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DOES SENTENCE CONTEXT CONSTRAIN CROSS-LANGUAGE LEXICAL ACCESS?

A Thesis in

Psychology

by

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ABSTRACT

Research on cross-language processing at the lexical level suggests that each of the bilingual's languages is active regardless of the requirement to use one language alone. Words that are language ambiguous (e.g., cognates) appear to be processed differently by bilinguals than monolinguals; constraints such as context, task instruction, and intention do not easily limit access to only one lexicon. However, some reduction in the activation of the unintended language has been found when sentence context is highly constrained semantically.

In the present study, we examined the effects of language-specific syntax on the nonselectivity of lexical access for Spanish-English and English-Spanish bilinguals. Specifically, participants named critical target words (cognates or controls) presented in the context of sentences with either language-specific or language-non-specific syntax.

We theorized that if the parallel activation of the bilingual's two languages can be eliminated in the presence of syntactically specific contextual information that corresponds to one language alone, then the cognate effect in word naming, found in previous studies in out-of-context naming, should also be eliminated in context. The results of this study suggest that syntax functions like semantics to constrain activation of the unintended language. We discuss the implications of these results for models of bilingual lexical access and also for code-switching performance.

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ACKNOWLEDGEMENTS

We don't accomplish anything in this world alone ... and whatever happens is the result of the whole tapestry of one's life and all the weavings of individual threads from one to another that creates something.
~ Sandra Day O'Connor

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Chapter 1

Introduction

Although most of the world's population speaks at least two languages, only in the past two decades have psycholinguistic studies of language processing considered bilinguals to be typical language users (Bhatia & Ritchie, 2004). Instead, research has centered on language production and comprehension in monolinguals, and as a result, models of the language faculty stemming from Chomsky's (1957) illustrate how interactions between the lexicon, syntactic structure, and semantic information result in communicative ability. Initial models of bilingual language use have approached the two languages in degrees ranging from total separation to a great deal of overlap. Recent studies have indicated that a bilingual's two languages overlap, but this gives rise to new questions: How are the two languages stored, and how do bilinguals negotiate potential competition across their two vocabularies? If vocabulary items overlap, do syntactic elements as well? If bilinguals with two shared languages meet, how is it that they can converse with ease, unperturbed by the idea that each speaker can spontaneously and seamlessly switch into another language? This phenomenon, termed *code-switching*, requires that both languages in their entirety—lexically, syntactically, and semantically—are active and available. It is the current study's goal to examine how syntactic and lexical information across both languages may overlap and interact in order to make such language mixing possible. Ultimately, by exploring the way in which cross-language

activity is modulated through studies like this, researchers hope to better understand the plasticity and mechanisms of the human capacity for one and more languages.

Background

Evidence for non-selective activation

Most of the past research demonstrating the presence of activity in the bilingual's two languages has come from studies of word recognition and word production (e.g., Costa, 2005; Dijkstra, 2005; Kroll, Sumutka, & Schwartz, 2005). Visual word recognition tasks have shown that when a bilingual reads in one language, their other language is active, even in contexts in which Grosjean (1998, 1999) predicts that the bilingual might be in "monolingual mode." The logic of word recognition tasks is to exploit the presence of words that are language ambiguous across the bilingual's two experiments such as cognates, interlingual homographs, and lexical neighbors. In many of these experiments, bilinguals are asked to make lexical decisions under either bilingual or monolingual conditions: that is, participants are asked to decide whether a visually-presented letter string is a real word in one or both of their languages. In both conditions, some of the ambiguous or potentially non-word letter strings are actually words in the non-target language (e.g., in Dutch when performing English lexical decision). Essentially, the conditions differ only in that participants are either made aware of or are naïve to the presence of letter strings shared between their languages. If both languages are activated in parallel, then performance in these word recognition tasks for bilinguals

should differ for language ambiguous words relative to unambiguous controls. If that activation occurs without conscious control on the part of the bilingual, (i.e., regardless of a belief that they are making lexical decisions in only one of their two languages) then evidence for parallel activation of both languages should be obtained regardless of whether the task itself is monolingual or bilingual.

In one such study, Dijkstra, De Bruijn, Schriefers, and Ten Brinke (2000) re-examined a previous experiment (Dijkstra, Van Jaarsveld, & Ten Brinke, 1998) on word recognition for interlingual homographs, or words with the same orthography but different meanings across two languages. For example, *room* is a viable word in both Dutch and English, but means "cream" or "an interior space," respectively. Dijkstra et al. (1998) asked Dutch-English bilinguals to perform a language-specific, or monolingual, lexical decision task in which they were to respond "yes" to real English words and "no" to all other letter strings, including strings they recognized either as non-words or real words in Dutch. Under these conditions, they observed reliable interference for the intermixed language-ambiguous homographs relative to English controls, such that participants were slower to respond that the homographs were real words in English. In the later study, Dijkstra et al. (2000) then manipulated the explicitness of the directions given to participants to further elucidate the effects of instruction as compared to that of language intermixing. Dutch-English bilinguals were again asked to respond "no" to exclusively Dutch words and non-words, but "yes" to English words. However, in this new experiment they were given information about interlingual homographs and were provided with examples of the homographs in pre-trial training. The first block of this experiment contained cross-language homographs, English words, and non-words, but

exclusively Dutch words introduced into the task only in the second block of the experiment. The data indicated that for the first block, reaction times did not significantly differ for interlingual homographs and matched English controls; that is, the information about homographs provided in training decreased those items' linguistic ambiguity. In the second block, the researchers observed that reaction times were strongly inhibited for the homographs relative to matched controls. As the only change in condition was the introduction of unambiguously Dutch words to the list of stimuli in the second block, Dijkstra et al. (2000) deduced that this direct activation of the Dutch lexicon (leading to cross-linguistic competition) rather than language mode (i.e., awareness of ambiguously bilingual stimuli in the task as fostered in the training portion) brought about the slowing of reaction times.

Experiments using other methods, such as eye-tracking and brain imaging, and spoken rather than visual word recognition have yielded similar results. In a series of experiments, Marian and Spivey (2003a) sought to create an experimental condition less reliant on participants' overt language use and intentions. Using the visual world paradigm (Tanenhaus & Spivey-Knowlton, 1996; Allopenna, Magnuson, & Tanenhaus, 1998; Magnuson, Tanenhaus, Aslin, & Dahan, 1999), they were able to observe brief eye fixations on competitor items in a pointing task. In one experiment, Russian-English bilinguals were instructed via audio-recorded short command-structured sentences in their L2 (English) to point to a target object on a board of within-language and across-language competitor items. While the participants were overwhelmingly accurate in selecting the correct item, the eye-tracking record indicated that they frequently looked to competitors first. For example, a participant hearing "Point to the *shark*" might first look

to the *sharik*, or "balloon" in Russian (across-language competition), and also to the *shovel* (within-language phonological competition). The second experiment included instructions in Russian (their L1) and replicated these results, with a significant proportion of looks to both within- and between-language competitor items. A second study (Marian & Spivey, 2003b) done as a control replicated these results, and showed that English monolinguals exhibit only within-language competition when presented with the same conditions. Additional work done by Marian, Spivey, and Hirsch (2003) included neuroimaging data indicating overlapping activation in areas like the Superior Temporal Gyrus in L1 and L2 processing, leading the authors like many others to conclude that, at least at the sublexical level, the same neural tissue is active in both of a bilingual's two languages.

Experiments on word production reveal similar evidence for parallel activation of the two languages, although it might seem that the conceptually-driven nature of speech planning would ensure that the language of speaking was chosen in advance. In picture-word interference tasks, a Stroop-type paradigm used for investigating speech planning, participants are asked to name pictures of common items while ignoring visual or auditory distractor words. Typically, these distractors are of an interfering nature—phonologically, semantically, and cross-linguistically similar to the name of the pictured item—or they may be unrelated. In a study by Hermans, Bongaerts, De Bot, and Schreuder (1998), Dutch-English bilinguals named pictures in their L2 (English). For example, a picture of a mountain might be paired with the word *mouth* (phonologically related), *bench* (phonologically related to the Dutch translation, *berg*, of *mountain*), *valley* (semantically related), or *present* (unrelated control item). Hermans and colleagues

theorized that participant performance would provide a window on the locus of selection; that is, differential responses to one or more classes of distractor items would show the level (pictured in Figure 1-1) at which cross-lexical activation can be resolved.

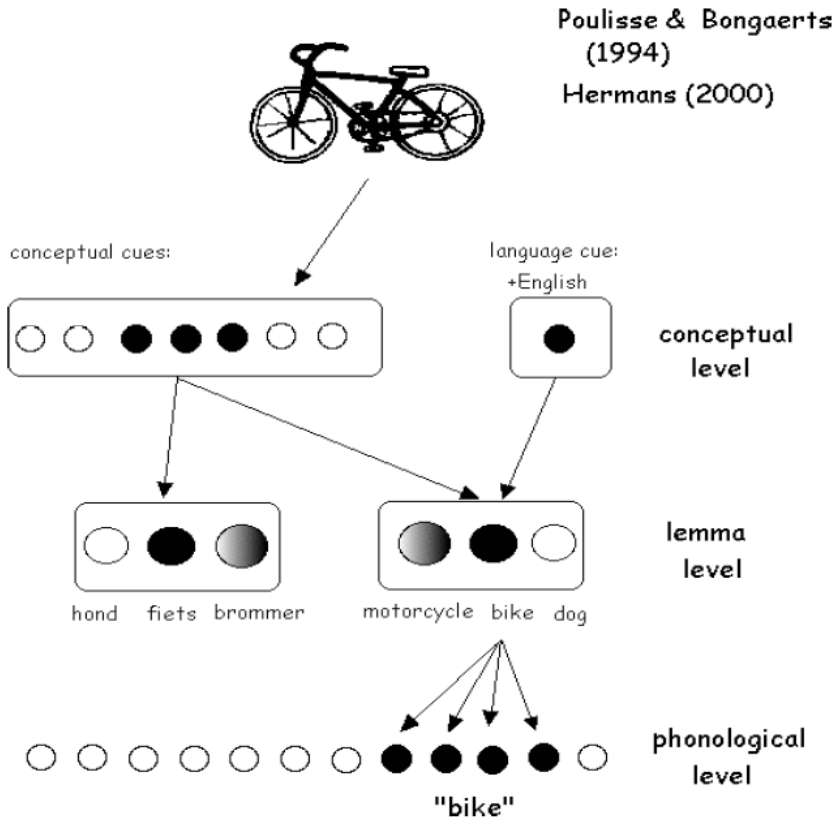

Figure 1-1: *A model of bilingual language production, adapted from Poulisse and Bongaerts, 1994, and Hermans, 2000.*

The time to name pictures in English was slowed relative to control conditions when distractor words were semantically related to the name of the picture, but speeded relative to controls when distractors were phonologically similar to the name of the picture. Critically, distractors that were phonologically related to the translation resembled the semantic distractors in that they produced interference in picture naming.

If selection of the appropriate lexical entry occurred at the conceptual level (that is, if awareness of task instruction and language cues precluded activation spreading to the lemma and phonological levels), participants should have experienced no interference from distractors in the non-target language. If selection occurred at the phonological level, Hermans and colleagues theorized that participants should have shown interference and not facilitatory effects from phonological distractors. The pattern of results instead suggests both that bilingual speakers cannot prevent the influence of their L1 when producing speech in their L2, and that selection occurs at the lemma level.

Costa, Caramazza, and Sebastian-Galles (2000) reported support for non-selective lexical activation using a simple picture naming task to investigate lexical production. In their study, Catalan-Spanish bilinguals, Spanish-Catalan bilinguals and Spanish monolinguals were asked to name pictures in Spanish whose names were cognates across the two languages or non-cognate controls. While interlingual homographs share orthography but not meaning across languages, cognates share both and often have very similar phonology. For example, *piano* references the same instrument and has the same orthography across many languages, although the pronunciation of this word may differ slightly. When asked to name pictures of these cognates, both the Catalan-dominant and Spanish-dominant bilinguals showed significant facilitation in response time as compared to naming non-cognates, although the Catalan-dominant speakers showed a greater cognate facilitation. Monolingual speakers did not respond differentially to the cognates and controls, suggesting that cognate facilitation is a consequence of bilingualism rather than a property of the experimental materials. At the same time, the results suggest that one's L2 is aided more than the L1 in accessing cognates. In subsequent studies, this so-

called *cognate effect* has been explained as a benefit arising from the strongly unambiguous or co-referential aspect of cognates across both active lexicons.

A study by Van Hell and Dijkstra (2002) investigated trilinguals' response times in reading aloud cognates in a strictly-controlled monolingual context, lest the data be confounded by participants' knowledge that the tasks involved all of their languages. In one experiment of their study, Van Hell & Dijkstra recruited Dutch-English-French trilinguals to participate in a "memory" experiment conducted entirely in Dutch through the Psychology Department; these participants were unaware that their language abilities were a criterion, and reported the same after the completion of the experiment. Even in the strict Dutch (L1) monolingual environment of the study, the participants' response times in naming both Dutch-English and Dutch-French cognates were significantly facilitated, further supporting theories of language non-selectivity.

