision task, the mean percentage of errors was similar for the words (19.9%) and the non-words (17.8%) and did not differ statistically, t_1 (1, 20) = .81, $p > .05$.

Cognate analyses

Latency data

The mean latencies and error rates for the cognate and control conditions in lexical decision and naming are summarized in Table **3-6.** A three-way [task (lexical decision versus naming) x cognate status (cognate versus control) x phonological similarity (+P versus –P)] repeated measures ANOVA was performed on the participant latency means and the item latency means. In the analysis by participants, all three variables were treated as within-participant variables. In the analysis by items, cognate status and phonological similarity were treated as between-item variables while task was treated as a within-items variable. It is important to note that the phonological similarity of the control words was not manipulated. For the purpose of the analyses these items were coded as either non-cognate +P or non-cognate –P based solely on the fact that they were matched with items from the respective critical cognate condition in terms of word frequency and length. Thus any main effect of phonological match based on the full set of items was followed by post-hoc t-tests on the subset of the actual cognate items to test for independent effects of cross-language phonological match.

Table 3-6

Mean latencies (milliseconds) and percent error rates (in parentheses) for the two cognate conditions and matched controls in lexical decision and naming of Experiment 1

Condition	Lexical decision	Naming
+ P cognates	671	579
	(10.0%)	(8.6%)
controls	738	587
	(27.1%)	(13.4%)
Difference	**-67***	**-8**
	(-17.1*)	**(-4.8*)**
- P cognates	711	594
	(12.1%)	(18.1%)
controls	685	588
	(16.0%)	(12.1%)
Difference	**+26**	**+6**
	(-3.9)	**(+6.0*)**

*** p < .05**

The ANOVA analyses revealed a main effect of task, significant by participants, F_1 (1, 20) = 27.06, MSe = 40,635.30, p<.001; and items, F_2 (1, 80) = 141.92, MSe = 332,561.19, p<.001. This was qualified by a triple interaction with cognate status and phonological similarity, significant by participants, $\underline{F}_1$ (1, 20) = 8.57, $\underline{p}<.01$; and items, $\underline{F}_2$ (1, 80) = 4.69, $\underline{p}<.05$. Follow-up t-tests performed with a Bonferroni correction indicated that in lexical decision, the +P cognates were recognized faster than controls, $\underline{t}_1$ (1, 20) = 3.8, $\underline{p}<.05$; $\underline{t}_2$ (1, 42) = 2.68, $\underline{p} < .05$, while –P cognates did not differ from controls, t_1 (1, 20) = 1.5, $\underline{p} > .05$; $\underline{t}_2$ (1, 42) = .97, $\underline{p} > .05$. In naming, neither contrast was statistically reliable (all $\underline{p}$ values > .05).

These results replicate and extend previous findings in the literature (Dijkstra et al., 1999; Schwartz et al, submitted) demonstrating that the cross-language mapping of phonological codes has a fundamental impact on processes of lexical access. Like Dijkstra and colleagues, the effects of phonological match were observed in the lexical decision task, which does not require overt production of the target word.

Error data

A three-way (task x cognate status x phonological similarity) repeated measures ANOVA was performed on the participant percent error means and the item percent error means. In these analyses, the main effect of task approached significance by participants $\underline{F}_1$ (1, 20) = 3.13, MSe = 2866.57, $\underline{p}= .092$ and was significant by items, $\underline{F}_2$ (1, 80) = 7.61, MSe = 19751.13, $\underline{p}<.01$, and reflected the higher error rates in lexical decision. There was also an interaction between task and cognate status, which was significant by participants, $\underline{F}_1$ (1, 20) = 16.59, MSe = 1567.97, $\underline{p}<.001$; and by items, $\underline{F}_2$ (1, 80)= 4.66, MSe = 38396.25, $\underline{p}<.05$. Follow-up t-tests performed with a Bonferroni correction indicated that in lexical decision, cognates were recognized more accurately than controls, $\underline{t}_1$ (1, 20) =

4.38, $\underline{p} < .05$; $\underline{t}_2$ (1, 82) = 2.54, $\underline{p} < .05$. In naming, however, accuracy for cognates was no different than controls, $\underline{t}_1$ (1, 20) = .54; $\underline{t}_2$ (1, 82) = .29.

Finally there was an interaction between cognate status and phonological similarity, which was significant by participants, $\underline{F}_1$ (1, 20) = 21.1, MSe = 1510.80, $\underline{p}<.001$, and by items, $\underline{F}_2$ (1, 80) = 7.03, MSe = 38396.25, $\underline{p} < .05$. Follow up t-tests performed with a Bonferroni correction revealed that the +P cognates were recognized more accurately, in lexical decision than the matched controls $\underline{t}_1$ (1, 20) = 4.37, $\underline{p} < .05$, $\underline{t}_2$ (1, 42) = 3.15, $p < .05$, while –P cognates did not differ from controls, $\underline{t}_1$ (1, 20) = 1.63, $\underline{p} > .05$; $\underline{t}_2$ (1, 42) = .92, $\underline{p} > .05$. In naming, there were significant effects of +P cognate facilitation, $\underline{t}_1$ (1, 20) =3.27, $\underline{p} < .05$ and –P cognate inhibition, $\underline{t}_1$ (1, 20) = 2.94, $p < .05$. Therefore, the facilitative effects associated with the +P cognates was robust across both tasks, while the inhibitory effects of the –P cognates was only manifest in naming. It was not surprising that –P inhibition would be observed more strongly in naming, since this task requires that the full phonological code of words be specified.

In summary, the cross-task comparisons for the cognate conditions demonstrated evidence of cross-language lexical activation. The +P cognate facilitation in lexical decision latency and naming error rates suggests that bilinguals were activating phonological codes across their two languages, and the convergence of the shared phonology facilitated lexical access. The lack of any cognate facilitation for the –P cognates suggests that the bilinguals were also activating phonological codes across their two languages, and that the activation of the conflicting phonological representations precluded cognate facilitation. Further evidence of this came from the naming task, in which the –P cognates were named more slowly than controls.

What remained unclear was the extent to which the facilitation for +P cognates was due to convergence of codes solely at the phonological level, or whether this facilitation was also influenced by shared semantics. If the facilitation was due exclusively to shared orthographic and phonological codes, one would predict that similar facilitative effects would be observed for homographs, which also share orthography and phonology but do not share semantics. If, on the other hand, activated semantics was a critical factor in the cognate facilitation, one would predict that the pattern observed for homographs would be distinct from that observed for the cognates. Before turning to the homograph analyses, we first report analyses of monolingual responses in lexical decision and naming for the cognates and controls

Monolingual control check

When performing cross-language research, there is always the concern that the observed effects of cross-language activation are due to some confounded factor in the materials employed and not due to participants' bilingualism. Although items in each condition were matched in terms of word frequency, length and phonological onset, it was not possible to control for every relevant lexical characteristic, such as phonemic complexity. In the present research we addressed this concern by using an on-line corpus (Balota et al., 2002) that contained English monolingual naming and lexical decision performance data. All of the critical cognate and control items were included in the corpus and Table **3-5** summarizes the mean lexical decision and naming latencies and error rates from that corpus.

Table 3-7

English monolingual lexical decision and naming latencies (in milliseconds) and error rates (in parentheses) for cognate and cognate-control items obtained from an on-line corpus[1]

Condition	Lexical decision	Naming
+ P cognates	631	644
	(0.3%)	(0.0%)
controls	637	641
	(0.4%)	(0.0%)
Difference	**-6**	**-3**
- P cognates	650	669
	(0.4%)	(0.0%)
controls	620	621
	(0.2%)	(0.0%)
Difference	**+30**	**+48**

1. Balota et al., 2002

A three-way (task x cognate status x phonological similarity) repeated measures ANOVA was performed on item latency means. Cognate status and phonological similarity were treated as between-item variables while task was treated as a within-items variable. The ANOVA analysis revealed no main effects or interactions (all p values > .05). However, the interaction between cognate status and phonological similarity approached significance, $\underline{F}_2$ (1, 80) = 3.52, MSe = 394,384.86, $\underline{p}$ = .06. This interaction was due to the slower latencies for the –P cognates. Therefore, it was likely that the phonological characteristics (e.g., onset complexity) were different than the other conditions. What is important to note is that the monolingual data did not show any of the facilitative effects that were observed in the bilingual lexical decision performance. However, it is possible that the –P cognate inhibition observed in the present naming experiment was due to a phonological or another lexical confound in the –P condition. The extent to which the –P inhibitory effects observed with the bilinguals were due to the within phonological properties versus the cross language phonological properties remained unclear.

In the cognate analyses, we have seen evidence that when there is a high degree of cross-language overlap across all three lexical codes (orthographic, phonological and semantic), processes of lexical access are speeded. In the next section we report data for homographs, which only have high lexical overlap at the orthographic and phonological levels. Conflicts at the semantic level could produce inhibitory effects in lexical access. It should also be noted that we did not have a measure of the relative phonological overlap for the homograph items. Therefore we could not conclusively discriminate between phonologically and semantically driven inhibitory effects for the homograph items. Also, as mentioned earlier, previous findings with homographs have been mixed and whether any effects are observed varies greatly across different tasks and experimental conditions.

Homograph analyses

Latency data

The mean latencies and error rates for the homograph and control conditions in lexical decision and naming are summarized in Table **3-8**. A two-way [task (lexical decision versus naming) x homograph status (homograph versus control)] repeated measures ANOVA was performed on the item and participant latency means. In the analysis by participants, both variables were treated as within-participant variables and in the analysis by items homograph status was treated as a between-items variable. These analyses revealed a main effect of task, significant by participants, F_1 (1, 20) = 16.78, MSe = 306,025.36, p<.001 and by items, F_2 (1, 46) = 66.55, MSe = 21,617.82, p<.05. The main effect of homograph status was not significant, by participants, F_1 (1, 20) = 1.84, MSe = 55,272.74, p > .05; or items, F_2 (1, 46) = .01, MSe = 359,409.02, p > .05. Finally, the interaction between these two factors was not significant by participants, F_1 (1, 20) = .32, MSe = 280,66.04, p > .05; or by items, F_2 (1, 46) = 1.30, MSe = 211,617.82 p > .05.

Table 3-8

Mean latencies (milliseconds) and percent error rates (in parentheses) for the homograph and control conditions in lexical decision and naming tasks of Experiment 1

Condition	Task: Lexical decision	Task: Naming	Mean
homographs	703	597	649
	(30.3%)	(22.2%)	(26.2%)
controls	692	577	634
	(28.0%)	(16.7%)	(22.4%)
Difference	**+11**	**+20**	**+15**
	(+2.3)	**(+5.5)**	**(+3.8)**

Error data

The analysis performed on the accuracy data revealed a main effect of task, significant by participants, $\underline{F}_1$ (1, 20) = 19.57, MSe = 2,034.81, $\underline{p}$<.01; and by items, $\underline{F}_2$ (1, 46) = 8.00, MSe = 17,994.55, $\underline{p}$ < .05, with better accuracy in naming than in lexical decision. The main effect of homograph status was not significant either by participants, $\underline{F}_1$ (1, 20) = 1.69, MSe = 3,699.18, $\underline{p}$ > .05; or by items, $\underline{F}_2$ (1, 46) = .42, MSe = 28,603.35, $\underline{p}$ > .05.

Overall the cross-task homograph comparisons failed to reveal any effects of homographic inhibition or facilitation in either lexical decision or naming. The lack of a homograph effect in a standard, unilingual, lexical decision is compatible with a number of prior studies (Dijkstra et al., 1998; Gerard and Scarborough, 1989; but see Von Studnitz & Green, 2002). Although there were no significant effects, an examination of Table **3-8** suggests there was some inhibition, particularly in naming, for the homograph items. This trend towards inhibition would be compatible with recent research on bilingual naming, in which inhibitory homographic effects were observed for English-French bilinguals (Jared & Szucs, 2002).

Recent research on bilingual lexical access has also demonstrated that the magnitude of homographic inhibition observed is dependent on the relative frequency of the homographs' lexical representation across bilinguals' two languages (Dijkstra et al., 1998). In the present experiment the homographs were matched with controls only in terms of the target language, English. The relative frequency of the homograph in the non-target language, Spanish, was not systematically controlled. The variability in cross-language frequency may have attenuated homographic inhibition.

To examine if naming responses to homographs were affected by cross-language frequency, partial correlations were computed, controlling for English word frequency, between the following variables: (1) naming latency (2) naming error rates (3) English length and (4) relative cross-language frequency. The cross-language frequencies could be directly compared because they both were based on a corpus of one million words. However, to ensure comparability, the frequencies for each word were first converted through a z-transformation. The converted English language frequency was then subtracted from the Spanish frequency as an index of the relative cross-language frequency. Before performing the analyses, error rates were converted through an arc-sine transformation. We predicted that, if performance was indeed influenced by the relative cross-language frequency of the homographs, then latency and error rates should be positively correlated with relative cross-language frequency.

A shown in Table **3-9**, naming latencies for the homographs were positively correlated with relative cross-language frequency, $r (21) = .51$, $p < .05$, suggesting that naming performance was indeed influenced by cross-language lexical characteristics thus providing evidence of cross-language activation. More specifically, naming latencies for the homographs were longer when the frequency of the non-target L1 reading was greater. None of the other performance measures correlated with cross-language frequency (all p values $> .05$). In the next section we report data showing that monolinguals' performance was not influenced by these variables.

Table 3-9

Intercorrelations between Spanish-English bilinguals' naming latencies and error rates in Experiment 1 and the cross-language lexical properties of the critical homograph items

Factor	2	3	4
1.Naming Latency (ms)	-.05	-.05	.52*
2. Naming accuracy (percent error rates)	---	.06	-.06
3. English word length (# of letters)		---	.07
4. Relative cross-language frequency			---

* p < .05

Monolingual control check

As with the cognate analyses, we were concerned about potential lexical confounds amongst the homograph and control conditions. We once again made use of the same on-line corpus that contained English monolingual naming and lexical decision performance data (Balota et al., 2002). All of the critical homograph and control items were included in the corpus and the mean lexical decision and naming latencies and error rates from that corpus are summarized in Table 3-10.

Table **3-10**

English monolingual lexical decision and naming latencies (in milliseconds) and error rates (in parentheses) for homograph and homograph control items obtained from an on-line corpus[1]

Condition	Task: Lexical decision	Task: Naming	Mean
homographs	639	644	641
	(0.6%)	(0.2%)	(0.4%)
controls	621	623	622
	(0.4%)	(0.2%)	(0.3%)
Difference	**+ 18**	**+21**	**+21**

1. Balota et al., 2002

A two-way (task x homograph status) repeated measures ANOVA was performed on item latency and error means. In the latency analysis the main effect of task was not significant, F_2 (1, 46) = 1.71, MSe = 97,445.04, $p > .05$, nor was the main effect of homograph status, F_2 (1, 46) = 2.92, MSe = 25,621.57, $p > .05$. Finally the interaction between the two variables was not significant, F_2 (1, 46) = .13, MSe = 97,445.04, $p > .05$. In the analysis of the error rates there was a main effect of task, F_2 (1, 46) = 10.33, MSe = 0.06, $p < .01$, which was reflective of the higher error rates in lexical decision. The main effect of homograph status approached significance, F_2 (1, 46) = 3.47, MSe = 0.09, $p = .07$.

Even though there were no statistically significant effects, we were still concerned that the trend in the data suggested effects of inhibition, the magnitude of which looked quite similar to that observed for the bilinguals (see Table **3-7**). Thus, we once again calculated partial correlations between monolinguals' homograph latency and error rates with the same variables used in the bilingual analysis (see Table **3-11**). As predicted, none of the monolingual performance measures were correlated with cross-language frequency (all p values > .05).

Table **3-11**

Intercorrelations between monolingual[1] homograph latencies and error rates and the homographs' cross-language lexical properties

Factor	2	3	4	5	6
1.Naming Latency (ms)	.73*	.26	.02	.25	-.32
2. Naming accuracy (percent error rates)	---	.23	.21	.12	-.19
3. Lexical decision latency (ms)		---	.43*	.08	.21
4. Lexical decision accuracy (percent error rates)			---	-.34	-.03
5. English word length (# of letters)				---	.06
6. Relative cross-language frequency					---

* $p < .05$

1. Balota et al., 2002

The homograph analyses provided evidence that bilingual naming performance is inhibited when words share form but not meaning across their two languages, which is consistent with findings from previous research (Jared & Szucs, 2002). Although these inhibitory effects were not statistically robust, the post-hoc analyses suggest that latencies were influenced by the relative cross-language frequency of the homographs, and that when the relative frequency in the nontarget L1 was greater, latencies were slower.

The fact that the effects of homograph status were inhibitory in nature suggests that the +P cognate facilitation effects described earlier may have been partially due to shared semantics, since homographs differ from cognates only in that they do not share semantics. This conclusion is still tentative, since we did not systematically control phonological overlap for the homograph items. Furthermore, the degree to which semantics is actually activated in a naming task has been debated (Balota, 1991). Indeed, citing previous within-language research, Jared and Szucs concluded that any effects of homographic inhibition observed in naming are most likely due to competition at the phonological level (2002). We are not claiming that semantics are never involved in naming. In the case of bilingual lexical access, the existence of lexical items that share semantics across languages (such as cognates) may increase the likelihood that semantics are engaged early enough to affect processes of lexical access.

In the next section we examined whether performance would be similarly inhibited for cognates words with imperfect semantic match (i.e. the existence of a homograph meaning such as the “burial place” meaning of *grave*). We assumed that any increase in ambiguity (via shared orthography and phonology) would extend the time-course of processing and make it more likely that the effects of semantic match would be revealed. Therefore, we predicted that any partial cognate facilitation observed would be attenuated by the existence of another, unshared, homographic meaning and/or by the dominance of that homographic meaning relative to the shared, cognate meaning.

Partial cognate analyses

Latency data

The mean latencies and error rates for the partial cognate and control conditions in lexical decision and naming are summarized in Table **3-10**. A three-way (task x partial cognate status x language of polysemy) repeated measures ANOVA was performed on the participant latency means and the item latency means. In the analysis by participants, all three variables were treated as within-participant variables. In the analysis by items, partial cognate status and language of polysemy were treated as between-item variables while task was treated as a within-items variable. In these analyses there was a main effect of task which was significant by participants F_1 (1, 20) = 24.15, MSe = 325,935.49, $p<.001$; and items F_2 (1, 72) = 144.26, MSe = 226,119.09, $p<.001$. There was also a main effect of partial cognate facilitation which was significant by participants, F_1 (1 20) = 5.00, MSe = 20,942.57, $p<.05$, and marginal by items, F_2 (1, 72) = 3.58, MSe = 394,456.31, $p = .062$. Follow-up t-tests performed with a Bonferroni correction failed to yield any significant differences in latencies for the partial cognates and controls in lexical decision, t_1 (1, 20) = 0.93 $p = .64$, and in naming, t_1 (1, 20) = 2.11, $p = .10$. However, the trend in the data suggests that the magnitude of facilitation was greater in naming. Thus, participants' latencies appeared to be facilitated by the overall lexical transparency of the partial cognates (which share both form and meaning) but not by the more subtle aspect of semantic match (i.e. the existence of another non-shared meaning), suggesting that semantics were not fully specified in either task.

Table **3-12**

Mean latencies (milliseconds) and percent error rates (in parentheses) for the two partial cognate conditions and matched controls in lexical decision and naming tasks of Experiment 1.

	Task	
Condition	Lexical decision	Naming
Partial cognates polysemous in English	657 (6.9%)	568 (11.9%)
Controls	667 (11.6%)	580 (19.2%)
Difference	**-10** **(-4.7)**	**-12** **(-7.3)**
Partial cognates polysemous in Spanish	677 (8.2%)	567 (13.0%)
Controls	685 (16.4%)	582 (18.5%)
Difference	**-8** **(-8.2)**	**-15** **(-5.5)**

Error data

A similar trend was observed in the analyses of the error rate data. Once again there was a main effect of task, significant by participants, $\underline{F}_1$ (1, 20) = 4.27, MSe = 4,618.06, $\underline{p}$<.05; but not by items, $\underline{F}_2$ (1, 76) = 1.81, MSe = 14,845.46, $\underline{p}$ = .18; and a main effect of partial cognate status, significant by participants $\underline{F}_1$ (1, 20) = 17.18, MSe = 2,043.08, $\underline{p}$ <05, and by items, $\underline{F}_2$ (1, 72) = 5.02, MSe = 24,601.44, $\underline{p}$ < .05.

Monolingual control check

As with the cognate and homograph analyses, we were concerned about potential lexical confounds amongst the partial cognate and control conditions. We once again made use of an on-line corpus (Balota et al., 2002) that contained English monolingual naming and lexical decision performance data. All of the critical partial cognate and control items were included in the corpus. The mean lexical decision and naming latencies and error rates from that corpus are summarized in Table **3-13**.

Table **3-13**

English monolingual lexical decision and naming latencies (in milliseconds) and error rates (in parentheses) for partial cognate and control items obtained from an on-line corpus[1]

	Task	
Condition	Lexical decision	Naming
Partial cognates polysemous in English	616 (0.3%)	641 (0.2%)
Controls	631 (0.2%)	634 (0.2%)
Difference	**-25**	**+7**
Partial cognates polysemous in Spanish	621 (0.2%)	632 (0.1%)
Controls	627 (0.3%)	645 (0.3%)
Difference	**-6**	**-13**

1. Balota et al (2002)

A three-way (task x partial cognate status x polysemy) ANOVA was performed on the item latency and error rate means. In the latency analysis the main effect of task was significant, F_2 (1, 72) = 6.13, MSe = 91,641.47, $p > .05$, indicating the shorter latencies in lexical decision than in naming. The main effect of partial cognate status was not significant, F_2 (1, 72) = .43, MSe = 336,359.26, $p > .05$, nor did it interact with polysemy, F_2 (1, 72) = .07, $p > .05$. As shown in Table **3-13**, partial cognates polysemous in English were recognized 25 ms faster than controls. This difference is not surprising since monolingual English speakers should indeed be affected by polysemy within their own language.

In the error rate analysis the main effect of task was not significant, F_2 (1, 72) = 2.49, MSe = 0.058, $p > .05$, nor was the main effect of partial cognate status, F_2 (1, 72) = .55, MSe = 0.10, $p > .05$. Finally interaction between the partial cognate status and polysemy was not significant, F_2 (1, 72) = 1.33, $p > .05$. This provided evidence that the observed partial cognate facilitation effects were due to bilingual, cross-language activation and not a materials confound.

In summary, the cross-task partial cognate analyses demonstrated an overall facilitative effect of partial cognate status which was manifest in both the naming and accuracy data. It should be noted that the overall magnitude of the partial cognate facilitation was quite small in both terms of latency and error rates. In lexical decision the partial cognates were responded to on average only eight ms faster than controls. This can be contrasted with the 67 ms difference for the +P cognates in lexical decision relative to controls.

One possible explanation for this reduced facilitation is that the bilinguals were activating the multiple meanings of the partial cognates and that they were sensitive to mismatches in semantic overlap, and this mismatch attenuated the overall facilitative effects. However, another possible explanation for the reduced facilitation may have had nothing to do with polysemy but rather it might have been due to differences in the relative dominance of the partial cognates' multiple meanings. For example, the shared meaning of the partial cognate *grave* is "serious". This meaning is less dominant than the non-shared meaning, "burial place". Thus, partial cognates like *grave* may be functionally more like homographs if the cognate meaning is subordinate and the non-cognate meaning is dominant. These subordinate partial cognates therefore might have masked the larger facilitative effects associated with cognate status.

We addressed this possibility by performing post-hoc regression analyses on the partial cognates. As described in Appendix A, a series of norming procedures were carried out on the initial pool of partial cognate items. In one procedure, highly proficient English-Spanish bilinguals provided relative dominance ratings for the multiple meanings of the partial cognates. We used the dominance ratings in the regression analyses to see if they would account for unique variance when predicting latencies and error rates and to determine whether, after controlling for these ratings, polysemy would account for unique variance.

In the regression analyses reported below, we entered the following four predictors, (1) word frequency, (2) task, (3) dominance rating and (4) polysemy. Task was coded as either a "1" for lexical decision, or "-1" for naming. Polysemy was coded as either "1" for polysemous in English, or "-1" for polysemous in Spanish. Since word frequency was not normally distributed a log linear transformation was used. Before performing the regression analyses on error rates, these were first converted through an arcsine transformation since they were not normally distributed.

The regression equation used to predict latency accounted for 55.0% of the data and this relationship was significant, F_2 (4, 71) = 23.92, p <.001 (see Equation. **3.1**) Frequency was negatively related to latency, t_2 (1, 71) = 2.52, p < .001, indicating faster latencies for higher frequency words. Task was positively related to latency, t_2 (1, 71) = 9.41, p < .001, indicating slower latencies in lexical decision relative to naming. Neither dominance rating nor polysemy were significant predictors of latency (both p values > .05).

$$\text{Latency} = -0.20 \text{ frequency} + 9.41 \text{ task} - 0.72 \text{ dominance rating} - 0.04 \text{ polysemy} + (656.70) \quad \textbf{3.1}$$

The regression equation used to predict error rates did not account for a significant portion of the data, R^2_{adj} = 6.0%, F_2 (4, 71) = 2.20, p = .08 (see Equation. **3.2**). Task was the only significant predictor, t_2 (1, 71) = 2.75, p < .05, and it was negatively related to error rate, indicating the higher error rates in lexical decision relative to naming. Neither dominance rating nor polysemy were significant predictors of latency (both p values > .05).

$$\text{Error rate} = 0.045 \text{ frequency} - 0.31 \text{ task} - 0.85 \text{ dominance rating} - 0.10 \text{ polysemy} + (10.19) \quad \textbf{3.2}$$

The regression analyses suggest that the relative dominance of the shared, cognate meaning of the partial cognates did not moderate performance for these critical items, this in turn provided some evidence that the relatively small magnitude of facilitation observed for partial cognates was due to the activation of the non-shared, homographic meaning. However, the lack of predictive power of the dominance ratings should be interpreted with caution. The dominance ratings used in these equations were provided by highly proficient bilinguals, who were mostly native English speakers. Thus, their ratings may not adequately reflect the relative dominance of partial cognates that were polysemous in Spanish.

One possible conclusion from the regression analyses is that the magnitude of partial cognate facilitation was small because the existence of another, homographic meaning slowed lexical access processes. However, we did not have a measure of the relative phonological similarity of the partial cognates so we could not ascertain whether the facilitation was attenuated as a result of competition at the phonological level. Yet, the fact that effects of partial cognate status were facilitative and not inhibitory (as in the case of the homographs) suggests that participants were activating the shared semantic representation of the cognate meaning.

Summary of out of context tasks

The data across all three critical word types reflected effects of cross-language activation. In regards to the cognates, when there was high semantic and form overlap (i.e., the +P cognates), naming accuracy was increased and recognition latencies in lexical decision were speeded. Even more interesting is the fact that participants showed sensitivity to the cross-language consistency in phonological match in the lexical decision task which does not require that phonology be specified.

In regards to the homographs, post-hoc correlational analyses indicated that latency across the naming and lexical decision tasks was inhibited by high lexical frequency in the non-target L1, suggesting that this alternative representation was active and competing for selection. The influence of the non-target language frequency has been previously observed in lexical decision (Dijkstra et al., 1998). Furthermore, inhibitory effects of homograph status in naming have also been reported previously (Jared & Szucs, 2002). These post-hoc analyses were also theoretically informative in that they demonstrated the importance of considering the relative cross-language frequency when interpreting effects of cross-language activation with homographs.

The data from the partial cognates showed some facilitation in terms of faster latencies and reduced errors. However, given the previous research demonstrating consistent cognate facilitation in lexical decision, one might have predicted more robust facilitative effects. Again, it is not clear whether this attenuated facilitation was due to lexical conflicts at the phonological and/or semantic level.

General Discussion

The primary goal of the present experiment was to replicate effects of cross-language activation that have been repeatedly observed in prior research in de-contextualized tasks. It was essential to establish these effects in order to later examine how the presence of a sentence context might moderate cross-language activation. The findings from the experiment clearly reflected effects of cross-language activation, and thus confirmed the viability of using the selected materials to examine cross-language activation in context. Furthermore, the findings from this experiment replicated some previously observed cross-language effects. More specifically, we replicated effects of homograph inhibition in naming and cognate facilitation effects (for +P cognates) in lexical decision.

Another goal of the present experiment was to address some new questions regarding cross-language competition effects in out-of-context tasks. For example, we were interested in examining whether cognate facilitation (an effect repeatedly reported in the literature) would be moderated by the corresponding cross-language phonological similarity of the cognate items, and whether these effects would be similar across the two different tasks, lexical decision and naming. Overall, the data from both the lexical decision and naming tasks demonstrated that cognate facilitation was indeed moderated by the corresponding overlap in phonology. In lexical decision, performance was mostly affected by the facilitative effects of similar phonology while in naming, performance was facilitated by similar phonology as well as inhibited by dissimilar phonology. However, what remained unclear was the extent to which –P inhibition was due to within-language phonological complexity, as indicated by the monolingual data, relative to cross-language phonological dissimilarity.

We were also interested in examining whether effects of cognate facilitation would be moderated by the polysemy of the cognates. The findings from both lexical decision and naming suggest that cognate facilitation was not significantly affected by polysemy, since both tasks yielded moderate facilitative effects. It is interesting to note that the overall magnitude of this facilitation was quite small, and that this reduction might have been due to polysemy.

The homograph analyses suggested overall that lexical access was inhibited by homographic status. Furthermore, the extent of this inhibition was a function of relative cross-language frequency. This suggests that reliable homographic inhibition is more likely to be observed when the representation from the nontarget language is of a higher frequency than the representation in the target language.

In Chapters 5 and 6 we examine how the observed effects of cross-language activation for the three critical word types was moderated by the presence of sentential context. The critical question was whether the top-down processes of sentence comprehension would influence the bottom-up processes of lexical access, thus modifying the effects of cross-language interaction.

Chapter 4

Experiment 2: Cross-language lexical activation for English-Spanish bilinguals in out-of-context tasks

Predictions

In the preceding chapter (Experiment 1) we reported evidence of cross-language interactions for a group of Spanish-English bilinguals. These interactions were observed across three, different critical word types (cognates, homographs and partial cognates) and across two different tasks (lexical decision and naming). More specifically, we observed facilitated performance for critical words that had high lexical overlap across the bilinguals' two languages (e.g., +P cognate facilitation). When the critical words had conflicting lexical representations (either at the phonological or semantic level) facilitative effects were either attenuated (i.e., the smaller partial cognate facilitation relative to +P cognates) or they turned into effects of inhibition (i.e., increased latencies for homographs).

Like Experiment 1, the over-arching goal of the present experiment was to replicate effects of cross-language activation in out-of-context tasks, which have been observed across a number of studies. In general, our predictions for this experiment were the same as those for Experiment 1. Furthermore, we wanted to examine whether effects of cross-language interaction would replicate for a new group of bilinguals, whose L1 was English. As mentioned previously, it is often difficult to draw comparisons across different studies because of the great variation in the bilingual samples used, the linguistic context in which they are immersed and tasks employed. Both task-related factors and linguistic context were very similar in the present experiment to those in

Experiment 1. In both cases participants performed lexical decision and naming in their L2 and both groups were immersed in their L1 culture during the time of the study. Furthermore, the overall proficiency level of the two groups of bilinguals was quite similar (as described below). This allowed us to more systematically examine how other aspects of bilingualism (e.g., lexical differences between the L1 and L2; differences in specific L2 experiences such as study abroad) modulate non-selectivity out of context.

Method

Participants

Twenty-eight native English speakers from the Pennsylvania State University and 16 native English speakers from an intensive language studies program in Middlebury, Vermont, who were proficient in Spanish, participated in the experiment. Due to technical errors in the experimental session, data from 8 participants was lost and not included in the analyses described below. Twelve of the remaining 36 participants had very high error rates in lexical decision (more than 50% error rates on non-words) and had to be eliminated as well, bringing the total number of participants to 24.

Materials

All together there were 103 critical Spanish words. These critical words were translations of the words used in Experiment 1 and were drawn from the same initial pool of items. These consisted of 45 cognates (*e.g., piano*), 23 homographs (*fin* meaning “end” in Spanish) and 35 partial cognates, 17 polysemous in English (e.g., *grave*) and 18 polysemous in Spanish (e.g., *real* meaning both "authentic" and "royal"). For the purposes of frequency matching, slightly different subsets of items were used in the present Spanish language experiment than those used in Experiment 1.

For each critical condition a control condition was created. These control conditions were created through an item-by-item match in which every critical word was paired with a Spanish control word matched on word frequency in Spanish, word length and, when possible, phonological onset. The Spanish frequencies were drawn from a computerized lexical database (Sebastián-Gallés et al., 2000) based on one million words.

An additional set of non-words was constructed to be used in the lexical decision conditions. The non-words were pronounceable letter strings created by changing one or two letters from an actual Spanish word (*e.g., tuarno*). The materials were divided into two lists (A and B). Each participant was presented with one list for naming and the other list for lexical decision, the order of which was counterbalanced. In the naming task, words were presented in random order. In the lexical decision task, words and non-word stimuli were also presented in random order. Examples of the word stimuli are presented in Table **4-1**.

Table **4-1**

Examples of stimuli used in Experiment 2 and their lexical characteristics

	Critical words			Controls		
Condition	Example	Spanish Frequency[1]	Length[2]	Example	Spanish Frequency[1]	Length[2]
Cognates						
+P	banda	47.1	6.2	barba	41.1	6.4
-P	base	35.8	5.9	brazo	36.3	6.1
Partial cognates						
Polysemous in English	roca	33.2	5.2	regla	36.2	5.5
Polysemous in Spanish	real	31.3	5.6	piel	31.4	4.9
Homographs	pan	63.9	4.6	piso	66.1	5.0

[1] (Sebastián-Gallés, 2000)
[2] Number of letters

Procedure

Participants were recruited through classroom visits and email announcements. Participants recruited at Penn State were greeted in English (L1), whereas participants in the intensive language studies program in Vermont were spoken to exclusively in

Spanish. The reason for this difference was, in the intensive language studies program, all students were required to speak in Spanish at all times. Because the research assistants administering the experiments at Penn State were not proficient enough in Spanish to conduct the entire experimental session in Spanish, the sessions were conducted in English. Researchers have argued that the language mode in which participants find themselves can have effects on language selectivity (Grosjean, 1997). However, recent studies on bilingual lexical activation suggest that the bottom-up non-selectivity observed in de-contextualized tasks such as lexical decision are not affected by surrounding extra-linguistic factors (e.g., the participations expectations or explicitness of instruction) (Dijkstra, De Bruijn, et al., 2000). All other aspects of the experimental running session were the same for the groups of participants and to the procedure described in Chapter 3 for Experiment 1.

Results and Discussion

General approach

Data from the three critical word types (cognates, homographs and partial cognates) and the two tasks (naming and lexical decision) were analyzed and discussed in a variety of ways. First, each condition was analyzed separately to test for general effects of cross-language activation. These per condition analyses were necessary given the constraints of item matching. For each word in each condition a control word, matched on lexical frequency and word length was selected. It was not possible to find a single set of control words that would adequately match the lexical characteristics of the items across all three of the critical conditions (i.e., cognates, homographs and partial cognates).

After the per condition analyses, we report post-hoc analyses in which we combine the lexical decision and naming data from Experiment 2 with the present Experiment. This allowed us to test for language interactions that were consistent across the two bilingual samples. Before turning to these analyses, we first summarize data from the language history questionnaires (LHQ's) completed by the participants.

Language history questionnaire data

Data from the LHQ are summarized in Table **4-2**. The proficiency statistics are reported separately for those participants recruited at Penn State and those recruited from the language intensive program in Vermont. Because students attending an intensive language study program may be more motivated language learners, we first compared the two participant groups in terms of their time studying Spanish, time spent in Spanish-speaking countries, their self-assessed proficiency ratings and their overall performance in the naming and lexical decision tasks. These comparisons showed that the two groups differed in terms of their age, F (1, 27) = 11.7, MSe = 1,247, $p < .05$. The two groups did not differ on any of the other measures (all p values > .05) and all subsequent analyses were based on the two participant groups collapsed together.

The participants' ages ranged from 18 to 48 years, with a mean age of 25 years. On average they had been studying Spanish for seven years, starting at around the age of

13. Their self-assessed ratings indicated that, although they considered themselves quite proficient in Spanish, (mean rating= 6.3) they were dominant in English (mean rating= 9.3).

Table 4-2

Language experiences and self-assessed proficiency ratings of the English-Spanish bilingual participants of Experiment 2

	Vermont (n = 11)		Penn State (n=13)	
Age	30.6		20.0	
Length of Spanish study (years)	7.2		6.9	
Length of immersion in a Spanish-speaking country (months)	12.4		7.1	
Mean lexical decision latency (ms)	736		734	
Mean naming latency (ms)	624		667	
	Self-assessed ratings[1]			
	Vermont		Penn State	
	English (L1)	Spanish (L2)	English (L1)	Spanish (L2)
Reading	9.1	6.0	9.3	6.6
Speaking	9.1	6.1	9.5	6.1
Writing	8.7	5.9	9.2	5.8
Speech comprehension	10.0	6.6	9.7	7.4
Mean rating	**9.2**	**6.1**	**9.4**	**6.5**

1. Based on a ten-point scale

Analyses per condition

Data trimming procedures

Lexical decision

Mean reaction times (RTs) for correct trials were calculated for each participant in each condition. RTs that were faster than 300 ms or slower than 3000 ma were counted as outliers and excluded from the analyses. RTs that were more than 2.5 standard deviations above or below the participants mean RT were also considered outliers and eliminated from analyses. The standard deviation cut-offs were calculated separately for the words and non-words. These data trimming procedures led to an exclusion of 3.0% of all trials.

Naming

The primary investigator and a trained research assistant independently coded the initial subset of participants' spoken responses from the Penn State sample. Since the inter-rater reliability exceeded the 95% criterion the primary investigator coded the remaining data from the Vermont sample.

Mean reaction times (RT's) for correct trials were calculated for each individual in each condition. RT's that were either faster than 200 ms or slower than 2000 ms were counted as outliers and excluded from the analyses. RT's that were more than 2.5

standard deviations above or below the participants' mean RT were also considered outliers and eliminated from analyses. This led to an exclusion of 3% of the data. Furthermore, on 6.1% of the trials the microphone failed to pick up the participants' voices.

Overall analyses

Overall latency analysis

Paired t-tests revealed that latencies were faster in naming (mean RT= 648 ms) than in lexical decision (mean RT = 738 ms), this difference was significant, t (1, 23) = 4.64, $p < .001$. In the lexical decision task participants were faster making "yes" responses to actual Spanish words than they were making "no" responses to the non-words (mean RT= 988 ms); t (1, 23)= 4.66, $p<.001$.

Overall error analyses

Paired t-tests revealed that error rates were significantly lower in naming (mean error rate = 13.7%) than in lexical decision (mean error rate = 21.7%), t_1 (1, 23) = 4.42, $p < .001$. In the lexical decision task, the mean percentage of errors was similar for the words (20.4%) and the non-words (22.8%) and did not differ statistically, t_1 (1, 23) =.09, $p > .05$.

Cognate analyses

Latency data

The mean latencies for the cognate and control conditions in lexical decision and naming are summarized in **Table 4-3**. A three-way [task (naming versus lexical decision) x cognate status (cognate versus control) x phonological similarity (+P versus –P)] repeated measures ANOVA was performed on the participant latency means and the item latency means. In the analysis by participants, all three variables were treated as within-participant variables. In the analysis by items, cognate status and phonological similarity were treated as between-item variables while task was treated as a within-items variable. These analyses revealed a main effect of task, which was significant in the analysis by participants, $\underline{F}_1$ (1, 23) = 8.85, MSe = 904,811.83, $\underline{p} < .05$; and by items, $\underline{F}_2$ (1, 86) = 69.00, MSe = 565,725, $\underline{p} < .001$, reflecting the longer latencies in the lexical decision task. The interaction between cognate status and phonological similarity was significant by participants, $\underline{F}_1$ (1, 23) = 5.43, MSe = 70,454.71, $\underline{p} < .05$, but not by items, $\underline{F}_2$ (1, 86) = .68, MSe = 565,725.69, $\underline{p} > .05$. Follow-up t-tests performed with a Bonferroni correction indicated that in lexical decision, the facilitation for the +P cognates was marginally significant, $\underline{t}_1$ (1, 23) = 1.93, $\underline{p}$ = .07, and the latencies for the –P cognates did not differ from controls, $\underline{t}_1$ (1, 23) = 1.33, $\underline{p}$ = .20. In naming, latencies for the +P cognates did not differ from controls, $\underline{t}_1$ (1, 23) = 1.50, $\underline{p}$ = .15[3], nor did latencies for the –P cognates, $\underline{t}_1$ (1, 23) = .33, $\underline{p}$ = .74.