Modeling the Bilingual Language Mechanism

Two initial goals of research on bilingualism were to understand differences between bilinguals and monolinguals, and to conceptualize how these differences might be engendered in a multilingual system. In pursuit of this second goal, Dijkstra and Van Heuven (1998) designed the Bilingual Interactive Activation (or BIA) model on the foundation of the monolingual Interactive Activation model (McClelland & Rumelhart, 1981). The BIA model and its subsequent revision, the BIA+ model (Dijkstra & Van Heuven, 2002), conceptualized the two languages as interactive at the lexical

orthographic and lexical phonological levels with spreading activation throughout the other levels as shown in Figure 1-2.

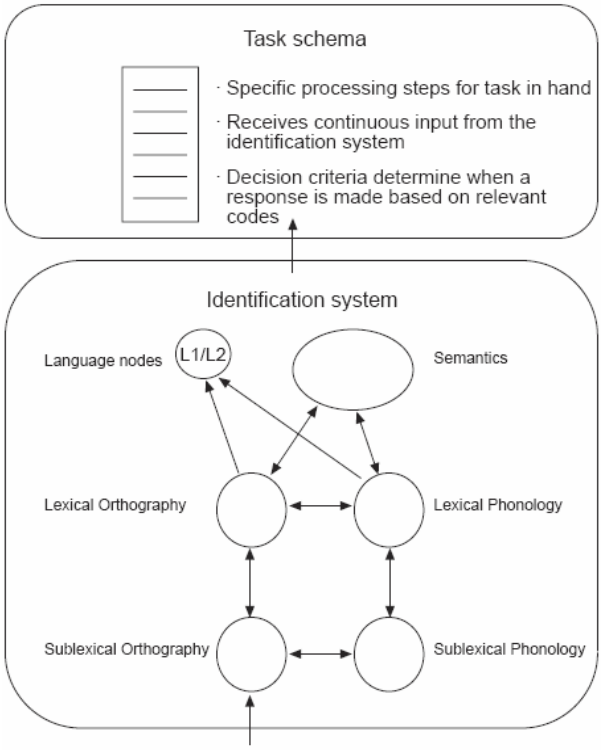

Figure 1-2: *The BIA+ model for bilingual word recognition (Dijkstra & Van Heuven, 2002) improves on the previous BIA model by including a task schema component.*

The model connects linguistic processing with a higher-level non-linguistic processing level while designating each as separate mechanisms, such that the word identification, access, and selection system (i.e., the lexicon) functions independently and also influences the non-linguistic task schematization, decision-making process and any eventual production processes (Dijkstra & Van Heuven, 2002; Schwartz & Kroll, 2006). The nodes in the initial stages of bottom-up processing indicate sensitivity to lexical, syntactic, and semantic elements of the input and later to the language in use, whereas the

task/decision schema incorporates the bilingual's awareness of extra-linguistic context, such as expectations, environment, language prestige, and intentions (Grosjean, 1998, 1999; Van Hell & Dijkstra, 2002), which can affect the final output, be it production or an indication of recognition. According to the BIA+ model, linguistic context may potentially modulate the degree of cross-language activation but non-linguistic context will only influence relatively late task schema processes once parallel activation has occurred.

Constraining non-selective activation

This model and the previously-mentioned studies raise a key question: if both lexicons are active and accessed, how is the resultant system constrained so that a bilingual may function normally in speech production and perception? Possible constraints could occur at any level of the BIA+ model as input is processed, but early activation such as priming could also act as a constraint. To explore the possibility of language priming in controlling activation, De Bruijn, Dijkstra, Chwilla, and Schriefers (2001) utilized event-related potentials recorded during a lexical decision task featuring triplets of English words, Dutch words, and interlingual homographs; as described above, homographs share orthography across languages but differ in meaning, such as *angel*, which in English means "celestial being" and in Dutch means "sting." De Bruijn et al. theorized that triplets beginning with an exclusively English word, followed by an interlingual homograph, and ending with a semantically related English word (*house* / *angel* / *heaven*) would produce different readings than the same triplet beginning with an

exclusively Dutch word (*zaak* / *angel* / *heaven*) or an unrelated third word (*house* / *angel* / *bush*). That is, in the context of a Dutch versus English language prime, participants would react differently to the nested homograph, and at the same time, would show differing activation from semantic relatedness as compared to unrelatedness between the homograph and final word in the triplet. During the EEG recording, Dutch-English participants indicated "yes" if all three words in the triplet were existing words in either language, and "no" if they were not. The results of this study showed an N400 effect of semantic relatedness between the homograph and final word, and this effect was unchanged in either language prime condition. De Bruijn et al. (2001) concluded that in the process of identifying the presented stimuli, both the Dutch and English readings for interlingual homographs were activated regardless of preceding information, and suggested that the data support a bottom-up bilingual word recognition model like the BIA+ with later context-sensitive decision-making processes, rather than early activation in lexical selection or suppression.

If the initial language prime does not constrain or limit cross-linguistic lexical access in what we currently understand as a non-selective system, what else might? Dijkstra and Van Heuven (2002) differentiated possible constraints into two categories: non-linguistic and linguistic as indicated in the BIA+ model, which gives more weight to language context rather than extra-linguistic factors. Suggestions from contemporary research include acoustic cues like language-specific place of articulation and voice-onset time in spoken word recognition (Ju & Luce, 2004), language "triggers" like cognates in sentences (Clyne, 2003; Broersma & De Bot, 2006), or real language context (Elston-Güttler, Paulmann, & Kotz, 2005; Elston-Güttler, Gunter, & Kotz, 2005; Glucksberg,

Kreuz, & Rho, 1986; Schwartz, 2003; Schwartz & Kroll, 2006; Van Hell & De Groot, 1998a). As an alternative to the parallel activity proposed by the BIA+ model, Grosjean (1998, 1999) suggests a pre-processing language mode continuum from functionally monolingual to intermediate to bilingual based on external clues like expectations and environment, although evidence from Dijkstra and Van Hell (2003), as described above, indicates non-selectivity even in the presence of what Grosjean terms a functionally monolingual environment. Given the widespread support for a lexically cross-activated model of bilingual language processing and a general agreement that in actual language use bilinguals function at the discourse level (which necessarily includes grammatical organization) rather than at the level of single words, the present study examines the way in which lexical processes may be constrained by linguistic context.

Real language context is generally manifested experimentally as sentential context in which participants are asked to make lexical decisions about or name target items; while a great deal of research has been devoted to monolingual lexical disambiguation in context, fewer have explored bilingual performance in tasks involving sentential context. Monolingual language context experiments have primarily explored the effect of semantic context as a potential linguistic constraint (as defined by Dijkstra & Van Heuven, 2002) on participant response to ambiguous target words and pseudo-words. In one experiment, Glucksberg, Kreuz, and Rho (1986) asked monolingual English participants to listen to sentences, and then respond with “yes” if the word presented on a video screen was an English word or “no” if it was not. The results of the study showed that context constrained the activation of meanings of polysemous words in that the presence of semantic specificity inhibited non-target meanings.

The results of Glucksberg et al. (1986) have been replicated and extended to show that monolingual lexical disambiguation in sentence context is guided both by the amount of contextual support for a given meaning and by the available meanings themselves (c.f. Binder & Morris, 1995; Duffy, Morris, & Rayner, 1988; Tabossi, 1988; Tabossi & Zardon, 1993), in that target meanings are more salient when non-target meanings are less frequent and when semantic clues are available. For monolinguals, then, the time course and strength of activation of competing lexical items are influenced by both linguistic information associated with those items and the context in which they appear.

For bilinguals, the process of disambiguation becomes more complicated, requiring input-internal information from lexical details and contextual clues both across and within languages as well as external information about the language environment and task demands. As specificity in any of these factors would allow for quicker resolution, it seems apparent that if the bilingual language system is cross-activated, effective constraints should modulate performance on timed tasks.

Elston-Güttler, Gunter, and Kotz (2005) explored the nature of language environment context on lexical access; German-English bilinguals performed a lexical decision task while response times and event-related brain potentials were measured. However, key to this study was the initial portion of language exposure: one group of bilinguals watched short film narrated in German and the other watched the same film narrated in English prior to the experimental tasks. Other than this pre-task exposure, the groups did not differ, and yet Elston-Güttler and colleagues noted significantly different results between the two. Participants who had seen the German film first responded on average faster in the lexical decision task than those in the other group, but only in the

first block of the experiment. Elston-Güttler et al. concluded that bilinguals in a condition of language-mixing experience a "zooming-in," in that parallel activation for highly-proficient bilinguals could be constrained based on recent language environmental specificity, if only for a short time.

Schwartz and Kroll (2006) asked whether the parallel activation of both languages that appears to occur out of context would also be observed in sentential context by using the RSVP (rapid serial visual presentation) paradigm. In this study, Spanish/English cognates and non-cognate controls were presented to bilingual participants in sentence context; an illustration of this paradigm follows in Figure **1-3**.

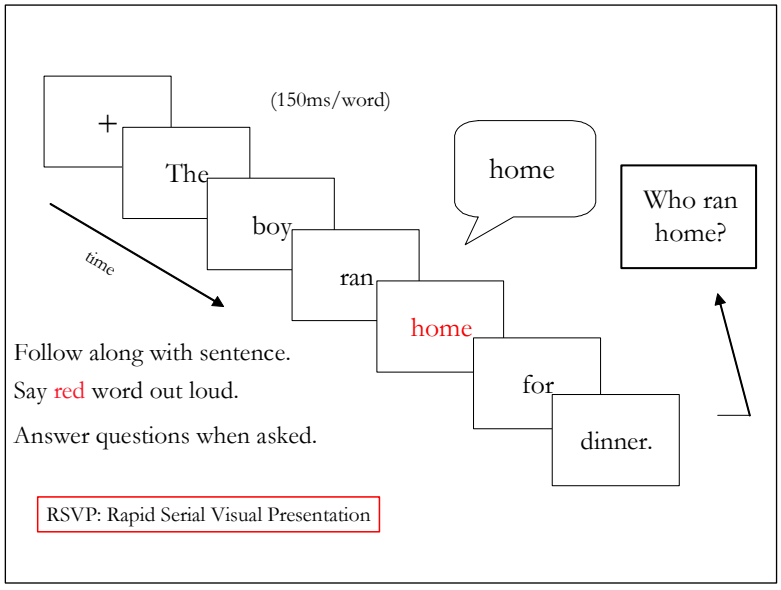

Figure **1-3**: *Illustrative sentence presented using RSVP (Schwartz & Kroll, 2006). The dependent measures are the speed and accuracy of producing the critical word,* home, *as well as accuracy in responding to periodically-presented comprehension questions like* "Who ran home?"

Participants viewed English sentences (their L2) word-by-word and responded verbally to a target, indicated in red, which was embedded in each sentence. Schwartz and Kroll

(2006) hypothesized that if lexical access becomes language-selective when the preceding sentence fragment appears in one language only, as in a monolingual environment, then no cognate effect should be observed in naming performance relative to language-unambiguous control words. Given that participants were Spanish-dominant bilinguals living in a highly English-dominant environment, which like Elston-Güttler et al.'s (2005) film would serve to encourage "zooming in" on English, the authors expected to observe no difference in response times to cognates and controls in at least the first block, if not all blocks, of the experiment. In fact, Schwartz and Kroll found that this was precisely the case, but only when the sentence context provided a high degree of semantic constraint. Essentially, in sentences in which the target cognate was easily predicted via contextual clues, bilinguals named cognates as if they were monolinguals, whereas in sentences that were less predictable, a cognate effect (i.e., facilitation in response time for cognates relative to controls) was observed. Table **1-1** illustrates contexts with high and low semantic constraint:

Table **1-1**: *An illustration of the materials used by Schwartz and Kroll (2006). The four conditions include cognate or control critical target items (in bold red) in sentences contexts with high or low semantic constraints.*

HIGH	Before playing, the composer first wiped the keys of the **piano** at the beginning of the concert.	Before the test, the student looked for some paper and a sharp **pencil** to write with.
	COGNATE	**CONTROL**
LOW	When we entered the dining hall we saw the **piano** in the corner of the room.	When I was not looking he kept trying to take the new **pencil** off of my desk.
	COGNATE	**CONTROL**

When the sentence beginning provided less semantic specificity, a cognate facilitation was observed as in previous out-of-context tasks, but as semantic information was provided, this facilitation was eliminated. These results suggest that the language of the sentence itself is not sufficient to constrain language-specific lexical access, but that semantic clues add enough to effect constraint. An additional implication of this finding is that sentential context in part may govern when bilinguals code-switch, in that switching may be less likely to occur in conditions of high semantic constraint. A number of other studies have reported a similar pattern of results, suggesting that the language of a sentence context itself does not eliminate parallel activation of the non-target language (e.g., Elston-Güttler, 2000; Greenberg & Saint-Aubin, 2004; Van Hell, 1998).

Syntax as a constraint

If semantic information can affect disambiguation in lexical access, then it stands to reason that the syntax of sentential context may also act as a constraint on non-selectivity. However, models like the BIA+ do not include potential influence from syntax on the system despite evidence that elements like grammatical gender and class can modulate language performance (Berg, 1992; Jiang, 2002; Sunderman & Kroll, 2006). For example, Sunderman and Kroll (2006) showed that in a translation recognition task where participants are asked to indicate whether two words are translation equivalents, lexical form interference effects can be eliminated when there is a mismatch in grammatical class between the presented words. Past these studies, little research currently exists on the relationship between syntax and lexical access in bilinguals.