The interaction between cognate status and phonological similarity was therefore due to the facilitation observed in lexical decision for the +P cognates. There were no significant inhibitory or facilitative effects for the –P cognates in either task. As in Experiment 1 (see Chapter 3), the cognate facilitation effects typically observed in lexical decision were restricted to those cases in which there was a high degree of cross-language phonological match. This provided converging evidence that bilinguals activated cross-language phonological codes, even in a task that does not require overt production.

[3] When the naming data from the participants who were excluded due to high error rates in lexical decision were included in the analysis, the interaction between cognate status and phonological similarity was marginal, $\underline{F}_1$ (1, 28) = 3.67, MSE = 31,570.40, $\underline{p}$ = .06. A follow-up t-test performed with a Bonferroni correction indicated that latencies were significantly faster for +P cognates than controls, $\underline{t}$ (1, 27) = 2.15, $\underline{p}$ < .05. This is consistent with previous studies demonstrating that less proficient bilinguals show larger cognate facilitation (Kroll, Michael, Tokowicz, & Dufour, 2002)

Table **4-3**

Mean latencies (milliseconds) and percent error rates (in parentheses) for the two cognate conditions and matched controls in the lexical decision and naming tasks of Experiment 2

Condition	Lexical decision	Naming
+ P cognates	709	635
	(5.5%)	(14.0%)
controls	744	654
	(13.9%)	(15.2%)
Difference	**-35***	**-19**
	(-8.4)	**(-1.2)**
- P cognates	754	653
	(10.4%)	(18.5%)
controls	731	655
	(15.9%)	(14.9%)
Difference	**+23**	**+2**
	(-5.5)	**(+3.6)**

* $p < .05$

Error data

The mean error rates for the cognate and control conditions in lexical decision and naming are summarized in **Table 4-3**. A three-way (task x cognate status x phonological similarity) repeated measures ANOVA was performed on the participant percent error means and the item percent error means. In these analyses the main effect of task was significant by participants, F_1 (1, 23) = 5.21, MSe = 3,748.48, $p < .05$, and by items, F_2 (1, 86) = 7.12, MSe =10,872.72, $p < .05$. This was qualified by an interaction with cognate status, significant by participants, F_1 (1, 23)= 5.17, MSe = 3,566.89, $p < .05$, and by items, F_2 (1, 86) = 7.18, $p < .05$. Follow-up t-tests performed with a Bonferroni correction indicated that in lexical decision, cognates were recognized more accurately than controls, t_1 (1, 23) = 2.85; $t2$ (1, 88) = 2.65, $p < .05$, whereas in naming accuracy did not differ for the cognates, t_1 (1, 23) = .04, $p > .05$, t_2 (1, 88) = .44. There were no other main effects or interactions in the error data (all p values > .05).

In summary, the cross-task comparisons for the cognate conditions demonstrated effects of cross-language activation of lexical codes, such that cognates were responded to faster than controls only when the corresponding phonological codes were highly similar across the bilinguals' two languages. The general pattern is similar to that observed in Experiment 1, in which the Spanish-English bilinguals showed cognates facilitation only for those items that had high cross-language phonological similarity. The +P cognate facilitation in lexical decision suggests that bilinguals were activating semantic codes across their two languages, and the convergence of the shared semantics facilitated making “yes” responses to those words.

One difference between the pattern of results across the two experiments was that the native Spanish speakers also showed inhibitory effects in naming for the –P cognates, whereas the naming latencies of the native English speakers appeared un-affected by conflicting phonology. This could have been due to the potential lexical confound for the English version of the –P cognates. As described in Chapter 3, monolingual naming latencies were relatively slow for the –P cognates than the other cognate conditions. Since in the present experiment participants were presented with the Spanish version of the –P cognates, the confound may not have been as relevant in their lexical processing.

Another potential explanation relates to differences in the orthographic to phonological consistency of the bilinguals’ L1 and L2. In Experiment 1, the participants’ L1, Spanish, is an orthographically shallow language, meaning that the mappings between orthography and phonology are highly consistent. However, they were performing in an orthographically deep language, English (the mappings between orthography and phonology are far less consistent). One possibility is that bilinguals whose L1 is orthographically deep are better able to negotiate discrepancies between orthographic and phonological mappings due to their extensive experiences with reading an inconsistent language. This interpretation is supported by recent evidence that bilinguals’ efficiency of lexical processing in the L2 is affected by the degree to which their two languages share certain script characteristics (e.g., alphabetic versus non-alphabetic scripts) (Akamatsu, 2003).

In the next section we report data for homographs, which only have high lexical overlap at the orthographic level. Conflicts at the phonological and semantic level could produce inhibitory effects in lexical access. However, as mentioned earlier, previous findings with homographs have been mixed and whether any effects are observed varies greatly across different tasks and experimental conditions.

Homograph analyses

Latency data

The mean latencies and error rates for the homograph and control conditions in lexical decision and naming are summarized in Table **4-4**. A two-way (task x homograph status) repeated measures ANOVA was performed on the item and participant latency means. In the analysis by participants, both were treated as within-participant variables and in the analysis by items, homograph status was treated as a between-items variable. These analyses revealed a main effect of task, which was significant in the analysis by participants, F_1 (1, 23) = 14.05, MSe = 248,671.05, $p < .05$; and in the analysis by items, F_2 (1, 46) = 57.56, 454,824, $p < .001$, reflecting longer latencies in the lexical decision than in the naming task. The main effect of homograph status was significant in the analysis by participants, F_1 (1, 23) = 10.72, MSe = 26719.06, $p < .05$, but not by items, F_2 (1, 44) = 1.12, MSe = 454,824.90, $p > .05$. Follow-up t-tests performed with a Bonferroni correction indicated that in lexical decision, homographs were recognized more slowly than controls by participants, $\underline{t}_1$ (1, 23) = 2.59, $\underline{p} < .05$, but not by items, $\underline{t}_2$(1, 64) = 1.25. In naming, the latencies for homographs did not differ from controls, $\underline{t}_1$ (1, 23) = 1.32, $\underline{p} >$ .05, $\underline{t}_2$ (1, 64) = .02, $\underline{p} > .05$. Thus, for these native English speakers the effect of homograph inhibition was greater in lexical decision than in naming.

Error data

In the analysis performed on the accuracy data, there were no main effects of either task, $\underline{F}_1$ (1, 23) = .14, MSe = 3774.54, $\underline{p}$ = .71; F_2 (1, 64) = .03, MSe = 9178.52, nor homograph status $\underline{F}_1$ (1, 23) = 1.88, MSe = 1039.39, $\underline{p}$ = .18; $\underline{F}_2$ (1, 64) = .33, $\underline{p}$ = .57, nor any interactions between these two variables, $\underline{F}_1$ (1, 23) = .08, MSe = 1524.17, $\underline{p}$ = .778; $\underline{F}_2$ (1, 64) = .006, MSe = 9178.52, $\underline{p}$ = .94.

Table 4-4

Mean latencies (milliseconds) and percent error rates (in parentheses) for the homograph and control conditions in the lexical decision and naming tasks of Experiment 2

Condition	Lexical decision	Naming
homographs	729	637
	(16.1%)	(15.6%)
controls	693	627
	(14.7%)	(13.2%)
difference	**+36***	**+10**
	(+1.4)	**(+2.4)**

* $p < .05$

Overall the cross-task homograph comparisons did reveal inhibitory effects of homograph status, however, these were restricted to lexical decision latency. The naming performance in the present experiment appeared unaffected by homographic status. However, as in Experiment 1, there was an inhibitory trend in naming. As mentioned in Chapter 3, previous studies in bilingual lexical access have demonstrated that the magnitude of homographic inhibition observed is dependent on the relative frequency of the homographs' lexical representation across bilinguals' two languages (Dijkstra et al., 1998). To examine if responses to homographs across lexical decision and naming were affected by cross-language frequency, partial correlations were computed, controlling for Spanish word frequency, between the following variables: (1) naming latency (2) naming error rates (3) Spanish word length, and (4) relative cross-language frequency, The cross-language frequencies could be directly compared because they both were based on a corpus of one million words. However, to ensure comparability, the frequencies for each word were first converted through a z-transformation. The converted Spanish language frequency was then subtracted from the English frequency as an index of the relative cross-language frequency. Before performing the analyses, error rates were converted through an arc-sine transformation. We predicted that, if performance was indeed influenced by the relative cross-language frequency of the homographs, then latency and error rates should be positively correlated with relative cross-language frequency.

As shown in Table **4-5**, naming latencies were positively correlated with relative cross-language frequency, $r(20) = .36$, $p < .05$, suggesting that naming performance was influenced by the cross-linguistic lexical properties of the homograph items. As in Experiment 1, the correlational analyses provided evidence that during naming, bilinguals were indeed activating lexical information from the non-target, L1.

Table 4-5

Intercorrelations between English-Spanish bilinguals' homograph latencies and error rates in Experiment 2 and the cross-language lexical properties of the critical homograph items

	2	3	4
1.Naming Latency (ms)	.39*	.14	.36*
2. Naming accuracy (percent error rates)	---	-.13	.21
3. Spanish word length (# of letters)		---	-.17
4. Relative cross-language frequency			---

* p < .05

A remaining issue concerned the locus of the homographic inhibition effects in naming and lexical decision. It was not immediately clear whether the inhibitory effects were the result of competition solely at the orthographic/phonological levels or whether semantic representations were also activated. The fact that +P cognates, which differ from homographs because they share semantics, were facilitated provides some suggestion that the inhibitory effects observed with homographs were at least partially due to competing semantics. However, it is important to point out that phonological similarity was not systematically controlled for the homograph items and it remains unclear the degree to which the inhibition was phonologically and/or semantically driven.

In the next section we report data for the partial cognates. In Experiment 1, Spanish-English bilingual performance was facilitated for the partial cognates. The magnitude of this facilitation was small relative to that observed for the cognates. In that chapter we argued that one possible explanation for the smaller degree of facilitation was competition from the activation of the non-shared, homographic meaning of the partial cognates. However, we could not conclusively attribute the attenuation to semantics since we did not systematically control for the cross-language phonological similarity of the partial cognates. In the next section we report additional evidence suggesting that bilinguals were activating the homographic alternative of the partial cognates.

Partial cognate analyses

Latency data

Overall there were 35 items in the initial sample of partial cognate items, 17 partial cognates polysemous in English, (e.g., *grave*) and 18 partial cognates polysemous in Spanish (e.g., *real*, which also means "royal"). Four partial cognates, polysemous in English, (*doméstico*, *grado*, *introducir*, *relativo*) had to be eliminated from the analyses because all participants falsely rejected these words in lexical decision. The rejection of these items that were polysemous in the non-target L1 is of theoretical interest and is discussed in more detail in the analyses sections that follow.

The mean latencies and error rates for the partial cognate and control conditions in lexical decision and naming are summarized in Table 4-6. A three-way (task x partial cognate status x language of polysemy) repeated measures ANOVA was performed on the participant latency means and the item latency means. In the analysis by participants, all three variables were treated as within-participant variables. In the analysis by items, partial cognate status and language of polysemy were treated as between-item variables while task was treated as a within-items variable. These analyses revealed a main effect of task, significant by participants, F_1 (1, 23) = 9.46, MSe = 770,217.47, $p < .05$; and by items, F_2 (1, 58) = 32.46, MSe = 639,269.92, $p < .05$, indicating longer latencies in lexical decision than in naming. There was also a main effect of partial cognate status, significant by participants, F_1 (1, 23) = 4.64, MSe = 130,667.78, $p < .05$; but not by items, F_2 (1, 58) = 2.84, MSe = 891,050.33, $p = .098$; indicating longer latencies for the partial cognates relative to controls. The main effect of partial cognate status was qualified by a three-way interaction with task and polysemy, significant by participants, F_1 (1, 23) = 4.58, MSe = 206,065.11, $p < .05$; and which approached significance by items, F_2 (1, 58) = 3.63, MSe = 621,315.64, $p = .062$. Although the interaction was significant in the omnibus analysis, the follow-up comparisons did not reveal any significant differences for either partial cognate type in either task (all p values > .05). However, an examination of Table 4-6 suggests that in lexical decision, the magnitude of inhibition was greater for partial cognates polysemous in English (a mean difference of 79 ms), while in naming there was greater inhibition for partial cognates polysemous in Spanish (a mean difference of 26 ms).

This pattern of results differed significantly from that observed in Experiment 1 in which native Spanish speakers showed overall *facilitative* effects of partial cognates. This difference may have been due to differences in the cross-language frequency of the partial cognate items. More specifically, the partial cognates were of a much higher frequency in English (the L1 of the participants in the present experiment) than in Spanish (the target language in the present experiment). This issue is addressed in more detail after the error analysis section below.

Table **4-6**

Mean latencies (milliseconds) and percent error rates (in parentheses) for the two partial cognate conditions and matched controls in the lexical decision and naming tasks of Experiment 2

Condition	Lexical decision	Naming
partial cognates polysemous in English	789 (28.9%)	646 (22.9%)
controls	710 (39.2%)	657 (18.7%)
Difference	**+79 (-10.3)**	**+11 (+4.2)**
partial cognates polysemous in Spanish	715 (9.7%)	664 (15.5%)
controls	716 (17.0%)	638 (13.2%)
Difference	**-1 (-7.3)**	**+26* (+2.3)**

* $p < .05$

Error data

The main effect of task was observed in the error data analyses and it was once again significant by participants, $\underline{F}_1$ (1, 23) = 11.16, MSe = 6,920.02, p < .05; and approached significance by items, $\underline{F}_2$ (1, 58) = 3.52, MSe = 26,884.43, $\underline{p}$ <.07. This was qualified by an interaction with partial cognate status, significant by participants, $\underline{F}_1$ (1, 23) = 9.70, MSe = 4,110.40, $\underline{p}$ < .05, but not by items, $\underline{F}_2$ (1, 58) = 1.77, MSe = 26,884.43, $\underline{p}$ > .05. Follow-up t-tests performed with a Bonferroni correction indicated that in lexical decision, partial cognates were recognized more accurately than controls, although this difference was only marginal, $\underline{t}_1$ (1, 23) = 2.4, $\underline{p}$ = .05.

The combined slower recognition latencies and higher accuracy for the partial cognates polysemous in English suggest that participants engaged a checking strategy when presented with word stimuli that had multiple semantic representations in the non-target L1. One reason why participants may have found it particularly difficult to suppress the non-target lexical representation of the partial cognates is that the partial cognates were of a much higher frequency in English (mean frequency = 78.8) than they were in Spanish (mean frequency = 38.8). This difference was statistically significant for the partial cognates polysemous in English, $\underline{t}_2$ (1, 13) = 2.70, $\underline{p}$ < .05; and for the partial cognates polysemous in Spanish, $\underline{t}_2$ (1, 13) = 4.3, $\underline{p}$ < .05.

When the critical stimuli were selected they were matched with control words based on their target language frequency, and not their frequency in the non-target language. For example, *grave* was paired with *golpe* (meaning “a hit or a slap”) based on its Spanish frequency and not its English frequency. The basis for this within-language frequency match was that if one assumes a selective account of bilingual lexical processing, than the frequency of a given word in the non-target language should not affect performance.

The homograph analyses, described earlier, demonstrated that relative cross-language frequency influences the nature of cross-language activation. Thus, it is plausible that the native English speakers showed inhibitory effects of partial cognate status due to the increased difficulty of suppressing the higher frequency lexical representation from L1. The greater magnitude of inhibition for partial cognates polysemous in the non-target L1, relative to those polysemous in the L2, further suggests that participants were sensitive to semantic polysemy. This contrasts with the data from the native Spanish speakers performing in English. Those participants showed general facilitative effects of partial cognate status, irrespective of polysemy. The different pattern observed with the native Spanish speakers could have been due to the fact that these items were of a much higher frequency in the target language than in the non-target, native language. At the end of this chapter we report analyses in which we directly compare the performance data for the partial cognate conditions across the two bilingual samples.

Post-hoc analysis of the influence of relative meaning dominance

In Experiment 1 a post-hoc analysis was performed on the native Spanish-speakers performance to examine the potentially modulating effects of the relative dominance of the multiple meanings of the partial cognates. Although in that analysis meaning dominance did not seem to affect performance, it was noted that the lack of an effect of dominance may have been due to the fact that the dominance ratings were obtained from native English speakers, and therefore may have not adequately reflected the dominance perception of native Spanish speakers. We therefore performed a similar post-hoc analysis of the native English-speakers' performance in the present experiment, since the dominance ratings might better reflect the participants' linguistic experiences.

As described in Appendix A, a series of norming procedures were carried out on the initial pool of partial cognate items. In one procedure, highly proficient English-Spanish bilinguals provided relative dominance ratings for the multiple meanings of the partial cognates. We used the dominance ratings in the regression analyses to see if they would account for unique variance when predicting latencies and error rates and to determine whether, after controlling for these ratings, polysemy would account for unique variance.

In the regression analyses reported below, we entered the following four predictors, word frequency, task, dominance rating and polysemy. Task was coded as either a "1" for lexical decision, or "-1" for naming. Polysemy was coded as either "1" for polysemous in English, or "-1" for polysemous in Spanish. Since word frequency was not normally distributed a log linear transformation was used. Finally, error rates were converted through an arcsine transformation since they were not normally distributed.

The regression equation used to predict latency accounted for 14.3% of the data and this relationship was significant, $\underline{F}_2$ (4, 61) = 3.54 $\underline{p}<.05$ (see Equation. **4.1**). Task was positively related to latency, $\underline{t}_2$ (1, 61) = 93.06, $\underline{p} < .01$, indicating slower latencies in lexical decision relative to naming. Polysemy was also positively related to latency, although this relationship only approached significance, $\underline{t}_2$ (1, 61) = 1.78, $\underline{p} = .08$, suggesting a trend for latencies to be slower for partial cognates polysemous in English. Dominance rating was not a significant predictor of latency, $\underline{t}_2$ (1, 61) = 0.91, $\underline{p} = .36$.

$$\text{Latency} = -0.89\ \text{frequency} + 3.06\ \text{task} + 0.92\ \text{dominance rating} + 1.78\ \text{polysemy} + (744.46) \qquad \textbf{4.1}$$

The regression equation used to predict error rates accounted for 11.9% of the data and this relationship was significant, $\underline{F}_2$ (4, 61) = 3.06, $\underline{p} < .05$ (see Equation. **3.2**). Polysemy was the only significant predictor, $\underline{t}_2$ (1, 61) = 3.22, $\underline{p} < .01$, and it was positively related to error rate, indicating higher error rates for partial cognates polysemous in English.

$$\text{Error rate} = -0.11\ \text{frequency} + 0.05\ \text{task} - 0.85 + 0.01\ \text{dominance rating} + 0.39\ \text{polysemy} + (25.47) \qquad \textbf{4.2}$$

The regression analyses suggest that the relative dominance of the shared, cognate meaning of the partial cognates did not moderate performance for these critical items. Furthermore, the effects of polysemy persisted even after controlling for frequency and task. This analysis provided further evidence that the native English participants' performance was inhibited by the lexical representations of the partial cognates in the non-target L1.

Summary and comparison of the out-of-context tasks across Experiments 1 and 2

General comparisons

In this section we summarize the major findings from the present experiment and report post-hoc analyses in which we directly compared the lexical decision and naming performance of the native Spanish speakers from Experiment 1 with the native English speakers of the present experiment. However, before performing these analyses, we first needed to ascertain whether the two participant groups differed in terms of L2 proficiency and task performance.

To test for proficiency differences, a one-way (participant group: Experiment 1 versus Experiment 2) MANOVA was performed on participants' mean self-assessed L2 proficiency ratings on L2 reading, writing, conversational fluency and speech comprehension. In that analysis, the main effect of participant group was not significant, $\underline{F}_1$ (5, 39) = 2.19, $\underline{p}$ = .08. Furthermore, follow-up t-test performed with a Bonferroni correction, indicated that the ratings across the two groups did not differ significantly (all $\underline{p}$ values > .05).

To test for differences in overall task performance two ANOVA's were performed on participants' latency and error rates for control items only (see Table **4-7**)

We restricted the analysis to control trials since these would not be biased by potential cross-language lexical activation.

In the latency analysis participant group was treated as a between-participants variable and task (lexical decision versus naming) was treated as a within-participants variable. In that analysis there was a main effect of task, $\underline{F}_1$ (1, 43) = 40.13, MSe = 273,618.21, $\underline{p} < .001$, reflecting the longer latencies for lexical decision relative to naming. The main effect of participant group was not significant, $\underline{F}_1$ (1, 43) = 2.05, MSe = 771,029.68, $\underline{p} > .05$, nor was the interaction with task, $\underline{F}_1$ (1, 43) = .63, $\underline{p} > .05$. Thus, the two participants did not differ overall in terms of the speed of their responding across the two tasks. However, it should be noted that, overall, the latencies of the native English speakers were slower than the native Spanish speakers in lexical decision and naming.

Table 4-7

Mean L2 response latencies (milliseconds) and percent error rates (in parentheses) of the Spanish-English bilinguals (Experiment 1) and English-Spanish bilinguals (Experiment 2) in lexical decision and naming[1]

	Task	
	Lexical decision	Naming
Spanish-English bilinguals	706	586
(n = 21)	(22.9%)	(21.0%)
English-Spanish bilinguals	733	639
(n =24)	(22.6%)	(11.0%)

[1] Based on control items only

In the analysis of error rates, participant group was treated as a between-participants variable and task was treated as a within-participants variable. In that analysis there was a main effect of task, F_1 (1, 43) = 22.48, MSe = 1,935.62, $p < .001$, and a main effect of participant group, F_1 (1, 43) = 5.60, MSe = 4,638.47, $p < .05$. The interaction between these two variables was significant, F_1 (1, 43) = 11.52, $p < .05$. Follow-up t-tests indicated that the difference in naming error rates between the two groups was significant, t (1, 43) = 3.74, $p < .05$, while lexical decision error rates were not, t (1, 43) = .15, $p > .05$.

One potential reason for the difference in L2 naming error rates across the two experiments was that, during the coding of the data, the raters adopted different criterion when scoring English spoken responses than Spanish spoken responses. Since both raters were dominant speakers of English, they might have been less sensitive to errors made in Spanish spoken responses. However, one of the raters was a native Spanish speaker and both coders formulated specific rules about what constituted an error in English and in Spanish.

Another possible reason for the difference in naming error rates was that the native English speakers were naming in an orthographically shallow language, in which the mappings between spelling and sound are highly consistent. The native Spanish speakers, on the other hand, were naming in a far less consistent, and orthographically deep language, English. Therefore, the native Spanish speakers could not as easily guess pronunciations of un-known words on-line without making errors.

A final possibility is that the different error rates were due to differences in L2 learning experiences. Overall, the native English speakers had spent more time immersed in their L2 environment (an average of nine months) than the native Spanish speakers (an average of four months), and this might have increased their oral proficiency. However, the fact that the native English speakers naming latencies were slower than the native Spanish speakers suggests that their naming accuracy was not due to better oral proficiency, but rather to the ability to guess the pronunciation of Spanish words. Since the two participant groups did differ in terms of naming accuracy in the analyses reported below participant group was added as an additional variable.

Cognates

The data from the present experiment overall reflected effects of cross-language activation. In regard to the cognates, the native English participants, like the native Spanish participants, were faster to recognize words that had high semantic and form overlap (i.e., the +P cognates) and showed a sensitivity to the cross-language consistency in phonological match in the lexical decision task which does not require that phonology be specified. Although the facilitative effects were not statistically reliable in naming in the present experiment, it should be noted that when an additional number of participants was included in a post-hoc analysis (the participants who were excluded based on high error rates in lexical decision) the magnitude of the effects was significant. The native Spanish speakers also showed facilitative effects for +P cognates in naming, however, only in accuracy. The lack of effects in latency may have been due to the fact that their overall naming latencies were faster than the latencies of the native English speakers.

Homographs

The homograph analyses provided further evidence that lexical access was affected by the cross-language match of lexical codes. This time performance was inhibited by inconsistent mappings in lexical codes (i.e. highly similar orthographic codes mapping on to different semantics). Although the inhibitory effects were statistically significant only in lexical decision in the analyses comparing homographs with controls, post-hoc correlational analyses performed on the homograph items alone revealed that naming latencies were influenced by the cross-language frequency of the homograph items.

In Experiment 1, the native Spanish speakers' naming performance was similarly influenced by the relative cross-language frequency of the homographs. One difference between the two experiments was that, in the present experiment, effects of homograph inhibition were significant in lexical decision, whereas in Experiment 1 they were not. To see whether the null effects was due to limited power we performed an analysis in which we combined the homograph performance data from both experiments. Homograph status was treated as a within-participants variable and participant group was entered as a between-participants variable. The main effect of homograph status was significant, F_1 (1, 43) = 5.16, MSe = 102,758.59, $p < .05$ and did not interact with participant group, F_1 (1, 43) = 1.47, $p > .05$. Thus, there were consistent inhibitory effects of homograph status in lexical decision for both groups of bilinguals.

Partial cognates

The data from the partial cognate analyses in the present experiment also provided evidence of inhibitory effects arising from cross-language activation of lexical codes. These effects were manifest in naming for partial cognates polysemous in Spanish and in lexical decision for items polysemous in English. As discussed earlier, the inhibitory effects for partial cognates was likely due to the overall higher lexical frequency of their L1 representations. However, what remains unclear is why inhibitory effects were observed for partial cognates polysemous in Spanish. To the best of the author's knowledge, this was the first examination of how polysemy influences the lexical access processes of cognates. In previous studies, such items would have been classified simply as cognates. The results from the present experiment suggest that polysemy does indeed modulate the commonly-observed effects of cognate facilitation, particularly since the magnitude of inhibition was greater for partial cognate polysemous in English.

What remains unclear is why the native Spanish speakers in Experiment 1 showed facilitative effects of partial cognate status. One possibility is that, since the partial cognates were of a much lower frequency in their L1 than the L2, it was easier for them to suppress the non-shared, homographic meaning and to therefore benefit from the general similarity in lexical form. In future studies the issue of polysemy should be further investigated by including more systematic matching in terms of cross-language frequency and the relative dominance of the alternative meanings of partial cognates.

General Discussion

The primary goal of the present experiment was to replicate effects of cross-language activation that have been repeatedly observed in prior research in de-contextualized tasks. It was essential to establish these effects in order to later examine how the presence of context (i.e. a sentence) might moderate cross-language activation. The findings from the experiment clearly reflected effects of cross-language activation, and thus confirmed the viability of using the selected materials to examine cross-language activation in context. Furthermore, the findings from this experiment replicated some previously observed cross-language effects. Such as facilitation for cognates with high form similarity.

Another motivation for conducting the present experiment was to draw comparisons between two different bilingual participant groups, performing the same tasks with the same critical materials, under similar linguistic contexts. There were a few parallels in the pattern of findings of the present experiment with the pattern observed for native Spanish speakers in Experiment 1. Both participant groups showed effects of cross-language activation across the three, critical word types (i.e. cognates, homographs and partial cognates). In both experiments there were significant effects of cognate facilitation and homographic inhibition.

There were also several differences between the two experiments. Overall, the naming performance of the native Spanish speakers appeared to be more affected by conflicting lexical codes. Their performance was inhibited by both –P cognates and homographs. The native English speakers on the other hand, did not show these effects in naming. As mentioned earlier, this might have been due to differences in immersion experiences. A subset of the native English speakers had spent more than a few years in their second language culture. This extended experience speaking the language, may have allowed them to better negotiate the phonological mismatches across their two languages.

Another difference between the two experiments was the pattern of findings in the partial cognate analyses. The native Spanish speakers showed general, facilitative effects associated with partial cognate status, which were not influenced by the language of their polysemy, or by the task. The native English speakers, however, showed effects of inhibition for the partial cognates. As discussed previously, these inhibitory effects may have been due to the high lexical frequency of the partial cognate items in their L1, making suppression more difficult.

The comparisons of cross-language activation effects across the two participant groups suggests that differences in task proficiency (which may be related to language proficiency) have an important influence on the types of effects observed. This issue is of particular relevance when studying bilinguals who are not yet highly proficient in their L2. Much of the research on bilingual lexical access has been based on the performance of highly proficient bilinguals. This focus has certainly helped the development of theoretical accounts of the nature of the bilingual lexicon. However, the findings from the present experiments clearly demonstrate the need to consider bilingual lexical access processes when L2 proficiency is developing.

The primary objective of Experiments 1 and 2 was to replicate cross-language activation effects for a set of word stimuli to be used in the examination of sentence context effects on language non-selectivity. This objective was achieved, and it was clear that the items selected were suitable to address issues of selectivity in a sentence processing experiment. In chapters 5 and 6, we investigated how effects of cross-language activation across the three, critical word types were influenced by the presence of sentence constraint.

Chapter 5

Experiment 3: Cross-language activation in sentence context: Spanish-English bilinguals

Predictions

In the preceding chapters we reported a set of results demonstrating non-selective language access during bilingual word recognition. These findings were obtained for a variety of different critical word types (e.g., homographs and cognates) across two different tasks (i.e., naming and lexical decision) and for two different bilingual samples (i.e., native Spanish and native English bilinguals). This, in conjunction with the plethora of prior research demonstrating similar effects of cross-language activation, presents a strong case for the non-selectivity hypothesis. Again, according to this hypothesis, the bilingual lexicon consists of two, integrated lexica in which activation spreads across the different levels of representation (i.e., orthographic, phonological and semantic) in a language non-selective way, such that lexical information from both languages becomes activated.

It is critical to note that the nature of the observed effects of cross-language activation is influenced by the context and the demands of the linguistic task, even when access is non-selective. An equally important assumption is that extra-linguistic factors, such as participant expectations, do *not* modulate cross-language activation. Instead, these factors appear to affect the lexical system relatively late and not early enough to constrain initial, bottom-up, non-selective processes (Dijkstra & Van Heuven, 2002; Marian et al., 2003).

The goal of the present experiment was to examine whether and how the presence of sentence context modulates cross-language activation. According to proponents of the non-selectivity hypothesis, sentence context constitutes a linguistic influence, and can therefore potentially influence what lexical information becomes active across a bilingual's two languages (Dijkstra & Van Heuven, 2002). Although there have been only a few studies to date that have examined bilingual lexical processing in sentence context, the findings so far suggest that sentence context does indeed constrain cross-language activation (Altarriba et al., 1996; Elston-Güttler, 2000; Van Hell, 1998).

Altarriba et al. (1996) examined the extent to which cross-language semantic and lexical features are generated when bilingual participants read high constraint sentences. They monitored the eye-movements of Spanish-English bilinguals as they read high and low constraint sentences in English. On half of the trials, one word in each sentence was a code-switched word from the non-target language, Spanish (e.g., He wanted to deposit all of his *dinero* (money) in the credit union). Critically, this code switched word was either a high frequency word or a low frequency word in Spanish. Analyses of the first fixation durations on the code-switched words revealed an interaction between sentence constraint and word frequency, such that fixations were delayed in high constraint sentences when the code-switched word was of a high lexical frequency. This suggests that the participants generated both semantic and lexical level feature restrictions when reading high constraint sentences. That is, when presented with the high frequency, code-switched word (e.g., *dinero*), processing was inhibited because the word met all of the semantic but not the lexical feature restrictions. If bilinguals generate lexical level restrictions when reading high constraint sentences, one would predict that less lexical information from the non-target language would become activated, thus attenuating effects of cross-language activation.

Both Elston-Güttler (2002) and Van Hell (1998) found further evidence that sentence constraint attenuates effects of cross-language activation. Elston-Güttler observed interlingual homograph priming in lexical decision, but when the same items were presented following a sentence context, the priming effect disappeared. Similarly, Van Hell found that presentation of a high constraint sentence eliminated cognate facilitation for highly proficient Dutch-English bilinguals in a subsequent lexical decision task.

The logic in the present experiment was to take the very same critical items and controls whose properties were examined out of context in the first two experiments, and to place them in sentence contexts that varied in constraint. Sentence contexts were designed to make the target word highly probable (high constraint) or not (low constraint). The sentences were presented to participants using an RSVP (rapid serial visual presentation) paradigm in which words were presented, one at a time, at the center of a computer monitor.

Given the preliminary findings in the literature, in the present study we expected to find effects of cross-language activation in sentence context but we also predicted that the nature of these effects would be modulated by sentence constraint. For the cognates, we expected to find similar effects of cross-language phonological match in low constraint sentences as those observed out of context. That is, we expected naming latencies to be facilitated for the +P cognates only[4]. In high constraint sentences we predicted that these effects would be attenuated or eliminated due to the top-down influences of message level information from the sentences being read.

Another critical prediction in the present experiment was that the language context provided by the sentences would not be sufficient, in and of itself, to constrain non-selectivity. This prediction was based on evidence from Van Hell (1998), in which low constraint sentences did not eliminate cognates facilitation, and from a recent neurocognitive study that examined the effects of linguistic context on non-selectivity (De Bruijn et al., 2001). In that study, highly proficient Dutch-English bilinguals performed a lexical decision on target words that were presented in sets of three words (thus, providing a language context). On critical trials the word triplet consisted of an exclusively Dutch word, followed by a Dutch-English homograph, which in turn was followed by a word that was semantically related to the non-target, English interpretation of the homograph (e.g., ZAAK- ANGEL- HEAVEN). If the first, language-exclusive word (e.g. *zaak*) were sufficient to constraint non-selectivity, no priming should have been observed for the target word (e.g., *heaven*).

Both event-related potentials and reaction-time measures reflected effects of semantic priming for target words that were preceded by interlingual homographs (De Bruijn et al., 2001). Thus, the language context provided by the first word of the triple

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[4] The reader will recall that in Experiment 1 analyses of monolingual data revealed a potential confound for the –P cognate items. Therefore, it remained unclear whether the inhibition observed for these items was due to cross-language activation of conflicting, phonological codes.

was not sufficient to constrain non-selectivity. To the extent that low constraint sentences provide only a language context, we expected effects of cognate facilitation and homograph inhibition to persist in low constraint sentences.

In the present experiment we included only the partial cognates that were polysemous in the target L2, English (e.g., *grave*). By focusing our analyses on this subset of items we were able to compare performance for partial cognates when they were inserted in sentences that supported the shared, cognate meaning (e.g., "serious") versus the L2 specific, homograph meaning (e.g., "tomb"). We expected performance to be influenced by the particular meaning supported by the sentence. More specifically, we expected lexical access to be inhibited when the sentence biased the L2-specific homograph meaning of the partial cognate. For the bilingual participants in the present experiment the L2 specific homographic meaning of the partial cognates was the subordinate meaning. Research on monolingual sentence comprehension has demonstrated that when sentences bias the subordinate meaning of ambiguous words, lexical processing is inhibited due to the competition from the more dominant interpretation (e.g., Duffy, Henderson & Morris, 1989; Duffy, Kambe & Rayner, 2001: Rayner & Duffy, 1986). Furthermore, we predicted that this inhibition would be greatest for the low comprehension performers reading high constraint sentences.

Method

Participants

Forty-six participants from the University of Valencia, Spain completed the experiment. All individuals were paid for their participation. Of these 46, four were excluded due to technical errors in the experimental session. Another three participants were excluded due to low proficiency (their average self-assessed rating was less than four and their average word naming RTs exceeded 900 ms). The remaining 39 participants were classified into two different comprehension performance groups [less (n= 22) and more (n= 17)] based on their overall naming accuracy and their performance on comprehension questions that were randomly presented during the RSVP procedure (see “Proficiency measures” section for a description).

Materials

Target words

A set of 86 critical English words comprised the critical materials. These critical words consisted of 43 cognates (*e.g., piano*); 24 homographs (e.g., *pan*) and 19 partial cognates (e.g., *grave*). A different number of items were selected in each condition in order to meet specific selection criteria (see Appendix A). These items were drawn from the same pool of items used in the out-of-context task. The identical cognate items, homograph items and partial cognate items from the out-of-context tasks were used in the RSVP task (see Table **5-1**).

For each critical condition a control condition was created. These control conditions were constructed through an item-by-item match in which every critical word was paired with an English control word matched on word frequency in English, word length and phonological onset. The controls selected were largely the same ones used in the out-of-context tasks. Different control words were selected when the demands of creating syntactically similar sentences called for replacement.

Table **5-1**

Examples of stimuli used in Experiment 3 and their lexical characteristics

	Critical words			Controls		
Condition	Example	English Frequency[1]	Length[2]	Example	English Frequency[1]	Length[2]
Cognates						
+P	band	41.9	6.2	bond	40.0	6.3
-P	acre	38.6	5.8	anger	38.6	6.0
Partial cognates						
Polysemous in English	grave	78.1	5.7	gift	78.5	5.6
Homographs	pan	40.0	4.4	pen	38.9	4.9

1. Kuçera & Francis, 1986
2. Number of letters

Critical sentences

The target words were inserted in two types of sentence conditions, high and low constraint. We operationalized "constraint" as the degree of semantic support provided by the sentence for the target word. Our goal was to create sentences that differed in the degree to which they provided semantic constraints for the to-be-named critical words (see Table 5-2). Thus, we were not concerned with the predictability of the target word per se, but rather we wanted to create sentences in which the initial frame, preceding the target, provided contextual support for the meaning of the target word.

Table 5-2

Example sentences used in the English RSVP task

	Condition	
Constraint	Critical	Control
High constraint	The composer sat at the bench and began to play the piano as the lights dimmed.	The student looked around for some paper and a sharp pencil as the test session began.
Low constraint	As we walked through the room we noticed there was a large piano by the window.	The drawers were so messy that I could not find my favorite pencil to write with.

When creating the sentences, care was taken to match each critical and control sentence in terms of number of words, syntactic complexity, and the length of the word preceding the target. Also, critical words were never in the word final position of the sentence and a minimum of one word followed the critical word. The primary investigator constructed these sentences after consultation with a linguist in the Department of Spanish linguistics, who has had considerable experience in experimental sentence construction. Sentences were created such that the syntactic complexity of the control and critical pairs were matched and, to the extent possible, the syntactic structure preceding the target word was the same. The maximum length of the sentences was 30 words, with a maximum of 15 words preceding the to-be-named target and 15 words following the target.

In a separate cloze norming experiment (described in Appendix B) we verified the constraint manipulation of the sentences. An independent sample of English monolingual speakers read each sentence frame, up to, but not including, the target word. They were asked to write a completion for each sentence. The percentage of times that they produced the actual target word or a synonym of the target was calculated (referred to here as production probability) (see **Table 5-3** for the mean production probabilities for the three critical word types and their respective controls). An analysis of variance was performed on the production probabilities of the high constraint sentences across all of the critical word conditions to ensure that the high constraint sentences indeed had higher production probabilities than the low constraint sentences and to be certain that the conditions did not differ in terms of the magnitude of this constraint. A two-way (constraint x condition) ANOVA revealed a main effect of constraint, $\underline{F}_2$ (1, 187) = 424.02, MSe = 91,948.30, $\underline{p} < .001$, but no interaction with condition. Thus, the high constraint sentences were indeed more semantically constraining than the low constraint sentences and the magnitude of this constraint was similar across all conditions. However, as seen in **Table 5-3**, the overall production probabilities for the high constraint sentences were not very high (mean probability = 54.2).

Table 5-3

Mean production probabilities for the English sentences across the three critical word type and control conditions

	Constraint	
	High	Low
cognates	.55	.00
homographs	.59	.04
partial cognates	.54	.05
controls	.48	.02

A set of analyses was also performed on the production probabilities of the specific conditions for each word type. For the cognate conditions, a two-way [constraint x condition (+P cognate, -P cognate, +P control, -P control)] repeated measures ANOVA was performed on the item means, with constraint as a within-items variable and condition as a between-items variable (see Table 5-4). There was a main effect of constraint, F_2 (1, 82) = 258.88, MSe = 35,283.46, $p < .001$, reflecting the higher production probabilities for the high constraint sentences, indeed neither the target word nor a synonym was ever produced in any of the low constraint sentences. The interaction between constraint and condition approached significance, F_2 (1, 82) = 2.19, $p = .095$. A follow-up t-test revealed that the difference in mean production probabilities for the high constraint, –P cognate sentences and matched controls was marginal, t_2 (1, 40) = 1.89, p = .065. Since this difference in sentence constraint could inflate performance differences between the critical and control conditions, the mean production probability for each high constraint item was entered as a covariate in the analyses of variance performed on the item latency and error means.