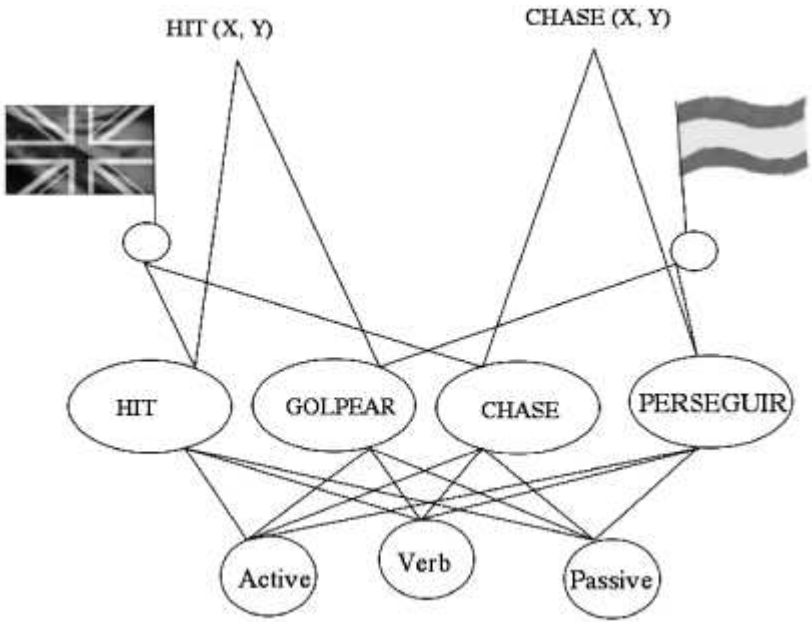

Figure **1-4**: *An illustration of a shared-syntax, shared-lexicon system from Hartsuiker et al. (2004). The lexical and conceptual elements of "to hit" and "to chase" are indicated at the first level and connect to the lemma nodes for each entry in both languages. These also connect with the morphosyntactic elements such as grammatical class indicated at the bottom level, as well as with the language nodes indicated by the British and Spanish flags.*

Hartsuiker, Pickering, and Veltkamp (2004) theorized that syntax itself may function like, or directly interacts with, the lexicon in bilinguals as shown in Figure 4 above. It is possible that overlapping syntactic structures in each of a bilingual's two languages may share storage, either by attaching qualities to lexical entries or in terms of a common grammatical framework. Alternately, it is possible that the two syntaxes are stored separately and reference an overlapping set of lexicons. To evaluate this, proficient Spanish-English bilingual participants were asked to participate in what was described to them as the dialogue game shown in Figure **1-5**.

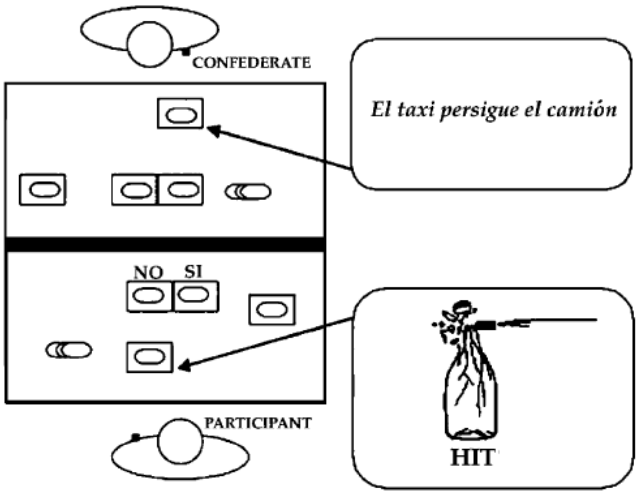

Figure 1-5: *An illustration of the method used by Hartsuiker et al. (2004), showing the bilingual communication game between a naïve participant and a confederate who were separated by a screen. In this case, the participant's selection card shows a bullet hitting a bottle, and the confederate's description card reads "The taxi chases the truck."*

The participants were unaware of the confederate's status as informed, and both were instructed to take turns describing picture cards featuring an agent, a patient, and a suggested verb while monitoring a pile of selection cards; the participant always used English, whereas the confederate always used Spanish. If one's description matched the other's selection card (e.g., if the participant's card showed a taxi chasing a truck as in Figure 1-5), then the participant was instructed to put that card into the "Si" or "Yes" box, and conversely, if the account did not match the selection card (as it does not in Figure 1-5), he or she should put the card into the "No" box. Unknown to the participant, the confederate instead read scripted sentences that featured active tense, passive tense, intransitive verbs (without direct objects), object-verb-subject word order (a structure not found in English), or filler controls. Participant responses were recorded, transcribed, and coded for grammatical structure.

According to accounts of syntactic priming (e.g., Bock, 1986, 1989; Bock & Loebell, 1990; Branigan, Pickering & Cleland, 2000; Scheepers, 2003), monolingual participants tend to use the tense or construction they have just encountered in producing a response; if they hear or read a passive sentence, they are more likely to produce a passive sentence. Despite the manipulation of consistently cross-linguistic communication, participants in the Hartsuiker et al. (2004) study tended to use passive sentence construction in English significantly more often after hearing a passive sentence in Spanish than in any other condition. This evidence indicates that syntactic priming can exist between production and comprehension and across two languages, and provides support for the theory of, at minimum, a marginally-shared grammatical store that interacts with an overlapping lexical store. Evidence in support of a shared grammatical store has also been found in other explorations of cross-lexical syntactic priming, including relative clause attachment (Desmet & Declercq, 2006), dative and transitive structures (Loebell & Bock, 2003), and ditransitive verbs matched with double object or prepositional object constructions (Schoonbaert, Hartsuiker, & Pickering, 2007).

Further research is needed, although cross-syntactic permeability appears to make sense in the context of the wealth of evidence for such permeability in lexical access. A shared grammatical store would allow for less redundancy of concurrent syntactic information between the two languages and would predict faster access to overlapping syntactical features than to features contained in two separate stores in a manner similar to the cognate effect (faster response times to overlapping lexical entries as described above). It is even possible to theorize that shared syntactic and lexical stores would better

facilitate rapid and fluent code-switching than separately stored information (Hartsuiker et al., 2004).

A natural extension of the studies presented above is to explore the interaction between syntax and the lexicon in bilinguals, namely the effects of syntactic match and mismatch across languages on the cognate effect. If the semantic content of a sentence can affect access to the lexicon as described in Schwartz and Kroll (2006), then it seems logical that syntactic context may as well. That is, if a sentence begins with a grammatical structure that is unique to only one of the bilingual's languages, he or she should be less likely to access the grammar and lexicon of the other language. In contrast, in sentences with shared or ambiguous grammar, non-selectivity might be more likely to be observed.

Chapter 2

General Design

The current study examined the potentially constraining effect of language-specific syntax on cross-lexical activation. While many studies, such as those reviewed above, have provided support for the presence of lexical non-selectivity, far fewer have covered what factors contribute to constraining the ambiguity inherent in this co-activation. In order to better understand these constraints, we focused on bilinguals who are highly proficient in Spanish and English, and who, regardless of language dominance, have been immersed in a highly English-dominant environment. We also tested English monolinguals in an English-only paradigm and English-Spanish bilinguals in a simple word-naming task with the same target items to tease apart the effects of cognate status, language of naming, and proficiency in a second language on lexical retrieval.

The low and high constraint framework presented in Table **1-1** and RSVP method illustrated in Figure **1-3** above as utilized in Schwartz and Kroll (2006) provided the foundation for this investigation into the role of language-specific syntax in constraining cross-language activation. The basic design of this study is illustrated in Table **2-1** below.

Table **2-1**: *An illustration of the materials designed for the critical conditions of the proposed study. The four conditions included in the table differ in the language of the sentence and the syntactic specificity of the first clause presented prior to the target indicated in bold red. Grammatical elements specific to Spanish are indicated in italics.*

Syntax Specific	Las monjas *le* llevaron las mantas que habían bordado *a la* ***directora*** del orfanato.	The nuns took the quilts that they had embroidered to the **director** of the orphanage.
	SPANISH	**ENGLISH TRANSLATION**
Syntax Nonspecific	El teniente que regresó de Afganistán habló con el **presidente** durante la reunión.	The lieutenant that returned from Afghanistan spoke with the **president** during the meeting.
	SPANISH	**ENGLISH TRANSLATION**

The conditions that are shown contain critical cognates in Spanish and English but differ in that the syntax specific condition, the sentence-initial fragment is grammatically unique to Spanish whereas in the syntax non-specific condition, it is grammatically allowable in the two languages. In RSVP presentation, the sentences contained either a cognate or matched control target. These two groups of sentences parallel the high and low constraint categories in Schwartz and Kroll (2006) in that high constraint is here defined as syntactic specificity and low constraint is defined as syntactic ambiguity. To test the influence of syntax independently of those effects observed previously for semantic specificity, however, it was necessary in all of the experiments that the sentence stimuli were relatively low in semantic constraint. In the task, functionally monolingual English speakers and Spanish-English bilinguals read sentences like those shown in Table **2-1** and were asked to name aloud the critical word indicated in red. While the monolinguals responded to critical items in English embedded in sentential context as described in Experiment 2, the bilinguals performed the same task in two language blocks

(Spanish and English, counterbalanced across participants), in sentential context in Experiment 1.

Participants

Three groups of participants, sampled from the Penn State University study and from the local community, were included in the study. One group consisted of monolingual English speakers and the two other groups (whose language dominance varied) were bilingual in Spanish and English. Although it is very difficult to find monolingual English participants in a college community with no exposure to a second language, all were highly proficient in English and indicated little to no functional ability in a second language. The bilingual participants, all highly proficient, were grouped according to their dominance in either Spanish or English. Bilingual participants were asked to rate their own proficiency on a language history questionnaire (described below), and the grouping was based on the direction of difference in these scores.

Materials and Procedures

The experiments included in this study involve very similar procedures and tasks, the following sections provide both an overview of the experimental organization and the details of the tasks involved for all participants. All departures from the general method are noted in the appropriate experimental method descriptions.

RSVP (Rapid Serial Visual Presentation)

As shown in Figure **1-3**, the RSVP task (e.g., Schwartz, 2003; Schwartz & Kroll, 2006) involved the rapid presentation of a sentence with single words in a serial manner on a computer screen. At some point in the sentence sequence, a target word appeared in red; the participant's task was to name the word aloud as quickly and accurately as possible. In addition to the naming task, readers were probed periodically with comprehension questions to ensure that they were reading the sentences in full. After instruction, participants completed 20 practice trials, and then the experimenter left the room. The session audio was digitally recorded, and reaction times (RTs) were recorded in milliseconds (ms) from the onset of the critical word to the onset of articulation. Each trial was initiated by fixation cross (+) in the center of the screen, that remained on-screen until the participant had pressed the space bar. The RSVP presentation occurred at a rate of 150 ms per word until the red word appeared on screen; this target word remained on the screen until a response was registered or after 3000 ms had elapsed, and then the sentence continued at the previous pace. For trials with associated comprehension questions, the question appeared in full on the screen after the sentence had finished, and remained until a response was registered or until 5000 ms had elapsed.

Materials

Target words

The critical items consisted of 80 English content words: 40 words that have cognate translations in Spanish (e.g. *idea, idea*) and 40 words that have non-cognates translations in Spanish (e.g. *friend, amigo*). The target words and controls were carefully chosen to maximize matching on group phonological and orthographical similarity across the syntactic conditions and to minimize the use of diacritic marks, which might trigger a stronger activation of the Spanish lexicon (for a list of the stimuli, refer to Appendices A and B).

Critical sentences

The sentences themselves were created according two conditions: language-specific syntax and language-ambiguous syntax. “Language-specific” and “specific syntax” were operationalized such that the beginning of each sentence was grammatically unique to Spanish whereas in the “ambiguous syntax” condition, each sentence began in a way that was grammatically viable in both languages. The syntax specific condition utilized a Spanish construction that is unavailable in English: in each sentence, the indirect object of a ditransitive verb was realized pleonastically with the proclitic *le* and with its corresponding noun phrase. In addition, an object relative clause also appearing prior to the target word contained a null element in the subject position. (As shown in Table **2-1**, one example of this construction is “*Las monjas* le *llevaron las mantas que*

habían bordado a la **directora** *del orfanato*.") On the other hand, in each sentence in the syntax ambiguous condition, the verb was followed by a prepositional phrase and the object relative clause was instead a subject relative clause—this structure can be translated directly, or nearly word-for-word, across English and Spanish. (One example of this, shown in Table **2-1**, is "*El teniente que regresó de Afganistán habló con el* ***presidente*** *durante la reunión*.") Following these rules resulted in 160 sentences: 40 Spanish sentences with specific syntax, 40 English translations of these sentences, 40 Spanish sentences with ambiguous syntax, and 40 English translations. Half of each set of 40 sentences contained cognates and half contain controls. As the syntax outlined above in the syntax-specific condition is unique to Spanish and cannot be grammatically well-formed in direct translation into English, the corresponding translations utilized non-specific grammar so that all 80 English sentences fall into the ambiguous grammar condition; the most substantial effects of language-specific grammar were thus expected to be realized in the Spanish specific syntax condition.

The sentences were constructed by a native Spanish speaker with considerable experience in experimental sentence construction, and the translations were developed in conjunction with the principal investigator, a native English speaker. The sentences were matched in terms of number of words and complexity, but featured as few overlapping content words as possible across all sentences (for a list of the sentences, refer to Appendices C and D).

Comprehension sentences

40 comprehension questions following 20 of the critical sentences and 20 of the filler sentences were presented randomly—these questions were intended to address the central topic of the sentences they followed (e.g., *Sumi read a book until the train that would take her to Texas arrived at the station. Where is Sumi going?*). Half of the comprehension questions had a yes/no answer, and the other half were answered with a content word. These questions were included in the experiment to assure that participants were paying attention to the full sentences and not simply reading the red words. Answers to the questions were digitally recorded and later coded for accuracy on a liberal correct scale (reasonably accurate responses like synonyms were noted as such but accepted as correct).

Measures of Cognitive Individual Differences

Because past research has shown that differences in cognitive ability may have an impact on word production (e.g. Ferreira & Pashler, 2002), two tasks were included for all participants: a measure of processing resources known as a memory span task and a measure of executive control known as the Simon task. The Simon task was included in the present study to examine participants' ability to ignore irrelevant information, in that the task requires the individual to respond to the color but not location of a rapidly-presented stimulus. While the task is language-neutral in nature, Bialystok and colleagues (Bialystok, Craik, Klein, and Viswanathan, 2004; Bialystok, Martin, and Viswanathan, 2005; Bialystok & Craik, 2007) have shown that bilinguals respond more quickly than

monolinguals, and have theorized that negotiating between two language systems affords cognitive benefits to bilinguals. For the purpose of this study, Simon task data provide a comparison across the bilingual groups and against the monolingual group.

While these measures are not an exhaustive survey of possible difference, they were included in order to ensure that group performance differences were due to experimental manipulations and language experience and not to within-group cognitive variability. The results of these measures will be discussed in Chapter 5.

The Simon Task

Materials

Two 28 by 28 pixel squares in red or blue were presented singly at one of three locations on-screen: at center, 2° left of center, and 2° right of center. The squares were presented 42 times per block for one practice block and three recorded blocks, resulting in 126 experimental trials.

Procedure

Participants were instructed on-screen and out loud to press the key marked on the keyboard corresponding to the color of the square presented. That is, when a red square appeared, the participant was instructed to press the key marked with a red square regardless of the on-screen square’s location.

A fixation cross (+) preceded each trial for 350 ms, and each square was presented for 2000 ms or until the participant responded. After correct responses, a blank screen preceded the next trial by 850 ms. Feedback was provided after incorrect responses or no response via *ERROR* displayed at the center of an otherwise-blank screen for 1500 ms, then a blank screen preceding the next trial.

The Memory Span Task

Materials

56 English sentences with either plausible or implausible (e.g. *It was milk that spilled the girl.*) meanings were sorted into twenty presentation sets containing between two and six sentences each. The order of presentation of each set was randomized.

Procedure

Participants were presented with instructions both out loud and on-screen to judge each sentence for plausibility as quickly and accurately as possible while remembering the last word of each sentence. Implausible sentences were explained with an example (*The cat drove me to the store*.), and participants completed three practice sets to become familiar with the task.

Although participants initiated each set with the space bar, each sentence within the set was presented on a fixed interval. A fixation cross (+) was presented for 1000 ms in the center of the screen, then was replaced with a sentence that remained until the

participant responded with a plausibility judgment (*yes* or *no* as relabeled on the keyboard over keys *D* and *K*) or 4000 ms elapsed. At the end of each set, the word *RECALL* appeared on-screen until the participant initiated the next set.

When cued by the recall screen, participants were asked to write in any order the last words of each sentence in a provided booklet, then proceed to the next page of the booklet and initiate a new set when ready.

The CARE Questionnaire

In addition to the tasks designed to probe individual differences across inhibitory control and available memory resources, participants were also asked to complete a questionnaire based on the CARE (College ADHD Response Evaluation). While intended not to diagnose but to provide a window on attentional disorder, the CARE has primarily been used in identifying levels of behaviors similar to those exhibited in individuals with ADHD (Attention Deficit/Hyperactive Disorder) symptoms. These behaviors are categorized as inattention, hyperactivity, and impulsivity. This questionnaire was included in the experimental tasks to explore a possible relationship between executive control, especially inattention, and sensitivity to experimental manipulations in a more demanding task like the RSVP paradigm, and was used only as a comparison between the three groups. The results of this comparison will be discussed in Chapter 5.

Materials

26 statements of behaviors and experiences (for example, *I am often restless*.) presented sequentially and in random order without a time limit.

Procedure

Participants were asked to consider and indicate how much each statement reflected their experiences. For each statement, three options were provided: agree, disagree, or not applicable. Participants responded by pressing the appropriate key on the keyboard for each statement.

Language History Questionnaire

After completing the RSVP, Simon, and memory span tasks, participants were asked to fill out a language history questionnaire in order to assess proficiency in writing, reading, listening, and speaking in their two strongest languages as self-rated on a ten-point scale. Participants were asked to indicate any experience with other languages, the dialect of their primary language, and years of proficient use of each language. (A copy of the language history questionnaire follows in Appendix F).

Data Cleaning Procedures

RSVP

Trials were coded across two dimensions: target word response and answer to a follow-up question. Correct trials thus included both correct production of the target word and correct answer to the question when appropriate. Error trials were sorted into two categories: those with an incorrect production of the target word and those with a correct production of the target but an incorrect answer to the question. This assignment allowed for two sets of analyses; the conservative approach excluded all error trials, and the liberal approach included all trials for which the target was correctly produced, regardless of response to any comprehension questions. Making this distinction allowed for an evaluation of the inclusion of comprehension questions in the RSVP task (results of liberal analyses are reported in Appendix E). Additionally, those RTs faster than 200ms or slower than 2500ms were excluded across all participants from all analyses. A mean correct RT was calculated for each participant and trials in which the RT was more than 2.5 standard deviations above or below the mean RT were excluded as outliers. RTs on filler sentences were included in the calculation of outliers, but were not included in final analyses. As a result, the following percentages of data were excluded from the conservative analyses: for the monolingual English participants, 17%; for the bilingual, Spanish-dominant participants, 17%; and for the bilingual, English-dominant participants, 16%.

The Simon Task

Correct status and RTs were recorded for each trial; RTs greater than 1500 ms were excluded as global outliers. Recovery trials, or those immediately following an error trial, were also excluded from analyses. From the remaining trials, correct responses were sorted into three categories: center, incongruent, and congruent trials. Central trials reflected those in which the square was presented in the center of the screen, whereas congruent trials corresponded to those presented on the same side as the appropriate key (i.e., presentation of a blue square on the left when the corresponding key was to the left). Incongruent trials were those that involved inhibition of irrelevant information, in that a correct response required ignoring the on-screen/keyboard mismatch. A measure of the interference caused by the mismatch called the Simon effect was calculated for each participant by subtracting the mean RT on congruent trials from the mean RT on incongruent trials.

The Memory Span Task

Each participant response was coded for judgment accuracy and RT, and recalled words were recorded as correct, unrecalled, or intrusions (any words other than those presented sentence-finally). Mean RTs were calculated across each participant for those items correctly assessed as plausible or implausible, and outliers 2.5 standard deviations above or below the mean were trimmed. In the remaining data, the number of correctly recalled words corresponding to correctly assessed sentences was tallied into a measure of memory span under cognitive load.

The CARE Questionnaire

For each participant, category totals and percentile rankings against totals across college-aged peers were tabulated according to a scoring rubric. Totals for each category were also coded below the 92nd percentile, between the 92nd and 97th percentiles, and above the 97th percentile in terms of attention deficit symptoms among college-aged peers; these designations were provided by the CARE and were coded as low, medium, and high categories.

Selection Criteria for Participant Inclusion

Language Ability Criteria

Although they are crucial concepts in conducting psycholinguistic inquiry, language proficiency and dominance have not yet been codified into variables agreed upon by the research community. At present, proficiency and dominance may be assigned based on performance on linguistic tasks, self-ratings of ability, the age at which the participant first learned or acquired his or her language(s), measures of accentedness, the language of the environment, proportions of daily language use, etc. For the purpose of this study, language dominance and proficiency were calculated from each participant's language history questionnaire. For each of the participant's two strongest languages, a mean score was calculated from his or her ratings across four dimensions (reading, writing, speaking, and comprehending speech in that language). The language with the higher of the two means was designated as the "L1," or the participant's more dominant

language, and the lower was designated as the "L2," or the participant's non-dominant language. Participants who indicated equal dominance in two languages were assigned to the English L1 category, as it is the dominant language of the environment. It is important to note that the L1 and L2 designations have also been used in the literature in categorizing the order of languages acquired over time, but for the purpose of this study these designations refer only to relative dominance in the present tense.

Bilingual participants were excluded from the study if they rated their non-dominant language ability at a mean of less than 6.5 on a ten-point scale (i.e., if they felt they were not highly proficient in both languages). In addition, bilingual participants who exhibited poor performance in the RSVP task were excluded from analyses for the same reason. Monolingual participants were excluded if they rated their non-dominant language ability at a mean of more than 4.5 on a ten-point scale (i.e., if they were advanced learners or somewhat proficient speakers of a language other than English, and were therefore not functionally monolingual).

RSVP Accuracy Criteria

As it was essential to the nature of the experimental manipulations that the participants read all words in the sentences and accurately comprehended and produced the target items, participants who exhibited high error rates in naming response (greater than a 15 percent error rate) or low accuracy in answering follow-up comprehension

questions were excluded from the results.[1] Moreover, participants taking more than 1000ms on average to respond to target items were excluded as outliers; these participants with long RTs also had lower accuracy scores on the comprehension questions, suggesting that they may have had difficulty with the rapid pace of presentation in the RSVP task. No monolingual participants and 2 bilingual participants exhibited average accuracy rates lower than 85%, so it was assumed that these participants were highly proficient in English or English and Spanish, respectively.

Cognitive Ability Criteria

Each participant was compared against the mean performance ratings for his or her group to ensure relative group homogeneity. Participants whose scores on the Simon and memory span tasks were two and a half standard deviations or more above or below their group mean were considered outliers. However, those participants who were excluded under the cognitive ability criteria also did not meet the language experience and RSVP performance criteria; no additional participants were excluded by the cognitive ability criteria.

The results from the CARE questionnaire were not used as criteria for participant inclusion, but were gathered to explore a possible additional measure in characterizing individual differences among participants.

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[1] Two grammatical errors in the Spanish stimuli led to the exclusion of those items from all analyses; the data presented reflect this exclusion.

General Procedure

Participants were recruited through posted fliers, email announcements sent to groups affiliated with the university, information provided in undergraduate courses via the subject pool, and contacts made by a visiting researcher fluent in Spanish and English. These participants were tested in the Language and Cognition Lab at Penn State University. All interactions between experimenters and participants took place in English.

Consistent with ethical regulations, each testing session began with written and verbal information about the full rights of a participant in the experimentation; those who consented to participate signed an informed consent form and were provided with a copy for their records. Following this, the participant was seated before a computer so that the keyboard and LCD monitor were at comfortable locations and so that the microphone was at distance suitable for audio recording. In every task, the participant read instructions on the screen, and an experimenter was present to review the instructions and answer any questions. In audio-recorded tasks, the participant was instructed to name targets (indicated in red) aloud, accurately, and clearly into the microphone. In all tasks, the participant was told that if a word or question was unfamiliar, they should answer “I don’t know” or guess at an answer. For the practice section of every task, the experimenter remained available in the testing room to further instruct and answer questions. When the participant indicated readiness to begin, the experimenter then left the testing room to allow the participant to proceed in a quiet environment, but waited in the main lab office next door until the participant indicated that the task had been completed.

For all participants, the experiment began with the RSVP task, followed by the Simon task, the Memory Span task, and the CARE questionnaire, and concluded with the language history questionnaire. Participants were then debriefed and paid or given course credit for their participation as appropriate. The experimentation session lasted approximately one hour for all participant groups.

General Predictions

If the presence of syntax-ambiguous information encourages or allows activation of lexical items across languages, then a differential response to cognates versus matched controls should be observed when the initial information of the sentence is common to both languages. Like the effects of low semantic constraint in Schwartz and Kroll (2006), the syntax-ambiguous conditions should not restrict language nonselectivity. It is also possible that a low amount of syntactic information is equivalent to that of the target words without any context, in which case the results for the bilinguals performing the RSVP task should be similar to those of bilinguals naming the same words without any sentential context.

On the other hand, if language-specific syntax effectively reduces the activity of the bilingual's other language, then a greater cost, operationalized as a longer response time, should be observed when readers are required to use the other language, e.g., following a language switch. The general prediction is that proficient Spanish-English bilinguals will name critical cognates faster than their respective controls in language-ambiguous syntactical conditions but that in the syntax specific sentences, no cognate

facilitation will be observed. Furthermore, larger cross-language effects are predicted when readers are functioning in the less dominant language.

Chapter 3

Experiment 1: Bilingual word naming in L1 and L2 sentence contexts

This study centered on the role of syntactic context in resolving cross-lexical ambiguity, and was motivated by previous research on the interaction of semantic contextual information with this ambiguity. In Schwartz and Kroll (2006), a high degree of semantic specificity facilitated a reduction in cross-language competition; it was theorized that syntactic specificity might function in a similar way. To this end, highly-proficient bilinguals were presented with stimuli that were ambiguous and unambiguous across their two languages in the context of sentences that were organized according to syntax that was either specific or ambiguous across the languages.