Table **5-4**

Mean production probabilities for the English cognate and cognate-control sentences

	+ P conditions		- P conditions	
	cognates	controls	cognates	controls
High constraint	.55	.58	.55	.37
Low constraint	0	0	0	0

For the homograph conditions, a two-way [constraint x homograph status (homograph, control)] ANOVA revealed a main effect of sentence constraint, F_2 (1, 46) = 99.69, MSe = 28,756.92, $p < .001$, which did not interact with homograph status (see Table **5-5**). A follow-up t-test confirmed that the difference in production probabilities for the high constraint homograph sentences and matched controls did not differ, $t_2(1, 46) = 1.08$, $p = .29$.

Table **5-5**

Mean production probabilities for the English homograph and homograph-control sentences

	Condition	
	homographs	controls
High constraint	.60	.49
Low constraint	.04	.02

For the partial cognate conditions two ANOVA's were performed on the production probabilities of the partial cognate and control items. In the first ANOVA, sentence constraint and partial cognate status (partial cognate or control) were the independent variables to test whether there were constraint differences across the critical and control items (see **Table 5-6**). In that analysis there was a main effect of constraint, $F_2(1, 36) = 115.33$, MSe = 12,433.48, $p < .001$, which did not interact with partial cognate status. Thus, the magnitude of sentence constraint was similar across the partial cognate and control items.

Table 5-6

Mean production probabilities for the English partial cognate and partial cognate-control sentences

	Condition		
	Partial cognate		
	Cognate meaning bias	Homograph meaning bias	controls
High constraint	.53	.55	.48
Low constraint	.01	.08	.03

In the present experiment we focused our attention on partial cognates that were polysemous in the participants' L2, English (e.g., *grave*). The reason for this focus was to enable us to manipulate whether these partial cognates were inserted in sentences that either supported the cognate meaning of the partial cognate (e.g., the "serious" meaning of *grave*) or supported the homograph meaning (e.g., the "tomb" meaning of *grave*). Thus, a second ANOVA was performed on the item production probabilities. In this analysis sentence constraint and sentence bias (cognate versus homograph) were the independent variables. Once again there was a main effect of constraint, F_2 (1, 19) =

70.49, MSe = 12,014.68, $p < .001$ and no interactions with sentence bias condition. A follow-up t-test confirmed that the production probabilities for the high constraint, partial cognate sentences did not differ from matched controls for either those sentences biasing the cognate meaning, t_2 (1, 36) = .44, $p = .67$ or those biasing the homograph meaning, t_2 (1, 36) = .63, $p = .54$. Thus, the sentences were equally constraining across the two bias conditions.

Comprehension sentences

In addition to the critical sentences, 30 filler sentences followed by a comprehension question were presented randomly. The follow-up questions were designed to address the main topic of the sentence it followed (e.g., *The couple lived in a small apartment in Amsterdam. Where did the couple live?*). These 30 fillers were initially included as a way of assuring that participants were indeed paying attention to the meaning of the sentences and were not included in any of the critical analyses described below. The filler sentences were created so that their syntactic complexity did not differ from the critical sentences and that there were not any linguistic cues that might signal to the participant that a follow-up question would be presented.

Procedure

Participants were recruited through announcements that were posted across the university campus. When participants arrived at the lab they were greeted in English

(L2). After completing an informed consent form (which was written in Spanish to ensure that the experimental description was clear), participants were seated in front of a laptop computer. Instructions were presented on the laptop LCD display in English. These instructions were read to the participants out-loud. They were told that they would see sentences in English, presented in the middle of the computer screen, one at a time. They were instructed that one word in each sentence would appear in red, and that they were to name this word out loud into the microphone, as quickly and accurately as possible.

If they did not know a word they were instructed to make their best guess in pronunciation. They were further told that on some trials the sentences were followed by a question and that they were to answer this question out loud into the microphone. If they did not know an answer they were encouraged to guess. If they did not guess they said “I don’t know”.

Clarifications were given in Spanish when needed. Participants then completed 10 practice trials. Following practice the experimenter left the room. The RSVP session was tape recorded and reaction times were recorded in milliseconds (ms) by the computer.

Each trial was initiated by the presentation of a fixation point (“+”) in the center of the screen. This fixation remained on the screen until the participant pressed a key on the response box. Each word of the sentence was then presented for 250 ms. The target word was presented in a red font and remained on the screen until either the microphone registered a spoken response, or after 3000 ms had elapsed. The remaining words of the sentence were then presented for 250 ms each. For filler trials, the sentences were presented in the same way, except that they were followed by the presentation of a question, in its entirety. The question remained on the screen until the microphone registered a spoken response or until ten seconds had elapsed.

After completing the RSVP task, participants completed a language history questionnaire (LHQ) in which they were asked to self-assess their proficiency in reading, writing, speaking and listening in English and Spanish on a ten-point scale. They also reported any immersion experiences they had in English-speaking countries as well as their familiarity and proficiency with languages other than English and Spanish. The entire experimental procedure was completed in approximately 40 minutes.

Results and Discussion

Proficiency measures

To ensure that participants comprehended the sentences they were reading, we analyzed their performance on the filler comprehension questions. The comprehension scores were based on participants' accuracy when answering the follow-up comprehension questions on filler trials. Each response was scored on a range from zero to three. A "0" was given if no answer was given at all. A "1" was given to a response that was not correct, but reflected information from the sentence. A "2" was given if the answer was correct but not complete. Finally, a "3" was given when the answer was correct and complete. There were a total of 30 fillers, thus the maximum number of possible points was 90.

Performance on the comprehension scores was quite variable, ranging from six to 79. Given the restricted number of participants and the fact that performance was not uniformly high, participants were grouped into two comprehension groups (low and high). It was critical to maximize the use of the available data while at the same time avoiding a potential masking of sentence context effects due to low comprehenders' performance since the major theoretical question of interest in this experiment was the influence of sentence constraint on cross-language activation. Thus, in the analyses reported in this chapter we included comprehension group as an additional independent variable. This differs from the out of context data, reported in Chapter 3, in which participants were not divided according to any proficiency measure. At the end of this chapter we address this issue when making cross-context comparisons across the two experiments. Participants were grouped as "high performers" based on two criteria: Their mean comprehension score had to be half of the total number of points (i.e. 45) and their overall accuracy in naming across control trials had to be less than 30%.

The difference in comprehension performance could have been due to a variety of factors, including differences in proficiency and/or motivation. The proficiency measures from the language history questionnaire for the two comprehension groups are summarized in **Table 5-7**. While both groups considered themselves to be relatively proficient in English, the high comprehension performers rated their overall English proficiency higher (mean rating = 7.9) than the low comprehension performers (mean rating = 6.3), t (1, 37) = 2.81, $p < .05$. Thus, participants' sentence comprehension was at least partially due to differences in proficiency.

The participants' ages ranged from 18 to 29, with a mean age of 22. Both proficiency groups had been studying their L2 for about ten to eleven years. The two groups had also spent similar amounts of time abroad (about 3 months on average). Of the 39 participants, 30 reported having high proficiency in Valenciano as well as in Spanish and English. Of these 30, 16 considered themselves native speakers of Valenciano. Thus, the majority of the participants were trilinguals, with proficiency in Spanish, English and Valenciano. It should be noted that Valenciano is more similar to Spanish than it is to English. It is therefore unlikely that their proficiency in Valenciano would affect English lexical processing differentially.

Table 5-7

Language experiences and self-assessed proficiency ratings of the Spanish-English bilingual participants (n=39) of Experiment 3

	High comprehension performers (n = 19)		Low comprehension performers (n=20)	
Age	22.4		22.3	
Length of English study (years)	10.8		10.3	
Length of immersion in an English-speaking country (months)	3.5		2.4	
Comprehension score (maximum = 90)	62.1		36.2	
	Self-assessed ratings[1]			
	High comprehension performers		Low comprehension performers	
	English (L2)	Spanish (L1)	English (L2)	Spanish (L1)
Reading	7.9	9.9	6.5	9.8
Speaking	7.2	9.8	5.8	9.9
Writing	7.4	9.6	5.6	9.6
Speech comprehension	8.0	9.9	6.7	9.9
Mean rating	**7.8**	**9.8**	**6.3**	**9.8**

1. Based on a ten-point scale

Data trimming procedures

The primary investigator and a trained research assistant independently coded the same subset of participants' spoken responses. A comparison of these ratings demonstrated that the inter-rater reliability exceeded the 95% criterion. Mean reaction times (RTs) for correct trials were then calculated for each participant in each condition. RTs that were faster than 300 ms or slower than 3000 ms were considered outliers and excluded from the analyses. RTs that were more than 2.5 standard deviations above or below the participants mean RT were also considered outliers and eliminated from the analyses. These data trimming procedures led to an exclusion of 2.5% of all trials. The microphone failed to pick up spoken responses on another 2.6% of all trials.

General approach

First, general analyses were performed to assess the overall effects of sentence constraint and comprehension ability on performance. Second, data from the three critical word types (cognates, homographs and partial cognates) were analyzed. Each condition was analyzed separately to test for general effects of cross-language activation. These per condition analyses were necessary given the constraints of item matching. For each word in each condition, a control word, matched on lexical frequency and word length was selected. It was not possible to find a single set of control words that would adequately match the lexical characteristics of the items across all three of the critical conditions (i.e. cognates, homographs and partial cognates).

Finally, we made comparisons between we the present experiment with the out-of-context performance reported in Chapter 3. In those comparisons we addressed how context (no context, low sentence constraint, high sentence constraint) and proficiency modulate effects of cross-language activation. When relevant we performed post-hoc analyses in which we directly compared the performance data across experiments.

Overall analyses of the effects of sentence constraint

Although the low comprehenders performed more poorly on the follow-up comprehension questions, this did not necessarily mean that they were not as sensitive to the sentence constraint manipulation as the high comprehenders. As mentioned earlier, their decreased ability to answer these questions could have been due to a number of factors such as L2 proficiency and/or individual differences in working memory capacity. To assess whether the sentence constraint manipulation had indeed affected participants' naming performance, and to assess whether this effect of constraint was different for the two comprehension groups, a two-way (sentence constraint by comprehension group) ANOVA was performed on the participant latency and error rate means for all control items. This analysis was restricted to control trials because the data for critical trials would be tainted by effects of the cross-language lexical properties.

The overall mean naming latencies and error rates of the two participant groups for control items in high and low constraint sentences are summarized in Table **5-8** . The ANOVA performed on the latency data revealed a main effect of sentence constraint, $\underline{F}_1$ = (1, 37) = 6.32, MSe = 9,928.44, $\underline{p} < .05$. This was reflective of the shorter naming latencies for target words embedded in high constraint sentences (mean RT = 689 ms) than target words embedded in low constraint sentences (mean RT = 699 ms). Thus, participants' performance was affected by the constraint manipulation. It should be noted that this effect of sentence constraint was manifest despite the lower production probabilities of the control sentences. The main effect of comprehension group was not significant, F_1 (1, 37) = .05, MSe = 635,665.53, p = .82, indicating that the low comprehenders were not slower at producing the target words. The interaction between constraint and comprehension group was not significant, F_1 (1, 37) = 2.91, MSe = 9,928.44, p = .10, which meant that the constraint manipulation affected both participant groups equally.

Table **5-8**

Mean naming latencies (in milliseconds) and error rates (in parentheses) across the high- and low- constraint control sentences of Experiment 3

	Comprehension performance	
Sentence constraint	High	Low
High	689	689
	(15.3%)	(26.2%)
Low	692	705
	(14.0%)	(25.3%)
Difference	**-3**	**-16**
	(+1.3)	**(+0.9)**

The ANOVA performed on the error rates showed a main effect of comprehension group, $\underline{F}_1$ (1, 37) = 21.79, MSe = 4,055.52, $\underline{p} < .001$, reflecting the higher error rates of the low comprehenders. There was no main effect of constraint, $\underline{F}_1$ (1, 37) = .87, MSe = 968.51, $\underline{p} = .36$ and no interaction, $\underline{F}_1$ (1, 37) = .04, $\underline{p} = .85$. Thus, unlike the latency data, the pattern in the error data did suggest a proficiency difference between the two comprehension groups. Also, unlike the latency data, error rates were not affected by sentence constraint.

Overall the effects of sentence constraint were subtle; they were only evident in latency and differed only by ten milliseconds on average. Similar subtle effects of sentence constraint have been observed in prior studies that have implemented RSVP methodology (Altarriba et al., 1996; Simpson et al., 1989). Sentence constraint did affect both high and low comprehenders equally and it was therefore important to add comprehension group as a variable rather than eliminate data from the low comprehenders (an approach that might be advisable if the constraint manipulation had not worked for the low comprehenders).

Analyses per condition

Cognate analyses

Latency data

The mean naming latencies for the cognate and control conditions for the two comprehension groups are summarized in **Table 5-9** . A Four-way (comprehension group x sentence constraint x cognate status x phonological similarity) ANOVA was performed on the participant means and an ANCOVA (using production probabilities as a covariate) on the item means. In the analysis by participants, comprehension group was treated as a between-participants factor and sentence constraint, cognate status and phonological status were within-participant factors. In the analysis by items, comprehension group and sentence constraint were treated as a within-item factors, cognate status and phonological status were between-item factors and production probability was entered as a covariate. There was a main effect of cognate status, which was significant in the analysis by participants, F_1 (1, 37) = 6.85, MS_e = 79,246.80, $p < .05$, and approached significance by items, F_2 (1, 81) = 3.27, MSe = 1,023,820.28. 13, $p = .07$. The effect of cognate status was qualified by a four-way interaction with comprehension group, sentence constraint and phonological similarity, significant in the analysis by participants F_1 (1, 37) = 6.73, MSe = 34,906.01, $p < .05$, but not by items, F_2 (1, 81) = .11, MSe = 589,908.42, $p > .05$.

Two, post-hoc 2 (constraint) by 2 (cognate status) ANOVA's, with Bonferroni corrections, were performed on the low comprehenders' and high comprehenders' latencies for the +P cognates and controls. The analysis performed on the low comprehenders' latencies revealed a main effect of cognate status, $\underline{F}_1$ (1, 21) = 12.50, MSe = 49,413.48, $\underline{p}$ = .02, indicating shorter latencies for the cognates. This did not interact with sentence constraint, $\underline{F}_1$ (1, 21) = 1.76, MSe = 20,108.09, $\underline{p}$ = .80. Thus, the magnitude of cognate facilitation for the +P cognates did not differ across the two sentence constraint types for the low comprehenders, suggesting that for these participants, sentence constraint did not attenuate cross-language activation.

The ANOVA performed on the high comprehenders' latencies revealed a main effect of cognate status, $\underline{F}_1$ (1, 18) = .016, MSe = 17,675.99, $\underline{p}$ = .02, which interacted with sentence constraint, $\underline{F}_1$ (1, 18) = 8.49, MSe = 17,383.57, $\underline{p}$ = .04. Thus, for the high comprehenders, +P cognate facilitation was moderated by sentence constraint.

Table 5-9

Mean naming latencies (in milliseconds) and percent error rates (in parentheses) for the cognate and control words in sentence context in Experiment 3

	Comprehension group			
	High performers		Low performers	
	Sentence constraint			
Condition	High	Low	High	Low
+P cognates	688 (14.4%)	663 (14.4%)	655 (18.9%)	675 (22.4%)
+P controls	692 (15.4%)	709 (18.8%)	696 (26.9%)	697 (24.9%)
Difference	**-5** **(-1.1)**	**-46*** **(-4.4)**	**-41*** **(-8.0)**	**-22*** **(-2.5)**
-P cognates	700 (32.2%)	700 (31.6%)	687 (34.0%)	700 (37.9%)
-P controls	692 (15.9%)	686 (12.9%)	692 (24.8%)	711 (23.0%)
Difference	**+8** **(+16.3)**	**+14** **(+18.7)**	**-5** **(+9.2)**	**-11** **(+14.9)**

* $p < .05$

In the cognate latency analysis effects of cross-language activation were observed, even in sentence context. This demonstrated that linguistic context in and of itself (i.e., the presence of words in a sentence) was not sufficient to override non-selectivity. However, the degree of non-selectivity was moderated by both contextual constraint and comprehension performance. Naming latencies for cognates were facilitated only when they had high cross-language phonological similarity (i.e., the +P cognates) and the magnitude of this facilitation was greatest in low constraint sentences. Furthermore, only for the more proficient bilinguals was the magnitude of this +P facilitation moderated by context.

Error data

The mean error rates for the cognate and control conditions are summarized in **Table 5-9**. There was a main effect of comprehension group, significant in the analysis by participants, $\underline{F}_1$ (1, 37) = 7.13, MSe = 20,596.45, $\underline{p} < .05$, and by items, $\underline{F}_2$ (1, 81) = 6.59, MSe = 13,435.53, $\underline{p} < .05$. This was reflective of the higher error rates of the low comprehenders. There was a main effect of cognate status, significant in the analysis by participants, $\underline{F}_1$ (1, 37) = 25.43, MSe = 3,561.15, but not by items, $\underline{F}_2$ (1, 81) = 1.53, MSe = 112,616.76, $\underline{p} = .28$. This main effect was qualified by an interaction with phonological similarity, significant in the analysis by participants, $\underline{F}_1$ (1, 37) = 54.06, MSe = 4,791.47, $\underline{p} < .05$, and by items, $\underline{F}_2$ (1, 81) = 4.61, MSe = 112,616.76, $\underline{p} < .05$. Follow-up t-tests performed with a Bonferroni correction showed that the low comprehenders made more errors when naming the –P cognates than when naming controls in both low constraint sentences, $\underline{t}_1(1, 19) = 2.97$, $\underline{p} < .05$, and high constraint sentences, $\underline{t}_1\ (1, 19) = 2.99$, $\underline{p} < .05$. The high comprehenders also showed this increased error rate for –P cognates in both low constraint sentences, $\underline{t}_1\ (1, 18) = 4.97$, $\underline{p} < .05$ and high constraint sentences, $\underline{t}_1\ (1, 18) = 4.61$, $\underline{p} < .05$.

The exact nature of the interaction between cognate status and phonological match differed across the latency and error data. In the latency data, the interaction was driven by the facilitative effects of the +P cognates. In the error data, the interaction was driven by the inhibitory effects of the –P cognates. As discussed in Chapter 3, there was a potential lexical confound for the –P cognate items. English monolinguals showed longer naming and lexical decision latencies for this condition relative to the other conditions. Therefore, it is likely that the phonological characteristics (e.g., onset complexity) were different than the other conditions. Cognates that differ phonologically across languages may be more likely to have within-language phonological characteristics that can slow lexical processing, because they are more likely to contain complex mappings between orthography and phonology. Thus, it was possible that the –P cognate inhibition observed in the present experiment was due to a phonological confound in the –P condition. Furthermore, the fact that the high constraint sentences constructed for the –P controls were not as constraining as the other conditions could explain why these inhibitory effects were not attenuated by sentence constraint.

Despite the potential problem with the –P cognate items, the data summarized here provided evidence that linguistic context in and of itself is not sufficient to eliminate effects of non-selectivity. Instead, non-selective effects appeared to be constrained by both the degree of contextual constraint and participants' comprehension ability. This is compatible with prior research on sentence context effects and bilingual lexical activation (Van Hell, 1998).

Currently the literature on bilingual lexical activation does not provide a specific account of the mechanism through which sentence context exerts its effect on non-selectivity. However, the pattern of performance in the cognate analyses can be understood through a feature constraint account of sentence processing (Schwanenflugel & Shoben, 1985). According to this account, sentence constraint influences performance through the generation of semantic feature restrictions. With increasing sentence constraint more numerous and more specific restrictions are generated. As discussed earlier, Altarriba et al. (1996) provided evidence that lexical feature restrictions are also generated from sentence context. Lexical feature restrictions could account for the attenuated +P cognate facilitation in high sentence constraint. As sentence constraint increases, the number of semantic and lexical feature restrictions also increases, and these features might have included information regarding language membership and/or specific orthographic and phonological characteristics of the cognates. The increased number and specificity of the lexical feature restrictions generated might have decreased the overall activation of the non-target L1.

Why did low comprehenders not show attenuated non-selectivity in high constraint sentences? The reader will recall that these participants did show a constraint effect in their performance overall, so the reason could not have been that they simply were not sensitive to the constraint manipulation. Rather, it seemed that these participants were less efficient at carrying out the processes involved in the RSVP task (naming target words while simultaneously maintaining the message of the sentence in working memory). In the monolingual domain there is evidence demonstrating that low comprehension performers are less efficient at suppressing irrelevant lexical information (Gernsbacher & Faust, 1991). It is possible that the low comprehension performers were not able to effectively suppress irrelevant information from the non-target L1 when reading the high constraint sentences.

In the case of cognates, the semantic features of the critical words in both languages always matched the semantic features of the sentences. What happens when the critical word's semantic properties from the L1 do not match these restrictions? A feature restriction account would predict that, if those semantic features from the non-target L1 are being activated, then performance should be inhibited. Furthermore, according to Gernsbacher and colleagues, this inhibition would be greater for low comprehension performers and should be observed irrespective of sentence constraint. The high comprehension performers, on the other hand, should only show inhibitory effects in low constraint sentences. In high constraint sentences their ability to effectively suppress the non-target L1 should eliminate inhibitory effects of homograph status. We addressed this possibility by analyzing performance for the interlingual homographs, words with high form similarity that do not share any meaning across languages (e.g., *fin* means "the end' in Spanish).

Homograph analyses

Latency data

The mean latencies for the homograph and control conditions for the two proficiency groups are summarized in Table **5-10**. Three-way (comprehension group x sentence constraint x homograph status) ANOVA's were performed on the participant and item latency means. In the analysis by participants, comprehension group was treated as a between-participants variable and sentence constraint and homograph status were treated as within-participant variables. In the analysis by items, homograph status was treated as a between-items variable and comprehension group and constraint were treated as within-item variables.

Table **5-10**

Mean naming latencies (in milliseconds) and percent error rates (in parentheses) for the homograph and control words in sentence context in Experiment 3

	Comprehension performance			
	More		Less	
	Sentence constraint			
Condition	High	Low	High	Low
Homographs	688 (20.5%)	698 (22.6%)	700 (28.6%)	698 (23.2%)
Controls	688 (13.0%)	704 (8.2%)	686 (20.4%)	705 (17.2%)
Difference	**0** **(+7.5)**	**-8** **(+ 14.4*)**	**+14** **(+ 8.2)**	**-8** **(+6.0)**

* p < .05

The main effect of comprehension group was not significant by participants, F_1 (1, 37) = .01, MSe = 1391,683.29, $p > .05$, but was significant by items, F_2 (1, 46) = 7.02, MSe = 248,687.77, $p < .05$, which was reflective of the shorter latencies of the high comprehension performers (mean latency = 691ms) relative to the low comprehension performers (mean latency = 719 ms). The interaction between comprehension group and sentence constraint was not significant by participants, F_1 (1, 37) = .12, MSe = 87,096.11, $p > .05$, but it was marginal by items, F_2 (1, 46) = 4.05, MSe = 27,9421, $p = .05$. Follow-up t-tests performed with a Bonferroni correction did not yield any significant differences in latency across the two sentence constraint conditions for either the high or low comprehenders (all p values > .05). An examination of the means suggested that the magnitude of facilitative effects associated with high constraint sentences was greater for the high comprehension performers than the low performers. The main effect of homograph status was not significant by participants, F_1 (1, 37) = .01, MSe = 39,505.10, p > .05 or by items, F_2 (1, 46) = .04, MSe = 578,303.44, p > .05.

Error data

The mean error rates for the homograph and control conditions are summarized in Table **5-10**. Three-way (comprehension skill x sentence constraint x homograph status) ANOVA's were performed on the participant and item error rate means. In the analysis by participants, comprehension skill was treated as a between-participants variable and sentence constraint and homograph status were treated as within-participant variables. In the analysis by items, homograph status was treated as a between-items variable and comprehension skill and constraint were treated as within-item variables.

The main effect of comprehension skill was significant by participants, F_1 (1, 37) = 5.81, MSe = 10,601.65, p < .05, and by items, F_2 (1, 46) = 15.87, MSe = 7285, p < .05. There was also a main effect of homograph status, significant by participants F_1 (1, 37) = 29.06, MSe = 4063.22, p < .001, but not by items, F_2 (1, 46) = 2.53, MSe = 56413.31, p = .12. This main effect of homograph status was indicative of the overall higher error rates for the homographs relative to controls. Although the three-way interaction between comprehension skill, sentence constraint, and homograph status was not significant, an examination of Table **5-10** suggests that sentence constraint had differential effects on the naming performance of the two proficiency groups. Follow-up t-tests performed with a Bonferroni correction showed that for the high comprehenders, homograph error rates were significantly higher than control words in the low constraint sentences, t_1 (1, 18) = 5.48, $p < .05$, but not in high constraint sentences, t_1 (1, 18) = 2.21, $p = .16$. For the low comprehenders, the error rates for the homographs did not differ from controls in either high sentence constraint, t_1 (1, 19) = 1.60, $p = .48$; or low constraint, t_1 (1, 19) = .24 Thus, sentence constraint did not reduce cross-language competition for the low comprehension performers as it did for the high comprehension performers.

As with the cognate analyses, the presence of a high sentence constraint attenuated effects of cross-language activation, but only for the high comprehension performers, in the error data. One surprising finding was that the low comprehension performers did not show any significant homographic inhibition effects. Although it may seem counterintuitive that the high comprehenders showed significant homograph inhibition in low constraint sentences while the low comprehenders did not, this could have been due to differences in the degree to which the two types of comprehenders integrated the target words into the sentences. If low comprehension performers have less working memory resources, they may not have been allocating resources to the semantic integration of the target words. This would lead them to rely mostly on form level features of the target words, particularly in low constraint sentences in which semantic information is degraded. Indeed, research on monolingual reading has demonstrated that low comprehension performers rely more on form-level features, such as phonology, during reading (Jared, Levy, & Rayner, 1999). The high comprehension performers, on the other hand, were more likely to have been allocating resources to the semantic integration of the target words in low constraint sentences, thereby increasing the activation of the competing semantic representations of the homographs. When these same participants were reading high constraint sentences, the additional semantic information allowed them to successfully suppress the irrelevant meaning of the homograph.

Recent findings from our lab provide additional support the hypothesis that the high comprehension performers can activate semantic information more readily in the absence of strong contextual constraints. In a lexical decision task monolingual English speakers with increased working memory resources were more sensitive to the semantic features of within language homographs, such as the number of meanings and the relatedness of those meanings relative to English speakers with less available resources (Kroll, Chwilla, & Hoshino, 2003),

This account could also explain why the low comprehension performers showed larger cognate facilitation in high constraint than in low constraint sentences (see **Table 5-9**). In low constraint sentences, their attentional resources were focused on form, and their performance reflected the benefits of cross-language similarity form similarity, and not semantics. In high constraint sentences, more semantic information was provided by the sentence thereby increasing the semantic information of the cognates. Performance was therefore given an “extra boost” by the convergence in form and meaning across the two languages.

In a sense homographs and cognates represent two opposite ends of a semantic continuum. On the one end, cognates represent full semantic overlap across languages, and on the other end, homographs represent no semantic overlap across languages. What happens when the critical words encountered in the sentences are somewhere in between? In other words, how will performance be affected when the critical word has one meaning that is shared across languages, but another that is not? In the next section we addressed this question by examining performance for partial cognates, form similar words that share one meaning across languages (the cognate meaning) but not the other (the homograph meaning) (e.g., *grave*, "serious" is the cognate meaning and "burial place" is the homograph meaning). We further examined the influence of sentence context by not only manipulating sentence constraint, but also sentence bias. In one condition the partial cognates were embedded in sentences that biased the cognate meaning (e.g., the "serious" meaning of *grave*) and in another condition they were embedded in sentences that biased the homograph meaning (e.g., the "burial place" meaning of *grave*). We predicted that to the extent that the alternative, conflicting meaning was activated, performance would be inhibited. Thus, we expected to observe the strongest inhibitory effects for the low comprehension performers reading high constraint sentences. We expected that the high comprehension performers might show some inhibitory effects in low constraint sentences, since they would be more likely to allocate attentional resources to semantic integration in a low constraining context. In high constraint sentences we predicted that the high comprehension performers might be able to fully suppress the non-target L1, thereby eliminating the inhibitory effects.

For the sentences biasing the cognate meaning of the partial cognates we expected the pattern of results to be similar to that observed in the cognate conditions. That is we expected to observe facilitation in low constraint sentences and elimination of facilitation for the high comprehension performers in high constraint sentences.

Partial cognate analyses

Latency data

The mean naming latencies for the partial cognate and control conditions for the high and low comprehenders are summarized in Table **5-11**. A three-way (comprehension group x constraint x condition ANOVA was performed on the participant means. In that analysis, comprehension group was treated as a between-participants variable with two levels: more and less. Constraint was treated as a within-participants variable with two levels: high and low. Condition was also treated as a within-participants variable and it had three levels: (1) partial cognates embedded in sentences biasing the cognate meaning, (2) partial cognates embedded in sentences biasing the homograph meaning, and (3) controls.

The analysis revealed a main effect of condition, $\underline{F}_1$ (1, 74) = 6.03, MSe = 151,081.17, $\underline{p} < .05$. Follow-up t-tests performed with a Bonferroni correction indicated that the partial cognates embedded in sentences biasing the homograph meaning were significantly faster than controls, $\underline{t}_1$ (1, 38) = 2.37, $\underline{p} < .05$ while those embedded in sentences biasing the cognate meaning were marginally faster than controls, t_1 (1, 38) = 3.46, $p = .05$. There were no other main effects or interactions (all p values > .05).

Two, separate ANOVA's were performed on the item means, one to test for the overall effect of partial cognate status, and the other to test for the effects of sentence bias. This was necessary since only a single set of control words were used. To test for effects of overall partial cognate status a three-way (comprehension group x constraint x partial cognate status) ANOVA was performed, collapsing the partial cognate item means across the two sentence bias conditions. There was no main effect of partial cognate status, F_2 (1, 34) = 1.40, MSe = 208,498.52, $p < .05$, nor did this variable interact with comprehension group or constraint (all p values > .05).

To test for effects of sentence bias, a three-way [comprehension group x constraint x condition (cognate meaning bias versus homograph meaning bias)] ANOVA was performed on the partial cognate item means only. This analysis revealed a main effect of comprehension group, F_2 (1, 17) = 6.95, MSe = 64,427.16, $p < .05$, which was indicative of the longer latencies of the high comprehenders for the subset of partial cognate items. The main effect of bias condition was not significant, F_2 (1, 17) = .16, MSe = 34,419.57, $p > .05$ nor did it interact with comprehension group nor constraint (all p values > .05).

Overall the latency analysis showed facilitation for partial cognates when they were embedded in sentences that biased the homograph meaning. This facilitation was not modulated by either the comprehension ability of the participants or by sentence constraint. The general facilitative effect observed in the latency data did not support the predictions. Contrary to what we predicted, partial cognate facilitation was greater in sentence contexts biasing the homograph meaning of the partial cognate, the condition that we predicted would produce the most interference from L1. One possibility was that the more subtle effects of sentence bias would be reflected in the error data.

Table **5-11**

Mean naming latencies (in milliseconds) and percent error rates (in parentheses) for the partial cognate and control se in sentence context in Experiment 3

	Comprehension group			
	High		Low	
	Sentence constraint			
Condition	High	Low	High	Low
Controls	685 (19.1%)	701 (20.7%)	676 (21.2%)	699 (21.6%)
Partial cognates biased cognate meaning	674 (11.6%)	676 (12.8%)	670 (17.0%)	673 (11.3%)
Difference	**-11** **(-7.5)**	**-25** **(-7.9)**	**-6** **(-4.2)**	**-26** **(-10.3)**
Partial cognates biased homograph meaning	670 (9.1%)	669 (9.4%)	664 (13.2%)	658 (16.9%)
Difference	**-15** **(-10.0)**	**-32** **(-11.3*)**	**-12** **(-8.0)**	**-38*** **(-4.7)**

* $p < .05$

Error data

The mean naming error rates for three conditions across high and low constraint sentences, for the more and less proficient groups are summarized in Table **5-10**. A three-way (comprehension group x constraint x condition ANOVA was performed on the participant means. In that analysis, comprehension group was treated as a between-participants variable with two levels: more and less. Constraint was treated as a within-participants variable with two levels: high and low. Condition was also treated as a within-participants variable and it had three levels: (1) partial cognates embedded in sentences biasing the cognate meaning, (2) partial cognates embedded in sentences biasing the homograph meaning, and (3) controls.

The analysis revealed a main effect of condition, $\underline{F}_1$ (1, 36) = 12.11, MSe = 15,814.74, $\underline{p} < .01$. Follow-up t-tests performed with a Bonferroni correction indicated that partial cognates embedded in sentences that biased the homograph meaning were named more accurately in both low constraint sentences, $\underline{t}_1$ (1, 38) = 2.87, $\underline{p} < .05$ and high constraint sentences, $\underline{t}_1$ (1, 38) = 3.09, $\underline{p} < .05$. When partial cognates were embedded in sentences that biased the cognate meaning, the facilitation effects were marginal in low constraint sentences, $\underline{t}_1$ (1, 38) = 2.57, $\underline{p} = .06$, and non-significant in high constraint sentences, $\underline{t}_1$ (1, 38) = 2.03, $\underline{p} = .20$.

Two, separate ANOVA's were performed on the item means, one to test for the overall effect of partial cognate status, and the other to test for the effects of sentence bias. This was necessary since only a single set of control words were used. To test for effects of overall partial cognate status a three-way (comprehension group x constraint x partial cognate status) ANOVA was performed, collapsing the partial cognate item means across the two sentence bias conditions. This analysis revealed a main effect of comprehension group, F_2 (1, 34) = 15.37, MSe = 5,482.03, $p < .001$, which was reflective of the higher error rates of the low comprehenders. Thus, although these participants showed faster latencies in the analyses above, they were more error prone. The main effect of partial cognate status was not significant, F_2 (1, 34) = 1.11, MSe = 36,903.14, $p > .05$, nor did it interact with comprehension group or constraint (all p values > .05).

To test for effects of sentence bias, a three-way [comprehension group x constraint x condition (cognate meaning bias versus homograph meaning bias)] ANOVA was performed on the partial cognate item means only. This analysis revealed a marginal main effect of comprehension group, F_2 (1, 17) = 4.45, MSe = 6,049.33, $p = .05$, which was indicative of the higher error rates of the low comprehension group. The main effect of bias was not significant, F_2 (1, 17) = .99, MSe = 4,608.27, $p > .05$, nor did it interact with any other variables (all p values > .05).

Overall the analyses of the partial cognate data suggest that lexical access was facilitated by partial cognate status and that this facilitation was greatest when the L2-specific, homographic, meaning of the partial cognate was supported by the sentence context. Once again, this was contrary to what we had predicted. One possibility was that the actual quality of the sentences used in the two bias conditions differed. However, as described in the beginning of this chapter, the production probabilities obtained from the cloze procedure did not differ across these two conditions. Thus, the sentences were equally constraining. Another concern was that participants were not sensitive to the sentence constraint of the partial cognate conditions since the effects of partial cognate status did not interact with sentence constraint. However, an examination of Table **5-11** suggests that performance was indeed affected by sentence constraint, since the magnitude of partial cognate facilitation was greatest for the low constraint sentences. To ensure that there were effects of sentence constraint on performance paired t-tests were performed on the latency and error means of the control items. There was a facilitative effect of sentence constraint in the latency data, F_2 (1, 37) = 4.56, $p < .05$, but not in the accuracy data ($p > .05$).

The most parsimonious interpretation of the data is that performance for the partial cognates was aided by overall lexical transparency but not affected by polysemy. Naming performance for the partial cognates was better than controls overall in both the latency and error data. The findings were very similar to those of Experiment 1, in which a separate sample of Spanish-English bilinguals showed general facilitative effects of partial cognate status, irrespective of the language of polysemy.

Thus, the data did not support our prediction that performance would be inhibited when partial cognates were embedded in sentences biasing the homographic meaning. One interpretation is that the participants simply were not selecting the appropriate meaning of the partial cognates by the time they had named them out loud, and instead resolved the semantic ambiguity at some later point. However, in the homograph analyses, the high comprehension performers did show evidence of semantic competition in low constraint sentences. We would not expect to see this competition unless they were trying to integrate the target words. Why would participants semantically integrate the homographs and not the partial cognates? It may be that the existence of another cognate meaning engaged strong feed-back activation from semantics, thus encouraging the lexical system to initially select the context-inappropriate cognate meaning. This account rests on the assumption that lexical semantics were more powerful than the message level semantics of the sentences. Future studies could help answer these questions by applying measures that would reveal the point in time in which participants resolved semantic ambiguity, such as eye tracking.

Summary of the sentence context task

Cognates

Similar to the findings from the out-of-context tasks reported in Chapter 3, the data from this sentence context experiment reflected some evidence of cross-language activation across all three critical word types. In low constraint sentences, the facilitative effects observed for the +P cognates persisted. However, this effect was modulated by both sentence context and the comprehension skill of the participants. The facilitative effects disappeared in high constraint sentences, but only for the high comprehension performers. This modulation of cognate facilitation in sentence context is consistent with a prior study of sentence context effects on bilingual lexical access (Van Hell, 1998). It is noteworthy that the findings converged despite differences in methodology across the two studies; Van Hell measured participants' lexical decision performance for cognates that followed high constraint sentences, whereas in the present experiment we measures naming latencies for words embedded in high constraint sentences. Together the findings place limitations on the degree to which current models of bilingual lexical processing can assume that bottom-up, lexical processes proceed without top-down influences.

Comparing the cognate data from Experiment 1 with the present experiment it is striking that the magnitude of cognate facilitation was greater in low constraint sentence context (an average difference of 34 ms) than out of context, in which facilitation was only observed in the error rates. The magnitude may have been larger in sentence context because of the need to simultaneously engage in the bottom-up processes of lexical access and the top down processes of semantic integration of words into the conceptual representation of the sentences. These added demands increased the load and time-course of processing (as evident by the longer latencies in RSVP relative to de-contextualized naming). In low constraint sentences, there was not enough semantic information to efficiently suppress the L1, thus leading to greater cognate facilitation.

As mentioned earlier, the fact that the high comprehension performers showed greater cognate facilitation in low constraint sentences (a difference of 46 ms) relative to the low comprehension performers (a difference of 22 ms) suggests that the low comprehension performers were not allocating the same attentional resources to the top-down processes of semantic integration. In the absence of this information, the low comprehension performers in the present experiment were not constructing representations of the low-constraint sentences in which to integrate the target words, and instead focused their attention on the bottom-up processes of individual word recognition. Thus, their cognate facilitation in low constraint sentences were reflective of the same lexical processes that produce cognate facilitation in out-of-context naming.

To further test this account, post-hoc analyses were performed in which we directly compared the pattern of cognate facilitation for the low comprehension performers with that of the native Spanish speakers' out of context from Experiment 1. We reasoned that if the low comprehension performers were not allocating resources to semantic integration in low constraint sentences, then this context may have been functionally like an out-of-context task. Therefore, the magnitude of +P cognate facilitation should have been similar to that observed out-of context. We performed a post-hoc two-way [context (out of context versus low constraint sentence) x cognate status (+P cognate versus control)] ANCOVA on the participant naming latency means from Experiment 1 and the means of the low comprehension performers from the present experiment. Since the participants differed in terms of proficiency, their mean L2 self-assessed rating was entered as a covariate. As predicted, the interaction between cognate status and context was not significant, $\underline{F}_1$ (1, 38) = .77, MSe – 47,668.88, $\underline{p}$ = .39.