Predictions

Because the manipulation of syntax affected only Spanish sentences, the prediction for the English sentence condition was that bilinguals would name critical cognates faster than their respective controls. As in the Schwartz and Kroll (2006) study, the English sentences were neither semantically nor syntactically specific to English and thus cognate facilitation was predicted; like the English conditions, cognate facilitation was predicted in the Spanish syntax ambiguous condition. The crucial prediction is that for the syntax specific sentences, no cognate facilitation would be observed. In addition to examining the effects of language-specific syntax on the presence of cross-language

activation, Experiment 1 allowed evaluation of the effect of language dominance on performance, such that larger cross-language effects were expected to be evident in the less dominant language.

Methods

In this experiment, participants were proficient speakers of Spanish and English, and were presented with the RSVP paradigm as described above in Chapter 2: the sentences stimuli appeared in two language blocks, and the order of presentation was counterbalanced across participants.

Participants

Participants were recruited via flyers posted around campus, and were paid for their participation. The bilingual group consisted of 32 participants; 17 students at Penn State University as well as 15 individuals from the surrounding community. Two participants were excluded from the analyses due to high error rates in the RSVP task, four were excluded as outliers in mean reaction time on the RSVP task, and one was excluded due a recording malfunction (the criteria for inclusion are described in Chapter 2 above). As a result, the reported data are for 25 bilingual participants, 17 Spanish-dominant speakers and 8 English-dominant speakers; their proficiency ratings follow in Table **3-1**.

Table 3-1: *Self-ratings of proficiency across four skills for bilingual participants grouped by language dominance. Ratings ranged from 10 (highly-proficient) to 0 (no ability). Means are provided with standard deviations in parentheses.*

Group	***English Language***				***Spanish Language***			
	Reading	Writing	Speaking	Listening	Reading	Writing	Speaking	Listening
ENGLISH	**9.88** (0.35)	**9.75** (0.46)	**9.88** (0.35)	**9.63** (0.52)	**8.88** (0.99)	**7.88** (1.73)	**8.19** (1.46)	**8.75** (1.04)
SPANISH	**8.65** (1.17)	**8.18** (1.29)	**7.94** (1.20)	**8.88** (0.99)	**9.82** (0.39)	**9.59** (0.71)	**9.82** (0.39)	**9.88** (0.33)

Materials and Procedure

The tasks and procedures did not differ from the general method as described in Chapter 2.

Results and Discussion

The experiment included three between-participant factors: context language (the language of the sentence, Spanish or English, in which the critical target word appeared), syntactic condition (Spanish-specific or language-non-specific), and cognate status of the critical target word (cognate or control). The dependent measures were response time (ms) and accuracy (%) to name the critical target words. Language dominance (i.e., whether participants were more dominant in Spanish or in English) was treated as a between-participants factor. Therefore, mixed Analyses of Variance (ANOVAs) were performed on each of the dependent measures across context language, syntactic condition, and cognate status as within-participants factors. As described in "Data

Cleaning Procedures" in Chapter 2, the coding system allowed for two types of analyses: the first (hereafter termed *conditional analyses*) included trials where participants both correctly named the target item and answered comprehension questions accurately. The conditional analyses are reported below. The second type of analyses (hereafter termed *independent analyses*) included all trials in which participants correctly produced target words regardless of answers to comprehension questions, and is included in Appendix E for comparison purposes. A comparison of the two sets of analyses suggests that the pattern of results was largely the same for both types of scoring.

Reaction times analyses

The English dominant participants were faster overall than the Spanish dominant participants (M = 645 ms, SD = 112.22 for the English-dominant group; M = 694 ms, SD = 87.77 for the Spanish-dominant group), but this difference between the two means was not statistically significant ($F(1,23) = 1.55$, $p = .224$).

Main effects for within-participant factors were not significant for context language ($F(1,23) < 1$), syntactic condition ($F(1,23) < 1$) or cognate status ($F(1,23) = 2.28$, $p = .144$). However, language dominance interacted with context language ($F(1,23) = 10.06$, MSE = 65354.20, $p = .004$), in that the English dominant participants were significantly faster in responding to English stimuli than the Spanish dominant participants ($t(1,23) = -2.06$, $p = .051$), as shown in Figure **3-1** below. Note that all *post hoc* comparisons between means in the section that follows were performed with the Bonferroni correction.

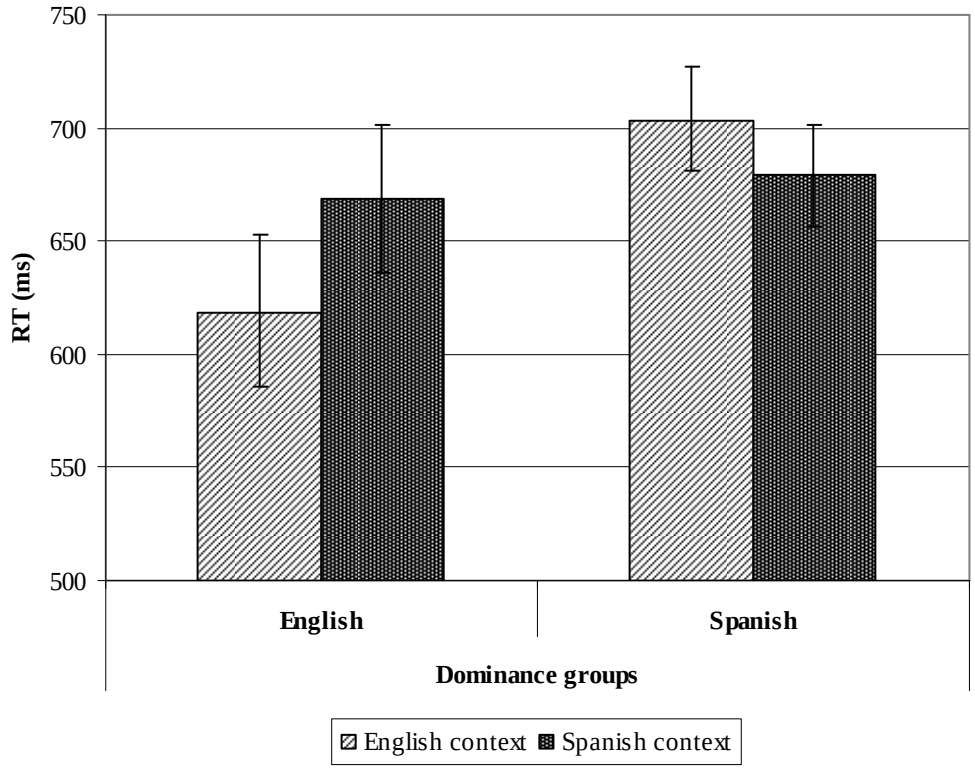

Figure **3-1**: *Reaction times (in milliseconds) to name target words for English- and Spanish-dominant participants in English and Spanish language blocks.*

These results suggest that, although they were highly-proficient in both languages, the English-dominant participants were indeed faster in English than in Spanish. The two dominance-based groups did not significantly differ in RTs in the Spanish context block ($t(1,23) = -.26$, $p = .794$), and the Spanish-dominant group were equally fast to name words in English or Spanish sentences ($t(1,16) = .89$, $p = .379$). As a Spanish-dominant group in a strongly monolingual English environment, a non-significant difference across the two language blocks is to be expected.

The results also showed a marginal interaction between language dominance and cognate status ($F(1,23) = 3.46$, MSE = 6372.92, $p = .076$). This interaction suggests

differential sensitivity to cognates versus controls across the two dominance groups. As shown in Figure 3-2, English-dominant participants named cognates more slowly than controls ($t(1,7) = -1.861$, $p = .076$), whereas for Spanish-dominant participants there was no difference in the speed of naming the two types of critical words ($t(1,16) = .35$, $p = .727$).

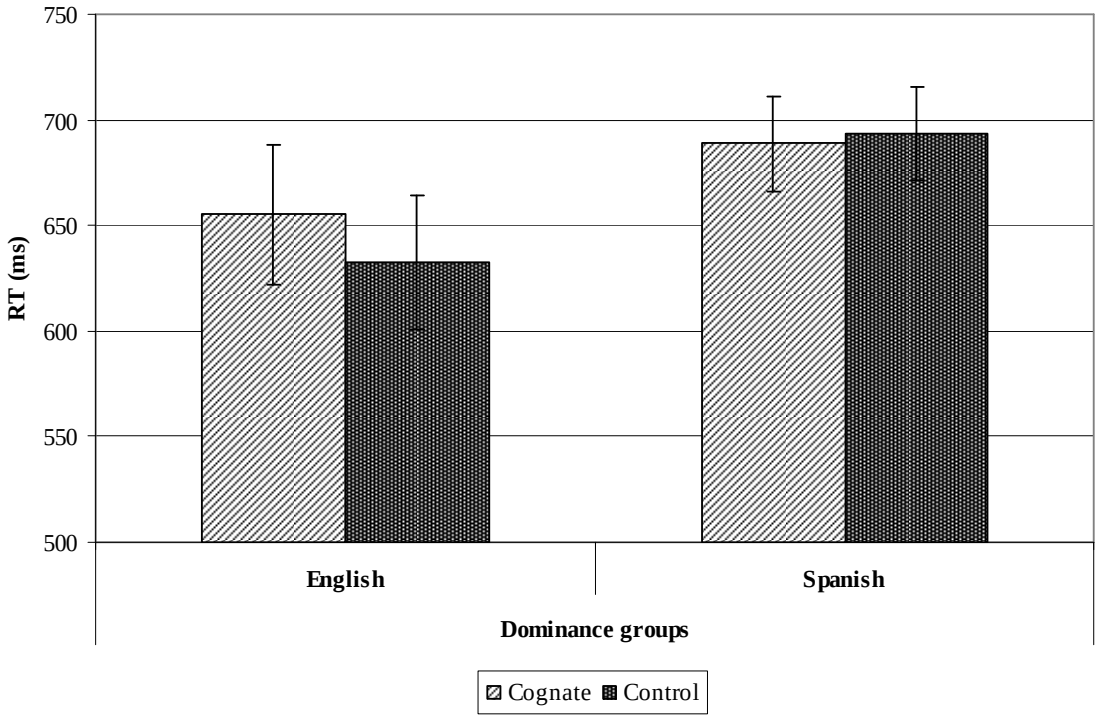

Figure 3-2: *Reaction times (in milliseconds) to cognate and control target words across English- and Spanish-dominant participants.*

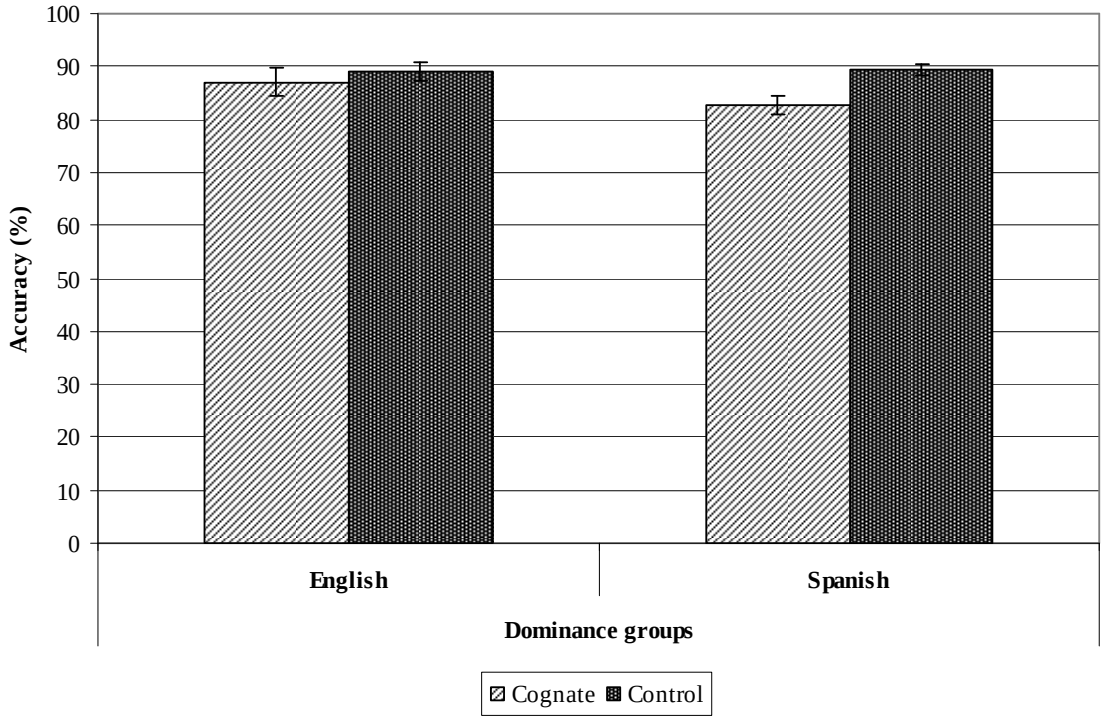

Figure 3-3: *Accuracy percentages for naming cognate and control target words across English- and Spanish-dominant participants.*

Critically, there was a significant interaction between syntactic condition and cognate status ($F(1,23) = 9.76$, MSE = 1189.42, $p = .005$) such that participants responded more slowly to cognates than controls in the context of Spanish-specific syntax than in the context of language-non-specific syntax ($t(1,23) = -3.36$, $p = .003$), as shown in Figure 3-4 through 3-7 below. As in the analyses above, the cognate effect (control – cognate RT) was inhibitory, with longer RTs for cognates than for controls. Because this inhibitory effect runs counter to facilitatory effects of cognate status typically found in previous research (e.g., Caramazza & Brones, 1979; Costa et al., 2000; Dijkstra et al., 1999; Schwartz & Kroll, 2006; Van Hell & Dijkstra, 2002; Van Hell & De Groot, 1998), it is possible that an additional feature of the stimuli may be affecting the results.