Of course this null effect could have been due to a number of other factors related to differences in the two experiments and tasks. To further test this account, a second ANCOVA was performed, this time comparing the *high comprehension performers*' naming performance in low constraint sentences with the performance from out-of context. If high comprehension performers were allocating resources to sentence construction/integration, in low constraint sentences, we would predict that the magnitude of +P cognate facilitation should be different in sentence context relative to out of context, that is, the two factors (cognate status and context) should interact. The analysis supported our hypothesis, this time there was a significant interaction between cognate status and context, $\underline{F}_1$ (1, 38) = 4.50, MSe = 36,892.75, $\underline{p} < .05$. This interaction reflected the greater magnitude of cognate facilitation in the high comprehension performers' naming latencies in low constraint sentences relative to that observed out of context.

Finally, we compared the low comprehension performers' naming performance in *high* constraint sentences with the performance from out-of-context. If low comprehension performers rely on the semantic information provided by high constraint sentences, then for these sentences, they should have been better able to allocate resources to sentence construction/integration relative to low constraint sentences. We would therefore predict that the magnitude of +P cognate facilitation should be different in sentence context relative to out of context, that is, the two factors (cognate status and context) should interact, as they did for the high comprehension performers in low constraint sentences. Furthermore, the interaction should reflect *greater* cognate facilitation in high constraint sentences relative to out of context. The analysis supported our hypothesis, this time there was a significant interaction between cognate status and context, F_1 (1, 38) = 4.09, MSe = 52,659.10, $p < .05$. This interaction reflected the greater cognate facilitation in sentence context relative to out of context. One could argue that these interactions arose only because of task differences between the two experiments. Naming latencies in context are generally longer and this extended time-course could be the reason why cognate facilitation was greater in sentence context. However, this does not explain why the low comprehension performers showed only an increase in cognate facilitation in high constraint sentences, while the high comprehension performers showed this increase in low constraint sentences.

Homographs

In the present experiment homographic inhibition was observed only in the error data of the high comprehension performers for low constraint sentences. When these same items were presented in high constraint sentences, the inhibitory effects disappeared, suggesting that sentence level information was constraining cross-language activation. However, we still expected the low comprehension performers to show effects of homograph inhibition, particularly in high constraint sentences in which they were more likely to engage semantics. Although it was not statistically significant, the magnitude of homograph inhibition did indeed increase for these participants in high constraint sentences.

As with the cognates, we wanted to test whether the high comprehension performers showed more evidence of semantic competition in low constraint sentences than the low comprehension performers. Since the effects of homographic inhibition were confined to the error rates we focused on that variable. Once again, we performed two ANCOVA's, one in which we tested for an interaction between context (out of context versus low constraint sentences) for the high comprehension performers, controlling for proficiency differences; and one in which we tested for the same interaction for the low comprehension performers. Although neither interaction was significant (all p values > .05) the resulting means were consistent with our account. The magnitude of homographic inhibition for the high comprehension performers in low constraint sentences was larger (error rates were 14% greater than controls) than that observed out of context, in which error rates were 4% greater than controls. In contrast, the magnitude of homographic inhibition for the low comprehension performers naming in low constraint sentences was much more similar to that observed out of context, a magnitude of only 6%.

Partial cognates

The partial cognate analyses did not reveal significant influences from either sentence constraint or comprehension skill. Furthermore, in direct contrast to our predictions, the magnitude of facilitation was greater when the partial cognates were embedded in sentences biasing the homographic meaning. It should be noted that the facilitative effects were greater in low constraint sentences than in high constraint sentences, which is consistent with our prediction that sentence constraint should moderate effects of cross-language activation. Unlike the cognate and homograph conditions, the attenuation of facilitation was similar for both more and low comprehension performers. It is not clear whether this was due to the relative higher frequency of the English reading of the partial cognates relative to the non-target Spanish reading or to problems in the construction of the sentences biasing the homograph meaning versus the cognate meaning of the partial cognates. Although the cloze norming procedures did not indicate any differences in constraint for these two different sentence biases, it should be noted that the norming was completed by native English speakers. It is also not clear whether participants were disambiguating the meaning of the partial cognates prior to production, or whether they waited until a later point. Thus, the lack of an effect of either sentence constraint or comprehension skill should be interpreted with caution.

Discussion

In general, the findings from the present experiment suggest that language context in and of itself is not sufficient to constrain non-selectivity, since both +P cognate facilitation and homographic inhibition persisted in low constraint sentences. The findings do provide evidence that the same bottom-up lexical processes that in out-of-context tasks have been shown to be unaffected by factors outside the lexicon such as participants' expectations and language mode, are modified by linguistic context. Both +P cognate facilitation and homographic inhibition effects were not observed in high constraint sentences for high comprehension performers.

However, we cannot conclude that the attenuation of the effects of cross-language activation were the result of selective access. It is possible that in high constraint sentences the cross-language representations of the critical words were initially activated and then suppressed. The variability in the sentential constraint of the materials, with the average production probability for the high constraint sentences not exceeding .7, makes it unlikely that pure selective access occurred uniformly.

The findings do suggest that individual differences in comprehension skill have a fundamental impact on the extent to which the presence of a high constraint sentence will lead to suppression of the non-target language. In the present experiment, participants' performance on follow-up comprehension questions determined whether evidence of cross-language interaction persisted in high constraint sentences. The comprehension scores may have reflected their L2 proficiency (the high scorers rated their L2 higher than the low scorers) which influenced the efficiency with which they performed the RSVP task. It was clear, not only by the range of comprehension scores, but also by participants' comments that the task of reading a sentence, producing the target word and holding the message in working memory for later questions was quite difficult. This makes it likely that the comprehension scores were a reflection of the processing resources available to the participants as they processed each sentence.

The hypothesis that the low comprehenders might have been less able to suppress their L1 in high constraint sentences (as indicated by the persistence and sometimes increase of cross-language activation effects) is compatible with monolingual theories of sentence processing that postulate that poor comprehenders do not suppress non-relevant information efficiently (Gernsbacher, 1996, 1997a, 1997b, 1997c). Since these comprehenders had limited resources, they were not constructing semantic representations of the sentences, particularly in low constraint sentences. Thus, for the low comprehension performers, the low constraint sentences were functionally similar to out-of-context tasks. The additional information provided by the high constraint sentences only exacerbated the effects of cross-language activation. This increase could have been due to two, related reasons. First, the additional information forced them to construct a semantic representation of the sentences in which they needed to integrate the target words. Second, the additional information provided by the sentences further taxed their working memory, thereby decreasing their ability to suppress the non-target L1.

For the high comprehension performers the additional information provided by the high constraint sentences also led them to construct a richer semantic representation of the sentences, in which to integrate the target words. However, given their additional processing resources, this additional information allowed them to suppress lexical activity from the non-target L1.

Chapter 6

Experiment 4: Cross-language activation in sentence context: English-Spanish bilinguals

Predictions

In the preceding chapters we reported a set of results demonstrating non-selective language access during bilingual word recognition out of context (Chapters 3 and 4) and in sentence context (Chapter 5). These findings were obtained for a variety of different critical word types (e.g., cognates, homographs and partial cognates) across three different tasks (i.e., naming, lexical decision, and RSVP) and for two different bilingual samples (i.e., native Spanish and native English bilinguals). This, in conjunction with the plethora of prior research demonstrating similar effects of cross-language activation, presents a strong case for the non-selectivity hypothesis. Again, according to this hypothesis, the bilingual lexicon consists of two, integrated lexica in which activation spreads across the different levels of representation (i.e., orthographic, phonological and semantic) in a language non-selective way, such that lexical information from both languages becomes activated.

As in Experiment 3, the goal of the present experiment was to examine whether and how the presence of sentence context modulates cross-language activation. According to proponents of the non-selectivity hypothesis, sentence context constitutes a linguistic influence, and can therefore potentially influence what lexical information becomes active across a bilingual's two languages (Dijkstra & Van Heuven, 2002). The findings from Experiment 3 supported this prediction. In that experiment, both cognate facilitation and homograph inhibition were attenuated in highly constraining sentences. It is critical to note that this attenuation occurred only in high constraint sentences and not in low constraint sentences. Therefore, language context, in and of itself was not sufficient to constrain cross-language activation. The findings from Experiment 3 also demonstrated that the degree to which sentence context actually constrains effects of cross-language activation was dependent upon participants' comprehension skill. Although there has been research in the monolingual domain that has examined the role of comprehension skill in sentence processing (e.g., Gernsbacher & Faust, 1991), this variable has not been examined in research on bilingual lexical access during sentence comprehension.

In the present experiment we examined whether the effects of sentence constraint and comprehension skill would replicate for a new group of bilinguals, whose L1 was English. As mentioned previously, it is often difficult to draw comparisons across different studies because of the great variation in the bilingual samples used, the linguistic context in which they are immersed and tasks employed. Both task-related factors and linguistic context were very similar in the present experiment to those in Experiment 3. In both cases, participants performed RSVP in their L2 and both groups were immersed in their L1 culture during the time of the study. Furthermore, the overall proficiency level of the two groups of bilinguals was comparable. This allowed us to more systematically examine how other aspects of bilingualism (e.g., lexical differences between the L1 and L2; differences in specific L2 experiences such as study abroad) modulate non-selectivity in sentence context.

As in Experiment 3, the logic in the present experiment was to take the very same critical items and controls whose properties were examined out of context, and to place them in sentence contexts that varied in constraint. Once again the three critical word types consisted of cognates, homographs and partial cognates. We included only the partial cognates that were polysemous in the target L2, which in this case, was Spanish (e.g., *real* also means "royal" in Spanish). By focusing our analyses on this subset of items we were able to compare performance for partial cognates when they were inserted in sentences that supported the shared, cognate meaning (e.g., "authentic") versus the L2 specific, homograph meaning (e.g., "royal").

Our predictions, in general, were the same ones we made in Experiment 3. For cognates, we expected to observe facilitation when cognates had high phonological similarity (+P cognates) in low constraint sentences. We expected the facilitation to disappear when these same +P cognates were embedded in high constraint sentences. For homographs we expected to observe inhibition and that this inhibition would go away in high constraint sentences. Finally, for the partial cognates we expected to observe facilitation when these were embedded in sentences that were low constraint and that biased the shared, cognate interpretation. When these same items were embedded in sentences that biased the homograph meaning, or in sentences of high constraint, we expected that facilitative effects to turn to effects of inhibition or null effects.

Method

Participants

All together 32 native speakers of English participated in the experiment. All individuals were paid for their participation. Of these 32, 22 were recruited from Penn State University and the other ten were recruited from an intensive language studies program in Middlebury, Vermont. Due to technical errors in the experimental session, data from three participants were lost and not included in the analyses below.

The remaining 29 participants were classified into two different comprehension skill groups [low performers(n= 10) and low performers (n= 19)] based on their performance on comprehension questions that were randomly presented during the RSVP procedure and their overall naming accuracy (see "proficiency measures" section for a description).

Materials

Target words

A set of 83 English words comprised the critical materials. These critical words consisted of 45 cognates (*e.g., piano*); 23 homographs (e.g., *pan*) and 15 partial cognates (e.g., *real*). A different number of items was selected in each condition in order to meet specific selection criteria (see Appendix A). These items were drawn from the same pool of items used in the out-of-context tasks of Experiment 2. The same set of cognate items used out of context was used in the RSVP task. The homograph items differed by three items due to limitations in sentence construction. All of the partial cognates used in Experiment 2 were used in the present experiment except for three, which were excluded due to difficulties in constructing high constraint sentences.

For each critical condition a control condition was created. These control conditions were created through an item-by-item match in which every critical word was paired with a Spanish control word matched on word frequency in Spanish, word length and phonological onset. The controls selected were the same ones used in the out-of-context tasks, except for 13, which were replaced with different controls due to the demands of creating syntactically similar sentences. These alternative controls were also matched with the critical word items in terms of frequency, length and phonological onset (see Table **6-1** for a summary of the lexical characteristics of the critical and control words).

Table 6-1

Examples of stimuli used in Experiment 4 and their lexical characteristics

	Critical words			Controls		
Condition	Example	Spanish Frequency[1]	Length[2]	Example	Spanish Frequency[1]	Length[2]
Cognates						
+P	banda	47.2	6.2	barba	38.7	6.3
-P	base	35.1	5.8	brazo	37.9	6.0
Partial cognates						
Polysemous in Spanish	real	56.5	5.5	piel	50.7	5.6
Homographs	pan	66.3	4.6	piso	66.0	5.0

1. (Sebastián-Gallés, 2000)
2. Number of letters

Critical sentences

The target words were inserted in two types of sentence conditions, high and low constraint. We operationalized "constraint" as the degree of semantic support provided by the sentence for the target word. Our goal was to create sentences that differed in the degree to which they provided semantic constraints for the to-be-named critical words (see Table 6-2).

Table 6-2

Example sentences used in the Spanish RSVP task (translations in parentheses)

Constraint	Condition: Critical	Condition: Control
High constraint	Iba ganando peso pero no quería empezar otra dieta que no iba a surtir efecto.	Fuimos a comprar el pan en una pequeña tienda que estaba al lado de mi casa.
	(I was gaining weight, but I did not want to start another diet that would not be effective.)	(We went to buy bread in a small store next to my house.)
Low constraint	Le informaron que el nuevo dieta reducirá su nivel de colesterol.	Ayer mi amiga y yo fuimos a la tienda para comprar unas blusas y pantalones.
	(They informed him that the new diet would reduce his cholesterol level.)	(Yesterday my friend and I went to the store to buy blouses and pants.)

The same procedures and considerations were used in constructing these sentences as those in Experiment 3, critical and control sentences were matched for syntactic complexity and length and the critical words were never in the word final position of the sentence and a minimum of one word followed the critical word. The maximum length of the sentences was 30 words, with a maximum of 15 words preceding the to-be-named target and 15 words following the target.

In a separate cloze norming experiment (described in Appendix B) we verified the constraint manipulation of the sentences. An independent sample of Spanish monolingual speakers read each sentence frame, up to, but not including, the target word. They were asked to write a completion for each sentence. The percentage of times that they produced the actual target word or a synonym of the target was calculated (referred to here as production probability) (see Table **6-3** for the mean production probabilities of the three, critical word types and their respective controls). An analysis of variance was performed on the production probabilities of the high constraint sentences across all of the critical word conditions to ensure that the high constraint sentences indeed had higher production probabilities than the low constraint sentences and to be certain that the conditions did not differ in terms of the magnitude of this constraint. A two-way (constraint x condition) ANOVA revealed a main effect of constraint, F_2 (1, 177) = 347.02, MSe = 11.69, $p < .001$, but no interaction with condition, F_2 (1, 177) = 1.16, $p < .05$. Thus, the high constraint sentences were indeed more semantically constraining than the low constraint sentences and the magnitude of this constraint was similar across all conditions.

Table 6-3

Mean production probabilities for the Spanish sentences used in Experiment 4

	Constraint	
	High	Low
cognates	.62	.08
homographs	.74	.14
partial cognates	.60	.10
controls	.70	.08

It should be noted that the production probabilities obtained for the high constraint sentences were consistently higher than those obtained in Experiment 3. Furthermore, there was far less variance in these probabilities, as is clear from the mean squared errors reported. One reason for this improvement in constraint manipulation could be that the primary investigator created the sentences for the present experiment after she had gone through the process of creating sentences for Experiment 3, and thus had become more skilled.

A set of analyses were also performed on the production probabilities of the specific conditions for each word type. For the cognate conditions, a two-way [constraint x condition (+P cognate, -P cognate, +P control, -P control)] repeated measures ANOVA was performed on the item means, with constraint as a within-items variable and condition as a between-items variable (see Table 6-4). There was a main effect of constraint, F_2 (1, 86) = 224.69, MSe = 5.64, $p < .001$, which reflected the higher production probabilities for the high constraint sentences relative to the low constraint sentences. This factor did not interact with condition, F_2 (1, 86) = .16, $p < .05$. Thus, the magnitude of constraint was similar across the four conditions. A follow-up t-test confirmed that the constraint for the –P cognates did not differ from their matched controls, t_2 (1, 44) = 1.54, $p = .13$.

Table 6-4

Mean production probabilities for the cognate and control Spanish sentence conditions

	+ P conditions		- P conditions	
	cognates	controls	cognates	controls
High constraint	.67	.67	.58	.71
Low constraint	.12	.07	.03	.12

For the homograph conditions, a two-way [constraint x homograph status (homograph, control)] ANOVA revealed a main effect of sentence constraint, F_2 (1, 44) = 124.49, MSe = 3.23, $p < .001$, reflecting the higher probabilities for the high constraint sentences (see Table 6-5). This did not interact with homograph status, F_2 (1, 44) = .38, p > .05, thus the magnitude of constraint was similar for homograph and control sentence items.

Table 6-5

Mean production probabilities for the homograph and control conditions

	Condition	
	homographs	controls
High constraint	.74	.77
Low constraint	.14	.10

For the partial cognate conditions, two ANOVA's were performed on the production probabilities of the partial cognate and control items (see Table 6-6 for a summary of the production probabilities). In the first ANOVA, sentence constraint and partial cognate status (partial cognate or control) were the independent variables to test whether there were constraint differences across the critical and control items. That analysis revealed a main effect of constraint, F_2 (1, 43) = 99.06, MSe = 2.77, $p < .001$, which did not interact with partial cognate status, F_2 (1, 43) = 1.75, $p < .01$. Thus, the degree of constraint was similar for partial cognates and controls.

Table 6-6

Mean production probabilities for the partial cognate and control Spanish sentence conditions

	Condition		
	Partial cognate		
	Cognate meaning bias	Homograph meaning bias	controls
High constraint	.45	.73	.64
Low constraint	.07	.13	0

A second ANOVA was performed on the item production probabilities for the partial cognate sentences only. In that analysis, sentence constraint and sentence bias [whether the sentence was biasing the homograph meaning of the partial cognate (e.g., the "royal" meaning of *real*) or the cognate meaning (e.g., the "authentic" meaning of *real*)] were the independent variables. Once again there was a main effect of constraint, F_2 (1, 28) = 52.74, MSe = 1.91, $p < .001$. Although this variable did not interact with sentence bias, F_2 (1, 28) = 2.66, MSe = 1.91, $p = .11$, an examination of Table 6-6 suggests that the sentences biasing the homograph meaning of the partial cognates were more constraining than those biasing the cognate meaning. A follow-up, un-paired t-test confirmed this difference, t_2 (1, 28) = 2.9, p = .01. Thus, in the item analyses for the partial cognates reported below, mean production probability was entered as a covariate.

Comprehension sentences

In addition to the critical sentences, 30 filler sentences followed by a comprehension question, which were translations of those used in Experiment 3, were presented randomly. These 30 fillers were initially included as a way of assuring that participants were indeed paying attention to the meaning of the sentences and were not included in any of the critical analyses described below.

Procedure

Participants were recruited through classroom visits and email announcements. Participants recruited at Penn State were greeted in English (L1), whereas participants in the intensive language studies program in Vermont were spoken to exclusively in Spanish. All other aspects of the experiment were the same as those reported in Experiment 3.

Results and Discussion

Proficiency measures

As in Experiment 3, participants' performance on the comprehension questions on filler trials was analyzed and used as an index of their overall comprehension skill. Each response was scored on a range from zero to three. A "0" was given if no answer was given at all. A "1" was given to a response that was not correct, but reflected information from the sentence. A "2" was given if the answer was correct but not complete. Finally, a "3" was given when the answer was correct and complete. There were a total of 30 fillers, thus the maximum number of possible points was 90.

The same criteria applied in Experiment 3 were used for distinguishing high comprehension performers from low comprehension performers. Participants who had a mean comprehension score of 45 or higher and whose naming error rates did not exceed 30% were classified as high performers while the others were classified as being low performers. Relative to the native Spanish speaking sample in Experiment 3, the range of comprehension scores in the present experiment was much smaller, from 30 to 70. Of the 29 participants, ten were classified as low comprehension performers and the remaining 19 were classified as high performers.

The proficiency measures from the language history questionnaire for the two comprehension groups are summarized in Table **6-7**. The participants' ages ranged from 19 to 29 years, with a mean age of 22 years. The two groups had also spent similar amounts of time abroad (about seven and a half months on average). Overall the self-assessed L2 proficiency ratings for the two groups was very similar, the average rating of the high comprehension performers was 7.5 and for the low performers it was 7.3. None of these ratings differed statistically. Although the high comprehension performers had spent more time immersed in a Spanish-speaking culture, this difference was not statistically reliable, t_1 (1, 27) = 1.44, p = .16. This differed from the findings of Experiment 3, in which the high comprehension performers rated their L2 proficiency higher than the low comprehension performers. This difference across the two experiments could have been due to the smaller variability in the participant sample in the present experiment. The self-assessed ratings of the native English speakers had a smaller range than that of the native Spanish speakers of Experiment 3. Furthermore, there were 39 participants in the prior experiment and in this experiment there were only 29. However, it was clear that the comprehension scores were not simply a reflection of general L2 proficiency. As stated in Chapter 5, it is likely that, to some degree, this measure reflected individual differences in working memory resources that were available to the participants during their on-line sentence comprehension.

Table 6-7

Language experiences and self-assessed proficiency ratings of the English-Spanish bilingual participants (n=29) of Experiment 4

	High comprehension performers (n = 19)	Low comprehension performers (n=10)
Age	23.3	21.2
Length of Spanish study (years)	9.5	7.8
Length of immersion in a Spanish-speaking country (months)	7.0	8.0
Comprehension score (maximum = 90)	57.4	39.1

	Self-assessed ratings[1]			
	High comprehension performers		Low comprehension performers	
	Spanish (L2)	English (L1)	Spanish (L2)	English (L1)
Reading	7.6	9.6	7.3	9.8
Speaking	7.3	9.6	6.9	10.0
Writing	7.0	9.4	7.1	9.6
Speech comprehension	8.0	9.7	7.7	9.8
Mean rating	**7.5**	**9.5**	**7.3**	**9.8**

1. On a scale of 1 to 10

Data trimming procedures

The verbal responses were coded for accuracy by the primary investigator and a trained research assistant. Mean reaction times (RTs) for correct trials were then calculated for each participant in each condition. RTs that were faster than 300 ms or slower than 3000 ms were considered outliers and excluded from the analyses. RTs that were more than 2.5 standard deviations above or below the participants mean RT were also considered outliers and eliminated from the analyses. These data trimming procedures led to an exclusion of 2.0% of all trials. The microphone failed to pick up spoken responses on another 5.8% of all trials.

General approach

First, general analyses were performed to assess the overall effects of sentence constraint and comprehension ability on performance. Second, data from the three critical word types (cognates, homographs and partial cognates) were analyzed. Each condition was analyzed separately to test for general effects of cross-language activation. These per condition analyses were necessary given the constraints of item matching. For each word in each condition, a control word, matched on lexical frequency and word length was selected. It was not possible to find a single set of control words that would adequately match the lexical characteristics of the items across all three of the critical conditions (i.e. cognates, homographs and partial cognates).

Finally, we made comparisons between the present experiment and the out of context performance reported in Chapter 4. In those comparisons we addressed how context (no context, low sentence constraint, high sentence constraint) and proficiency modulate effects of cross-language activation. When relevant we performed post-hoc analyses in which we directly compared the performance data across experiments.

Overall analyses of the effects of sentence constraint

To assess whether the sentence constraint manipulation had indeed affected participants' naming performance, and to assess whether the effect of constraint was different for the two comprehension groups, a two-way (sentence constraint by comprehension group) ANOVA was performed on the participant latency and error rate means for all control items. This analysis was restricted to control trials because the data for critical trials would be biased by effects of the cross-language lexical properties.

The overall mean naming latencies and error rates of the two participant groups for control items in high and low constraint sentences are summarized in Table **6-8**. As evident in Table **6-8**, both comprehension skill groups named targets faster in high constraint sentences than in low constraint sentences. However, the main effect of sentence constraint did not reach statistical significance, $\underline{F}_1$ (1, 27) = 2.44, MSe = 30,283, $\underline{p}$ = .13. The main effect of comprehension skill was marginal, $\underline{F}_1$ (1, 2) = 3.97, MSe = 86,521.34, $\underline{p}$ = .06, and it did not interact with sentence constraint, $\underline{F}_1$ (1, 27) = .002, $\underline{p}$ =

.97. In the analysis on error rates there was no effect of sentence constraint, $\underline{F}_1$ (1, 27) = .001, MSe = 711.63, $\underline{p} > .05$, nor of comprehension skill, $\underline{F}_1$ (1, 27) = 1.9, MSe = 1,598.91, $\underline{p} > .05$, nor did these factors interact, $\underline{F}_1$ (1, 27) = .04, $\underline{p} > .05$

Table **6-8**

Mean naming latencies (in milliseconds) and error rates (in parentheses) across the high- and low- constraint control sentences of Experiment 4

	Comprehension performance	
Constraint	High	Low
High	683	781
	(8.2%)	(10.8%)
Low	697	796
	(7.9%)	(11.1%)
difference	**-14**	**-15**
	(+0.3)	**(-0.3)**

In Experiment 3 target words in high constraint sentences were named on average 10 ms faster than words in low constraint sentence and the difference was statistically reliable. Although the magnitude of this facilitation was similar to that of the present experiment (a magnitude of 15 ms) it did not reach significance, which might have been due to the smaller sample. Across both experiments the magnitude of high constraint facilitation was small. In Experiment 3 this did not preclude sentence constraint from influencing the nature of cross-language interactions. Furthermore, in prior monolingual studies, limited effects of overall sentence constraint did not preclude selective results from being observed (Altarriba et al., 1996; Simpson, 1994). Thus, we included sentence constraint as a variable in the analyses reported below.

Analyses per condition

Cognate analyses

Latency data

The mean naming latencies for the cognate and control conditions for the two comprehension groups are summarized in Table **6-9**. A four-way (comprehension group x sentence constraint x cognate status x phonological similarity) ANOVA was performed on the participant means and item means. In the analysis by participants, comprehension group was treated as a between-participants factor and sentence constraint, cognate status and phonological status were within-participant factors. In the analysis by items, comprehension group and sentence constraint were treated as a within-item factor, cognate status and phonological status were between-item factors. There was a main effect of sentence constraint, significant by participants F_1 (1, 27) = 7.66, MSe = 66,648.94, $p < .05$; and marginal by items, F_2 (1, 86) = 4.0, MSe = 834,371.15, $p = .05$, which was indicative of the longer latencies in the low constraint sentences relative to the high constraint sentences. There was a main effect of comprehension skill, marginal by participants, F_1 (1, 27) = 4.11, MSe = 3,786,074.61, $p = .05$; and significant by items, F_2

(1, 86) = 193.76, MSe = 445,724.07, p <.001, which was indicative of the faster latencies of the higher skilled comprehenders. The interaction between comprehension performance and sentence constraint was significant by participants, F_1 (1, 27) = 5.12, MSe = 66,648.94, p < .05 but not by items, F_2 (1, 86) = 1.66, MSe = 587,234.48, p < .05. A follow-up t-test performed with a Bonferroni correction showed that the low comprehension performers named targets faster in high constraint sentences than in low constraint sentences, t_1 (1, 9) = 2.74, p < .05; but not the high comprehension performers, t_1 (1, 19) = .46, p > .05.

The interaction between cognate status and phonological similarity was significant by participants, F_1 (1, 27) = 5.50, MSe = 94,148.35, p < .05; but not by items, F_2 (1, 86) = 1.13, MSe = 1,347, 231.44, p > .05. Follow-up t-tests performed with a Bonferroni correction indicated that the +P cognates were named significantly faster than the matched controls, t_1 (1, 27) = 2.61, p < .05; while latencies for the –P cognates did not differ from controls, t_1 (1, 27) = 1.61, p = .12.

Table 6-9

Mean naming latencies (in milliseconds) and percent error rates (in parentheses) for the cognate and control words in sentence context in Experiment 4

	Comprehension group			
	High performers		Low performers	
	Sentence constraint			
Condition	High	Low	High	Low
+P cognates	686 (8.9%)	674 (4.2%)	779 (7.3%)	811 (5.5%)
+P controls	696 (7.7%)	711 (9.3%)	798 (10.5%)	819 (13.2%)
Difference	**-10** **(+1.2)**	**-37** **(-5.1)**	**-15** **(-3.2)**	**-8** **(-8.3)**
-P cognates	711 (11.8%)	713 (9.2%)	792 (9.3%)	848 (14.6%)
-P controls	697 (12.4%)	706 (7.9%)	777 (18.4%)	807 (15.0%)
Difference	**+14** **(-0.6)**	**+7** **(+1.3)**	**+15** **(-9.1)**	**+41** **(-0.4)**

The three-way interaction between cognate status, phonological similarity and constraint was not significant by participants, F_1 (1, 27) =.79, MSe = 32,519.35, $p > .05$ or by items, F_2 (1, 86) = 2.65, MSe = 12,314.20, $p > .05$. However, an examination of Table **6-9** suggests that for the high comprehension performers, +P cognate facilitation was more robust in low constraint sentences than in high constraint sentences. In follow-up t-tests, performed with a Bonferroni correction the +P cognate facilitation for the high comprehension performers in low constraint sentences approached significance, t_1 (1, 18) = 1.82, $p = .08$, while in high constraint sentences the comparison did not approach significance, t_1 (1, 18) = 0.81, $p = .43$. For the low comprehension performers the +P cognate facilitation was not significant in either high constraint sentences, t_1 (1, 9) = .91, $p > .05$, nor low constraint sentences, t_1 (1, 9) = .48, $p > .05$.

Although the means for the low comprehension performers did not reflect any +P cognate facilitation, it seemed their performance was inhibited for –P cognates in low constraint sentences, however, in the follow-up t-tests the inhibitory effects were not significant, t_1 (1, 9) = 1.7, $p = .12$.

Overall the latency data showed an interaction between cognate status and phonological similarity. The nature of this interaction was very similar to what was observed out of context in Experiments 1 and 2. However, unlike the previous sentence context experiment, Experiment 3, the interaction with sentence constraint was not significant.

Error data

The mean error rates for the cognate and control conditions are summarized in Table 6-9. A Four-way (comprehension group x sentence constraint x cognate status x phonological similarity) ANOVA was performed on the participant means and item means. In the analysis by participants, comprehension group was treated as a between-participants factor and sentence constraint, cognate status and phonological status were within-participant factors. In the analysis by items, comprehension group and sentence constraint were treated as a within-item factor, cognate status and phonological status were between-item factors.

The main effect of sentence constraint was not significant either by participants, F_1 (1, 27) = .31, MSe = 3,947.03, $p > .05$; or by items, F_2 (1, 86) = .01, MSe = 12,314.20. The main effect of comprehension skill though not significant by participants, F_1 (1, 27) =1.69, MSe = 6,466.92, $p > .05$, but was significant by items, F_2 (1, 86) = 6.51, MSe = 7,995.37, $p < .05$. This effect reflected the increased error rates of the low comprehension performers.

There was a main effect of cognate status, significant by participants, F_1 (1, 27) = 4.49, MSe = 2,747.20, $p < .05$, but not by items, F_2 (1, 86) = .63, MSe = 55,976.75, $p > .05$. This was qualified by a three-way interaction with phonological similarity and sentence constraint, which was marginally significant in the analysis by participants, F_1 (1, 27) = 4.43, MSe = 2,329.70, $p = .05$ and not significant by items, F_2 (1, 86) = 2.65, MSe = 12,314.20, $p = .11$. Follow-up t-tests performed with a Bonferroni correction indicated that there was significant +P cognate facilitation in low constraint sentences, t_1 (1, 28) = 2.25, $p < .05$, but not in high constraint sentences, t_1 (1, 28) = .11, $p > .05$.

Thus, in the error data, cross-language interactions were significantly modulated by sentence constraint. There was cognate facilitation for the +P cognates in sentence context, indicating that the language context provided by a sentence, in and of itself was not sufficient to affect cross-language interactions. However, in high constraining sentences, this facilitation disappeared, suggesting that the presence of a high-constraining context can prevent effects of cross-language interaction from being observed.

Although the cognate analysis did reflect interactions between sentence constraint and cross-language activation, these effects were restricted to the error data and they were not modulated by participants' comprehension skill, as they were in Experiment 3 with the native Spanish speakers. One potential reason for this was that in the present experiment only ten participants were classified as low comprehension performers and there may have not been enough variance overall for the effects of comprehension skill to be manifest in the data.

In the next section we report the analyses for the homograph items. As in Experiment 3 we predicted that the conflicting semantic representations across languages would lead to inhibited performance, particularly in low constraint sentences.

Homograph analyses

Latency data

The mean latencies for the homograph and control conditions for the two comprehension groups are summarized in Table **6-10**. Three-way (comprehension group x sentence constraint x homograph status) ANOVA's were performed on the participant and item latency means. In the analysis by participants, comprehension group was treated as a between-participants variable and sentence constraint and homograph status were treated as within-participant variables. In the analysis by items, homograph status was treated as a between-items variable and comprehension group and constraint were treated as within-item variables.

The main effect of sentence constraint approached significance by participants, $\underline{F}_1$ (1, 27) = 3.59, MSe = 115,686.73, $\underline{p}$ = .07; and by items, $\underline{F}_2$ (1, 44) = 3.28, MSe = 350,943.42, $\underline{p}$ = .08, reflecting the shorter naming latencies for the high constraint sentences. The effect of comprehension skill was also marginal in the analysis by participants, $\underline{F}_1$ (1, 27) = 3.71, MSe = 1,628,949.51, $\underline{p}$ = .06, and was significant by items, $\underline{F}_2$ (1, 44) = 52.00, Mse = 301,569.67, $\underline{p} < .05$. Finally, the main effect of homograph status approached significance in the analysis by participants, $\underline{F}_1$ (1, 27) = 3.50, MSe = 39,206.51, $\underline{p}$ = .07; but was not significant by items, $\underline{F}_2$ (1, 44) = .61, MSe = 878,212.51, $\underline{p}$ = .61.

The marginal effect was reflective of the *faster* latencies for homographs relative to controls. This was contrary to our initial predictions and was a somewhat surprising result since in the three experiments reported earlier the effects of homograph status were all inhibitory in nature.

Table **6-10**

Mean naming latencies (in milliseconds) and percent error rates (in parentheses) for the homograph and control words in sentence context in Experiment 4

	Comprehension performance			
	High		Low	
	Sentence constraint			
Condition	High	Low	High	Low
Homographs	658	680	746	780
	(5.5%)	(4.9%)	(7.5%)	(8.0%)
Controls	671	698	769	782
	(8.2%)	(6.6%)	(8.3%)	(7.5%)
Difference	**-13**	**-18**	**-23**	**-2**
	(-2.7)	**(-1.7)**	**(-0.8)**	**(-0.2)**

Error data

The mean error rates for the homograph and control conditions are summarized in Table **6-10**. Three-way (proficiency group x sentence constraint x homograph status) ANOVA's were performed on the participant and item error rate means. In the analysis by participants, proficiency group was treated as a between-participants variable and sentence constraint and homograph status were treated as within-participant variables. In the analysis by items, homograph status was treated as a between-items variable and proficiency group and constraint were treated as within-item variables. In both analyses there were no main effects of comprehension skill, sentence constraint or homograph status, or interactions (all p values > .05).

Previous studies of bilingual lexical access have demonstrated that the magnitude of homographic inhibition observed is dependent on the relative frequency of the homographs' lexical representation across bilinguals' two languages (Dijkstra, Van Jaarsveled, et al., 1998). As in the out-of-context experiment reported in Chapter 4, we wanted to examine whether latencies were influenced by the relative cross-language frequency of the homographs across the bilinguals' two languages.

Partial correlations were computed, controlling for Spanish word frequency, between the homograph naming latencies of the two comprehension skill groups in high and low constraint and the following variables and the relative cross-language frequency of the homographs. The cross-language frequencies could be directly compared because they both were based on a corpus of one million words. However, to ensure comparability, the frequencies for each word were first converted through a z-transformation. The converted Spanish language frequency was then subtracted from the English frequency as an index of the relative cross-language frequency. As shown in Table **6-11** the correlations with cross-language frequency were small and were not significantly correlated with any of the naming latencies (all p values > .05). Thus, homograph naming performance in sentence context appeared unaffected by the frequency properties across the bilinguals' two languages.

Table **6-11**

Correlations between the cross-language frequency of the homograph items and the naming latencies of the more and low comprehension performers across high and low constraint sentences

	Comprehension group			
	High performers		Low performers	
	Sentence constraint			
	High	Low	High	Low
Correlation with relative cross language frequency	-.17	.01	-.23	.00

The null effects of homograph status in the present experiment were quite different from those observed out of context in Experiment 2, in which a different group of native English speakers showed inhibitory effects associated with homograph status. This difference could have been the result of a number of factors. One reason why we failed to observe significant effects of homograph status could have had to do with the influence of sentence context, it is possible that the semantic information provided by the sentences was sufficient to suppress the non-target representation of the homographs. Support for this interpretation comes from the fact that in the sentence context experiment reported in Chapter 5, the effects of homograph inhibition were small and restricted to the error rates of the high comprehension performers.

Another important consideration relates to the tenuous nature of homographic effects. The effects of homograph status across previous studies have been quite mixed, with some studies showing significant inhibitory effects (Dijkstra et al., 2000; Dijkstra, Van Jaarsveld, et al., 1998; Von Studnitz & Green, 2002) and others failing to find any significant influences (Gerard & Scarborough, 1998). Furthermore, in the present study, the magnitude of homographic inhibition in the out-of-context naming experiments reported in Chapters 3 and 4 were also small. The effects were not statistically reliable in the overall analysis in which we compared the homographs to controls. Instead the effects were observed in the post-hoc analyses in which we demonstrated that naming latencies were a function of the relative frequency of the homographs across the bilinguals' two languages.

Finally, the lack of homographic inhibition may have been the result of participants pronouncing the homographs based on bottom-up, linear decoding. Such linear decoding would minimize the effects of lexical competition from the L1. Since Spanish is an orthographically shallow language, participants could have engaged such a strategy with minimum consequence on accuracy. If participants were relying more heavily on linear decoding relative to the participants in the previous experiments, then their naming latencies should have been more highly correlated with word length. We therefore performed partial correlations, controlling for word frequency, between the naming latencies of control word items (pooled across the high and low comprehension performers) with word length. We restricted our focus to control words since these would not be tainted by other cross-linguistic lexical influences. The resulting correlation between naming latency in high constraint sentences and word length was significant, r (80) = .40, $\underline{p} < .01$; as was the correlation between naming latency in low constraint sentences and word length, r (80) = .37, $\underline{p} < .01$, suggesting that participants were relying to some extent on serial decoding.

To further test this hypothesis, we computed the same correlations for the native Spanish speakers' naming latencies in sentence context from Experiment 3. Since those participants were naming in an orthographically deep language, they should have shown less of a reliance on linear decoding and the resulting correlations should have therefore been smaller. The analyses supported our predictions. For those participants, the slope between naming latency in high constraint sentences and word length was smaller, r (79) = .25, $\underline{p} < .05$ and the correlation for naming latencies in low constraint sentences was not significant, r (79) = .12, $\underline{p} > .05$. These post-hoc correlations therefore provided additional evidence that the participants in the present experiment may have been relying more on serial decoding, which in turn could have contributed to the dampening of homograph effects.

In the following section we report the analyses for the partial cognate items. Our initial prediction for the partial cognates was that inhibitory effects would be observed for partial cognates that were embedded in sentences that biased the L2-specific homograph meaning (e.g., the “royal” meaning of *real*), because of the conflict with the activated semantic representation from L1. We further predicted that this inhibitory effect would be attenuated for high comprehension performers in high constraint sentences because the message level information would allow for language-selective activation and the non-target L1 representation would not become activated. In Experiment 3, the native Spanish speakers did not show any inhibitory effects for partial cognates in sentences. However, for those participants suppression of the non-target L1 representation was not problematic since the partial cognates were of a higher frequency in the target L2. As reported below, for the native English speakers, the increased difficulty of suppressing the high frequency L1 representation of the partial cognates increased the time-course of processing, which in turn revealed the predicted inhibitory effects for partial cognates embedded in sentences that biased the homographic meaning.

Partial cognate analyses

Latency data

The mean naming latencies for the partial cognate and control conditions for the high and low comprehenders are summarized in Table **6-12**. A three-way (comprehension group x constraint x condition) ANOVA was performed on the participant means. In that analysis, comprehension group was treated as a between-participants variable with two levels: high and low performers. Constraint was treated as a within-participants variable with two levels: high and low. Condition was also treated as a within-participants variable and it had two levels: (1) partial cognates embedded in sentences biasing the homograph meaning, and (2) controls. Since the high constraint sentences that biased the cognate meaning of the partial cognates were not as constraining as the other conditions, and since it was not possible to add this as a covariate in the analysis by participants, we did not include that condition in the analysis. The effect of bias was thus restricted to the item analyses reported later.