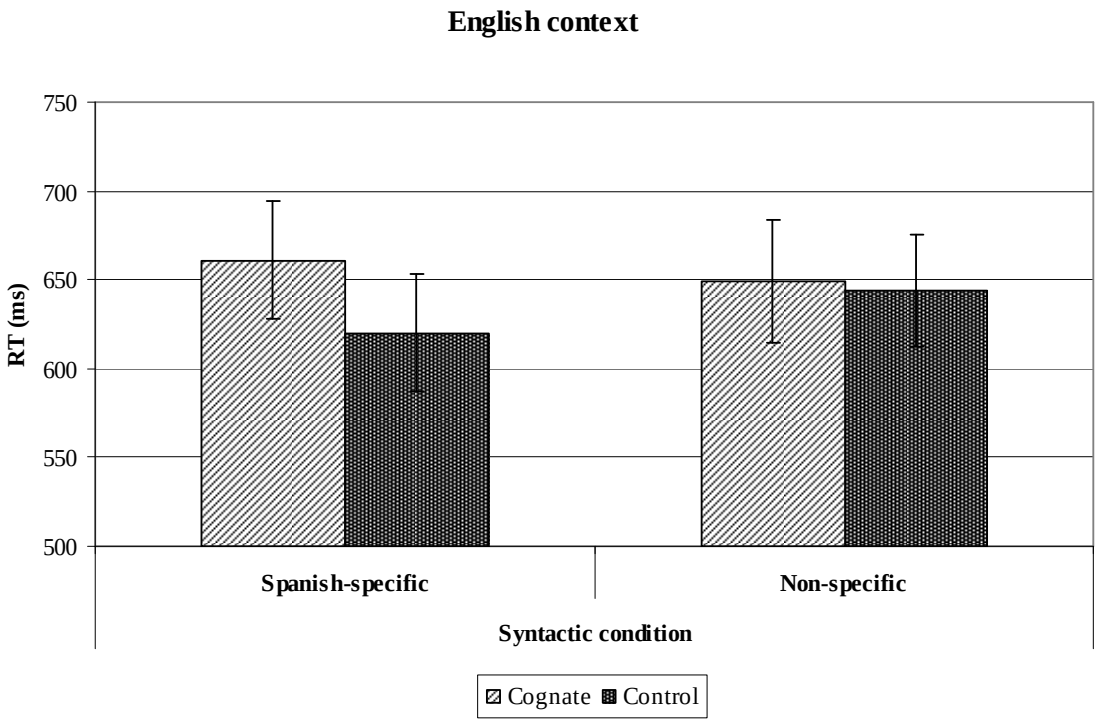

Figure **3-4**: *Reaction times (in milliseconds) to target words for cognates and control items across Spanish-specific and language-non-specific syntactic conditions in English sentential contexts.*

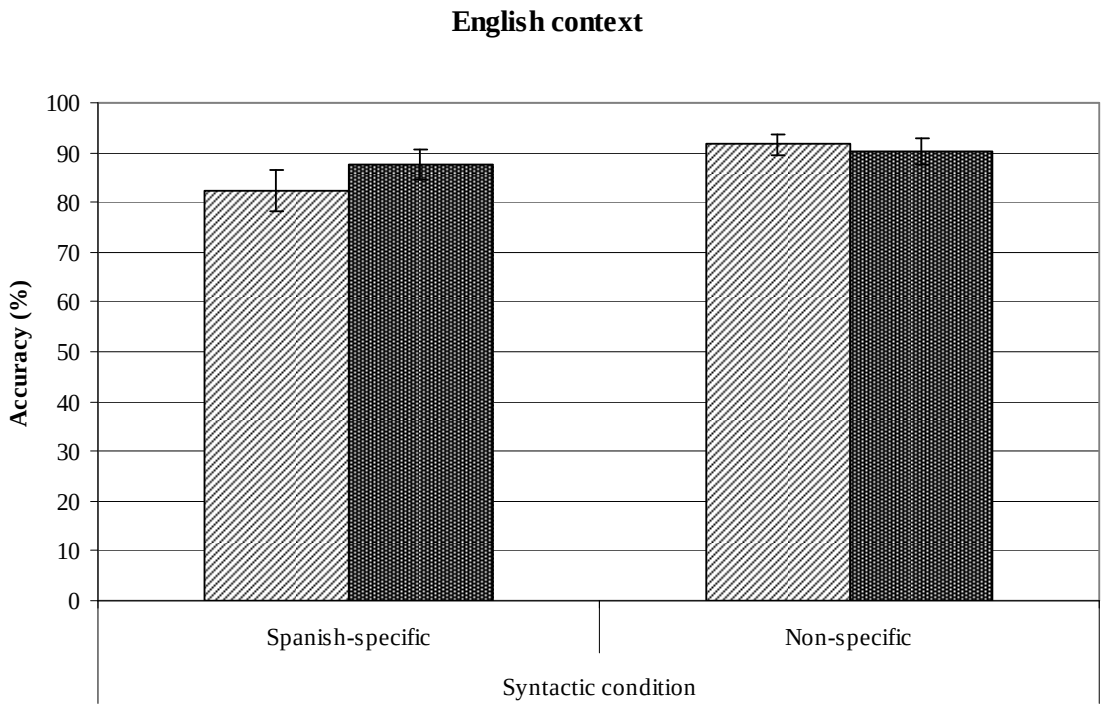

Figure **3-5**: *Accuracy in naming cognates and control items across Spanish-specific and language-non-specific syntactic conditions in English sentential contexts.*

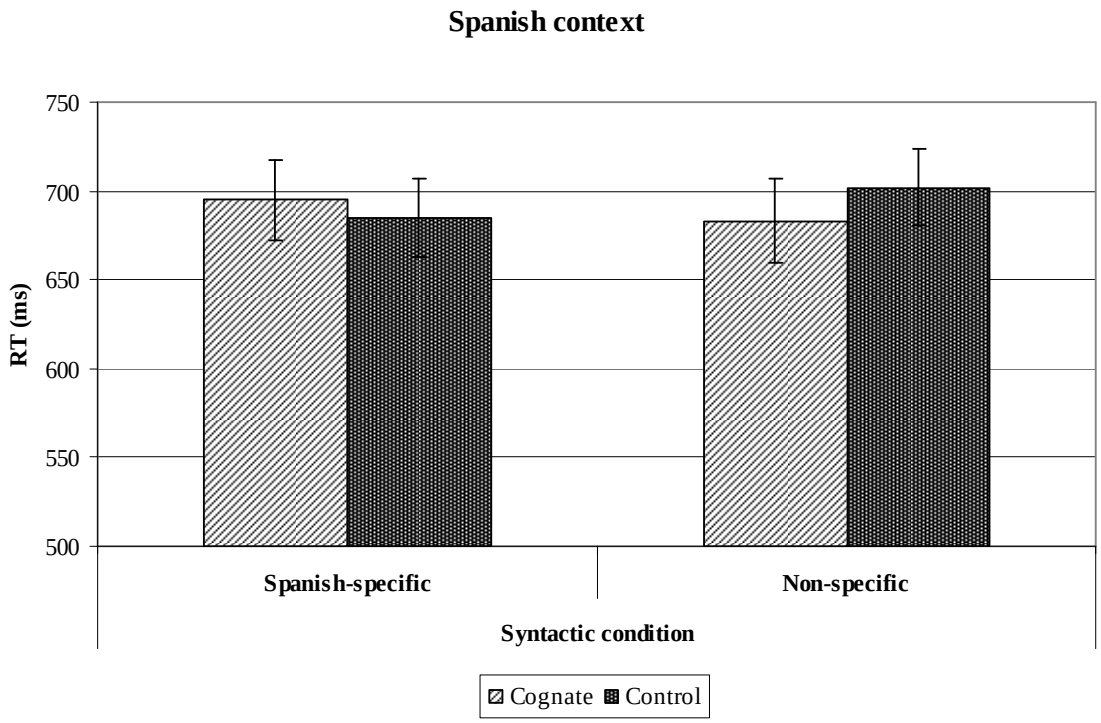

Figure **3-6**: *Reaction times (in milliseconds) to target words for cognates and control items across Spanish-specific and language-non-specific syntactic conditions in Spanish sentential contexts.*

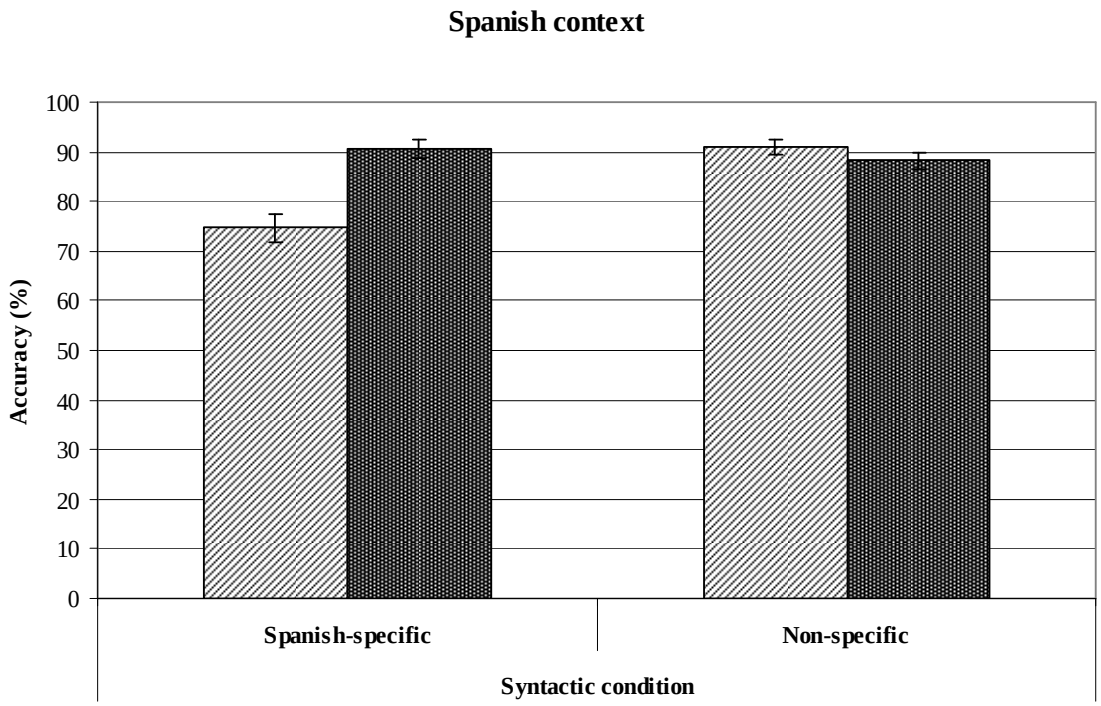

Figure **3-7**: *Accuracy in naming cognates and control items across Spanish-specific and language-non-specific syntactic conditions in English sentential contexts.*

In addition, the predicted three-way interaction (context language x syntactic condition x cognate status) was not significant ($F(1,23) < 1$), as the syntactic manipulation appeared to affect naming in the context of both the English and Spanish sentences equally ($t(1,23) = -1.41$, $p = .170$). Although this interaction was not significant, the figure above makes clear that the inhibitory effects for cognates were primarily observed in the Spanish sentences for which the manipulation of syntax was relevant. It is important to remind the reader that for English sentences, Spanish-specific syntax only means that the Spanish translation of that sentence includes Spanish-specific syntax. For the English sentences themselves, the distinction between specific and non-

specific syntax was not meaningful, although it is possible that the participants as bilinguals non-selectively had the Spanish translations available.

The magnitude of the cognate effects across conditions of the experiment (context language and syntactic condition) for the two dominance groups is included in Table 3-2. No other effects were significant ($p > .10$).

Table 3-2: *Mean reaction times (ms) and mean accuracy rates (percent) to critical targets (cognates or non-cognates) for English- and Spanish-dominant participants in English and Spanish sentence contexts in the Spanish-specific or language-non-specific syntactic conditions. The cognate effect is calculated as (mean non-cognate RT - mean cognate RT) and reflects the differential result of cognate status on RT: facilitation in a positive direction or interference in a negative direction.*

Group	*Context language*	SPANISH-SPECIFIC SYNTAX			NON-SPECIFIC SYNTAX		
		Cognate	*Control*	***Cog effect***	*Cognate*	*Control*	***Cog effect***
ENGLISH	English	625 *75%*	612 *86%*	**-11**	622 *91%*	619 *88%*	**-3**
	Spanish	702 *89%*	636 *90%*	**-66**	674 *92%*	667 *93%*	**-7**
SPANISH	English	707 *77%*	705 *88%*	**-2**	699 *89%*	718 *88%*	**18**
	Spanish	690 *72%*	666 *93%*	**-25**	674 *92%*	691 *88%*	**17**

In the presence of the Spanish-specific syntax, no cognate effects were predicted because the parallel activity of the two languages would be overridden by the available syntactic constraints. The pattern of results suggests just the opposite, i.e., that inhibitory cognate effects were present for the Spanish-specific sentences but absent for language non-specific sentences. In the discussion we consider why the apparently counter-intuitive pattern of data may actually be not as surprising as it seems when we take into account differences in correlated lexical properties for the cognate and noncognate

control words. Although efforts were made to match materials in advance of the experiment, it appears that some residual lexical differences may have remained. Experiment 2, with English monolingual participants, will allow us to determine whether these results are due to bilingual language ability, lexical properties of the target words, or heterogeneity among the bilingual participants themselves.