The main effect of comprehension skill approached significance, $\underline{F}_1$ (1, 27) = 3.19, MSe = 1,700,752.91, $\underline{p}$ =.06. There was a main effect of condition, $\underline{F}_1$ (1, 27) = 9.92, MSe = 87,236.13, $\underline{p}$ < .05, indicative of the longer latencies for the partial cognates relative to controls. Follow-up t-tests performed with a Bonferroni correction indicated that for the low comprehension performers, naming latencies for partial cognates embedded in high constraint sentences that biased the homograph meaning were slower than controls, $\underline{t}_1$ (1, 9) = 2.76, $\underline{p}$ < .05, but not when they were embedded in low constraint sentences, $\underline{t}_1$ (1, 9) = .96, $\underline{p}$ > .05. For the high comprehension performers the differences between the partial cognates and controls was marginal for both high constraint sentences, $\underline{t}_1$ (1, 18) = 2.0, $\underline{p}$ = .06; and low constraint sentences, $\underline{t}_1$ (1, 18) = 2.0, $\underline{p}$ = .06.

This suggests that, for both comprehension groups the cognate meaning of the partial cognates was active and competing with the homographic meaning supported by the sentence.

Table 6-12

Mean naming latencies (in milliseconds) and percent error rates (in parentheses) for the partial cognate and control words in sentence context in Experiment 4

	Comprehension performance			
	High		Low	
	Sentence constraint			
Condition	High	Low	High	Low
Controls	665	673	767	769
	(6.2%)	(6.6%)	(11.2%)	(8.1%)
Partial cognates biased cognate meaning	716	694	751	829
	(6.6%)	(3.9%)	(2.5%)	(3.3%)
Difference	**+51**	**+21**	**-16**	**+60**
	(+0.4)	**(-2.7)**	**(-8.7)**	**(-4.8)**
Partial cognates biased homograph meaning	699	714	808	792
	(5.9%)	(5.0%)	(4.5%)	(2.0%)
Difference	**+34**	**+41**	**+41***	**+23**
	(-0.3)	**(-1.6)**	**(-6.7)**	**(-6.1)**

* $p < .05$

Two, separate ANCOVA's were performed on the item means, one to test for the overall effect of partial cognate status, and the other to test for the effects of sentence bias. This was necessary since only a single set of control words were used. To test for effects of overall partial cognate status a three-way (comprehension group x constraint x partial cognate status) ANCOVA was performed, collapsing the partial cognate item means across the two sentence bias conditions. As mentioned earlier, in the cloze norming experiment the high constraint sentences that biased the cognate meaning of the partial cognates had lower production probabilities than the sentences constructed to bias the homograph meaning and the control sentences. Thus, the mean difference between the production probabilities given for the high constraint sentences and those given for the low constraint sentences, termed here as the "magnitude of constraint" was calculated. The magnitude of constraint for each partial cognate was then averaged across the two sentence bias conditions (those biasing the homograph meaning and those biasing the cognate meaning) and entered as a covariate. That analysis revealed a main effect of comprehension skill, $\underline{F}_2$ (1, 27) = 8.54, MSe = 2,937.82, $\underline{p} < .05$, reflective of the longer latencies of the low comprehension performers. The main effect of partial cognate status was not significant, $\underline{F}_2$ (1, 27) = 2.14, MSe = 25,693.90, p = .16.

To test for effects of sentence bias, a three-way [comprehension group x constraint x condition (cognate meaning bias versus homograph meaning bias)] ANCOVA was performed on the partial cognate item means only. Since the high constraint sentences that biased the cognate meaning of the partial cognates had lower production probabilities than those biasing the homograph meaning, the difference between the magnitude of constraint for these two bias conditions was calculated and entered as a covariate. In that analysis there was only a main effect of comprehension skill, $\underline{F}_2$ (1, 13) = 24.00, MSe = 43,472.05, $\underline{p} < .05$. The effect of bias was not significant, $\underline{F}_2$ (1, 13) = .52, MSe = 419,368.74, $\underline{p} > .05$.

Error data

The mean naming error rates for the three conditions across high and low constraint sentences, for the high and low comprehension groups are summarized in Table **6-12**. A three-way (comprehension group x constraint x condition ANOVA was performed on the participant means. In that analysis, comprehension group was treated as a between-participants variable with two levels: high and low performers. Constraint was treated as a within-participants variable with two levels: high and low. Condition was also treated as a within-participants variable and it had two levels: (1) partial cognates embedded in sentences biasing the homograph meaning, and (2) controls. Since the high constraint sentences that biased the cognate meaning of the partial cognates were not as constraining as the other conditions, and since it was not possible to add this as a covariate in the analysis by participants, we did not include that condition in the analysis.

The effect of bias was thus restricted to the item analyses reported later. The error rates for the high and low comprehension performers were similar and were not statistically different, $\underline{F}_1$ (1, 27) = .06, MSe = 3,293.99, $\underline{p} > .05$. The effect of condition approached significance, $\underline{F}_1$ (1, 27) = 3.54, MSe = 2,708.88, $\underline{p} = .07$, and was indicative of the lower error rates for partial cognates relative to controls. Thus, although in the latency analyses the partial cognates were named more slowly than controls, they were still named more accurately.

Two, separate ANCOVA's were performed on the item means, one to test for the overall effect of partial cognate status, and the other to test for the effects of sentence bias. To test for effects of overall partial cognate status a three-way (comprehension group x constraint x partial cognate status) ANCOVA was performed, collapsing the partial cognate item means across the two sentence bias conditions. As with the latency analysis, the mean "magnitude of constraint" across the two sentence bias conditions (those biasing the homograph meaning and those biasing the cognate meaning) was entered as a covariate. There were no main effects or interactions (all p values > .05).

To test for effects of sentence bias, a three-way [comprehension group x constraint x condition (cognate meaning bias versus homograph meaning bias)] ANCOVA was performed on the partial cognate item means only. Since the high constraint sentences that biased the cognate meaning of the partial cognates had lower production probabilities than those biasing the homograph meaning, the difference between the magnitude of constraint for these two bias conditions was calculated and entered as a covariate. Once again there were no main effects or interactions (all p values > .05).

The results from the partial cognate analyses provided partial support of our hypotheses that lexical access processes would be inhibited when the L2-specific, homographic meaning of the partial cognates was biased by sentence context. The naming latencies of the low comprehension performers were significantly longer than controls when reading high constraint sentences that biased the homographic interpretation.

Parallels can be drawn from this result to findings from monolingual research on semantic ambiguity and sentence context: In a number of studies inhibitory effects of semantic ambiguity were greatest when sentence context strongly biased the subordinate meaning of polysemous words (e.g., a sentence biasing the "spying devices" meaning of the word *bugs*) (Duffy et al., 1998; Rayner & Duffy, 1986). The reason given for this enhanced inhibition has been that, when polysemous words have one meaning that is strongly dominant, that meaning is activated irrespective of sentence context. When the sentence context either biases the dominant meaning or it is neutral, the subordinate meaning is not activated fast enough to compete for selection. When the sentence context strongly biases the *subordinate* meaning, on the other hand, the activation of that subordinate meaning is speeded, allowing it to compete with the dominant meaning, thereby producing inhibitory effects.

In the present experiment, the L2 homographic meaning of the partial cognates (e.g., the "royal" meaning of *real*) was functionally the less dominant meaning for the bilinguals, since they were clearly less proficient in their L2 relative to their L1. The presence of a sentence context biasing that subordinate meaning increased its activation, allowing it to compete with the dominant meaning from the L1 (the "authentic" meaning of *real*). It is interesting to note that this competition was particularly robust for the low comprehension performers in high constraint sentences. In that condition, the increased activation of the subordinate meaning via sentence constraint made it particularly hard for them to efficiently suppress the dominant L1 representation.

The high comprehension performers also showed inhibition for partial cognates embedded in low constraint sentences that biased the homographic meaning. Although the magnitude did decrease somewhat for the high comprehension performers in high sentence constraint, we would have predicted a greater decrease since we hypothesized that the high comprehension performers could use the added information from context to suppress the L1. The fact that the partial cognates were of a much higher frequency in the non-target L1 may have prevented the high comprehension performers from suppressing the L1 representations, even in the presence of a highly constraining context.

The pattern of results for the partial cognates embedded in sentences biasing the cognate meaning were less clear. We did not expect this condition to yield such strong inhibitory effects. Although not statistically reliable, the magnitude of inhibition was quite large for these sentences. The reason may have had to due with the fact that the sentences were not sufficiently constraining. The lack of constraint in addition to the higher lexical frequency of the partial cognates in the L1 might have been responsible for the general inhibitory trend. Given the limitation of sentence constraint and the differences in cross-language frequency of the partial cognates it is not possible to draw strong conclusions about the effects of cross-language polysemy on bilingual sentence processing from the present data. However, the general pattern does suggest that lexical access was inhibited by the competition between the alternative meanings of the partial cognates.

Summary of the sentence context task

Cognates

Similar to the findings from the out-of-context tasks from Experiment 2, reported in Chapter 4, the data from this sentence context experiment reflected some evidence of cross-language activation across all three critical word types. In low constraint sentences, the facilitative effects observed for the +P cognates were evident in the error data. This effect was modulated by sentence context such that the facilitative effects were no longer evident in high constraint sentences. However, unlike Experiment 3, the facilitative effects were not further modified by comprehension skill. This may have been due to the restricted range in comprehension skill and the overall smaller number of participants. Despite this difference, the similarity in the general pattern across the two sentence context experiments is striking. In both cases the cognate facilitation for the low comprehension performers was greater in high constraint sentences than the low constraint sentences, while the opposite was true for the high comprehension performers. As argued in Chapter 5, this suggests that the low comprehension performers were not allocating the same attentional resources to the top-down processes of semantic integration in low constraint sentences. In the absence of this information, the low comprehension performers in the present experiment were not constructing representations of the low-constraint sentences in which to integrate the target words, and instead focused their attention on the bottom-up processes of individual word recognition. Thus, their cognate facilitation in low constraint sentences were reflective of the same lexical processes that produce cognate facilitation in out-of-context naming. Once again this modulation of cognate facilitation in sentence context is consistent with a previous study using a different methodology (Van Hell, 1998).

Homographs

The homograph analyses in the present experiment failed to yield any significant inhibitory effects of homograph status. Indeed, the trend in the data was facilitative in nature. A variety of factors could have contributed to this difference including limitations in statistical power and the adoption of different lexical decoding strategies on the part of the participants. The fact that effects of homograph status are variable across experiments suggests that the lack of shared semantics makes homographic inhibition more vulnerable to influences from the task, participant strategies, and sentence context.

Partial cognates

Overall naming performance was inhibited by partial cognate status across all sentence constraint and bias conditions. Although we cannot draw any strong conclusions, the data suggest that lexical access was influenced by competitive processes between the two alternative meanings of the partial cognates. When the bilinguals read sentences that biased the L2- specific, homographic meaning of the partial cognates (e.g., the “royal” meaning of *real*), the resulting competition with the more dominant, cognate meaning, delayed performance. However, before drawing conclusions this effect needs to be replicated with a better sentence constraint and cross-language frequency manipulation.

Discussion

As in Experiment 3, the findings from the present experiment suggest that language context, in and of itself, was not sufficient to constrain non-selectivity since effects of cross-language interaction were observed in low constraint sentences. However, the findings do suggest that these effects are modulated by sentence constraint. This was particularly clear in the cognate analyses, in which cognate facilitation in accuracy was only evident in low constraint sentences.

Once again it is important to point out that we cannot conclude that the attenuation of the effects of cross-language activation were the result of selective access because of limitations in the sensitivity of the measures used and the constraint of the sentences. Furthermore, since this attenuation was more consistently observed for the high comprehension performers across the two sentence experiments, it is likely that the apparently selective performance was due to suppression mechanisms that could have been engaged after initial activation of cross-language lexical representations.

The data replicated the finding from Experiment 3 in that individual differences in comprehension skill have a fundamental impact on the extent to which lexical information from the non-target language is suppressed. However, in the present experiment the interaction with comprehension skill was not as consistent across the three critical word types as it was in Experiment 3. This was likely due to the limited range of comprehension skill in the participant sample. Despite this limitation, it is clear from the two experiments that comprehension skill is a variable that must be considered when examining cross-language interactions in sentence context.

There were also several differences between the pattern of results observed in Experiment 3 and the present experiment. First, the overall magnitude of cognate facilitation in the present experiment was smaller than that observed in Experiment 3. Second, there were no significant effects of homograph inhibition in the present experiment. In fact, the trend was facilitative in nature. As argued earlier, it is possible that participants in the present experiment adopted different lexicalization strategies. Since they were responding in an orthographically shallow language, they may have been relying more on linear decoding when pronouncing the target words. The post-hoc correlations reported earlier supported this interpretation. Another striking difference between the two experiments was the pattern of results for the partial cognates. The native Spanish speakers showed general facilitative effects of partial cognates whereas the performance of the native English speakers was inhibited. We argued earlier that this difference might be partially explained by the cross-language differences in the lexical frequency of the partial cognates. These items were higher frequency in English, which might have made it more difficult for the native English speakers to suppress the non-target L1 representation.

Another possible explanation for the differences observed across the two sentence context experiments relates to participants' L2 learning experiences. In general, the L2 experiences of the native Spanish speakers were more uniform than those of the native English speakers. There was greater variability in the length of immersion experiences reported by the native English speakers (a standard deviation of twelve months) than that reported by the native Spanish speakers (a standard deviation of five months). Furthermore, in Europe success in the university requires some level of proficiency in English. Most university students have spent some time in English speaking countries, or in English language academies. English instruction is also part of the core curriculum in Spanish public education. Thus, the overall L2 learning experiences of the native Spanish speakers may have been more uniform than the native English speakers. This could partially explain why the effects of cross-language activation and sentence context were more consistent for that group.

In the next chapter we discuss the pattern of findings across the four experiments in terms of recent of bilingual models of lexical representation and monolingual models of sentence comprehension. In that discussion we argue that the findings overall are most compatible with non-selective models of lexical activation. Currently there are not any models that address or specify the possible mechanisms through which sentence context influences bilingual lexical access. Therefore, one goal of the discussion is to provide an initial account of the specific ways in which top-down sentential processes interact with the bottom-up processes of lexical access.

Chapter 7

General discussion and conclusions

In this final chapter we address the major theoretical questions that motivated the present study: How are the processes of lexical access in a second language influenced by the presence of a sentence context? Does the presence of sentence context modulate effects of non-selectivity? What is the role of individual differences in comprehension skill? Before turning to these questions, we first summarize the major findings from the four experiments reported in this thesis.

Summary of major findings

Bilingual lexical access out of context

The primary objective of the first two out-of-context experiments was to replicate effects of non-selectivity that have been reported in previous studies (e.g., De Bruijn, et al., 2001; Dijkstra, et al., 1999; Dijkstra, et al., 2000; Dijkstra, Van Jaarsveld, et al., 1998; Jared & Kroll, 2001; Jared & Szucs, 2002; Van Hell & Dijkstra, 2002) with a set of critical words that were later examined in sentence context. Overall, the findings from these two experiments clearly reflected effects of non-selective activation, such as cognate facilitation and homographic inhibition. Furthermore, the findings from these experiments provided additional information regarding how the specific nature of cross-language activation is influenced by participants' proficiency in the L2, the relative frequency of the critical words across the bilinguals' two languages and task demands.

Cognate facilitation: Effects of task demands and proficiency

Both out-of-context experiments revealed consistent effects of cognate facilitation in lexical decision and the magnitude of this facilitation was similar for both the native Spanish speakers and the native English speakers. This finding is consistent with a number of previous studies (De Groot & Nas, 1991; Dijkstra et al., 1999; Dijkstra, Van Jaarsveld, et al., 1998; Van Hell & Dijkstra, 2002) and demonstrates that bilingual lexical processing is speeded when words share a high degree of form and semantic overlap across languages. In naming, the effects of cognate facilitation were much smaller and restricted to the error rates of the native Spanish speakers.

The lack of cognate facilitation in naming replicates previous studies (Kroll & Stewart, 1994; Schwartz et al., submitted) and is attributable to several factors. First, unlike lexical decision, naming requires that phonology be fully specified before making a response. This requirement could override any benefit derived from general, lexical transparency. Second, naming latencies are, in general, faster than lexical decision latencies (Forster & Chambers, 1973). This truncated time-course could prevent effects of cognate facilitation from being observed. Finally, there is evidence that less proficient bilinguals derive more of a benefit from cognate status than more proficient bilinguals (Kroll et al., 2002). In Experiment 2, there was significant cognate facilitation in naming latency when data from less proficient participants (those who performed poorly in lexical decision) was included. This suggests that less proficient bilinguals may be more reliant on the general, lexical transparency of cognates and that the representations of theses words are not linguistically differentiated. More proficient bilinguals, on the other hand, are more likely to have finer-grained, linguistically-differentiated representations of cognates. This interpretation is consistent with monolingual research demonstrating that increases in lexical skill are associated with higher quality representations in the lexicon (Perfetti, 1985).

Homographic inhibition: Effects of stimulus list and cross-language frequency

The out-of-context results also revealed consistent homographic inhibition in lexical decision but no significant effects in naming. As discussed in earlier chapters, the effects of homograph status on bilingual lexical processing have been inconsistent across studies (Altarriba & Gianico, 2002; De Bruijn et al., 2001; De Groot et al., 2000; Dijkstra et al., 2000; Dijkstra et al., 1999; Gerard & Scarborough, 1989; Jared and Szucs, 2002; Von Studnitz & Green, 2002). Differences in methodology have made it difficult to resolve the inconsistencies. In the present study, we addressed this inconsistency by implementing a within-participants design, in which the same participants processed homographs in both lexical decision and naming. Furthermore, the proficiency and the linguistic context of the two experiments were comparable.

Our findings from lexical decision support Dijkstra et al.'s (1998) hypothesis that homograph inhibition is more likely to be observed when both languages are clearly present in the task and when responses must be language specific. Although we did not include distractor words from the non-target L1 in our stimulus lists, there were a high proportion of words that were orthographically similar to words in the L1 (i.e., cognates, homographs and partial cognates). This could have boosted the activation of the non-target language, thereby inhibiting performance. The fact that homographs only share lexical form across languages, and not semantics, may make the effects associated with this type of interlingual competitor particularly vulnerable to such task-related factors.

The results from naming support the claim that the frequency of the L2 reading of a homograph relative to the L1 reading further modulates homographic inhibition. In a set of post-hoc analyses, we found that naming performance was slower and less accurate when the L1 reading of the homographs was higher than the L2 reading. Overall, we feel that the findings from the two experiments have elucidated factors that influence the nature of homographic effects on lexical access.

Lexical access of partial cognates: Influences of polysemy and cross-language frequency

Finally, in the out-of-context experiments we examined how bilingual lexical access was affected by language-ambiguous words that have only partial semantic overlap, the partial cognates. In previous research these items are typically classified as cognates since they do share one meaning across languages. To date there are no published studies that have specifically examined how the existence of another, non-shared meaning might modify the facilitative effects associated with cognates in lexical decision and naming tasks. However, there have been some preliminary findings demonstrating that bilinguals activate the multiple meanings of cognates that are polysemous (Elston-Güttler, 2000).

Our results corroborated the finding from Elston-Güttler (2000) since performance of both the native Spanish speakers and native English speakers was influenced by partial cognate status. More interestingly, the results demonstrated the influence of the relative frequency of the partial cognates across languages. The partial cognates used in the present study were higher frequency in English than in Spanish. The performance of the native Spanish speakers, for whom English was the target language, reflected general facilitation of partial cognate status, irrespective of the language of polysemy. The performance of the native English speakers, who needed to suppress the higher-frequency English reading of the partial cognates, was inhibited and this inhibition was greatest when the partial cognates were polysemous in English. This suggests that the boosted activation of the non-target reading, by virtue of its higher frequency, slowed down lexical access, allowing the alternative, non-shared meaning to compete for selection in a way that was not evident in the performance data of the native Spanish speakers.

Overall the findings from the two out-of-context experiments reflected effects of cross-language activation, and thus confirmed the viability of using the selected materials to examine cross-language activation in context. Furthermore, the findings revealed the importance of other contributing factors such as proficiency, task demands and differences in the relative cross-language frequency of the critical words.

Bilingual lexical access in sentence context: Influences of sentence constraint and comprehension skill

The primary objective of the two sentence context experiments (Experiments 3 and 4) was to determine whether effects of non-selective activation are modulated by sentence context. Overall the findings demonstrated that the presence of a sentence context, and the language cues it might provide, were not sufficient to constrain non-selectivity since effects of cross-language activation persisted in low constraint sentences. Instead, effects of non-selectivity were decreased only when the sentences provided rich semantic information and when the reader had sufficient processing resources to effectively integrate this information. For example, effects of cognate facilitation persisted in low constraint sentences, across both experiments and for both high and low comprehension performers. The effects of cognate facilitation disappeared only in high constraint sentences and only for the high comprehension performers. This suggests that the top-down processes of sentence comprehension can interact directly with the bottom-up processes of lexical access when there is rich semantic information and when the reader has sufficient processing resources to effectively integrate this information into a mental representation of the sentence.

There was also evidence that the more and low comprehension performers differed in terms of how they allocated resources to the bottom-up processes of lexical access versus the top-down processes of sentence comprehension. Across both experiments, the performance of the low comprehension performers consistently reflected *increases* in cross-language activation in high constraint sentences relative to low constraint sentences. One interpretation of this pattern is that in low constraint sentences, low comprehension performers were not able to allocate the same amount of attentional resources to creating a mental representation of the sentences being read as the high performers. Instead, they were relying more heavily on the bottom-up processes of lexical access of the individual words. Thus, the cognate facilitation and homograph inhibition effects for those readers in low constraint sentences were based solely on cross-language interactions at the lexical level. High constraint sentences provided the low comprehension performers with additional semantic information, which increased semantic activation of the cognates and homographs, thereby increasing the magnitude of facilitation and inhibition for these two critical word types.

The high comprehension performers, on the other hand, were allocating additional resources to top-down sentence integration processes, even in low constraint sentences. These top-down processes increased the semantic activation of the homographs and cognates. In the case of cognates, the boosted semantic information produced larger facilitative effects and in the case of homographs the same semantic boost produced larger inhibitory effects. When reading high constraint sentences the high comprehension performers were able to use the additional semantic information to efficiently suppress irrelevant information from the L1.

The results from the sentence context experiments also suggest that the orthographic depth of the language of the sentences encouraged different lexicalization strategies for the two bilingual samples. For the native English speakers, who were reading in an orthographically shallow language, the magnitude of cognate facilitation and homograph inhibition were smaller than the native Spanish speakers, who were reading in an orthographically deep language. We reasoned that, given the working memory demands of the task, the native English speakers may have relied more heavily on linear decoding of words rather than retrieving lexical level phonological representations from memory. If participants were relying more on linear decoding their naming latencies should have been positively correlated with word length. Since this strategy could be used effectively in Spanish, but not in English, the relationship between word length and naming latency should have been greater for the native English speakers than the native Spanish speakers. A set of post-hoc correlations confirmed these predictions, the slopes of the correlations were much steeper for the native English speakers relative to the native Spanish speakers. The greater reliance on linear decoding could explain why there was less evidence of cross-language lexical competition for the native English bilinguals.

The findings from the sentence experiments demonstrated that sentence context can influence effects of cross-language activation, but more importantly they elucidated the conditions under which this interaction is most likely to be observed. Currently there is not a theoretical account in the literature of how sentence context exerts its influence on bilingual lexical access. In the next section we discuss how a current model of bilingual lexical processing (the BIA+ described in Chapter 1) could account for the present results. We then describe the specific mechanisms through which sentence context influence bilingual lexical processing by applying existing theories from monolingual research.

Implications for the BIA+

General architecture

The BIA+ model (Dijkstra & Van Heuven, 2002) is one of the most recent models of bilingual lexical processing. It is an extension of a previous model, the BIA (Bilingual Interactive Activation) (Dijkstra & Van Heuven, 1998) in that it incorporates phonological and semantic representations in addition to orthographic representations. In Chapter 1 we provided a brief overview of the model, in this chapter we discuss the model in more detail and relate its specific assumptions and predictions to the findings of the present study (see Figure **7-1**). One of the most critical aspects of the BIA+ is that lexical information from a bilingual's two languages reside in a single, integrated lexicon and that activation of this lexical information is activated in a language non-selective way. Within the integrated lexicon orthographic, phonological and semantic units are represented within an interconnected network through which there is bi-directional flow of activation. It is this interconnected network that allows the BIA+ to account for cross-language activation of orthography, phonology and semantics, which have been repeatedly observed in the literature.

The lexicon also contains language nodes. These are best understood as language tags, which are representations of the language membership of individual words. These tags become activated by general lexical activity within the lexicon. Unlike the BIA, the language nodes in the BIA+ do not act as language filters. That is, they do not directly influence the relative levels of activation of words within a given languages. Rather, they simply provide additional lexical information.

The BIA+ also includes a task/decision system in addition to the lexicon. This system was incorporated to accommodate cross-experimental differences that arise as a consequence of differences in methodology and tasks employed. Within the task/decision system task schemas are formulated to meet the requirements of specific task demands. Thus, processing within the task/decision system is directly affected by nonlinguistic factors such as task demands and participant expectations and goals. The system operates by triggering a response when the criteria of a given task schema are fulfilled. The timing of this response will depend on an interaction between activated information from the lexicon, which is fed-forward to the task schema, and the criteria generated by the task schema. For example, a response might be triggered earlier if one criterion of the task schema is to respond quickly. The response triggering can similarly be delayed to enhance accuracy. It is critical to note that, while the task/decision system is affected by non-linguistic factors and is under strategic control, the lexicon is not.

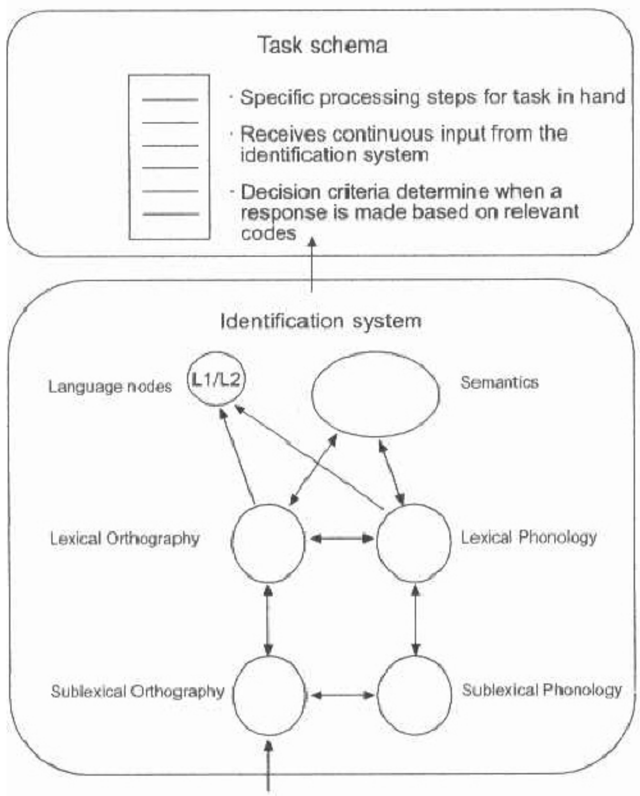

Figure 7-1
The BIA+ model (Dijkstra & Van Heuven, 2002)

The process of lexical access

To illustrate this non-selective process we next provide a step-by-step description of how a word is recognized in this model. According to the BIA+, when an input string of letters is presented to the lexical system a set of potential lexical candidates is activated. The size of the activated set will depend on the number of lexical entries that are orthographically similar to the input string and their resting level of activation. Lexical entries that have a high frequency or have recently been processed will become more quickly activated as will entries that are highly similar to the input. It is critical to point out that it is the similarity of the lexical entry that is critical and not language membership.

After the initial set of orthographic candidates has been activated, activation proceeds to the phonological and semantic units. Thus, the model assumes a temporal delay between the activation of orthography (the fast code) and activation of phonology and semantics (the slower codes). As phonological and semantic units become activated they, in turn, feedback activation to corresponding orthographic units. Once activity amongst the orthographic, phonological and semantic units within the lexicon has reached a certain level of stability, lexical access is completed and a word is identified.

Links between the critical assumptions of the BIA+ and the present findings

There are several assumptions of the BIA+ that are supported by the major findings of the present thesis. Most critically is the assumption that activation within the bilingual lexicon can be directly affected by surrounding linguistic context. The authors defined linguistic contextual effects as those effects “arising from lexical, syntactic or semantic sources (e.g., sentence context)” (Dijkstra & Van Heuven, 2002, p. 187). This assumption is clearly supported by the results from the high constraint sentence conditions, in which effects of cross-language activation (e.g., cognate facilitation) were eliminated.

The BIA+ also assumes that information regarding a word’s language membership becomes activated relatively late, and does not have a direct influence on the initial set of lexical candidates that become activated upon presentation of the input string. The modelers recognized the possibility that the presence of a sentence context might produce pre-activation of the language nodes, which in turn could constrain lexical activation from the non-target language. However, this filtering ability would be incompatible with the assumption that the language nodes function only as language tags. The fact that in the present study effects of cross-language interaction persisted in low constraint sentences provides strong support for the assumption of the limited influence of language membership. If the language membership of the words preceding the critical target words reduced cross-language activation we would have observed either attenuation or elimination of cross-language activation effects even in low constraint sentences.

To bilinguals it may seem counterintuitive that the language of the text being read has such a limited influence. Recent research on monolingual sentence processing has demonstrated that initial processing of lexically ambiguous words is influenced by local context arising from a sentence, but not by higher level, discourse information (Binder, in press). One possibility is that influences of language membership information on bilingual reading occur at the discourse level and thus have a relatively late effect on processing.

A final assumption relevant to the present discussion relates to the differential representation of homographs and cognates in the bilingual lexicon. Dijkstra and Van Heuven (2002) propose that interlingual homographs have two, independent representations, one for each language, while cognates have a single, semantically-linked representation. The assumption of multiple representations of homographs is based on previous findings demonstrating that recognition of interlingual homographs is dependent upon the relative cross-language frequency of their readings (Dijkstra, Van Jaarsveld, et al., 1998). In the present thesis both native Spanish speakers' and English speakers' naming performance for homographs was influenced by the frequency of the homograph reading in L1 relative to L2. The authors suggest that cognates have a "special" representation in the lexicon due to shared semantics. This could partially explain why cognate effects are more consistently observed than homograph effects across previous studies (Dijkstra et al., 2000; Dijkstra, Van Jaarsveld, et al., 1998; Gerard & Scarborough, 1989; Jared and Szucs, 2002; Von Studnitz & Green, 2002) as well as across the four experiments of the present study.

Although the BIA+ can adequately account for several findings from the present study, the model lacks a specific account of how sentential context might influence lexical access. Within the model, sentential context exerts its influence through semantics. However, the exact nature of the semantic representations is under-specified. In the model no distinctions are made between lexical level semantic information versus message level semantic information. In the next part of this discussion we describe the possible mechanisms through which sentence context might influence bilingual lexical processing by applying theories of sentence processing that have been based on monolingual studies.

Proposed mechanisms of the influence of sentential context on bilingual lexical access

In this section we describe possible mechanisms through which sentence context might exert its effect on bilingual lexical processing. These mechanisms are drawn from two theories of monolingual sentence processing, described in Chapter 1; the feature restriction account (Schwanenflugel, 1991; Schwanenflugel & LaCount, 1988; Schwanenflugel & Shoben, 1985) and the structure building framework (Gernsbacher, 1990; Gernsbacher & Faust, 1995; Gernsbacher & St John, 2001). These two theories are not mutually exclusive. Indeed, we believe that they are compatible and that a combination of their specific assumptions can provide an account of the present study's findings.

To briefly review, the feature restriction model postulates that sentence constraint influences processes of lexical access through the generation of feature restrictions. With increasing sentential constraint, more numerous and specific feature restrictions are generated. These features in turn reduce the set of activated lexical candidates and facilitate only lexical candidates that meet all of the restrictions. Thus, in low constraint sentences, fewer restrictions are generated which allows for facilitation of a greater number of words, as long as those words are congruent with the overall meaning of the sentence. In high sentence constraint, a smaller set of words will be facilitated and they must meet all of the feature restrictions. In fact, in high constraint sentences inhibition has been observed for congruent, yet unexpected words, which satisfy only a portion of the feature restrictions (Schwanenflugel & LaCount, 1988).

According to the structure building framework, sentence comprehension is dependent on two general, cognitive mechanisms, enhancement and suppression. Enhancement refers to the activation of information necessary to construct an initial mental representation of text and suppression refers to the inhibition of irrelevant information. The structure building framework postulates that comprehension skill is partially determined by individual differences in the efficiency of enhancement and suppression.

The combination of these two accounts of sentence processing can be applied to the interpretation of some of the major findings of the present study. For example, we observed persistent effects of cognate facilitation in low constraint sentences. In the low constraint context, fewer feature restrictions were generated. Thus, cross-language activation was not restricted and lexical entries from the nontarget L1 could have been included in the initial set of activated lexical candidates. In high constraint sentences, on the other hand, more numerous and specific feature restrictions were generated, which may have included a combination of both semantic level features, as well as lexical form level features (Altarriba et al., 1996).

If the two comprehension skill groups differed in terms of available processing resources, then it is possible that only the high comprehension performers were able to use the additional feature restrictions to efficiently suppress the L1. This would explain why cognate facilitation was only eliminated in high constraint sentence for the high comprehension performers. Further support for this account comes from the pattern of homograph effects in sentence context observed with the native Spanish speakers, in which high comprehension performers showed homographic inhibition in low constraint sentences and in high constraint sentences the inhibition was eliminated.

Another important pattern that emerged across both sentence context experiments was that the magnitude of cross-language activation in low constraint sentences was greater for the high comprehension performers than the low comprehension performers. One possible explanation of this difference is that the low comprehension performers had a less efficient enhancement mechanism. In the absence of a constraining context, these bilinguals might have been less able to efficiently activate potentially relevant information that would allow them to construct an initial mental representation of the sentences. As a consequence, they were allocating less resources to the top-down processes of semantic integration and the effects of cross-language activation that they did exhibit was mostly reflective of activation of lexical form (orthography and phonology). The high comprehension performers, in contrast, had sufficient processing resources to efficiently activate the semantic information necessary to construct a more detailed representation of the sentences being read. The richer mental representation of the sentence may have boosted semantic representations of the alternative readings of the target, ambiguous words thus producing larger cognate facilitation and homograph inhibition effects.

Additional considerations

Before concluding it is important to first consider some remaining questions regarding the specific ways in which sentence context affects non-selectivity. It is clear from the present findings that for the high comprehension performers reading in high constraint sentences, language selection had taken place. If the non-target L1 were at all active at the time of responding, we should have observed some evidence of cross-language interaction. What remains unclear is the specific time-course of this selection. Did it occur prior to or after lexical access? Was there initial cross-language activation of the non-target L1, which later became suppressed? Or was language already selected before the target word was produced? The present data do not clearly discriminate between these two alternatives. However, there are some aspects of the RSVP task that support a post-access account. First, response latencies in RSVP were relatively long, ranging from 600 to 800 milliseconds. There is evidence that this is sufficient time for post-access selection to take place (Gernsbacher & Faust, 1991a, 1991b).

There is also evidence from monolingual studies that true selectivity is less likely to take place when the competing alternative of an ambiguous word is the dominant representation (Duffy et al., 2001; Rayner et al., 1999). For the bilinguals in the present study, the non-target alternative was always the more dominant, L1 representation. Furthermore, although the high constraint sentences used in the present study were more constraining than the low constraint sentences, the mean production probabilities were relatively low. The combination of these factors makes it unlikely that true language selectivity (i.e. language selection prior to lexical access) took place. However, this does not exclude the possibility that language selectivity can take place in sentence context. Research from the monolingual domain has demonstrated that selectivity is possible under sufficiently constraining contexts (Morris, 1994; Simpson & Kreuger, 1991; Tabossi, 1988; Tabossi et al., 1987; Tabossi & Zardon, 1993).

Another remaining issue is how feature constraint and suppression skill mechanisms might be instantiated in the BIA+ (Dijkstra & Van Heuven, 2002). As mentioned earlier, the precise way in which sentence context might allow for language selection is not specified. The authors propose that sentence context exerts its effect through boosted semantics. However, boosted semantics cannot explain why effects of cognate facilitation were eliminated in high constraint sentences. Cognates share semantics across languages, and boosted semantic activation would not discriminate between them. The elimination of cognate facilitation suggests that either at some point a language membership feature restriction may have been generated or increasing contextual constraint somehow pre-activates the language nodes. One possibility is that the presence of a highly constraining context allowed for lexical activity in the lexicon to reach a stable state at an earlier time, which in turn, might have allowed for earlier activation of the language nodes.

A final consideration is the possible role of syntax. In the present study we did not systematically manipulate the syntactic match of the critical word types. However, it is interesting to note that the cognates were always of the same syntactic category across languages, whereas this was not always the case for the homographs. For example, there were a few homographs that were nouns in one language and adjectives in the other (e.g., *pale*/*palo* meaning "stick"). It is possible that for the homograph items, differences in syntactic structure allowed for earlier selection of the appropriate representation. Furthermore, it is possible that differences in the overall syntactic structure of the sentences could have allowed for earlier language selection. In the present study, care was taken to ensure that the syntactic structure of the critical and control sentences were similar. A perfect match, however, was not always possible, particularly when the target words were of a different grammatical class. This might partially explain why the cross-language effects of homograph status were smaller and less reliable in the sentence context studies relative to the effects of cognate status.

Conclusions

The primary theoretical question of the present study was whether sentence context can modulate effects of cross-language activation. The findings demonstrate that sentence context does influence effects of cross-language interaction when there is sufficient contextual constraint and when bilinguals have sufficient processing resources to efficiently construct mental representations of the text being read. It is clear that individual differences in L2 proficiency and reading skill have a fundamental impact on the extent to which sentence context influence lexical processing. The findings also demonstrate that the language cues provided by a sentence are not sufficient to constrain cross-language activity. Instead, rich semantic information was required for non-selective patterns of responding to emerge.

Future directions

Although the present study provided evidence of interactions between the top-down processes of sentence comprehension and the bottom-up processes of lexical access, we could not definitively conclude that actual selective access had taken place.

The degree to which language selective access is possible can be examined in future studies, using different methodological approaches, such as eye-tracking. The eye-movement record can potentially discriminate between cross-language activity that occurs prior to lexical access versus activity that occurs post-lexical access. In the present study limitations in sentential constraint and differences in the cross-language frequency of the critical materials, might have precluded true language selectivity. In future investigations improved stimulus materials might reveal more direct influences of sentence context on non-selectivity.

The limited L2 proficiency of the participants might have further limited the impact of sentence context on lexical processing. However, we feel that the focus on relatively proficient bilinguals, is a strength of the present study. All of the world's bilinguals are in a continual process of developing their proficiency in their non-native language(s). For this reason it is critical to examine bilingual lexical access, in and out of context, from a developmental perspective. Future research could address the extent to which L2 comprehension skill is dependent on general, cognitive resources or skills specific to reading or L2 proficiency.

The psycholinguistic study of bilingual (and multilingual) reading processes is a relatively new area, which has received increasing attention in the past ten years. It is fortunate that there is much reading research from monolingual investigation to draw from. However, it is critical that a rich research base be developed that focuses specifically on the psycholinguistic variables that guide reading in non-native languages.

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Appendix A

Materials norming

Introduction

To examine effects of cross language activation in and out of context the present study implemented three critical word types; homographs, cognates and partial cognates. As described in the introduction, these three types of words differ in terms of the degree to which they share lexical form and meaning across English and Spanish. For example, homographs (*e.g. red*, meaning "net" in Spanish) only share form and do not have any meaning overlap at all across the two languages. Cognates (*e.g. piano)* and partial cognates (*e.g. real*), on the other hand, share both lexical form and meaning. Another distinction is that only cognates have complete meaning overlap (e.g. *piano* always refers to the instrument in both languages) whereas partial cognates have one meaning that is shared across the languages (e.g. *real* refers to "authentic" in both languages) and one that is not shared (e.g. *real* in Spanish also refers to something that is "royal").