Accuracy analyses

There was not an overall accuracy difference ($F(1,23) < 1$) between the two groups as measured in percent of total possible targets correctly named (M = 88% for the English-dominant group; M = 86% for the Spanish-dominant group)[2] and the main effect of sentence language was not significant ($F(1,23) = 1.18$, $p = .288$), suggesting that the groups were equivalent in proficiency and knowledge of critical target items across their two languages.

Accuracy data showed a main effect of syntactic condition ($F(1,23) = 21.38$, MSE = 84.77, $p < .001$), as participants responded more accurately on trials with language-non-specific syntax. Cognate status also reached significance ($F(1,23) = 6.55$, MSE = 119.707, $p = .017$), and the interaction between syntactic condition and cognate status ($F(1,23) = 9.81$, MSE = 175.468, $p = .005$) reached significance. Participants showed better performance in naming controls versus cognates and best performance in naming

[2] As with the RT results above, the reported accuracy results are based on the conditional criteria discussed in Ch. 2; accuracy in naming data independent of comprehension question accuracy are reported in Appendix E.

cognates in the language-non-specific syntactic condition, as presented below in Figure 3-8.

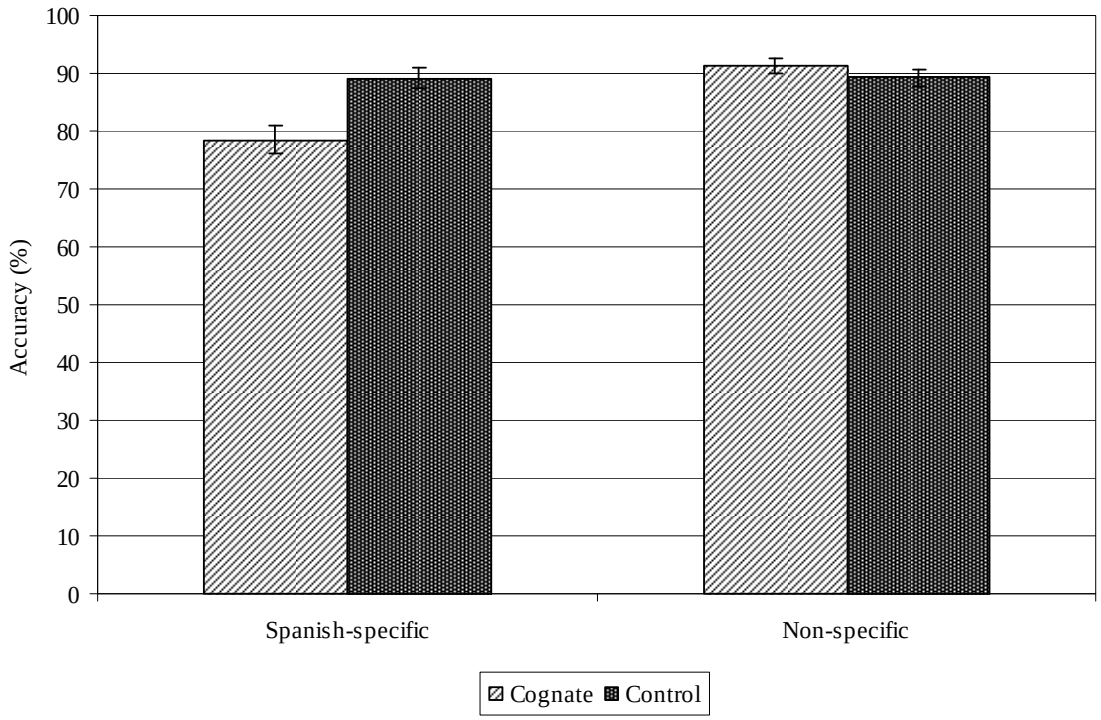

Figure 3-8: *Naming accuracy (%) for cognates and controls in Spanish-specific and language-non-specific syntactic conditions.*

There were no *a priori* calibrations of comprehension question difficulty across all conditions and questions were not presented after every trial, so this analysis based on question accuracy is speculative but theoretically informative. As described above in Chapter 2, these questions were included to ensure that participants were proficient, staying on task, and reading each sentence. Performance on these questions was also used as a criterion for inclusion in the primary analyses; because the RSVP paradigm is cognitively tasking and demands rapid reading ability in the languages presented, participants scoring below 50% on the questions were excluded. However, accuracy in

answering these questions may also provide a measure of sensitivity to experimental manipulations, as a correct answer necessitates retention of the details of each sentence despite the complexity of the task. Applying a more stringent criterion for accuracy (performance above 60% accuracy) resulted in the exclusion of eight participants—the higher-accuracy group included both English- and Spanish-dominant participants (N = 17; M = 88.19%). A mixed ANOVA performed on RTs as a dependent measure across language context, syntactic condition, and cognate status factors is reported below.

For this higher-accuracy group, context language ($F(1,16) < 1$), syntax ($F(1,16) = 1.53$, $p = .234$), and cognate status ($F(1,16) = 2.47$, $p = .135$) did not significantly affect performance. However, several of the interactions were significant. Participants in this group were faster to name Spanish controls than cognates or English target items ($F(1,16) = 5.18$, MSE = 883.05, $p = .037$), and were faster to name controls in Spanish-specific grammar than cognates or those in language-non-specific grammar (F(1,16) = 5.97, MSE = 1327.40, p = .026). Parallel to the original prediction, the three-way interaction was significant ($F(1,16) = 7.33$, MSE = 803.20, $p = .016$), in that the participants showed the largest differential response to cognates versus controls in the Spanish-specific syntactic condition in Spanish sentential context ($t(1,16) = -4.43$, $p < .001$), as shown in Figure **3-9** below.

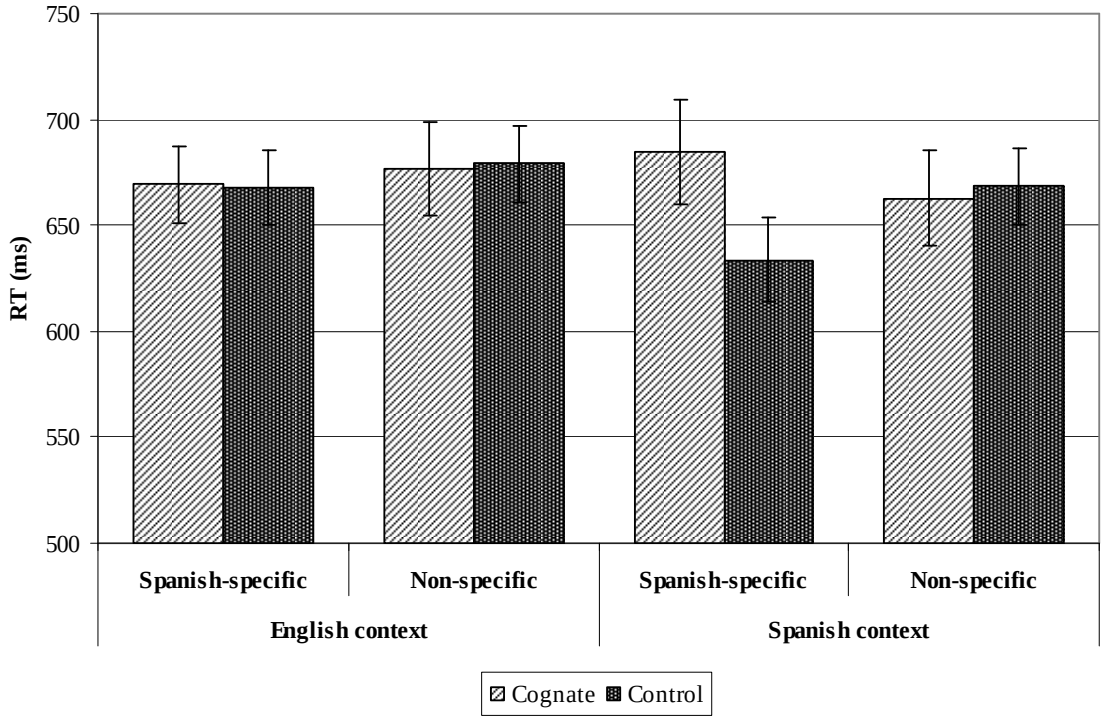

Figure **3-9**: *Cognate effects (control RT – cognate RT in ms) for the higher-accuracy group across language contexts and syntactic conditions.*

These results, though tentative, suggest that participants with higher accuracy scores on comprehension measures were more responsive to experimental factors embedded in an RSVP paradigm, and in this experiment were more sensitive to syntactic condition and cognate status. In fact, there was a significant four-way interaction between context language, syntactic condition, cognate status, and language dominance group ($F(1,23) = 5.91$, MSE = 518.53, $p = .023$). Both groups were equivalently more accurate to name controls versus cognates in English sentences with Spanish-specific syntax ($t(1,23) = 3.63$, $p = .001$), and both were more accurate naming words in language-non-specific than in Spanish-specific syntactic conditions ($t(1,23) = -5.19$, $p < .001$). However, the English-dominant participants were equivalent in their performance across

English and Spanish language contexts whereas the Spanish-dominant participants were significantly more accurate in Spanish in the language-non-specific syntactic condition than in the Spanish-specific syntactic condition or either of the English language contexts, as shown in Table **3-3** below. This supports the dominance categorization in that the English-dominant participants are highly proficient in both Spanish and English, and that the Spanish-dominant participants have maintained a high degree of their dominant language despite living in a monolingual English environment.

No other effects were significant ($p > .10$).

Table **3-3**: *Naming accuracy (%) for cognates and controls in Spanish-specific and language-non-specific syntactic conditions in the context of English or Spanish by English-dominant or Spanish-dominant participants.*

Group	*Context language*	**SPANISH-SPECIFIC SYNTAX**		**NON-SPECIFIC SYNTAX**	
		Cognate	*Control*	*Cognate*	*Control*
ENGLISH	English	75%	86%	91%	88%
	Spanish	89%	90%	92%	93%
SPANISH	English	77%	88%	89%	88%
	Spanish	72%	93%	92%	88%

Discussion

While participants in this experiment showed differential performance to cognates versus controls in both RT and accuracy measures across language context and syntactic conditions, several results did not follow the predictions. Counter to the critical prediction for RT data, language context did not significantly interact with syntactic condition and cognate status. In Ch. 2, it had been predicted that the data would show a differential

response in the Spanish-specific syntactic condition such that non-selectivity would be constrained and the cognate effect, a hallmark of cross-lexical access, would be eliminated. Yet the data show a cognate effect in all but the Spanish trials with Spanish-specific syntax as shown in Table **3-3** above. It was not anticipated that the English trials would show any constraint, as the translations across the two syntactic conditions were equivalently non-language-specific, but it is not surprising that the two conditions did not differ. This may be due to the availability of the Spanish translations of the English stimuli in that non-language-specific syntax allowed for a greater non-selectivity across both syntax and lexicons than a less grammatically-neutral structure might. Accordingly, although the predicted three-way interaction was not significant, the trend towards a differential effect for the Spanish trials with Spanish-specific syntax should be acknowledged in light of the three constrained conditions.

However, it is also possible that the syntactic manipulation, presented in a difficult and speeded task like the RSVP paradigm, was not effectively salient to the participants. If this is true, if participants found the task and load on memory resources too difficult, then these results should be modulated by individual differences. Schwartz (2003) reported that bilinguals who were unable to answer comprehension questions above a critical level of accuracy performed in context as if they were naming words out of context. That is, they demonstrated cognate effects throughout. Bilinguals who accurately comprehended the meaning of the sentence demonstrated a selective effect, with the cognate effect modulated by the degree to which the sentence was semantically constrained. Participants with lower accuracy on the comprehension questions following a proportion of the stimuli are predicted to show more non-selectivity as evidenced by

consistent cognate effects across all conditions. As examining participant accuracy on both naming and on the comprehension questions allows for a more detailed view of the data in light of individual differences, this will also be pursued in Experiment 2.

In addition, participants generally responded more slowly to cognates than controls, although previous research has defined the cognate effect as a decrease rather than an increase in RT, or a benefit resulting from cross-lexical similarity in form and meaning. Because this benefit is unavailable to monolinguals (i.e., those with only one lexicon), Experiment 2 explores the possibility that other lexical properties of the critical cognates modulated bilinguals' naming performance.

Chapter 4

Experiment 2: Monolingual word naming in sentence context

In order to unpack the differential effect of participant response times to cognates and controls in the two syntactic conditions, an experiment was performed using the English versions of the experimental and control sentences with native and functionally monolingual speakers of English.

Predictions

Because the cognate-control distinction is irrelevant and because the English translations of the critical syntactic conditions were equivalent in relative unambiguity to the Spanish non-specific syntax sentences, the prediction for this experiment is that monolingual speakers should not produce any differences in naming cognates and their matched controls across the syntactic conditions.

Method

In this experiment, participants were proficient monolingual speakers of English, and the same RSVP paradigm in Experiment 1 was used. However, these participants were presented with stimuli in English only.