In addition to these inter-condition variability there is also intra-condition variability. That is, within each condition words varied in the degree to which they shared form and/or meaning similarity. For example, the word *piano* is form identical in English and Spanish whereas *just* and *justo* are not completely identical. Similarly, there was variation in the degree of similarity of a word's meanings across languages. For example, the multiple meanings of the partial cognate *real* ("authenitc" and "royal") are more distinct than the multiple meanings of the partial cognate *diario*, which means both "diary" and "newspaper" in Spanish. Given this variation and ambiguity, a series of norming procedures were performed on the critical words before using them in the actual experiments. These procedures were conducted specifically for the homographs and partial cognates since the cognates in this study were selected from previous research and had already been normed.

Overall there were two goals of the norming procedure. The first goal was to confirm the initial distinction between homographs and cognates, since this determination can be quite subjective. For example, some speakers of Spanish may use the word *cabina* exclusively to mean "phone booth" whereas other speakers might also incorporate the English meaning as in "log cabin". The second goal was to derive additional information on the materials (e.g., degree of form similarity, degree of meaning similarity) that could be used in later analyses.

Experiment A1: Monolingual Translation Elicitation

In the first norming experiment a monolingual translation elicitation was performed to obtain a measure of the degree of form overlap of the homographs and partial cognates initially selected for the study. In the translation elicitation task, English monolinguals were presented with words in Spanish and were asked to guess the English translation. The goal of this task was to obtain a measure of the degree of lexical transparency of the homographs and partial cognates that were originally selected. The effectiveness of this procedure has been previously demonstrated (Friel & Kennison, 2001; Kroll & Stewart, 1994)

Method

Participants

Forty-eight monolingual English speakers from the Pennsylvania State University participated in the experiment. Participants were recruited from an introductory psychology class and received course credit for their participation. Two participants were eliminated from the analyses because they had taken Spanish courses beyond the high school level.

Materials

An initial pool of 113 Spanish words were selected from the Lexesp electronic database (Sebastián-Gallés, 2000) and the Dictionary of Spanish False Cognates (Prado, 1993). These words consisted of 45 homographs and 66 partial cognates according to their original coding.

Procedure

Participants sat at individual computers in a computer laboratory. They received written and oral instructions on how to perform the task at the beginning of the session.

Each Spanish word was presented, one at a time, in the middle of the computer screen. Participants were instructed to guess the English translation and to type this response in the space provided on the screen. Included in the written instructions was a Spanish vowel pronunciation tool to help with their guesses and they were encouraged to vocalize the words to themselves.

Results and discussion

The frequency of each given translation was tallied and its percentage was calculated based on the total number of responses given. Spanish words for which the same translation was given at least 50% of the time were considered to have high lexical transparency whereas those words that did not receive the same translation for at least 50% of the time were considered to have low lexical transparency. Overall, the majority of homographs and partial cognates were consistently translated at least 50% of the time, only eleven homographs and six partial cognates did not meet this criterion. This suggests that the initial pool of homographs and partial cognates were indeed highly lexically transparent across languages (See Table **A-1**).

However, two issues remained unresolved. First, it was not clear if those items that did not meet the 50% criterion should indeed be excluded from the materials set since these items might seem highly similar to a bilingual of English and Spanish who is aware of cross-language orthographic translations (e.g. the suffix "-dad" in Spanish is often translated into the suffix "-ness" in English). Second, the monolingual ratings do not provide any indication regarding the degree to which the homographs and partial cognates shared meaning across language. The degree of meaning overlap is a critical feature for distinguishing homographs from cognates or partial cognates. Since words are often used in different ways within a single language it was possible that a portion of the words initially classified as homographs had another meaning that was shared across English and Spanish and would therefore need to be re-classified as partial cognates. For these reasons a second, bilingual norming experiment was carried out.

Table **A-1**

Subjective form similarity ratings obtained from monolinguals (Experiment A-1) and bilinguals (Experiment A-2) and an objective measure obtained from Van Orden (1987)

	Subjective		Objective
	Monolingual[1]	Bilingual[2]	Van Orden (1987)[3]
Homographs	.81	6.0	0.82
Partial cognates			
Polysemous in English	.87	5.5	0.74
Polysemous in Spanish	.89	5.5	0.73

1. Based on mean percentages
2. Based on a scales of 1-7
3. A quotient of the graphemic similarity of two words based on the number of letters that are shared, the degree to which letter order is preserved and the relative length difference of the two words (Van Orden, 1987)

Experiment A2: Bilingual Form and Meaning Ratings

One limitation of the monolingual translation elicitation procedure is that participants that are not familiar with the language in question will not be sensitive to certain cross-linguistic regularities. For example, the "-ness" and "-tion" English suffixes correspond to the "-dad" and "-ción" suffixes in Spanish respectively. Since sensitivity to these regularities influences bilinguals' perception of lexical transparency (Tokowicz, Kroll, de Groot, & Van Hell, 2002), an additional bilingual norming experiment was conducted. In this experiment, English-Spanish bilinguals were presented with the same set of words as the monolinguals. However this time each word was presented with its form related pair in Spanish (e.g. the partial cognate pair *station-estación,* the homograph pair *pile-pila*). Since the bilinguals also had knowledge of the meanings of the words they were asked to rate their lexical and semantic similarity of each pair.

Method

Participants

Fifteen bilinguals were recruited from the Department of Spanish of Penn State University. Most of these participants were graduate teaching assistants of Spanish with high levels of proficiency in Spanish.

Materials

An extended version of the homographs and partial cognates from experiment A1 were used. This version of the materials included translation pairs that did not share high form similarity (e.g. *lata-can*) so that the ratings would reflect the full use of the scale.

Procedure

Participants came for individual sessions in which they were presented with the word materials on a computer. In the form-rating phase of the experiment participants were presented with each word pair and asked to rate how similar the pair of words looked on a scale of one to seven. The first word listed was always in Spanish and the language membership of each word was indicated to avoid confusion. These form ratings were performed first so that participants would be less biased by form similarity when rating the pair on meaning relatedness. Each participant first rated ten practice pairs to get used to the task.

Immediately after the form-rating phase participants performed meaning-ratings on the same set of word pairs. They were instructed to rate each pair on how similar the meanings were, regardless of form similarity, on a scale of one to seven. Since partial cognates (*e.g. real, grave*) have two translations, one that is a cognate translation *(e.g. real* meaning "authentic" and, *grave* meaning "serious") and one that is not (*e.g. real* meaning "royal" in Spanish and *grave* meaning "tomb" in English), each partial cognate was presented twice, once with each possible translation. This allowed for a comparison of the relative ratings of each translation, which would serve as an indication of meaning dominance. In a pilot version of this task an English-Spanish participant indicated that her relative ratings of the two translations of the partial cognates would be more accurate if both translation pairs were presented simultaneously. For this reason the two partial cognate translation pairs were presented together.

To minimize confusion, the first word presented was always in Spanish and the language membership of all the words was indicated. Furthermore, each participant was instructed to perform the ratings by asking her/himself the following question: "How similarly do I use the word "X" in Spanish the way that I use the word "Y" in English? Thus for the partial cognate polysemous in Spanish such as *real/real/royal*, the participant would ask her/himself the following two questions:

a) "How often do I use the word "real" in Spanish the way that I use the word "real" in English?
b) "How often do I use the word "real" in Spanish the way that I use the word "royal" in English?"

For a partial cognate polysemous in English such as *grave/grave/fosa* the participant would ask her/himself the following two questions:

a) "How often do I use the word "grave" in Spanish the way that I use the word "grave" in English?
b) "How often do I use the word "fosa" in Spanish the way that I use the word "grave" in English?"

Each participant first rated ten practice pairs to get used to the task. After the experimental session participants were debriefed and paid for their participation.

Results and discussion

Form ratings

Word pairs receiving an average rating of four or more were considered to be highly similar. Unlike the monolingual ratings, all of the homographs (mean rating =5.8) and partial cognates (mean rating= 5.3) met this criterion. This was most likely due to the bilinguals' sensitivity to common cross-language orthographic translations (e.g. "-dad" into "ness") (See Table **A-1**).

Meaning ratings

Overall the homographs received low ratings (mean rating= 2.2) and the partial cognates received high ratings (mean rating = 5.4) (See Table **A-2**). The meaning ratings provided two types of information. First, they provided a way of distinguishing homographs from cognates and partial cognates. That is, if a homograph pair (e.g. *cabin-cabina*) received a high mean rating, this would mean the pair was not actually a homograph but a cognate or partial cognate. 12 homographs with mean ratings of greater than three were eliminated from the materials set (e.g., *espina/spine*; *marcha/march*). One possibility was to retain these items and re-classify them as partial cognates. However, it was not clear if these high ratings were a result of the different Latin American varieties of Spanish that the participants were familiar with. Since Castilian Spanish and its specific meaning conventions were to be the focus of the study, these items were completely eliminated. Thus, 12 homographs were eliminated overall, bringing the total to 33. In a similar fashion 2 partial cognates with mean ratings of less than three were eliminated (*nervio/nerve* and *tuna/tuna*).

The meaning ratings of the partial cognates also provided an indication of the relative dominance of a partial cognate's multiple meanings. For example if the pair "*puro-pure*" received a higher rating than the pair "*puro-cigar*" this would mean that the former was the dominant meaning and the latter was the subordinate meaning. If the difference in rating of the two pairs did not differ by more than 1.5 points, the partial cognate was considered to be balanced. For 14 of the total partial cognate pairs the cognate translation was rated as the subordinate interpretation (e.g., *noticias/notices* was rated lower than *noticias/news*); for 15 pairs the cognate translation was rated as the dominant interpretation (e.g., *pipa/pi*pe was rated higher than *pipa/seed*); and for the remaining 22 pairs the two meanings were balanced. Overall the dominance ratings for the two types of partial cognates (those polysemous in English and those polysemous in Spanish) were similar (See Table **A-2**).

Although the monolingual translation elicitation and bilingual rating procedures aided in the refinement of the stimulus materials and confirmed the initial distinction between homographs and partial cognates, additional norming was needed for the latter condition. As mentioned in the introduction, partial cognates vary in the degree to which their multiple meanings are related. Thus a partial cognate like *diario/diary* which has highly related multiple meanings (i.e., newspaper and diary) may function more as a cognate relative to a partial cognate whose meanings are less related, such as *real/real* which can mean either "royal" or "authentic".

The partial cognates also differed in the extent to which their multiple meanings were truly used in distinctive ways across the two languages. For example, for partial cognate like *brilliant/brillante* it was not clear whether Spaniards truly did not also use the term *brillante* to mean “intelligence”. For this reason two final norming experiments were carried out to obtain measure of the relative distinctiveness of the multiple meanings of the partial cognates. The goal of the final two norming experiments was to derive measures of the distinctiveness of the multiple meanings of the partial cognates that could be used in future analyses.

Experiment A3: English monolingual distinctiveness ratings of partial cognates’ meanings

The goal of this experiment was to derive a measure of the relatedness of the multiple meanings of the partial cognates (e.g., *diary*/*diario* which can mean either “newspaper” or “diary” in Spanish).

Method

Participants

Sixteen monolingual English speakers were recruited from a general psychology course at Pennsylvania State University. None of the participants had experience with Spanish beyond the high school level.

Materials

The multiple meanings of each partial cognate were translated into English. For example the partial cognate *real* translated into “real” and “royal”. For those partial cognates that were polysemous in English, the target meaning was indicated in parentheses [*e.g. bank (a financial institution), bank (riverside)*].

Procedure

Participants sat at individual computers in a computer laboratory. They received written and oral instructions on how to perform the task at the beginning of the session. Each pair of partial cognate meanings (*e.g., real, royal*) were presented together, in the middle of the computer screen. Participants were instructed to rate, on a scale of 1 to 7, how related they felt the two words were. They indicated these ratings by entering them in the space provided on the computer screen. They were further instructed to use the entire scale in their ratings.

Results and discussion

The mean rating for the set of homographs was 2.6 and the mean rating for the partial cognates was 3.3. The distribution of ratings for the partial cognates indicated that about half of these items had highly related meanings (a mean rating of 3 or greater) and half of the items had less related meanings (a mean rating of less than 3). This distinction could thus be used in later analyses to determine if the relatedness of the partial cognates' meanings influences bilinguals' performance. An inspection of Table **A-2** reveals that the English monolingual gave equally low relatedness ratings to the non-shared meanings of the partial cognates polysemous in English as they did to the partial cognates polysemous in Spanish.

Experiment A4: Spanish monolingual ratings of distinctiveness of partial cognates' meaning use

This final norming experiment was conducted to determine whether the partial cognates were indeed used in distinctive ways in Spanish. That is, we wanted to determine the degree to which the supposed non-shared meanings of partial cognates were truly not used in Spanish communication.

Method

Participants

Thirty-seven monolingual Spanish speakers were recruited from a general psychology course in the University of Valencia. They received course credit for their participation.

Materials

For each partial cognate polysemous in English two sentences were constructed. Each sentence biased one of the meanings of the partial cognates. One of the sentences should have been implausible. The partial cognate was always underlined in the sentence. These sentences were presented in a questionnaire format. Next to each sentence was a scale ranging from 1 to 10 (See Appendix F).

Procedure

Participants were given the questionnaires on paper format. Participants received oral and written instructions about how to perform the task. They were told to read each sentence and to indicate how appropriately the underlined word was used in the sentence by circling the corresponding number on the scale. They were also told to suggest words that could substitute inappropriately used words. This instruction was included to confirm that the participants did understand the overall meaning of the sentences that contained an inappropriately used word.

Results and discussion

Ratings were averaged for all sentences. Five partial cognates whose non-shared meaning (e.g., *brillante* used to mean "intelligent") received an average rating of 4 or more were eliminated. To obtain a measure of the "goodness" of each partial cognate the average rating of the sentence containing the non-shared meaning was subtracted from the average rating of the sentence containing the shared meaning. Thus a large difference would indicate a "true" partial cognate. Overall the ratings confirmed the distinction between the shared and non-shared meaning of the partial cognates. That is the meanings purported to be shared across languages received high ratings and the meanings purported to not be shared received low ratings (See Table **A-2**).

Overall these norming procedures led to the inclusion of 33 homographs and 49 partial cognates. The multiple norming procedure performed ensured that these items matched the specific lexical characteristics implied by their condition classification. That is, the homographs did not share any semantic information across English and Spanish and the partial cognates had only one meaning that was shared and one meaning that was not shared. Finally, both the homographs and partial cognates had high lexical form similarity across English and Spanish.

Table **A-2**

Dominance and distinctiveness ratings for the partial cognate materials obtained from bilinguals (Experiment A-2), English monolinguals (Experiment A-3) and Spanish monolinguals (Experiment A-4)

Partial Cognate type	Relative dominance of meaning[1]	Relatedness of meanings[2]	Appropriateness of meaning use in Spanish[3]
Polysemous in English			
Cognate translation (e.g., grave-grave)	5.6	NA	8.7
Non-cognate translation (e.g., grave-tomb)	5.3	3.3	2.2
Polysemous in Spanish			
Cognate translation (e.g., real-real)	5.4	NA	NA
Non-cognate translation (e.g., real-royal)	5.4	3.0	NA

[1]. Ratings provided by monolingual English speakers; Based on a scale of 1-7
[2]. Ratings provided by English-Spanish bilinguals; based on a scale of 1-10
[3]. Ratings provided by monolingual Spanish speakers; based on a scale of 1-10

Appendix B

Description of sentence context norming procedures

Context norming of English sentences

In order to verify the constraint manipulation of the critical and control sentences used in Experiment 3, a cloze norming experiment was performed[5].

Method

Participants

Forty monolingual English speakers from the Pennsylvania State University participated in the experiment. Participants were recruited from an introductory psychology class and received course credit for their participation.

Materials

A total of 388 sentence fragments were normed, (194 high constraint and 194 low constraint). These sentence fragments consisted of the initial portion of the actual experimental sentences up to, but not including the target word. Half of these sentence

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[5] Due to time constraints regarding data collection in Spain the sentence cloze norming procedures were completed after the actual sentence experiments had been completed. Thus, it was not possible to use the ratings from the these procedures to exclude poor sentence items.

fragments were derived from critical sentence items; 45 cognate items, 33 homograph items and 19 partial cognate items. The other half was derived from control items. The sentences were divided into four lists (97 sentences per list). Within each list there were an equal number of randomly listed high and low constraint sentences.

Procedure

Participants sat at individual computers in a computer laboratory. They received written and oral instructions on how to perform the task at the beginning of the session. They were told that they would be presented with English sentence fragments, one at a time, in the middle of the computer screen. They were asked to generate a completion for each sentence, and to write this completion in the space provided. We asked that participants think of the most likely completion and to not make an extra effort in generating creative completions. The sentences were presented via a Microsoft Access on-line form. This form was linked to an excel sheet that contained the sentences in a randomized order. When participants completed the sentence completion task they were thanked for their participation and given course credit. The entire experimental session took about 90 minutes.

Analyses

For each sentence fragment we tallied the number of times that the target word or a synonym of the target word was given. The percentage of total responses given was then calculated and converted into probabilities (ranging from zero to 1). The results of these analyses are discussed in Chapter 5.

Context norming of Spanish sentences

In order to verify the constraint manipulation of the critical and control sentences used in Experiment 4, a cloze norming experiment was performed[6].

Method

Participants

Forty monolingual Spanish speakers from the University of Valencia participated in the experiment. Participants were recruited from an introductory psychology class and received course credit for their participation.

Materials

A total of 360 Spanish sentence fragments were normed, (180 high constraint and 180 low constraint). These sentence fragments consisted of the initial portion of the actual experimental sentences up to, but not including the target word. Half of these sentence fragments were derived from critical sentence items; 45 cognate items, 30

[6] Due to time constraints the sentence cloze norming procedures were completed after the actual sentence experiment had been completed. Thus, it was not possible to use the ratings from the these procedures to exclude poor sentence items.

homograph items and 15 partial cognate items. The other half was derived from control items. The sentences were divided into four lists (90 sentences per list). Within each list there were an equal number of randomly listed high and low constraint sentences.

Procedure

Participants sat at individual desks in a university classroom. Each participant received a questionnaire containing the to-be-normed sentence fragments. A paper format was chosen due to limited access to computer laboratories in the University.

Participants received written and oral instructions on how to perform the task at the beginning of the session. They were told that the questionnaire contained Spanish sentence fragments. They were asked to write down a completion for each sentence in the space provided. We asked that participants think of the most likely completion and to not make an extra effort in generating creative completions. The sentences were listed in the questionnaire in a randomized order. When participants completed the sentence completion task they were thanked for their participation and given course credit. The entire experimental session took about 90 minutes.

Analyses

For each sentence fragment we tallied the number of times that the target word or a synonym of the target word was given. The percentage of total responses given was then calculated and converted into probabilities (ranging from zero to 1). The results of these analyses are discussed in Chapter 6.

Appendix C

Word stimuli used in Experiments 1 and 2

Word stimuli used in Experiment 1

+ P cognates			+P cognate controls		
Word	English Frequency	Number of letters	Word	English Frequency	Number of letters
actor	24	5	affair	33	6
band	53	4	bond	46	4
calm	35	4	coat	43	4
cereal	17	6	scenery	14	7
director	101	8	teacher	80	7
echo	10	4	elbow	10	5
error	36	5	ending	31	6
formal	48	6	female	50	6
hospital	110	8	husband	131	7
insect	14	6	indoors	5	7
inspector	13	9	inquiry	17	7
metal	61	5	mantle	48	6
mortal	10	6	mellow	1	6
perfect	58	7	pleasant	38	8
piano	39	5	pencil	34	6
poet	99	4	summer	134	6
professor	57	9	painting	59	8
reform	30	6	recall	39	6
romantic	32	8	reluctant	15	9
superior	46	8	skilled	30	7
tractor	24	7	treaty	20	6
triple	5	6	tasty	2	5

-P cognates			-P cognate controls		
Word	English Frequency	Number of letters	Word	English Frequency	Number of letters
air	260	3	age	227	3
cable	7	5	caress	1	6
canoe	7	5	carrot	1	6
debate	32	6	damage	33	6
diagram	10	7	delivery	19	8
diet	21	4	delay	21	5
escape	65	6	empty	64	5
false	29	5	fish	35	4
genuine	34	7	lovely	44	6
gradual	16	7	graceful	10	8
horrible	15	8	hopeless	14	8
image	119	5	army	132	4
motor	56	5	player	51	6
notable	20	7	peaceful	26	8
oxygen	43	6	arrival	23	7
palm	22	4	print	18	5
severe	39	7	silver	29	6
tiger	7	5	toilet	13	6
vacant	11	6	velvet	4	6
visible	34	7	fallen	34	6

Homographs			Homograph controls		
Word	English Frequency	Number of letters	Word	English Frequency	Number of letters
arena	7	5	alley	8	5
choke	9	5	cheer	8	5
code	40	4	coal	32	4
curse	11	5	creed	8	5
dote	0	4	dine	2	4
fabric	15	6	furnace	11	7
file	81	4	fair	77	4
fin	2	3	fad	3	3
floor	158	5	fluid	21	5
funds	0	5	fight	98	5
genial	5	6	jealous	4	7
gentle	27	6	jerky	4	5
hippo	0	5	hobby	4	5
horn	31	4	herd	22	4
mayor	38	5	movie	29	5
pale	58	4	pink	48	4
pan	16	3	pin	16	3
pie	14	3	pen	18	3
pile	25	4	plug	23	4
play	200	4	past	281	4
red	197	3	clear	197	5
sane	8	4	sore	10	4
veil	8	4	stamp	8	5
vent	10	4	vase	4	4

Partial cognates polysemous in English			Partial cognate controls		
Word	English Frequency	Number of letters	Word	English Frequency	Number of letters
bank	83	4	beach	61	5
bulb	7	4	bean	5	4
domestic	63	8	devoted	51	7
fan	18	3	fog	25	3
float	3	5	flea	2	4
goal	60	4	gold	52	4
grade	35	5	grant	47	5
grave	33	5	gift	33	4
introduce	11	9	apologize	1	9
labor	149	5	letter	145	6
positive	74	8	break	88	5
record	137	6	summer	134	6
relative	46	8	valuable	46	8
rest	163	4	road	197	4
rock	75	4	rule	73	4
sentence	34	8	surplus	27	7
turn	233	4	town	212	4
union	182	5	market	180	6

Partial cognates polysemous in Spanish			Partial cognate controls		
Word	English Frequency	Number of letters	Word	English Frequency	Number of letters
column	71	6	cousin	51	6
cube	1	4	crib	5	4
cure	28	4	coach	24	5
direction	134	9	afternoon	106	9
diversion	7	9	deadline	1	8
double	56	6	destroy	48	7
effective	129	9	everyone	129	8
gas	98	3	gun	118	3
globe	13	5	glove	9	5
grain	27	5	gear	26	4
invite	11	6	ensure	8	6
note	127	4	army	132	4
pipe	20	4	pint	13	4
plant	125	5	pool	111	4
pulp	5	4	pear	6	4
pure	56	4	proud	50	5
real	260	4	past	281	4
rich	74	4	round	81	5
station	105	7	saturday	67	8
type	200	4	level	213	5

Word stimuli used in Experiment 2

+ P cognates			+P cognate controls		
Word	Spanish Frequency	Number of letters	Word	Spanish Frequency	Number of letters
banda	35.5	5	barba	21.3	5
calma	30.6	5	ciego	30.7	5
cereal	1.4	6	cinturón	14.6	8
correcto	16.2	7	comprado	17.2	8
director	132.5	8	pregunta	116.2	8
eco	24.2	3	alba	17.4	4
error	56.3	4	hogar	37.5	5
final	244.1	5	libro	193.3	5
hospital	45.5	8	orgullo	36.1	6
insecto	5.5	7	hidalgo	4.1	7
inspector	26.5	9	infierno	29.8	8
metal	18.3	5	mancha	16.2	6
perfecto	42.5	8	pensado	36.9	7
piano	33.4	5	pájaro	20.6	7
poeta	62.2	5	pecho	67.7	5
profesor	77.6	8	escritor	81.4	8
reforma	36.1	7	regalo	29.1	6
romántico	9.9	8	recogido	11.2	8
superior	87	8	solamente	78.3	9
terror	35	5	hombro	28.8	6
tractor	3.9	7	truchas	3.2	7
triple	13.7	6	torpe	14.2	5

-P cognates			-P cognate controls		
Word	Spanish Frequency	Number of letters	Word	Spanish Frequency	Number of letters
acre	1.6	4	jarro	2.3	5
aire	208.6	4	hijo	223.3	4
audible	2.3	7	abertura	3.7	8
base	89.5	4	brazo	71.4	5
cable	13.9	5	cabra	11.2	5
canoa	2	5	canción	31.1	7
debate	38	6	deporte	47.4	7
diagrama	1.4	8	desafío	17.2	7
dieta	25.5	5	tienda	0.4	6
escape	8.5	6	empuje	7.3	6
falso	21.5	5	fallo	15.6	5
gradual	3.7	7	grabada	3.6	7
horrible	17.9	7	borracho	15.8	8
imagen	163.1	6	mirada	168.2	7
motor	33	5	misa	25	4
notable	30.4	7	mentira	38.4	7
oxígeno	28.2	7	olvido	30.9	6
palma	13.7	5	perra	10.7	5
radio	82.7	5	ropa	71.9	4
severo	9.6	6	semanal	7.6	7
tigre	4.3	5	talón	3.7	5
vacante	2.3	7	vaciado	4.1	7
visible	21.7	7	vecina	25.2	6

Homographs			Homograph controls		
Word	Spanish Frequency	Number of letters	Word	Spanish Frequency	Number of letters
arena	38.7	5	amiga	51.9	5
asignatura	6.8	10	aperitivo	5.3	9
choque	14.9	6	chistes	11.5	7
codo	7.5	4	cojo	6.9	4
curso	48.9	5	caja	44.8	4
fábrica	27.5	7	vecina	25.2	6
fila	18.1	4	falda	21.9	5
fin	215.7	3	luz	281.2	3
flor	32.9	4	miel	18.3	4
fundas	2.8	6	fosas	3	5
gente	276.7	5	guerra	250.3	5
horno	7.1	5	hacha	6.2	5
leer	70.2	4	mirar	66.1	5
mayor	396.9	5	mejor	470	5
once	40.3	4	poca	44.1	4
pan	54.4	3	piso	70.2	4
pie	132	3	piel	127.4	4
pila	10.5	4	perra	10.7	4
playa	41.7	5	puente	35.5	6
red	42.8	3	risa	38.4	4
sano	14.6	4	seca	17.8	4
vela	14.7	4	besos	14.7	5
venta	28.6	5	vidrio	18.3	6

Partial cognates polysemous in English			Partial cognate controls		
Word	Spanish Frequency	Number of letters	Word	Spanish Frequency	Number of letters
bulbo	0.2	5	bollo	2	4
fan	0.4	3	fosas	3	5
flota	13.1	5	falda	21.9	5
gol	27.7	3	golpe	69.3	5
grave	87.2	5	brazo	71.4	5
labor	40	5	lujo	38.5	4
positivo	24.5	8	peligrosa	18.1	9
récord	11.9	6	regalo	29.1	6
resto	127.2	5	rostro	129	6
roca	20.8	4	regla	26.1	5
sentencia	33.9	9	sacerdote	22.6	9
turno	15.3	5	taza	16.7	4
unión	29.3	5	uñas	23.5	4
domestico	13.9	8	diseñado	10.3	8
grado	53.7	5	golpe	69.3	5
introducir	18.3	9	enfrentarse	10.3	11
relativo	11.4	8	redonda	11.4	7

Partial cognates polysemous in Spanish			Partial cognate controls		
Word	Spanish Frequency	Number of letters	Word	Spanish Frequency	Number of letters
columna	37.3	7	cadenas	37.3	7
cubo	41.9	4	pata	13.9	4
cura	38.1	4	cabra	11.2	5
diario	19	4	roja	30	4
dirección	79.4	9	desempleo	11	9
doblar	11	9	dibujo	20	6
efectivo	6.9	6	domingo	62.9	7
estación	10.1	8	elegida	9.4	7
grano	53.3	8	helado	13.3	6
invitar	33	3	sed	12.2	3
nota	10	5	guante	8.3	6
pipa	8.9	5	cuento	48.9	6
planta	3.6	7	empuje	7.3	6
pulpo	50.7	4	nariz	52.6	5
puro	14.4	4	pez	15.5	3
real	38.2	6	pista	37.7	5
rica	1.6	5	pieza	43.2	5
tipo	130.4	4	piel	127.4	4

Appendix D

Sentences used in Experiments 3 and 4

English sentences used in Experiment 3

+P cognate sentences

Target	Constraint	Cognate sentences	Control sentences
actor	high	While in Hollywood I did not see a single famous **actor** on the street or in the stores.	While in New York the unfaithful husband had a long **affair** with another woman.
actor	low	She assured me that he was quite a wonderful **actor** and that the movie would be great.	My neighbor told me it was a long **affair**, one she will never forget.
band	high	For many years she was a singer in a small **band** that used to play at this bar.	For many months we got to know each other and a close **bond** was formed between us.
band	low	She finally got a chance to see a good **band** play live music at the bar last week.	He saw that there was a **bond** between the mother and her daughter.
calm	high	I was getting annoyed but I tried to keep my **calm** as she complained.	It was getting very cold so I put on the **coat** as it began to snow.
calm	low	It was impressive that she remained so **calm** through all those problems.	I was thankful that the **coat** was warm enough for the cold weather.
cereal	high	For breakfast she did not put milk in the **cereal** because it would no longer be crunchy.	Before leaving the beautiful mountains we took pictures of the **scenery** for our photo album.
cereal	low	As soon as I had turned around my nephew threw the **cereal** on the floor and refused to eat.	We could not help but to admire the **scenery** of the town and we did not want to leave.
correct	high	The child felt ashamed because the answer was not **correct** and he did not raise his hand again.	Her parents often had fights but she hoped they would not **quarrel** in front of her friends.
correct	low	I was not sure if the recipe was **correct** but I tried to make the meal anyway.	I was sure that we would **quarrel**, but I told him my opinion anyway.

+P cognate sentences (continued)

Target	Constraint	Cognate sentences	Control sentences
director	high	During the filming of the movie there were many changes made by the **director** who had many successful films.	During the school year there were many tests made by the teacher who had very high standards.
director	low	After many disagreements they started not to like the **director** and thought about firing him.	They confided to me that they were not pleased with the **teacher** and thought about dismissing him.
echo	high	The child yelled into the well and she could hear her **echo** a few times.	While learning to ride her bike she scraped her knee and her **elbow** a few times
echo	low	We were interested in the talk but there was an **echo** in the room and we could not hear well.	The child began to cry because she bumped her **elbow** but there was not a bad bruise.
error	high	I got a lower grade on my paper because I made a careless **error** and the teacher expected better.	The movie had an interesting beginning but a weird **ending** that did not make sense to us.
error	low	I was embarrassed because I thought that was a silly **error** to make on an easy test.	I thought that was a weird **ending** for such a good movie.
final	high	Before executing the prisoner they asked him if he had a **final** wish or request.	I brought the broken bike into the shop on Monday but it was not **fixed** until Saturday.
final	low	Before going to the store I asked what the **final** agreement was for the gift.	We rushed home to make sure the plumbing was **fixed** and that all was safe.
formal	high	He had to rent a tuxedo and limousine because the party was **formal** and very high class.	The dog gave birth to five male puppies and one **female** puppy last month.
formal	low	She let us know that it was a **formal** party and that we would need to dress up.	She let us know that it was a **female** puppy and that we would need to have her neutered.
hospital	high	His fever was so high that we decided to take him to a **hospital** in the strange town.	The single woman said she could not imagine ever having a **husband** in the future.
hospital	low	She was relieved that the **hospital** was only a few blocks away.	She was happy that her **husband** was walking to work everyday.

+P cognate sentences (continued)

Target	Constraint	Cognate sentences	Control sentences
insect	high	The frog caught a fly and another **insect** on its tongue.	It started to rain so we went **indoors** to play monopoly.
insect	low	I did not know that another **insect** had gotten into the room.	I did not think that **indoors** it was any warmer than outside.
inspector	high	The restaurant was so dirty that the health **inspector** came and forced it to close.	The defendant cried during the lawyer's **inquiry** and could not speak for a few moments.
inspector	low	The family had to call the town's **inspector** to test the water.	We were getting annoyed during his long **inquiry** about our lives.
local	high	The phone company charges for long distance calls but not **local** calls, which are all free.	The floor was slightly slanted and not **level** enough to build the walls.
local	low	After work some co-workers shared a drink at a **local** bar and talked about old times.	They played soccer on a **level** field just behind the park.
metal	high	At the airport gate we had to pass through a **metal** detector and some guards.	Above the fireplace was a wooden **mantle** with pictures of the family on it.
metal	low	She kept the equipment that was loaned to her in a **metal** case, inside the closet.	He kept the pictures on his favorite **mantle,** where everyone could see them.
mortal	high	There is a time in life when we truly realize we won't live forever and that we are **mortal** beings who must die.	My college friends do not get upset easily, they are **mellow** and fun to be with.
mortal	low	In the story that we read last night there was a magical fairy who turned **mortal** beings into gods.	My sister's wild behavior turned her **mellow** boyfriend into a nervous person.
perfect	high	Everything went as planned so their trip was **perfect** and worth the extra expense.	The food was very good and they had a **pleasant** dinner at the restaurant.
perfect	low	When they returned they told us that they had a **perfect** trip, full of excitement and beauty.	Based on their reaction I could tell that they had a **pleasant** dinner, with lots of good food and drink.

+P cognate sentences (continued)

Target	Constraint	Cognate sentences	Control sentences
piano	high	The composer sat at the bench and began to play the **piano** at the beginning of the concert.	The student looked for some paper and a sharp **pencil** for the test.
piano	low	As we walked through the large dining hall we noticed that here was a large **piano** in the corner of the room.	I hoped that I would find a sharp **pencil** inside of the desk.
poet	high	After writing a few sonnets he decided he wanted to become a **poet** and not a song writer.	Because it did not rain enough in the spring we had a drought in the **summer** which was made worse by the humidity.
poet	low	An old friend of mine from college was a **poet** and we enjoyed his work very much.	I wrote my friend a long letter about the **summer** I had spent in New England.
professor	high	She said she enjoyed the college course because the young **professor** was interesting and helpful.	At the art gallery I thought the new **painting** was the most interesting.
professor	low	They looked forward to the arrival of the new **professor** to the university.	They looked forward to the arrival of the new **painting** to the art gallery.
reform	high	The town cried out for change but the mayor did not know if he could **reform** much in just one year.	He had a terrible memory for names but he tried to **recall** everyone's name at the party.
reform	low	Everyone in the meeting needed to realize that the principal could not **reform** the school in just one year.	During the first day the nervous teacher could not **recall** the students' names.
romantic	high	When we first dated, my boyfriend was very **romantic** and bought me many flowers and chocolates.	She did not want to speak with him at first and was very **reluctant** about going to meet him.
romantic	low	When I first met him he was very **romantic** and bought me many flowers and chocolates.	When I first met her she was very **reluctant** to tell me about her family and her past.
superior	high	The salesman told us that compared with other models the luxury car was a far **superior** in many ways.	She had worked with many cars for many years and was now a highly skilled mechanic.
superior	low	They searched a long time because they wanted to find a **superior** carpenter to build their patio.	I called up my uncle at home because we wanted to find a **skilled** carpenter to build the new book shelves.

+P cognate sentences (continued)

Target	Constraint	Cognate sentences	Control sentences
terror	high	Watching the tornado near my home I felt great **terror** but tried to keep calm.	Her comment about his baldness was a rude **remark** to make to anyone.
terror	low	The small town experienced much **terror** during the tornado.	I let her know that it was a strange remark to make in that situation.
tractor	high	The local farmer rode on his **tractor** where ever he went.	The warring nations finally signed the peace **treaty** and we hoped the killing would stop.
tractor	low	They were pleased that a new **tractor** had been bought.	They were pleased that a new **treaty** had been signed.
triple	high	My new salary is more than double and even **triple** of what I used to earn.	The tomato sauce made the meal even more **tasty** than I anticipated.

-P cognate sentences

Target	Constraint	Cognate sentences	Control sentences
acre	high	We determined that our land measured one **acre,** which was just enough.	She got frustrated and turned away in **anger,** which was not surprising.
acre	low	We were impressed that his **acre** of land was maintained so well.	We were surprised that her **anger** could get so violent.
air	high	We had to stop the car because the tires did not have enough **air** in them for the trip.	Our grandfather walked slowly because his **age** prevented him from moving too fast.
air	low	After a few hours we noticed that we did not have enough **air** in our tires so we stopped at a garage.	We did not know his **age** and we had to be careful of what we said.
audible	high	He spoke in such a soft tone that his voice was barely **audible** from where we were standing.	The house next door has a garage that is almost **adjacent** to our own garage.
audible	low	I told my friends that the music was barely **audible** from the room next door.	We did not know that the couple's room was practically **adjacent** to our own room.
base	high	We visited the military **base** with our friends.	We played with the soccer **ball** with our friends.
base	low	They enjoyed life on the large **base** because there were so many people from their country.	He was bored with the red **ball** and wanted to try something else.
benign	high	The doctor said that the tumor was **benign** and did not threaten her health.	There was a light breeze and it was a **balmy,** comfortable week during our vacation.
benign	low	We were relieved that the **benign** tumor did not pose a threat to her health.	We were lucky that it was a **balmy** day at the beach and the storm did not reach us.
cable	high	In order to connect the computer we needed a long **cable** that would reach the wall.	The child was soothed by her mother's soft **caress** and soon fell asleep.
cable	low	I told my boss that we needed a new **cable** for the computer to work.	The baby smiled from her father's **caress** and fell asleep soon after.

-P cognate sentences (continued)

Target	Constraint	Cognate sentences	Control sentences
canoe	high	In the rain forest they rowed up the river in a **canoe** made of wood.	In my garden a rabbit ate the **carrot** and then ran away.
canoe	low	My younger sister was afraid to go in the **canoe** so she stayed at home.	My younger brother did not want to eat the **carrot** so he was very hungry at lunch time.
debate	high	Before the election we watched the presidents discuss issues in the **debate** but were not impressed by any of the arguments.	Although the storm was fierce and lasted a long time, the **damage** was minimal and we were fine.
debate	low	During dinner it was clear that none of us thought the **debate** was very good, neither side defended their points well.	After looking at the car carefully we did not think the **damage** was very bad and we knew the insurance would cover it.
diagram	high	To make her presentation clear she drew a **diagram** that illustrated her ideas.	The mail system is efficient and the **delivery** of our package did not take long.
diagram	low	We understood her idea better once we saw the **diagram** that she had drawn for us.	I felt a lot better once I knew the **delivery** had arrived at the home safely.
diet	high	I was gaining wait but I did not want to go on another **diet** that would not work.	My connecting flight finally took off after a long **delay** and many complaining passengers.
diet	low	He was told that the newest **diet** would reduce his cholesterol.	We were very tired but we were glad that the short **delay** would allow us to rest.
escape	high	The prisoners thought they were trapped until they found an **escape** route and ran away.	All of the drawers were full and we could not find an **empty** place to put the books
escape	low	It was a great relief that my friend knew an **escape** route and we did not get caught by anyone.	In her home my friend had an **empty** closet where we could hide the gift.
genuine	high	The jeweler wanted to assure us of the ring's authenticity and said the stones were all **genuine,** including the diamond.	My mother told me that she enjoyed the bouquet and that the flowers were **lovely,** especially the tulips.
genuine	low	The coat that I wanted to buy you for your birthday was made of **genuine** leather and it fit very well.	The dress that we bought for my aunt's party was made of a **lovely** material and did not cost too much.

-P cognate conditions (continued)

Target	Constraint	Cognate sentences	Control sentences
gradual	high	Her recovery from the illness was slow and **gradual** so we were delighted to see she was better.	The dancer made a beautiful and **graceful** leap across the stage.
gradual	low	The actor made a gracious and **gradual** exit off of the stage.	My sister made a beautiful and **graceful** leap off the stage.
horrible	high	The violent accident involved many cars, it was **horrible** to have to watch.	There was no solution to the problem, it was a **hopeless** situation and our spirits sank.
horrible	low	Throughout all of these years growing up I felt it was **horrible** for me and my brothers to fight so much.	After so many years of living together she thought it was **hopeless** for them to be arguing so often.
image	high	The baby looked in the mirror and smiled at his **image** laughing back at him.	The general saw enemy troops and ordered his **army** to cross the river.
image	low	No matter how hard I tried, I could not get the **image** of the accident from my mind.	They were unable to get the **army** across the bridge safely.
motor	high	Judging from the sound of the car I had a bad feeling that the old **motor** was about to break down.	The coach worried that the soccer **player** would not play again.
motor	low	She took her uncle's advice and let the old **motor** run for a while to see if it would sound better.	He let the new **player** run out of bounds and then called him off sides.
notable	high	She is a well known writer who has many **notable** achievements and awards.	I had a quiet and relaxing vacation with many **peaceful** nights and enjoyable days.
notable	low	It was clear that there were many **notable** changes in the house after she had gone.	There were many **peaceful** thoughts in my head as I listened to the music.
oxygen	high	In science class the children learned how animals breath in the **oxygen** from the air though the air passages and lungs.	At the airport the family anxiously awaited the **arrival** of their son from Tokyo.
oxygen	low	Later on that afternoon he came to install the new **oxygen** tank in the patient's room.	Despite his bad mood and fatigue he looked forward to his **arrival** in Madrid the next day.

-P cognate sentences (continued)

Target	Constraint	Cognate sentences	Control sentences
palm	high	I held the key tightly in the **palm** of my hand so I would not lose it.	I needed my glasses to read the book because the **print** was so small.
palm	low	I went to the sink to wash off the ink on the **palm** of my hand.	The stain from the spilled cup of coffee covered the **print** on the paper.
radio	high	In the car my friend and I listened to the songs on the **radio** and sang along.	We watched the boat float down the **river** as we tried to run along the bank.
radio	low	There was a big, comfortable chair near the **radio** in the living room.	He knew that somewhere nearby there was a **river** in which he could go swimming.
severe	high	The thunderstorm was strong and really **severe,** knocking down trees and phone lines.	Although the earring were gold plated they were really **silver** and cost a little bit less.
severe	low	Yesterday there was a **severe** thunderstorm in the afternoon.	I gasped with delight when I saw that there was a **silver** necklace in the box.
tiger	high	At the safari we came up close to a lion and a striped **tiger** with huge fangs.	In the bathroom the plumber tried to fix the **toilet** with the plunger.
tiger	low	The children were convinced they heard a loud **tiger** roar in the woods.	The hikers hoped that there was a **toilet** they could use near by.
vacant	high	With all of the furniture moved out the apartment was completely **vacant** and it looked very different.	The king wore a crown and a long robe that was made of smooth **velvet** that flowed in the air.
vacant	low	We walked around the newly **vacant** apartment and it no longer felt like home.	We could not help but to touch the green **velvet** robe and admired its color.
visible	high	The tree blocked my sight and the stop sign was not **visible** from my view point.	There were broken branches everywhere and we were glad the large tree had not **fallen** in our yard.
visible	low	We complained about to the town mayor because the sign was not **visible** to all drivers.	I looked through the kitchen window and made sure that nothing had **fallen** from the wind's shaking.
false	high	On part of the test we had to determine if certain statements were true or **false,** which was difficult.	On the airplane we could choose for dinner either chicken or **fish,** which was nice.
false	low	I could tell she was about to make another **false** statement about her friend.	The waiter was about to serve me another **fish** but I told him I was full.

Homograph sentences

Target	Constraint	Cognate sentences	Control sentences
arena	low	It took several months before the school **arena** was ready for the first hockey game.	It took about one month before the **couch** arrived from France.
arena	high	Before the competition the skaters practiced in the ice **arena** while the fans watched.	She was in the living room watching t.v. and sitting on the **couch** eating popcorn.
choke	low	I thought that I was going to **choke** from laughing so hard.	I knew they were going to **cheer** very loudly when Fernando scored the goal.
choke	high	He swallowed a small chicken bone and began to **choke** during last night's dinner	When the winning goal was scored the soccer fans began to **cheer** and celebrate the victory.
code	low	We were told that the newer **code** to open the door was top secret.	Our neighbor said she left the bowl of **corn** outside for the birds.
code	high	The thieves tried to crack the secret **code** to open the safe.	At the barbecue I ate a burger and an ear of **corn** fresh from the nearby farm.
curse	high	The prince became a frog because the witch had put a **curse** on him.	The detective became impatient as he looked for a **clue** at the crime scene.
curse	low	The child woke up after she dreamed that a **curse** had been placed on her by a witch.	I hoped that the **clue** would help me solve the mystery.
dote	high	The child's grandparents loved to give her gifts and to **dote** on her in any way possible.	I could tell that the shopping cart rolling towards the car was going to **dent** the side door.
dote	low	I think those parents love to **dote** on their children preventing them from being more independent.	I knew the teenager did not mean to **dent** the car and I felt sorry for him.
fabric	high	Although the shirt had long sleeves it was made out of a light **fabric** that kept me cool.	Although it was cold outside the hot **furnace** kept the room warm and comfortable.
fabric	low	When I got home I was happy that the blue **fabric** I bought for the dress was soft and comfortable.	We were relieved that the old **furnace** in the house worked well and kept us warm.
file	high	The secretary has each student's information in a private **file** in the office upstairs.	My cousin placed the new picture **frame** on the table in the living room.
file	low	We searched all night for the missing **file** but did not find it in the office.	We spent an hour finding the right **frame** for the picture.

Homograph sentences (continued)

Target	Constraint	Cognate sentences	Control sentences
fin	high	From the beach we could see the shark's **fin** pass through the water.	At the pond we could see the green **frog** jumping in and out of the water.
fin	low	We were all a little nervous as we watched the large **fin** of the shark go through the water.	The school children had fun as they watched the small **frog** jump from one rock to another in the pond.
floor	high	This weekend we vacuumed the rug and mopped the **floor** to help our parents.	After a hot summer I looked forward to the **autumn** and the changing leaves.
floor	low	When we went inside we could see the **floor** was covered with dirt.	It felt good to sit in the **autumn** sun and admire the golden leaves.
funds	low	The employee had to track how the **funds** were being spent by the company.	The kids did not leave because they wanted to see how the **fight** would be resolved.
funds	high	The accountant examined how the university spent the **funds** last year.	The referee tried to control the two boxers during the **fight** last night.
genial	high	My sister is friendly and honest, her **genial** manner puts people at ease.	My friend is mistrusting and paranoid, her **jealous** ways often frighten people.
genial	low	We were put at ease by her **genial** manner and immediately relaxed.	She was annoyed with his **jealous** manner and left him the following week.
gentle	high	The mother's voice was warm and **gentle** as she talked to her new baby.	The extroverted neighbor had a friendly and **chatty** manner that made us feel at home.
gentle	low	The family was surprised to see how happy and **gentle** their cat was with her new kittens.	I was surprised to see how relaxed and **chatty** my father was during my boyfriend's visit.
horn	high	The annoyed driver kept honking the car **horn** while he yelled out the window.	In the museum we saw the king's gold, royal **crown** locked behind a glass door.
horn	low	The dog ran when he heard the toy **horn** blowing behind him.	The curator was upset when she heard the ancient **crown** had been stolen from the display.
mayor	low	During dinner last night I saw the young **mayor** eating with his family.	After lunch I saw the short **movie** two times with my sister.
mayor	high	The day before elections our town **mayor** gave a speech about maintaining the community.	The famous actress talked about her latest **movie** and her recent marriage.

Homograph sentences (continued)

Target	Constraint	Cognate sentences	Control sentences
pale	low	The summer sky was a pretty, **pale** blue with only a few, small clouds.	The child would not let anyone take her old, **pink** blanket to have it washed.
pale	high	He was so frightened that his lips trembled and his face was deathly **pale** from the sight of the accident.	I do not understand why people dress baby girls in the color **pink** so much.
pan	high	I leave the bacon frying in the **pan** until it becomes cris p.	I try to keep some paper and a **pen** in my purse at all times.
pan	low	We went to the store to buy a **pan** for our kitchen.	She went to the store to buy a **pen** for the desk.
pie	high	I sliced apples because I was going to bake a **pie** for my dinner guests that evening.	The doctor handed me the prescription and said to take one **pill** before bedtime.
pie	low	I rushed around because I was worried that the **pie** would not be ready in time for my guests.	She called because she was concerned that the **pill** prescribed would interact with her other medication.
pile	high	The papers were all over the room so we put them in one, big **pile** on the desk.	An American electrical chord will not fit into a European **plug** so you will need to get an adapter.
pile	low	I found my wallet under a huge **pile** of clothes in the middle of my room.	Behind the desk I found a hidden **plug** to connect my computer to.
play	high	The child saw the new toy and wanted to **play** with it right away.	The child saw the **pool** and wanted to swim in it right away.
play	low	The children wanted to **play** with the new puppy.	The children wanted the **pool** with the new diving board.
red	low	Together we sat and watched the **red** boat sail slowly away.	I realized I had washed the **wrong** shirt that day.
red	high	The apple we picked was **red** and delicious.	Her answer was **wrong** and careless.
sane	high	I felt so stressed that I had to struggle to keep **sane** and I knew I needed a vacation.	My weight got so high I had to struggle to keep **slim** and I knew I should diet.
sane	low	Regular exercise is important for me to keep **sane** and not go crazy from stress.	Regular cycling is a good way for me to keep **slim** and healthy for the summer.

Homograph sentences (continued)

Target	Constraint	Cognate sentences	Control sentences
veil	low	They spent a lot of time in the store choosing my sister's **veil** for her wedding.	We had fun choosing my grandmother's **vase** for her anniversary.
veil	low	They spent a lot of time in the store choosing my sister's **veil** for her wedding.	We had fun choosing my grandmother's **vase** for her anniversary.
vent	high	There was a lot of dust in the air conditioner's **vent** that we needed to clean out.	There was a lot of money locked in the bank's **vault** where we kept our savings.
vent	low	The couple noticed that the room's **vent** was dirty and blowing dust into the apartment.	The couple noticed that the family's **vault** had been opened and jewelry was stolen.

Partial cognate sentences

Target	Constraint	Cognate sentences	Partial cognate sentences	Control sentences
bank	high	cognate meaning	After I saved up some money I went to deposit it in the **bank** down the street from my house.	Near our vacation house the lifeguards sat on the **beach** as the day slowly passed by.
bank	high	homograph meaning	On the side of the river the fishermen sit on the **bank** and cast their fishing lines.	Near our vacation house the lifeguards sat on the **beach** as the day slowly passed by.
bank	low	Cognate meaning	We waited for an hour by the bank where my cousin works as a teller.	On Sunday the family relaxed on the **beach** and watched the children play in the sand
bank	low	homograph meaning	During the summer the kids sit on the **bank** of the river and throw rocks in the river.	On Sunday the family relaxed on the **beach** and watched the children play in the sand
bulb	high	cognate meaning	Because the tulips needed to be planted in the spring, we bought the **bulbs** in March.	Our yard was overgrown and we had to trim the **bush** on the side of the house.
bulb	high	homograph meaning	The lamplights went out so I changed the **bulbs** before continuing with work.	Our yard was overgrown and we had to trim the **bush** on the side of the house.
bulb	low	cognate meaning	During biology class we examined the **bulbs** of flowers.	She removed the **bush** from the garden.
bulb	low	homograph meaning	I cleaned up the room and replaced the **bulbs** from the lamps.	She removed the **bush** from the garden.

Partial cognate sentences (continued)

Target	Constraint	Cognate sentences	Partial cognate sentences	Control sentences
case	low	cognate meaning	Last week my family called and said that the **case** was closed and the defendant found guilty.	Each weekend she was left in the **care** of her grandparents.
case	low	homograph meaning	I went to the store because I needed a **case** to lock my documents in.	Each weekend she was left in the **care** of her grandparents.
case	high	cognate meaning	The lawyer knew the defendant personally so it was unethical for her to be involved in the **case** and they found someone else.	I let my daughter stay with my parents because I knew she would be safe under their **care** and supervision.
case	high	homograph meaning	I took off my eye glasses and put them back in their **case** so they would not get scratched.	I let my daughter stay with my parents because I knew she would be safe under their **care** and supervision.

Partial cognate sentences (continued)

Target	Constraint	Cognate sentences	Partial cognate sentences	Control sentences
domestic	high	cognate meaning	Although cats were once wild, they have now become **domestic** and enjoy human companionship.	After the civil war the north and south separated and this was a **divided** country for many years.
domestic	high	homograph meaning	Unlike international flights, when traveling on a **domestic** flight you do not have duty-free shopping.	After the civil war the north and south separated and this was a **divided** country for many years.
domestic	low	cognate meaning	We all knew that they had become a **domestic** type of animal and had lost their hunting instincts.	He had traveled to many places but had never been in such a **divided** country with warring regions.
domestic	low	homograph meaning	We had less trouble since it was a **domestic** flight and we did not need to go through customs.	He had traveled to many places but had never been in such a **divided** country with warring regions.
fan	high	cognate meaning	After the winning goal at the soccer game a screaming **fan** danced on top of the bleachers.	We could barely see through the thick **fog** but made it home safely.
fan	high	homograph meaning	It was too hot in the room so we plugged in the large **fan** to cool down a little.	We could barely see through the thick **fog** but made it home safely.
fan	low	cognate meaning	We laughed as a **fan** jumped with joy for his team.	Last night there was a big **fog** that made driving dangerous.
fan	low	homograph meaning	Next to the bed there was a **fan** plugged into the wall.	Last night there was a big **fog** that made driving dangerous.
float	high	cognate meaning	The paper boat I made yesterday sunk, so I want this one to **float** without a problem.	The shepherd led his **flock** through the hills covered with green grass.
float	high	homograph meaning	In the parade there was one beautiful **float** decorated with colorful flowers.	The shepherd led his flock through the hills covered with green grass.
float	low	cognate meaning	I tried to show my brother how to **float** on top of water without moving.	Each morning we decide which **flock** of sheep should graze first.
float	low	homograph meaning	Every year the judges vote which beautiful **float** of the parade was the most original.	Each morning we decide which **flock** of sheep should graze first.

Partial cognate sentences (continued)

Target	Constraint	Cognate sentences	Partial cognate sentences	Control sentences
goal	high	cognate meaning	The soccer coach was very angry because the referee annulled the **goal** causing the Spanish team to lose.	The teacher said if we did not know the answer that we should try to **guess** the answer before giving up.
goal	high	homograph meaning	The school psychologist repeated the importance of achieving your **goal** through faith and dedication.	The teacher said if we did not know the answer that we should try to **guess** the answer before giving up.
goal	low	cognate meaning	I jumped out of my seat because his **goal** was what won the game for the team.	Although he thought about it, his **guess** was far from the truth.
goal	low	homograph meaning	The couple told us that their **goal** this year was to save enough money for a new house.	Although he thought about it, his **guess** was far from the truth.
grade	high	cognate meaning	The wine taster was pleased by the high **grade** chardonnay offered to her.	The children were excited the morning of their birthday because they saw the big **gift** their grandparents had given them.
grade	high	homograph meaning	The student was angry when she saw her test because she thought the **grade** would be much higher.	The children were excited the morning of their birthday because they saw the big **gift** their grandparents had given them.
grade	low	cognate meaning	The dinner guests knew that it was high **grade** wine that they were drinking.	I could tell Sharon was not pleased with the cheap **gift** she got for her birthday.
grade	low	homograph meaning	I could tell that Anthony was unhappy with the low **grade** he got on his test.	I could tell Sharon was not pleased with the cheap **gift** she got for her birthday.
grave	high	cognate meaning	None of us knew if it was just a chronic cold or a **grave** illness that was bothering her.	At the party we hosted we saw that all the **guests** were having a good time.
grave	high	homograph meaning	In the cemetery we walked past the **grave** where my aunt was buried.	At the party we hosted we saw that all the **guests** were having a good time.
grave	low	cognate meaning	My friend knew that a **grave** illness could get worse if it was not treated.	We looked in our living room and found the **guest** asleep on the couch.
grave	low	homograph meaning	We walked around until we found the **grave** where my aunt was buried.	We looked in our living room and found the **guest** asleep on the couch.

Partial cognate sentences (continued)

Target	Constraint	Cognate sentences	Partial cognate sentences	Control sentences
introduce	high	cognate meaning	We thought we had seen all the characters in the play but a new one was introduced towards the end of the story.	I knew Anthony was mad at me, so I tried to **apologize** to him later on.
introduce	high	homograph meaning	I knew Carlos did not know anyone at the party, so I tried to **introduce** him to many of my friends.	I knew Anthony was mad at me, so I tried to **apologize** to him later on.
introduce	low	cognate meaning	Our professor thought the topic was **introduced** too early in the semester**.**	She knew that her cousin would be willing to **apologize** for being late.
introduce	low	homograph meaning	I hoped that my boyfriend would remember to **introduce** me to his friends at the party.	She knew that her cousin would be willing to **apologize** for being late.
labor	high	cognate meaning	Many businesses in this area use new immigrants as cheap **labor** and do not offer them work benefits.	The mailman delivered the love **letter** a few days after I had sent it out.
labor	high	homograph meaning	The pregnant woman went into her first **labor** shortly after arriving at the hospital.	The mailman delivered the love **letter** a few days after I had sent it out.
labor	low	cognate meaning	They could not handle the difficult **labor** required at the factory.	Several weeks later her long **letter** finally arrived.
labor	low	homograph meaning	Around mid afternoon her first **labor** pains started to increase.	Several weeks later her long **letter** finally arrived.
positive	high	cognate meaning	She was very surprised to discover that the pregnancy test was **positive** and she immediately told her husband.	Although this computer is quite fast, it is not powerful enough to run this program.
positive	high	homograph meaning	Although I think that the ceremony is tomorrow, I am not **positive** about the time and it might be later.	Although this computer is quite fast, it is not powerful enough to run this program.
positive	low	cognate meaning	They said it was **positive** but we were not sure if the test result was reliable.	We knew she was a **powerful** person in politics, but she was always fair.
positive	low	homograph meaning	She said she was **positive** that she had left the keys on the table.	We knew she was a **powerful** person in politics, but she was always fair.

Partial cognate sentences (continued)

Target	Constraint	Cognate sentences	Partial cognate sentences	Control sentences
record	high	cognate meaning	In competitive sports it is always exciting when an athlete breaks a **record** that has been long standing.	The cars started their engines at the starting line and the **race** was about to begin.
record	high	homograph meaning	I looked through his music collection and found a **record** that I listened to when I was young.	The cars started their engines at the starting line and the **race** was about to begin.
record	low	cognate meaning	It was a great moment because the **record** for the highest jump was broken	My grandfather watched the second **race** to see if his horse would win.
record	low	homograph meaning	My cousin still owns the first **record** she ever bought when she was eight years old.	My grandfather watched the second **race** to see if his horse would win.
relative	high	cognate meaning	One might argue that Einstein's theory suggests that everything is **relative** and that there are no absolute truths.	I had been sick for many months and I hoped my **recovery** would not take long.
relative	high	homograph meaning	Before eating Thanksgiving dinner my family waited for my **relative** from New Jersey to arrive.	I had been sick for many months and I hoped my **recovery** would not take long.
relative	low	cognate meaning	It disturbed us that everything is **relative** and that there are no absolute answers in life.	The athlete waited months for her **recovery** from the injury to be complete.
relative	low	homograph meaning	I waited a long time for my **relative** to arrive at the airport.	The athlete waited months for her **recovery** from the injury to be complete.

Partial cognate sentences (continued)

Target	Constraint	Cognate sentences	Partial cognate sentences	Control sentences
rest	high	cognate meaning	I only took one of the boxes and my brother took the **rest** and put them in his car.	The nervous passenger told the driver to keep his eyes on the **road** and to slow down.
rest	high	homograph meaning	The doctor told the tired patient to drink fluids and get plenty of **rest** before returning to work.	The nervous passenger told the driver to keep his eyes on the **road** and to slow down.
rest	low	cognate meaning	After we had some dessert and talked for a while, we put the **rest** of the dishes in the sink to wash later.	I looked out of the window and I could see that the **road** ahead was long and full of curves.
rest	low	homograph meaning	My sister told me that after a long **rest** the tired traveler felt much better.	We looked out of the window and saw that the long **road** ahead of us was rough and poorly lit.
rock	high	cognate meaning	The window was broken because someone had thrown a **rock** which smashed the glass.	The king and queen would **rule** the land for many years to come.
rock	high	homograph meaning	The baby liked it when the cradle would **rock** gently causing him to fall asleep.	The king and queen would **rule** the land for many years to come.
rock	low	cognate meaning	I looked around for a **rock** to hold the door open as we moved the furniture.	He knew he would **rule** the land some day in the future.
rock	low	homograph meaning	At nights she would **rock** the baby to sleep as sang a song.	He knew he would **rule** the land some day in the future.
sentence	high	cognate meaning	After a difficult trial, the criminal was given a long **sentence** that we thought was fair and justified.	To everyone's surprise, the new president had turned a deficit into a **surplus** within two years.
sentence	high	homograph meaning	In her English class the young student practiced writing a complete **sentence** with a subject and predicate.	To everyone's surprise, the new president had turned a deficit into a **surplus** within two years.
sentence	low	cognate meaning	The people on the news show discussed the **sentence** that the criminal would have to carry out.	I tried to understand how the **surplus** from last year had been completely depleted.

Partial cognate sentences (continued)

Target	Constraint	Cognate sentences	Partial cognate sentences	Control sentences
sentence	low	homograph meaning	While playing with the child I tried to understand the **sentence** he had written, but it was unclear.	I tried to understand how the **surplus** from last year had been completely depleted.
turn	high	cognate meaning	I was standing in line for so long that I was relieved that it was finally my **turn** to order meat.	My husband comes from a big city but I come from a small **town** near the state border.
turn	high	homograph meaning	At the intersection we made a left **turn** and were almost hit by another car.	My husband comes from a big city but I come from a small **town** near the state border.
turn	low	cognate meaning	It took me a couple of seconds to realize that it was his **turn** to go skiing down the hill.	We saw the small **town** grow into a large city over the years.
turn	low	homograph meaning	We were worried because we had made the wrong **turn** and got lost for a while	We saw the small **town** grow into a large city over the years.
union	high	cognate meaning	The priest said that between a husband and wife there is a sacred **union** that cannot be broken.	The feminist discussed in great detail the unequal treatment of young **women** in the workforce during her lecture.
union	high	homograph meaning	Last month there was another strike because the workers' **union** was not satisfied with their wages.	The feminist discussed in great detail the unequal treatment of young **women** in the workforce during her lecture.
union	low	cognate meaning	The family and friends witnessed the **union** of the bride and groom during the small ceremony.	Last week the committee wanted to speak with the **women** employees to discuss salary inequities.
union	low	homograph meaning	Last month we wanted to speak with the company's **union** members to discuss salary increases.	Last week the committee wanted to speak with the **women** employees to discuss salary inequities.

Spanish sentences used in Experiment 4

+P cognate sentences

Target	Constraint	Cognate sentences	Control sentences
actor	high	Mientras estuve en Hollywood no vi a ningún **actor** famoso paseando por las calles o comprando en las tiendas.	Vimos al pájaro posarse en la rama de un **árbol** en el jardín.
actor	low	Ella me aseguró que él era un gran **actor** y que la película era muy buena.	Desde mi ventana puedo ver el viejo **árbol** en el jardín.
banda	high	Durante muchos años ella fue cantante de una pequeña **banda** que solía tocar cada viernes en este bar.	El adolescente no quiso afeitarse la pequeña **barba** que tenia y la dejo crecer.
banda	low	Por fin vimos a una **banda** tocar música jazz la semana pasada.	El joven no quería tener **barba** y se afeitaba todos los días.
calma	high	Aunque me estaba enfadando mucho, intenté mantener la **calma** y no chillar.	En clase leemos la historia de Hellen Keller, una niña sorda y **ciega** que aprendió con gran rapidez a leer y escribir.
calma	low	Fue impresionante que ella mantuviera la **calma** ante todos esos problemas.	La madre temía que después de la enfermedad su hija se quedara **ciega** para el resto de su vida.
cereales	high	Para desayunar ella no hecha la leche a los **cereales** porque entonces no salen tan crujientes.	Los pantalones me quedaban grandes y me puse un **cinturón** para que no se me cayesen.
cereales	low	En cuanto me di la vuelta mi sobrino había tirado los **cereales** al suelo.	Creo que mi hermana tiene mi **cinturón** en su armario.
correcta	high	El estudiante se sentía avergonzado porque su respuesta a la pregunta no era **correcta** y no volvió a levantar la mano de nuevo	Me gustó mucho su sombrero y quise preguntarle dónde lo había **comprado** y cuánto costaba.
correcta	low	No estaba muy segura de que la receta fuera **correcta** así que llamé a mi suegra.	Antonio había **comprado** un anillo para su novia antes de pedirle que se casara con el.

+P cognate sentences (continued)

Target	Constraint	Cognate sentences	Control sentences
director	high	Durante el rodaje de la película, el guión original lo cambió bastante el **director** que ganó un Oscar el año pasado.	Durante la entrevista el famoso no quiso responder a ninguna **pregunta** sobre su familia.
director	low	Después de muchas peleas decidieron despedir al **director**, ya que era muy difícil trabajar con él.	El niño era muy inteligente y su **pregunta** nos hizo pensar mucho.
eco	high	La niña gritó su nombre en el pozo para oír el **eco** de su voz.	El granjero se levantó muy temprano todos los días y ya al **alba** estaba en el campo.
eco	low	Nos interesó mucho la charla pero había un **eco** en la sala que impedía oírla muy bien.	Todos los días el granjero trabaja desde el **alba** hasta que anochece.
error	high	Me dieron una calificación baja en el examen porque cometí un **error** tonto en el último problema.	En esta tienda de muebles hay de todo para decorar el **hogar** y el jardín.
error	low	Me avergoncé un poco porque me pareció un **error** muy tonto para una pregunta tan fácil.	Quise comprar unas cosas para el **hogar** con mi primer sueldo.
final	high	Antes de ejecutar al prisionero le preguntaron si tenía un deseo o petición **final** antes de que se muriera.	Me fui a la biblioteca para devolver el **libro** que había sacado prestado.
final	low	Me dijo que al **final** decidieron comprarme una blusa nueva.	El chico se enfadó y tiró el **libro** al suelo.
formal	high	Mi novio se alquiló una limosina para llevarme al baile **formal** la primavera pasada.	Con el pasar de los años había aprendido mucho y en su vejez era un hombre **sabio** y respetado en el pueblo.
formal	low	Ella nos informó de que era una fiesta **formal** y que hacía falta llevar corbata.	Hacia mucho tiempo que la mujer conocía a Jaime y no le parecía un hombre **sabio** ni inteligente.
hospital	high	Su fiebre era tan alto que decidimos llevarle al **hospital** de la ciudad.	Cuando su hijo ganó el premio Nobel su familia sintió mucho **orgullo** y alegría.
insecto	high	La rana cazó a una mosca y a otro **insecto** con su lengua.	Don Quijote leyó un libro de un **hidalgo** y eso le hizo volverse loco.
insecto	low	No me di cuenta de que se había metido otro **insecto** en el despacho.	Es un hombre muy raro que viste como un **hidalgo** de la edad media.

+P cognates sentences (continued)

Target	Constraint	Cognate sentences	Control sentences
inspector	high	El agente de policía informó al **inspector** sobre los detalles del asesinato.	Mi hermana no cree que haya un diablo o un **infierno** en el que castigar a los pecadores.
inspector	low	El alcalde llamó al **inspector** de la salud y medio ambiente para que revisara el agua potable del pueblo.	Mi hermana sonó que estaba atrapada en el **infierno** y no pudo escapar.
metal	high	En el aeropuerto tuvimos que pasar por un detector de **metal** y abrir los guardias revisaron nuestras maletas.	Al coger el vaso, el vino se derramó sobre mi blusa blanca y dejó una **mancha** grande y roja.
metal	low	Ella guardaba el equipaje en una caja de **metal** que estaba cerrado con llave.	Regresó de la fiesta muy cansado y con una **mancha** de vino en su camiseta.
mortal	high	Llega un momento en que nos damos cuenta de que no vamos a vivir para siempre y que somos seres **mortales** y un día moriremos.	La estatua griega estaba hecha de **mármol** y valía millones de dólares.
mortal	low	En el cuento que leíamos anoche había un duende que convertía a una persona **mortal** en una diosa.	Según la leyenda, la bruja convirtió a la mujer en **mármol** para vengar la muerte de su hermana.
perfecto	high	Todo salió como lo habían planeado, así que fue un viaje **perfecto** y valió la pena gastarse el dinero en ello.	Mi mejor amiga estaba deprimida por mucho tiempo, pero ahora que ha llegado la **primavera** se siente mucho mejor.
perfecto	low	La verdad es que el viaje fue **perfecto**, no divertimos mucho y conocimos a mucha gente.	Después de un invierno tan frío da gusto saber que ya viene la **primavera** y que pronto hará mejor tiempo.
piano	high	El compositor de música clásica se sentó en el banquillo y empezó a tocar el **piano** para empezar el concierto.	Había un nido en el árbol del jardín y un **pájaro** cantando dentro.
piano	low	Cuando entramos en el comedor nos dimos cuenta de que había un **piano** grande en la esquina.	Ayer por la noche el **pájaro** se escapo de su jaula.
poeta	high	Después de haber escrito unos sonetos mi amigo decidió que quería ser **poeta** además de novelista.	Me gusta oír latir su corazón y por eso pongo mi cabeza en su **pecho** cuando duerme.
poeta	low	Un viejo amigo mío es **poeta** y disfrutamos mucho leyendo sus trabajos.	El soldado tenía una herida en el **pecho** y no sabíamos si iba a sobrevivir.

+P cognate sentences (continued)

Target	Constraint	Cognate sentences	Control sentences
profesora	high	Dijo que se disfrutó de la clase que recibió en la universidad porque la **profesor** era interesante y muy animado.	Ha publicado muchos libros y por eso es un **escritor** muy famoso en este país.
profesora	low	Esperaban con ilusión la llegada de la **profesora** nueva a la universidad.	Desde que era pequeño he querido ser **escritor** y creo que ahora mi sueño se va cumplir.
reformar	high	Los ciudadanos del pueblo exigieron cambios pero el alcalde dudó que podía **reformar** muchas cosas en un solo año.	Por mi cumpleaños me compraron un **regalo** y me invitaron a cenar.
reformr	low	Todos los que asistieron a la reunión se dieron cuenta de que el director no pudo **reformar** mucho en la escuela en un año solo.	Sus padres no querían darle el **regalo** porque era un niño muy mimado.
romántico	high	Al principio cuando salimos juntos mi novio era muy **romántico**, siempre comprándome flores y dulces.	Por higiene, las cocineras están obligadas a llevar el pelo **recogido** mientras preparen o sirven comida.
romántico	low	Cuando nos conocíamos al principio él era muy **romántico** y me compró muchas flores y regalos.	Esta mañana nuestro vecino nos había **recogido** el periódico de camino a su casa
superior	high	El vendedor de coches nos dijo que comparado con otros modelos, este coche es **superior** y no es muy caro.	Me voy al cine para ver una **película** de Cary Grant de los anos cincuenta.
superior	low	Buscaron mucho tiempo un coche **superior** del que compraron hace muchos años.	Ayer mi novio y yo vimos una **película** pero no nos gustó mucho.
terror	high	Viendo como el tornado se acercaba a mi casa sentí un gran **terror** pero luego no ocurrió nada.	Le dolía toda la parte superior del cuerpo desde el **hombro** hasta la cintura.
terror	low	Todos sentimos mucho **terror** viendo el tornado.	Mi vecino del cuarto tiene un **hombro** mas alto que el otro.
tractor	high	El granjero conducía su **tractor** por toda la granja.	A mi padre le gusta mucho pescar **truchas** en el río.
tractor	low	Estaban satisfechos con el **tractor** nuevo que compraron.	Ayer mi madre compro **truchas** para comer.
triple	high	Yo gano más que el doble de lo que ganaba antes, casi gano el **triple** pero también tengo muchos gastos.	A José siempre se le cae todo de las manos, es una persona muy **torpe**, no como su hermana.
triple	low	Ella me prometió que yo iba a ganar el **triple** de lo que ganaba antes si me contratara con su compañía.	Yo diría que mi padre es la persona más **torpe** que he conocido en mi vida.

-P cognate sentences

Target	Constraint	Cognate sentences	Control sentences
acre	high	Hemos averiguado que el terreno mide un **acre**, lo cual era suficiente.	Decidí poner las flores dentro del **jarro** que mi tía me regalo el ano pasado.
acre	low	Nos impresionó mucho que el **acre** de terreno estaba tan bien cuidado.	Encima de la mesa en el pasillo había un **jarro** lleno de flores.
aire	high	Tuvimos que parar el coche porque los neumáticos no tenían suficiente **aire** para el viaje.	Yo pensaba que Maria solo tenía dos niñas, pero ella me dijo que tiene otro **hijo** mayor.
aire	low	Después de unas horas de viaje nos dimos cuenta de que no quedaba bastante **aire** en los neumáticos y paramos en un garaje.	Después de dos anos, su otro **hijo** decidió no continuar estudiando derecho.
audible	high	Su tono de voz era tan bajo que casi no era **audible** desde donde estábamos nosotros sentados.	La botella estaba vacía porque el agua había salido por una **abertura** en el plástico.
audible	low	Les dije a mis amigos que la música no era **audible** desde nuestra habitación.	El camino era peligroso porque había una **abertura** entre las rocas.
base	high	La familia del soldado vivió en la **base** militar que estaba situada a las afueras de la ciudad.	He levantado tantas pesas que me duele mucho el **brazo** y por eso no quiero hacer más ejercicio.
base	low	Les gustaba mucho vivir en la **base** militar porque conocían a mucha gente de su país.	Me agarró del **brazo** cuando íbamos paseando por el parque y nos fuimos a casa.
benigno	high	El doctor diagnosticó el tumor como **benigno** y les tranquilizó afirmando que su vida no estaba en peligro.	Debido a que el árbitro había anulado un gol el equipo de fútbol fue **vencido** por los alemanes.
benigno	low	Nos alegramos mucho porque resulta que era **benigno** el tumor que tenía mi hermana en su brazo.	El equipo de fútbol fue **vencido** en la última fase del campeonato mundial.
cable	high	Para conectar el ordenador hacía falta un **cable** mas larga.	En este país se bebe leche de vaca pero en Holanda la leche de **cabra** es más popular.
cable	low	Le informé a mi jefe de que hacía falta un **cable** nuevo para el ordenador.	La niña se asustó cuando vio a la **cabra** correr hacia ella.
canoa	high	En el lago del parque había personas remando en una **canoa** y divirtiéndose mucho.	Por las tardes él tocaba el piano mientras ella cantaba una **canción** de su infancia.
canoa	low	A mi hermana pequeña le daba miedo montarse en la **canoa**, así que se quedó en casa.	Todos nos quedamos callados mientras la **canción** sonaba en la radio.

-P cognate sentences (continued)

Target	Constraint	Cognate sentences	Control sentences
debate	high	Antes de las elecciones los candidatos discutieron el tema de los impuestos en un **debate** bastante interesante.	El béisbol es el **deporte** nacional de los Estados Unidos.
debate	low	Estaba claro que ninguno de nosotros pensamos que el **debate** era bueno, puesto que ningún político defendía bien sus ideas.	El medico me dijo que ese tipo de **deporte** no era bueno para mi.
diagrama	high	Para explicarnos mejor el plano de la nueva casa el arquitecto nos dibujó un **diagrama** con bastantes detalles.	Enfrentarnos contra el mejor equipo de fútbol y luchar por la victoria fue un gran **desafió** para nosotros.
diagrama	low	Entendimos mejor su idea cuando vimos el **diagrama** que nos dibujo en la pizarra.	Vivir en este pueblo tan alejado ha sido un **desafió** para mi y mi familia.
dieta	high	Iba ganando peso pero no quería empezar otra **dieta** que no iba a surtir efecto.	Fuimos a comprar el pan a una pequeña **tienda** al lado de mi casa.
dieta	low	Le informaron que el nuevo **dieta** reducirá su nivel de colesterol.	Ayer mi amiga y yo fuimos a la nueva **tienda** para comprar ropa.
escape	high	Los prisioneros pensaron que estaban atrapados hasta que encontraron una ruta de **escape** por donde huyeron.	Cuando ayer bañé a mi bebé eché tanto jabón que se hizo mucha **espuma** y el agua se cayo por el suelo.
escape	low	Menos mal que mi amigo conocía una ruta de **escape** y nadie nos pilló en el almacén.	El padre se asustó al ver el suelo cubierto de **espuma** y basura en el cuarto de baño.
falsa	high	En el examen había que determinar que si la frase era verdadera o **falsa**, lo cual era muy difícil.	Había llovido por eso el suelo estaba mojado y mi ropa estaba llena de **barro** y manchada de hierba.
falso	low	Me parecía a mí que era **falso** lo que ella estaba diciendo.	Mi prima de España lloraba porque encontró su juguete con **barro** y con una pieza rota.
genuinos	high	El joyero quería asegurarnos de que todos los diamantes en el collar eran **genuinos** y de alta calidad.	El niño se parecía tanto a su hermano que yo pensé que era su **gemelo**, pero estaba equivocada.
genuino	low	La comida en el nuevo restaurante tenía un sabor **genuino** de Italia.	A veces me pregunto como sería tener un **gemelo** en vez de un hermano.

-P cognate sentences (continued)

Target	Constraint	Cognate sentences	Control sentences
gradual	high	Se recuperó de la enfermedad de una forma lenta y **gradual**, así que cuando por fin estuvo mejor nos alegramos mucho.	Cuando el ladrón entro en la casa el perro asustado soltó un **gruñido** y salio corriendo.
gradual	low	Su despedida fue **gradual** porque en realidad no quería irse tan temprano.	Mis amigas y yo salimos de la habitación aterrorizadas porque escuchamos un **gruñido** que venia de afuera.
horrible	high	El violento accidente afectó a muchos coches, fue **horrible** verlo.	Había bebido mucho esa noche y regresó a casa **borracho** y violento.
horrible	low	Durante tantos años me pareció **horrible** que los hermanos se llevaran tan mal y que no se hablasen entre ellos.	Mi amigo me aseguraba que no estaba **borracho**, pero no le permití meterse en el coche de todos modos.
imagen	high	El bebé se miró en el espejo y se rió al ver su **imagen** sonriente.	Los padres estaban muy contentos porque su hijo dijo su primera **palabra** esta mañana.
imagen	low	Por mucho que lo intente, no puedo quitarme la **imagen** del accidente de mi mente.	Los alumnos estaban muy cansados y no querían aprender una **palabra** mas de Inglés.
motor	high	El coche sonaba tan mal al arrancarse que temía que el viejo **motor** se iba estropearse ya.	La familia era muy religiosa y todos los domingos iban a **misa** sin falta.
motor	low	Hicimos caso al consejo de mi tío, y dejamos el **motor** en marcha un rato antes de sacar al coche.	Siempre se queja cuando vamos a **misa** porque nunca quiere ir.
notable	high	Era obvio que el pueblo había cambiado mucho, la diferencia era **notable** para cualquier persona que haya vivido allí.	Nunca se sabe si ese chico esta diciendo la verdad o una **mentira** y por eso no le hago caso.
notable	low	Había un cambio **notable** en la casa una vez que se fue mi madre.	Nosotros te conocemos muy bien y sabemos que es **mentira** lo que estas diciendo.
oxígeno	high	En la clase de ciencias los niños aprendieron como los animales respiran el **oxígeno** a través de los pulmones.	Su mala memoria hizo que la cita quedara en el **olvido** y nunca se presento.
oxígeno	low	Hemos mirado esta mañana y casi no quedaba más **oxígeno** en el tanque y hay que rellenarlo hoy.	Aunque fue famosa en los sesenta, paso al **olvido** y nadie la volvió a contratar.

-P cognates (continued)

Target	Constraint	Cognate sentences	Control sentences
palma	high	La gitana nos dijo que podía leer nuestros futuros mirando la **palma** de la mano.	Nuestro huésped no pudo dormir anoche porque estuvo ladrando el **perro** de nuestra vecina
palma	low	Intenté quitarme la tinta de la **palma** de mi mano con agua y jabón.	Mi sobrino me dijo que lo único que quería para su cumpleaños era un **perro** muy grande
radio	high	En el coche mi amiga y yo escuchábamos las canciones que pusieron por la **radio** y las cantábamos juntas.	La lavadora es muy pequeña y no podemos meter toda la **ropa** de una vez.
radio	low	Al lado de la **radio** había un sillón muy grande y cómodo.	Mi padre se enfada porque siempre tengo toda la **ropa** tirada por el suelo.
severa	high	El crimen fue tan horrible que recibió una **severa** condena.	Ella nunca se caso porque prefiere la vida de **soltera** ya que es muy independiente
severa	low	Por lo visto no fue muy **severa** la tormenta de anoche.	El camarero me dijo que su hermana esta **soltera** y vive en Valladolid.
tigre	high	En el safari nos acercamos mucho a un león y a un **tigre** muy grande.	Tenia una lesión en la parte posterior del pie y el **talón** me dolía mucho.
tigre	low	Los niños estaban convencidos de que había un **tigre** enorme en el bosque.	Ayer al volver a casa me caí y hoy el **talón** me duele mucho.
vacante	high	Cuando despidieron a mi jefe inmediatamente publicaron el aviso de **vacante** y no tardaron en encontrar otra persona.	Esta papelera está llena de basura porque nadie lo ha **vaciado** todavía.
vacante	low	Una vez que se quedó **vacante** el puesto muchos vinieron a solicitar el contrato.	Cuando llegamos a la Universidad vimos que habían **vaciado** las clases por un aviso de bomba
visible	high	El árbol ocultaba la señal de "stop" que no era **visible** desde el coche.	En la casa de al lado la **vecina** grita mucho a sus hijos.
visible	low	Nos quejamos porque no estaba **visible** la señal de tráfico, y eso causó el accidente.	Cuando iba de compras vi a mi **vecina** en una tienda.

Homograph sentences

Target	Constraint	Cognate sentences	Control sentences
arena	high	A los niños les encanta ir a la playa para jugar en la **arena** con sus cubos y palas.	A mi nieta le encanta ir al parque para jugar con su mejor **amiga** y con sus perros.
arena	low	Me regaló una botella llena de **arena** de distintos colores cuando regresó de sus vacaciones.	La protagonista de la película se parecía mucho a la **amiga** de mi hermano.
asignatura	high	No pudo terminar la carrera porque le quedaba una **asignatura** sin aprobar.	Antes de la comida fuimos al bar para tomar el **aperitivo** y unas cervezas.
asignatura	low	Este año solo me queda una **asignatura** para terminar la carrera.	Estaba enfermo y no quiso tomar el **aperitivo** esa tarde.
choque	high	Si fuera mejor conductor habría podido evitar el **choque** con el otro coche.	Si fuera mejor cómico habría sabido contar el **chiste** con gracia.
choque	low	Si fuera clarividente habría podido evitar el **choque** con el otro coche.	Si fuera mas listo habría entendido el **chiste** sin dificultades.
codo	high	No puedo mover el brazo porque me hice daño en el **codo** jugando al rugby.	Se le ha roto un hueso del pie y por eso anda **cojo** y necesita muletas.
codo	low	Creo que a mi tío le duele el **codo** por la mañana porque está viejo y tiene artritis.	Después de la pelea su perro estaba **cojo** de un pie y lo llevaron al veterinario.
curso	high	Mi sobrino suspendió todas sus clases y tuvo que repetir el **curso** al año siguiente.	Antes de mandar la camiseta la metí en una **caja** y la envolví en papel de regalo.
curso	low	Al principio no conocía a nadie, pero al final del **curso** ya tenía muchísimos amigos.	El juguete es demasiado grande y la **caja** no cabe en nuestro coche.
fábrica	high	Durante la Depresión muchos niños forjaron hierro en esa **fábrica** por muy poco dinero.	Al lado de nuestra casa la **vecina** tiene una piscina gigantesca.
fábrica	low	Desde la autopista se veía la vieja **fábrica** donde antes trabajaba mi abuelo.	Mientras compraba carne vi a nuestra **vecina** hablando con Jorge.
fila	high	En la escuela al final del día los niños se tienen que poner en **fila** antes de salir de la clase.	Le gusta lucir las piernas y por eso suele llevar la **falda** muy corta.
fila	low	Para matar el tiempo contamos chistes y las otras personas en la **fila** empezaron a reírse.	Fuimos a mas de cuatro tiendas antes de encontrar una **falda** que le favorecía.
fin	high	Cada Nochevieja miles de neoyorquinos van a celebrar el **fin** de año bebiendo champán.	La casa estaba muy oscura hasta que encendí la **luz** del cuarto de estar.

Homograph sentences (continued)

Target	Constraint	Cognate sentences	Control sentences
fin	low	Todos vamos a casa de mis tíos porque es el **fin** de año y van a hacer una gran fiesta.	No me gusta mi despacho porque la **luz** es insuficiente para mi gusto.
flor	high	Yo creo que la rosa es la **flor** que mejor simboliza el amor.	Apago el cigarrillo porque estaba prohibido **fumar** en el hospital.
flor	low	El niño saludó a su madre con una **flor** en la mano.	En aquel sitio no le dejaban **fumar** y por eso no entramos.
fundas	high	Antes de hacer la cama hay que meter las almohadas en **fundas** limpias y sacudir las sábanas.	Mientras andaban por el cementerio procuraron no acercarse a las **fosas** de sus familiares.
fundas	low	Busqué por toda la casa pero no pude encontrar **fundas** limpias para las almohadas.	El cuento le asustaba tanto que ya no quería acercarse a las **fosas** del cementerio.
gente	high	En la discoteca no podíamos ni movernos por la cantidad de **gente** que había así que nos fuimos.	Su abuelo era un soldado durante la segunda **guerra** mundial pero no le gusta hablar de esos tiempos.
gente	low	Desde el ultimo piso del rascacielos tanto la **gente** como los coches se ven muy pequeños.	Mi madre era solamente una niña pequeña durante la **guerra** y no recuerda bien esos tiempos.
horno	high	Para hacer pan, primero amasas la harina y luego la metes en el **horno** durante una hora.	Por el campo paseaba un pastor con una **oveja** blanca que seguía sus pasos.
horno	low	Nos va a costar mucho dinero arreglar este **horno**, deberíamos comprar uno nuevo.	Los niños daban de comer a la pequeña **oveja** mientras la acariciaron.
leer	high	Es analfabeto y este año quiere aprender a **leer** con la ayuda de sus amigos.	Dicen que es malo para los ojos **mirar** tanto la pantalla del ordenador.
leer	low	Se preocupa porque a su hijo no le gusta **leer** y saca malas notas en el colegio.	Por los domingos no hace mas que **mirar** la televisión todo el día.
mayor	high	Aunque Pepe tiene cuatro años mas que Luis, es difícil saber cual es el **mayor** porque los dos son muy altos.	Carmen estaba muy enferma pero ahora dice que se encuentra mucho **mejor** y que volverá pronto al trabajo.
mayor	low	Conozco a los dos desde hace mucho tiempo pero aun no sé quién es el **mayor** y quién es el más joven.	Sandra me asegura que vivir en un pueblo pequeño sin crimen es **mejor** que vivir en la gran ciudad.

Homograph sentences (continued)

Target	Constraint	Cognate sentences	Control sentences
once	high	Las torres gemelas fueron atacadas el día **once** de Septiembre del año 2001.	Algunos dicen que el contrario del amor es el **odio**, pero yo creo que es la indiferencia.
once	low	Ellos decidieron casarse el día **once** de Octubre del año 2004.	Ahora lo único que le queda a ese miserable es el **odio** que siente hacia todo el mundo.
pan	high	La pequeña fue a la tienda para comprar una barra de **pan** para la comida.	Su padre aun no ha encontrado trabajo y sigue en el **paro** después de un año.
pan	low	Habían invitado a demasiadas personas y por eso no había bastante **pan** para todos.	Siempre vive con el miedo de quedarse un día en el **paro** y por eso ahorra mucho.
pila	high	Se me paró el reloj porque estaba gastada la **pila** y tuve que ir al joyero para arreglarlo.	Había dado a luz a seis cachorros y por eso la pobre **perra** solo quería descansar.
pila	low	No podía jugar con el juguete porque la **pila** no era del tamaño adecuado.	No estoy segura pero creo que vi la **perra** de nuestros vecinos andando por la calle.
playa	high	Fuimos a tomar el sol y a buscar conchas en la **playa** mientras ellos prepararon la comida.	Para cruzar el río que separa los dos pueblos construyeron un nuevo **puente** porque el viejo se había caído.
playa	low	Hemos decidido que este año no iremos a la **playa** sino a la sierra donde hace mas fresco.	Nos avisaron que era muy peligroso cruzar el **puente** y que deberíamos escoger otra ruta.
red	high	Los pescadores se alegraron porque pescaron centenares de peces en la **red** en cuestión de horas.	El chiste que me contaron era tan gracioso que no pude contener la **risa** y la profesora me echó de clase.
red	low	Desafortunadamente, tardamos mas de dos horas intentando arreglar la **red** antes de continuar la pesca.	No sé explicarlo, pero la verdad es que muchas cosas me dan **risa** por ninguna razón en particular.
sano	high	Tanto fumar y beber no es **sano** y tienes que cambiar tu estilo de vida.	La toalla estaba empapada pero ahora que lleva una hora al sol está **seca** y puedes usarla.
sano	low	Mi madre cree que lo que hacemos los fines de semana no es **sano** y me lo quiere prohibir todo.	Salimos mas tarde porque aun no estaba completamente **seca** la camiseta que me iba a poner.

Homograph sentences (continued)

Target	Constraint	Cognate sentences	Control sentences
vela	high	Se cortó la luz así que tuvimos que buscar una **vela** y un mechero.	Los novios estaban en el parque dándose muchos **besos** en toda la cara.
vela	high	Se cortó la luz así que tuvimos que buscar una vela y un mechero.	Los novios estaban en el parque dándose muchos **besos** en toda la cara.
venta	high	Ahora puedo comprar mi película preferida porque ya está a la **venta** en el videoclub.	Para reciclar esa botella, échala al contenedor para el **vidrio** que está en la esquina.
venta	low	Ha tardado mucho pero ya está a la **venta** el nuevo modelo de Volkswagon.	Mi padre no sabe dónde queda el contenedor para el **vidrio** que puso el ayuntamiento.

Partial cognate sentences

Target	Constraint	Sentence bias	Partial cognate sentences	Control sentences
columna	high	cognate meaning	Entre las ruinas del templo griego solo quedaba una **columna** entera en pie.	En la prisión el prisionero estaba atado a la pared con unas **cadenas** y sus ojos estaban tapados.
columna	high	homograph meaning	Le duele mucho la espalda porque tiene problemas de **columna** y no puede hacer deporte.	En la prisión el prisionero estaba atado a la pared con unas **cadenas** y sus ojos estaban tapados.
columna	low	cognate meaning	Los trabajadores repararon la **columna** del edificio donde trabaja mi primo.	En el garaje mi padre estaba buscando unas **cadenas** para atar al perro.
columna	low	homograph meaning	El mes pasado me dijeron que tenia un problema con la **columna** y que debería ir a nadar.	En el garaje mi padre estaba buscando unas **cadenas** para atar al perro.
cura	high	cognate meaning	Los científicos que investigan el cáncer esperan encontrar pronto una **cura** para la enfermedad.	Casi todo el mundo sabe que Drácula era un **conde** de Transylvania que se convertió en un vampiro.
cura	high	homograph meaning	En la iglesia los padres hablaban con el **cura** sobre la boda de su hija.	Casi todo el mundo sabe que Drácula era un **conde** de Transylvania que se convertió en un vampiro.
cura	low	cognate meaning	El alcalde les informo a los campesinos que una **cura** para la plaga estaba en camino.	Según la leyenda en el siglo dieciséis vivía un **conde** que se convertió en un vampiro y mato a todos los niños del pueblo.
cura	low	homograph meaning	Vi a mi vecino paseando por el parque y al **cura** y hablando con el.	Según la leyenda en el siglo dieciséis vivía un **conde** que se convertió en un vampiro y mato a todos los niños del pueblo.

Partial cognate sentences (continued)

Target	Constraint	Sentence bias	Partial cognate sentences	Control sentences
dirección	high	cognate meaning	Llegamos tarde a la fiesta porque en vez de ir por el norte fuimos por la **dirección** contraria y nos perdimos.	Mi jefe tenia mucho trabajo que hacer y para evitar molestias dejo la puerta de su **despacho** cerrada todo el día.
dirección	high	homograph meaning	La carta que mi tío me envió no me llego porque había escrito mal la **dirección** y el código postal no era correcto.	Mi jefe tenia mucho trabajo que hacer y para evitar molestias dejo la puerta de su **despacho** cerrada todo el día.
dirección	low	cognate meaning	Nadie me hizo caso pero yo sabia que no íbamos por la **dirección** correcta y que nos íbamos a perder.	Pensé que había perdido mi cartera pero después lo encontré en mi **despacho**, metida en un cajón.
dirección	low	homograph meaning	Mi amiga se ríe de mi porque he tardado meses en recordar mi nueva **dirección** y numero de teléfono.	Pensé que había perdido mi cartera pero después lo encontré en mi **despacho**, metida en un cajón.
doblar	high	cognate meaning	Los españoles nunca ven películas en versión original y por eso los cines tienen que **doblar** todas las películas extranjeras.	Mi marido no regresó hasta la una de la madrugada aunque me había prometido que no iba a **tardar** mucho en llegar.
doblar	high	homograph meaning	La fabrica necesitaba mas producción y los trabajadores tuvieron que **doblar** su trabajo y hacer horas extra.	Mi marido no regresó hasta la una de la madrugada aunque me había prometido que no iba a **tardar** mucho en llegar.
doblar	low	cognate meaning	En su nuevo trabajo tenia la oportunidad para **doblar** su salario.	Es muy coqueta y cuando vamos a alguna fiesta se que va **tardar** mucho tiempo en arreglarse.
doblar	low	homograph meaning	Yo creo que en España es donde mejor saben **doblar** películas extranjeras.	Es muy coqueta y cuando vamos a alguna fiesta se que va **tardar** mucho tiempo en arreglarse.

Partial cognate sentences (continued)

Target	Constraint	Sentence bias	Partial cognate sentences	Control sentences
efectivo	high	cognate meaning	El nuevo método de reproducción ha funcionado muy bien y ha resultado ser muy **efectivo** en la clonación de proteínas.	Tras las elecciones de este otoñó la candidata mas joven fue **elegida** como la nueva alcalde.
efectivo	high	homograph meaning	Como no llevábamos tarjeta de crédito tuvimos que pagar en **efectivo** y ya no nos queda dinero para cenar.	Tras las elecciones de este otoño la candidata mas joven fue **elegida** como la nueva alcalde.
efectivo	low	cognate meaning	Mis compañeros de la oficina me dijeron que era un método **efectivo** para blanquear la dentadura.	Fuimos a celebrar porque su cuñada fue **elegida** como la alcalde de nuestro pueblo.
efectivo	low	homograph meaning	Se enfado porque no le quedaba **efectivo** y tuvo que pagar con su tarjeta de crédito.	Fuimos a celebrar porque su cuñada fue **elegida** como la alcalde de nuestro pueblo.
estación	high	cognate meaning	Los niños observaban el ir y venir de los trenes en la **estación** de Atocha de Madrid.	La niña me describió como eran los alumnos y profesores en la **escuela** a que iba el ano pasado.
estación	high	homograph meaning	Aunque mucha gente esquía en invierno, yo creo que la primavera es la mejor **estación** del ano para hacerlo.	La niña me describió como eran los alumnos y profesores en la **escuela** a que iba el ano pasado.
estación	low	cognate meaning	Compre un regalo para mi sobrino en la **estación** esta tarde mientras esperaba la llegada del tren.	Andando por mi viejo barrio me detuve frente a la **escuela** a la que iba cuando era pequeña.
estación	low	homograph meaning	Tras haber vivido aquí muchos anos puedo confirmar que esta **estación** de invierno es de las mas frías que se ha pasado en esta zona.	Andando por mi viejo barrio me detuve frente a la **escuela** a la que iba cuando era pequeña.

Partial cognate sentences (continued)

Target	Constraint	Sentence bias	Partial cognate sentences	Control sentences
grano	high	cognate meaning	Los invitados comían toda la paella y no quedaba siquiera un **grano** de arroz.	Este maquillaje no me costo nada porque me lo dieron **gratis** cuando me compre un bote de champú.
grano	high	homograph meaning	El adolescente no se lavaba bien la cara y le salio un **grano** bastante grande en la cara.	Este maquillaje no me costo nada porque me lo dieron **gratis** cuando me compre un bote de champú.
grano	low	cognate meaning	Detrás de la basura había un ratón comiendo un **grano** de arroz.	Todo el maquillaje que tengo en el bolso era **gratis** para mi porque mi madre trabaja en una perfumería.
grano	low	homograph meaning	Tuve mala suerte y esa misma mañana me salio un **grano** en la cara.	Todo el maquillaje que tengo en el bolso era **gratis** para mi porque mi madre trabaja en una perfumería.
nota	high	cognate meaning	Como sabia que iba llegar tarde a casa le escribí a mi madre una **nota** y la deje sobre la mesa de la cocina.	Parecía un payaso porque después de tanto estornudar mi **nariz** estaba muy roja y me dolía bastante.
nota	high	homograph meaning	Se enfado cuando vio su examen porque pensó que iba sacar una **nota** mas alta de lo que le habían puesto.	Parecía un payaso porque después de tanto estornudar mi **nariz** estaba muy roja y me dolía bastante.
nota	low	cognate meaning	Cuando regrese a mi despacho después de comer había una **nota** sobre la mesa escrita por mi jefa.	Mi hermana pequeña esta se reía cuando veía el dibujo animado con la **nariz** muy larga y roja.
nota	low	homograph meaning	Sandra me contó que se había enfadado porque había recibo una **nota** mas baja de lo que esperaba.	Mi hermana pequeña esta se reía cuando veía el dibujo animado con la **nariz** muy larga y roja.
pipa	high	cognate meaning	Por las tardes mi abuelo solía sentarse en el sillón y fumarse una **pipa** mientras veía la televisión.	El pobre animal andaba cojo porque tenia una espina clavada en su **pata** derecha, pero logramos quitárselo sin problemas.

Partial cognate sentences (continued)

Target	Constraint	Sentence bias	Partial cognate sentences	Control sentences
pipa	high	homograph meaning	Los girasoles se utilizan para obtener **pipa** y aceite.	El pobre animal andaba cojo porque tenia una espina clavada en su **pata** derecha, pero logramos quitárselo sin problemas.
pipa	low	cognate meaning	Dentro del cajón de la mesilla de noche había una **pipa** antigua de mi bisabuelo.	El dueño examinaba con mucha atención la **pata** de su perro porque pensaba que tenia una espina clavada.
pipa	low	homograph meaning	Se le inflamo la encía porque tenia un trozo de **pipa** entre los dientes.	El dueño examinaba con mucha atención la **pata** de su perro porque pensaba que tenia una espina clavada.
planta	high	cognate meaning	Casi no ha llovido nada esta primavera y en el jardín la **planta** preferida de mi madre se ha muerto.	Pasamos todo el día trabajando con el puzzle pero no pudimos encontrar la ultima **pieza** que faltaba para completarlo.
planta	high	homograph meaning	El ascensor no funciono y tuvimos que subir la escalera hasta la tercera **planta** del edificios	Pasamos todo el día trabajando con el puzzle pero no pudimos encontrar la ultima **pieza** que faltaba para completarlo.
planta	low	cognate meaning	Me comentaron que ayer hubo un pequeño fuego en la **planta** superior del hotel.	Fue mi padre quien al final encontró la ultima **pieza** que faltaba para completar el puzzle
planta	low	homograph meaning	Hacia mucho viento ayer y por eso la **planta** se cayo del balcón.	Fue mi padre quien al final encontró la ultima **pieza** que faltaba para completar el puzzle

Partial cognate sentences (continued)

Target	Constraint	Sentence bias	Partial cognate sentences	Control sentences
pulpo	high	cognate meaning	A mi me gusta tomar zumo de naranja casero, con mucho **pulpo** y mejor sabor.	Por las tardes voy al parque y me siento frente al laguito para dar trozos de pan a los **patos** que viven por ahí.
pulpo	high	homograph meaning	En el documental vimos los tentáculos de un gigantesco **pulpo** que parecía un monstruo de otro mundo.	Por las tardes voy al parque y me siento frente al laguito para dar trozos de pan a los **patos** que viven por ahí.
pulpo	low	cognate meaning	Aun quedaba sobre la mesa de la cocina un poco de **pulpo** de las naranjas que habíamos exprimido.	Ayer por la tarde me di un paseo por el parque con mi vecino y vi a unos **patos** jugando en los charcos.
pulpo	low	homograph meaning	Le gusta casi todo tipo de comida pero no quiso probar el **pulpo** que había en la barra.	Ayer por la tarde me di un paseo por el parque con mi vecino y vi a unos **patos** jugando en los charcos.
puro	high	cognate meaning	Esta maquina filtra el aire y hace que salga muy **puro** y de buena calidad.	Ayer mi mejor amigo me contó una adivinanza pero no quiso darme siquiera una **pista** para ayudarme en resolverlo.
puro	high	homograph meaning	A mi tío le gusta sentarse en el sillón y fumarse un **puro** mientras ve la televisión.	Ayer mi mejor amigo me contó una adivinanza pero no quiso darme siquiera una **pista** para ayudarme en resolverlo.
puro	low	cognate meaning	Me gusta hacer ejercicio cuando el aire es **puro** y la atmósfera limpia.	El joven estaba muy enojado porque después de muchas horas no pudo encontrar ninguna **pista** para resolver el problema.
puro	low	homograph meaning	Mi hermano no pudo encontrar el **puro** que mi tío le había regalado.	El joven estaba muy enojado porque después de muchas horas no pudo encontrar ninguna **pista** para resolver el problema.

Partial cognate sentences (continued)

Target	Constraint	Sentence bias	Partial cognate sentences	Control sentences
real	high	cognate meaning	Aunque el abrigo de piel era falso a mi me parecía **real** y por eso no quise comprarlo.	El joven príncipe era muy humilde aunque sabia que un día será el **rey** de su pequeño país.
real	high	homograph meaning	En el palacio de esa ciudad viven el rey y la reina y otros miembros de la familia **real** de este país.	El joven príncipe era muy humilde aunque sabia que un día será el **rey** de su pequeño país.
real	low	cognate meaning	Después de la clase discutimos si es posible distinguir lo **real** de lo falso.	El otro día mientras iba caminando por Madrid pensé haber visto al **rey** y a la reina pasar en una limosina.
real	low	homograph meaning	He vivido mucho tiempo en esta ciudad pero aun no he visto la familia **real** en persona.	El otro día mientras iba caminando por Madrid pensé haber visto al **rey** y a la reina pasar en una limosina.
rica	high	cognate meaning	Nosotros somos pobres pero mi hermana gana mucho dinero y creo que es la persona mas **rica** de toda la familia.	Sabia que mi abuelo se había avergonzado mucho porque su cara estaba completamente **roja** y no podía mirarme a los ojos.
rica	high	homograph meaning	Mi sobrina es una bebe preciosa, yo creo que es la niña mas **rica** de este pueblo.	Sabia que mi abuelo se había avergonzado mucho porque su cara estaba completamente **roja** y no podía mirarme a los ojos.
rica	low	cognate meaning	Durante la cena anoche mi hermano nos presento a su novia, una mujer **rica** que vive cerca de Valencia.	Para la cena formal la mesa estaba puesta de una forma muy elegante con una flor **roja** metida en un jarrón de cristal.
rica	low	homograph meaning	Esa niña es un poco egoísta porque todo el mundo le dice que es la mas **rica** y la mas guapa del mundo.	Para la cena formal la mesa estaba puesta de una forma muy elegante con una flor **roja** metida en un jarrón de cristal.

Appendix E

Language history questionnaire

Participant # _____ **Exp #_________** **Condition ________**

Language History Questionnaire

Sex: M / F **Age (in years) ______** **Native country ______**

Years spent in the U.S. ______ **Years spent in U.S. schools ______**

This questionnaire is designed to give us a better understanding of your experience learning a second language. We ask that you be as accurate and thorough as possible when answering the following questions and thank you for your participation in this study.

If at any time, you need more space to write, please feel free to use an extra sheet of paper. Please put the question number beside your responses.

1.) Do you have any known visual or hearing problems (corrected or uncorrected)?

____

____

2.) What is your first language (i.e., **language first spoken**)? If more than one, please briefly describe the situations in which each language was used.

____

____

3.) Which language do you consider your second language (**please circle:** English or Spanish)?

4.) If you have ever lived in or visited a country where languages other than your native language are spoken, please indicate below the name of the country (countries), the duration of your stay in number of months, and which languages you used while you were in the country (please indicate if you were spoken to in a language other than your first language, even if you never actually spoke that language).

Country visited	# Months there	Language(s) used

5.) List below, from most fluent to least fluent, all of the languages you know. Also specify the age in years at which you began to learn the language and the context in which you learned it. For example, "English, birth, home". Include all languages to which you have been exposed, although you may never have had formal training in them and may not be able to read, speak or write them.

Please remember to list your native language.

Language	*Age in yrs.*	*Learning Situation*

6.) What languages were spoken in your home while you were a child and by whom?

___

___

___

7.) How many years have you studied your second language? Please indicate the setting(s) in which you have had experience with the language (i.e., classroom, with friends, foreign country...)

Number of years:

___

Setting(s):

___

___

___

___

What Spanish courses have you taken in the past or are currently taking?

For the next eight questions, please circle the number of your response:

8.) Please rate your **English** reading proficiency on a ten-point scale.
(1= not literate, 10= very literate)

1 2 3 4 5 6 7 8 9 10
not literate very literate

9.) Please rate your **Spanish** reading proficiency on a ten-point scale.
(1= not literate, 10= very literate)

1 2 3 4 5 6 7 8 9 10
not literate very literate

10.) Please rate your **English** writing proficiency on a ten-point scale.
(1= not literate, 10= very literate)

1 2 3 4 5 6 7 8 9 10
not literate very literate

11.) Please rate your **Spanish** writing proficiency on a ten-point scale.
(1= not literate, 10= very literate)

1 2 3 4 5 6 7 8 9 10
not literate very literate

12.) Please rate your **English** conversational fluency on a ten-point scale.
(1= not fluent, 10= very fluent)

1 2 3 4 5 6 7 8 9 10
not fluent very fluent

13.) Please rate your **Spanish** conversational fluency on a ten-point scale.
(1= not fluent, 10= very fluent)

1 2 3 4 5 6 7 8 9 10
not fluent very fluent

14.) Please rate your **English** speech comprehension ability on a ten-point scale. (1= unable to understand conversation, 10= perfectly able to understand conversation)

1 2 3 4 5 6 7 8 9 10

no comprehension perfect comprehension

15.) Please rate your **Spanish** speech comprehension ability on a ten-point scale. (1= unable to understand conversation, 10= perfectly able to understand conversation)

1 2 3 4 5 6 7 8 9 10

no comprehension perfect comprehension

16.) Have you ever been immersed in your second language culture?
(please circle one) yes no

17.) Is there anything else about your language background that you would like to comment on? Please feel free to make comments about things which were not covered on this questionnaire.

____

____

____

THANK YOU FOR YOUR PARTICIPATION !

Appendix F

Questionnaire used by monolingual Spanish speakers to rate the appropriateness of the alternative meanings of the partial cognates polysemous in English

SEXO: ___ (1 = MUJER; 2 = HOMBRE)
EDAD: ____ AÑOS

INSTRUCCIONES GENERALES

En español hay muchas palabras que se pueden utilizar de distintas formas. Por ejemplo, la palabra "cura" puede hacer referencia a un clérigo o al alivio de una enfermedad. De manera similar la palabra "pipa" puede referirse a las semillas de una fruta o a un objeto que se utiliza para fumar.

A continuación le presentamos una serie de frases con una palabra subrayada. Después de cada una hay una escala de 1 a 10. Le pedimos que lea cada frase y después **juzgue si la palabra subrayada está utilizada de una forma correcta**. Es decir, que juzgue si la palabra, tal como está presentada en la frase tiene sentido. Indique su respuesta poniendo un círculo alrededor del numero correspondiente. Si la palabra no está utilizada de una forma correcta (no tiene nada de sentido) ponga el círculo en el número 1. Si la palabra está utilizada perfectamente, ponga el círculo en el número diez. Emplee los demás números para indicar clasificaciones intermediadas.

Finalmente, si usted puede sugerir una palabra que sustituya a la subrayada, por favor, escríbala al lado derecho de cada frase. Si no tiene una palabra que sugerir, déjela en blanco.

Ejemplos:

Frase	*Valoración*	*Palabra*
Fuimos en coche hasta la estación de tren.	1 2 3 4 5 6 7 8 9 **10**	
Metemos la estación en la cama cada noche a las 10	**1** 2 3 4 5 6 7 8 9 10	**niña**

Prosemio

Frase	*Valoración*	*Palabra*
Sabía que yo tenía la culpa, pero no quise admitirlo delante de mi amiga.	1 2 3 4 5 6 7 8 9 10	(1
En los EEUU no se admite que los menores de edad entren en los bares	1 2 3 4 5 6 7 8 9 10	(2
Antes de ingresar mis ahorros visité todos los bancos de mi pueblo.	1 2 3 4 5 6 7 8 9 10	(3
La hierba que crecía en los bancos del río estaba muy verde.	1 2 3 4 5 6 7 8 9 10	(4
Para sacar la oposición tuvimos que aprobar una batería de preguntas.	1 2 3 4 5 6 7 8 9 10	(5
El coche no arrancó porque la batería estaba descargada.	1 2 3 4 5 6 7 8 9 10	(6
Ella es una estudiante brillante, siempre saca sobresaliente en los exámenes.	1 2 3 4 5 6 7 8 9 10	(7
Anoche admiramos los colores brillantes que desprendían los fuegos artificiales.	1 2 3 4 5 6 7 8 9 10	(8
El bulbo de la lámpara se fundió y tuvimos que cambiarlo.	1 2 3 4 5 6 7 8 9 10	(9
Sembramos los bulbos de nuestras plantas en la primavera.	1 2 3 4 5 6 7 8 9 10	(10
Guardé las gafas en el caso marrón que el óptico me había regalado.	1 2 3 4 5 6 7 8 9 10	(11
El abogado era muy conocido porque solía defender los casos más famosos de la ciudad.	1 2 3 4 5 6 7 8 9 10	(12
No esperaba verle y nuestro encuentro fue casual y sorprendente.	1 2 3 4 5 6 7 8 9 10	(13
La reunión no era formal y la gente iba vestida con ropa casual.	1 2 3 4 5 6 7 8 9 10	(14
La cobraron una carga adicional por haber pagado tarde el recibo.	1 2 3 4 5 6 7 8 9 10	(15
Los alumnos aprendieron como la carga eléctrica de un imán puede atraer a los metales.	1 2 3 4 5 6 7 8 9 10	(16
No quise perder ningún minuto de mi programa de televisión favorito, así que me preparé la merienda durante los comerciales.	1 2 3 4 5 6 7 8 9 10	(17
El cantante viajaba en un avión privado pero el resto de la banda tenía que viajar en un vuelo comercial.	1 2 3 4 5 6 7 8 9 10	(18
Las luces se apagaron porque la corriente eléctrica era demasiado fuerte.	1 2 3 4 5 6 7 8 9 10	(19
Leemos los periódicos para enterarnos de las noticias corrientes del país.	1 2 3 4 5 6 7 8 9 10	(20
El paciente se había recuperado de la enfermedad y fue descargado del hospital.	1 2 3 4 5 6 7 8 9 10	(21
Los soldados descargaron todos los rifles.	1 2 3 4 5 6 7 8 9 10	(22
En los vuelos domésticos no hace falta viajar con pasaporte.	1 2 3 4 5 6 7 8 9 10	(23
Los gatos y perros son ejemplos de animales domésticos.	1 2 3 4 5 6 7 8 9 10	(24

Frase	***Valoración***	***Palabra***
Hacía mucho calor así que enchufamos el fan para que nos diera aire.	1 2 3 4 5 6 7 8 9 10	(25
Cuando marcaron el tercer gol del partido un fan empezó a gritar y saltar.	1 2 3 4 5 6 7 8 9 10	(26
En California hay mucho riesgo de terremotos cerca de la falta de San Andrés.	1 2 3 4 5 6 7 8 9 10	(27
El accidente no fue por mi falta, es que las carreteras estaban mal iluminadas.	1 2 3 4 5 6 7 8 9 10	(28
Hice un barquito de papel que se hundió, éste flota mejor.	1 2 3 4 5 6 7 8 9 10	(29
En la procesión había una flota muy grande decorada con muchas flores.	1 2 3 4 5 6 7 8 9 10	(30
El psicólogo de la escuela nos dijo que era posible conseguir más goles si aumentábamos nuestro trabajo y nuestra fe.	1 2 3 4 5 6 7 8 9 10	(31
El entrenador se enfadó porque el arbitro anuló los dos últimos goles de su equipo.	1 2 3 4 5 6 7 8 9 10	(32
El estudiante se sorprendió cuando vió su examen porque pensó que había sacado un grado mas alto.	1 2 3 4 5 6 7 8 9 10	(33
Era un vino de alto grado y por eso costó tanto.	1 2 3 4 5 6 7 8 9 10	(34
En el cementerio pasamos por el grave donde estaba enterrado mi abuelo.	1 2 3 4 5 6 7 8 9 10	(35
No sabíamos que ella sufría una enfermedad grave.	1 2 3 4 5 6 7 8 9 10	(36
Como Carlos no conocía a nadie en la fiesta le introduje a mis amigos.	1 2 3 4 5 6 7 8 9 10	(37
Pensamos que ya conocíamos a todos los personajes de la obra, pero al final introdujeron a otro personaje nuevo.	1 2 3 4 5 6 7 8 9 10	(38
Muchos negocios en esta ciudad utilizan a los inmigrantes por su labor barata.	1 2 3 4 5 6 7 8 9 10	(39
La mujer embarazada sintió los primeros dolores del labor a las dos de la madrugada.	1 2 3 4 5 6 7 8 9 10	(40
Los niños no querían dejar a sus amigos y lloraron cuando se enteraron de que se iban a mover a una nueva ciudad.	1 2 3 4 5 6 7 8 9 10	(41
No me gusta como están colocados los muebles, pero el sillón es demasiado grande y no puedo moverlo yo sola.	1 2 3 4 5 6 7 8 9 10	(42
Ese chaval era un grosero, menudo nervio tiene al insultarnos de esa forma.	1 2 3 4 5 6 7 8 9 10	(43
Los nervios están compuestos por neuronas.	1 2 3 4 5 6 7 8 9 10	(44
Fue convencido sin mucha persuasión y llegamos fácilmente a un acuerdo.	1 2 3 4 5 6 7 8 9 10	(45
Aunque no somos de la misma persuasión religiosa, los dos estamos de acuerdo en que el ser humano tiene ciertos derechos que son inalienables.	1 2 3 4 5 6 7 8 9 10	(46
Creo que la ceremonia es mañana a las dos, pero no estoy positiva.	1 2 3 4 5 6 7 8 9 10	(47
Fue sorprendida cuando le dijeron que la prueba del embarazo era positiva.	1 2 3 4 5 6 7 8 9 10	(48

Frase	*Valoración*	*Palabra*
Hoy en día se añaden muchos productos químicos a la comida para que se preserve más tiempo.	1 2 3 4 5 6 7 8 9 10	(49
Los ecologistas quieren encontrar formas de preservar las selvas de América del Sur.	1 2 3 4 5 6 7 8 9 10	(50
En su colección de música había un record que yo escuchaba frecuentemente cuando era pequeña.	1 2 3 4 5 6 7 8 9 10	(51
Es emocionante cuando en los deportes un atleta derriba un record.	1 2 3 4 5 6 7 8 9 10	(52
Antes de empezar la cena de Noche Buena la familia esperaba la llegada de un relativo de Valladolid.	1 2 3 4 5 6 7 8 9 10	(53
La teoría de Einstein sugiere que todo es relativo y que no hay verdades absolutas.	1 2 3 4 5 6 7 8 9 10	(54
Yo me llevé una de las cajas y mi hermano se llevó el resto a su coche.	1 2 3 4 5 6 7 8 9 10	(55
El médico dijo al paciente que tenía que beber muchos líquidos y tomar un resto.	1 2 3 4 5 6 7 8 9 10	(56
Los cristales se rompieron cuando un niño tiró una roca a la ventana.	1 2 3 4 5 6 7 8 9 10	(57
Al bebé le gustaba mucho cuando la cuna rocaba.	1 2 3 4 5 6 7 8 9 10	(58
Los niños admiraron las escalas brillantes de los peces.	1 2 3 4 5 6 7 8 9 10	(59
El compositor de música creó una compleja canción con muchas escalas.	1 2 3 4 5 6 7 8 9 10	(60
La niña estaba aprendiendo como escribir sentencias completas en su clase de lenguaje.	1 2 3 4 5 6 7 8 9 10	(61
Al final, al criminal le condenaron a una sentencia larga y justa.	1 2 3 4 5 6 7 8 9 10	(62
En el cruce hicimos un turno a la derecha y por eso nos perdimos.	1 2 3 4 5 6 7 8 9 10	(63
Llevaba mucho rato esperando y fue un alivio cuando al final llegó mi turno.	1 2 3 4 5 6 7 8 9 10	(64
El mes pasado hubo huelga porque los miembros de la unión no estaban satisfechos con sus salarios.	1 2 3 4 5 6 7 8 9 10	(65
El cura dijo que la unión entre un hombre y su mujer era sagrada.	1 2 3 4 5 6 7 8 9 10	(66

Vita

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Education

2000-2003 Ph.D., Psychology, The Pennsylvania State University
1997-2000 M.S., Educational Psychology, The Pennsylvania State University
1992-1996 B.A., Psychology, Rutgers University

Selected Publications

Schwartz, A. I., Kroll, J.F. & Diaz, M. (submitted). *Reading words in Spanish and English: Mapping orthography to phonology in two languages*. Submitted to Psychonomic Bulletin and Review.

Kroll, J.F., Sumutka, B. M., Schwartz, A., (2003). *A cognitive view of the bilingual lexicon: Reading and speaking words in two languages*. Paper invited for a special issue of The International Journal of Bilingualism.

Schwartz, A (2002). National Standards and the diffusion of innovation: Language teaching in the USA. In S.J. Savignon (Ed.) Interpreting communicative language teaching: Contexts and concerns in teacher education (pp.112-130) Yale University Press.

Schwartz, A., Duo, P.C, Djamou, M.(1999). Curriculum standards in the foreign languages. In R.F Nicely, (Ed.) Curriculum Standards: National and Pennsylvania Perspectives.

Selected Presentations

Schwartz, A.I., (2003) *The nature of cross-language lexical activation in sentence context*. Paper presented at the Fourth International Symposium on Bilingualism, Tempe, Arizona.

Schwartz, A.I., (2003) *The cognitive processes of bilingual reading: Cross-language activation of orthography, phonology and semantics*. Colloquium presented to the Learning Research and Development Center of the University of Pittsburgh. Pittsburgh, PA.

Schwartz, A. I., (2002) *Bilingual lexical access: Mapping orthography to phonology in two languages.* Colloquium presented to the Department of Special Education,University of Nijmegen, The Netherlands..

Schwartz, A.I., Kroll, J.F. & Diaz, M. (2001) Reading cognates: *Mapping orthography to phonology in two languages*. Poster presented at the 42nd Annual Meeting of the Psychonomic Society, Orlando, Florida.

Schwartz, A.I., Kroll, J.F. & Diaz, M. (2000) *Reading Spanish words with English word bodies: Activation of spelling-to-sound correspondence across languages*. Paper presented at the Second International Conference on the Mental Lexicon, Montreal, Canada.

Awards

National Institute of Mental Health, National Research Service Award Grant 1 F31 MH66476-01A1: Sentence Based Processing in Second Language Reading, 2002-2003 ($25,327)

National Science Foundation Grant BCS 0212571: Word and Sentence Based Processing: A psycholinguistic approach, 2002-2003 ($11,622)

Spector Award for Outstanding Graduate Student in Applied Linguistics for 2001-2002

College of the Liberal Arts Research and Graduate Studies Office Dissertation Award, December

William D. and Patricia A. Horton Scholarship in Education, Pennsylvania State 2001 University, September 1999