Participants

The monolingual English group consisted of 27 participants; 22 students at Penn State University as well as five individuals from the surrounding community. Those participants responding to the flyers were paid for their participation, whereas those recruited from undergraduate courses via subject pool received course credit as per departmental policy. Two participants were excluded from the analyses after reporting intermediate proficiency in a second language and immersion experience in a Spanish-speaking environment, and one was excluded due significantly slower performance in the RSVP task as described in Chapter 2. As a result, the reported data are for 24 monolingual English participants; ratings from the language history questionnaire are included in Table **4-1** below.

Table **4-1**: *Self-ratings of proficiency across four skills for monolingual participants. Ratings ranged from 10 (highly-proficient) to 1 (no ability). Means are provided with standard deviations in parentheses.*

English Language				***Second Language, if any***			
Reading	Writing	Speaking	Listening	Reading	Writing	Speaking	Listening
9.68	**9.72**	**9.84**	**9.84**	**3.80**	**2.88**	**2.84**	**2.96**
(0.75)	(0.74)	(0.80)	(0.62)	(1.61)	(1.54)	(1.37)	(1.57)

Materials and Procedure

The tasks and procedures differed from the general method as described in Chapter 2 in two ways. The 80 critical items were presented entirely in English: those that shared a cognate status with Spanish (e.g. *idea*) will henceforth be called cognates

and those that did not (e.g. *friend*, or *amigo* in Spanish) will henceforth be called controls for simplicity, although it is important to remember that the cognate/control distinction should not be salient to speakers of one language only. Additionally, the sentence stimuli in the monolingual condition were matched English translations (i.e., as word-for-word as possible) of the Spanish stimuli and fillers as described in Chapter 2, presented in two blocks.

Results and Discussion

Experiment 2 included two within-participant factors: syntactic condition (English translations of the Spanish-specific or language-ambiguous sentences) and cognate status of the critical target word (cognate or control). For these monolingual speakers of English, the expectation was that there would be no effect of cognate status to the extent that the cognate effect reflects cross-language activity. Mixed ANOVAs were performed on the dependent variables of RT (ms) and naming accuracy (%) across the within-participant factors. All participants were monolingual English speakers, so language dominance was not a meaningful between-participants factor. As in Experiment 1, ANOVAs were conducted for two sets of data: data conditional on comprehension question accuracy and data independent of comprehension- question accuracy. The more conservative approach is reported below, and the independent approach is reported in Appendix E. All *post hoc* calculations were Bonferroni-corrected.

Reaction time analyses

The main effect of syntactic condition was not significant ($F(1,23) < 1$), indicating that the English translations across the two types of Spanish sentences did not differentially affect RT performance. However, the main effect of cognate status ($F(1,23) = 12.46$, MSE = 476.28, $p = .002$) in that participants named cognates more slowly than control items.

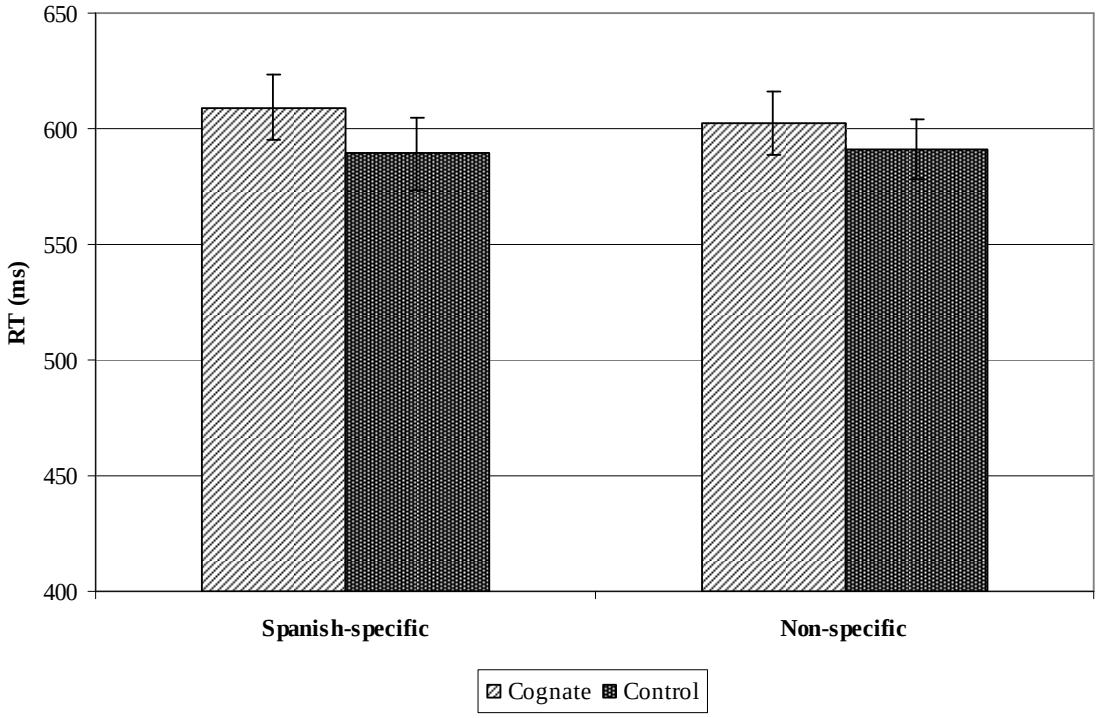

Figure **4-1**: *Reaction times for cognates and control items across the syntactic conditions for monolingual English participants.*

As shown in Figure **4-1** above, the effect of cognate status did not differ across syntactic conditions ($F(1,23) = 1.21$, $p = .281$). These results suggest that, while the participants as monolinguals were unaware of the cognates as such and were unaffected

by the syntactic manipulation, lexical properties of the items themselves may have contributed to the slower reaction times—possible properties are pursued in the following discussion.

Accuracy in naming

All participants named the critical target words with a high degree of accuracy (M = 90.13%, SD = 6.74), suggesting that the participants were highly proficient in English as expected. Although analyses independent of comprehension question performance show naming accuracy very near ceiling, the difficulty of the RSVP task and questions added variability. Syntactic condition significantly affected naming accuracy ($F(1,23) = 6.50$, MSE = 15.59, $p = .018$), as did the interaction between cognate status and syntactic condition ($F(1,23) = 13.54$, MSE = 40.65, $p = .001$), as in Figure **4-2** below.

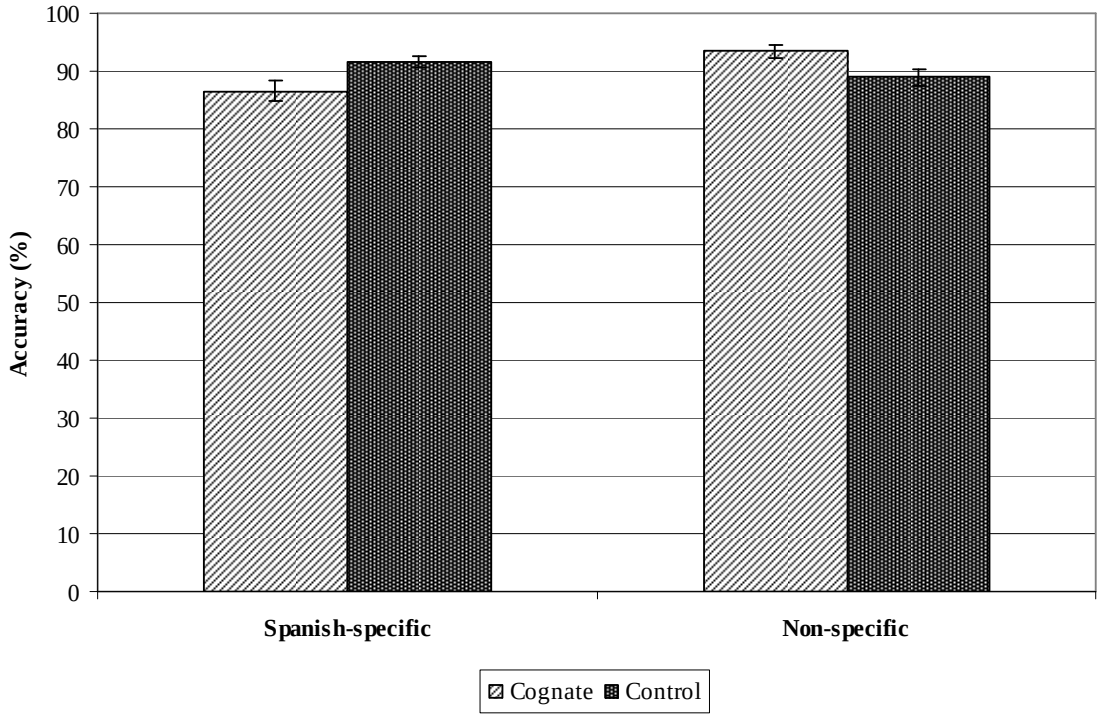

Figure **4-2**: *Naming accuracy (%) by English monolinguals for cognates and controls in Spanish-specific and language-non-specific syntactic conditions.*

The cognate status manipulation did not affect naming performance ($F(1,23) < 1$), suggesting that a lexical overlap with Spanish (per the definition of cognates in this study) was not salient to the participants.

Discussion

As predicted, the participants were highly-proficient English speakers who responded equivalently across the syntactic conditions. This was to be expected, as the critical Spanish-specific syntactic construction is unavailable and ungrammatical to English speakers. Additionally, the stimuli in both English syntactic conditions used

language-non-specific constructions that could be back-translated in a word-for-word manner as determined by two highly-proficient bilingual research assistants. As a result, the distinction between the two syntactic conditions was not meaningful as was shown in the monolingual results.

However, contrary to the initial predictions, the participants named cognates more slowly than controls across syntactic conditions; this distinction should not have been relevant to monolinguals. Previous research has shown that lexical properties such as length and frequency may modulate word naming performance (c.f. Bachoud-Lévi, Dupoux, Cohen & Mehler, 1998, for a review of the debate); longer or less-frequent words are typically named more slowly than shorter or less-frequent words. It is also possible that the cognate-control distinction (based on overlap or lack thereof between form and meaning) was too arbitrary in nature. Motivated by this, item-by-item analyses were conducted such that correctly-named items were compared in an ANOVA with one dependent factor (word length) and three independent factors (sentence language, syntactic condition, and cognate status).

There was an overall effect of cognate status in that cognates were longer than controls ($F(1,152) = 37.29$, MSE = 4.06, $p < .001$); no other effects and interactions were significant ($p < .10$). Although monolingual participants named cognates more slowly across both syntactic conditions, their performance appears to have been modulated by word length. That is, when length was included as a covariate, monolingual participants named cognates and controls equivalently quickly ($F(1,75) = 1.57$, $p = .214$) across syntactic conditions ($F(1,75) < 1$).

To verify that the participants in Experiment 2 were a representative sampling of monolinguals and that their performance on the cognate items was not indicative of potentially confounding language experience (given that the participants had all experienced a small degree of second language education in primary or secondary schools), response time data from the eLexicon project (Balota, et al., 2002) were included in the item-by-item analyses. Because the eLexicon project data provided naming RT data out of context for over 1200 monolingual participants, it was also possible consider whether the observed effects may have been due to uniquely English syntactic properties of the context itself.

The two data sets were correlated (R = .422) according to a two-tailed Pearson correlation (significant at .01), and the eLexicon data showed a similar effect of cognate status where the critical cognates were named more slowly than controls out of context ($F(1,76) = 13.52$, MSE = 3191.23, $p < .001$). When word length was included as a covariate, the effect of cognate status was no longer significant ($F(1,75) = 3.25$, $p = .075$); while other properties may have been contributing to a differential response to cognates in the study, it is clear that length accounted for some of the variance, and that monolingual naming performance for targets in sentence context may differ from naming performance for targets out of context.

While cognates are defined as lexical entries sharing form and meaning across multiple languages, previous research has indicated that the amount of overlap between a cognate pair can affect performance (Duyck, Van Assche, Drieghe & Hartsuiker, 2007; Schwartz, Kroll & Diaz, 2007; Schwartz and Yeh, submitted). In Duyck et al., participants responded differently to near-perfect cognates—words that overlap across the dimensions

of meaning, phonology, and orthography, such as *piano* across English and Dutch—as compared to near-cognates that have less in common, but still share meaning, such as *engineer* and *ingenerio* in English and Spanish, respectively. In the eye-tracking experiment of their study, participants responded more quickly to near-perfect cognates than controls, but did not show a differential effect for cognates with less overlap relative to controls.

To better evaluate the cognate status of the critical target items of this study, orthographic similarity ratings (Van Orden, 1987) were calculated across the English and Spanish translations. The rating formula provided a measure of the graphemic similarity of two words as calculated from the number of letters that are shared, the length difference across the two words, and the degree of letter order preservation; ratings on this scale range from 0 to 1 (perfect match). The ratings were compared across the categories of cognate status and syntactic condition with a univariate ANOVA. The critical items differed significantly in orthographic similarity such that cognate pairs were more similar than control translations (M = .755 for cognates vs. M = .192 for controls; $F(1,78) = 300.21$, MSE = .022, $p < .001$); this difference was maintained across syntactic conditions ($F(1,78) < 1$). These results indicate that the form similarity distinction between cognates and controls is valid for this study.

These results raise important questions about sensitivity to word length effects for individuals bilingual in English and Spanish. Despite being equivalent in orthography and meaning, the Spanish cognates were significantly longer than their English translations. It is conceivable that bilinguals might be less sensitive to length effects, or that the benefits

of cognate status may outweigh interference from word length—these questions will be further pursued in the General Discussion.

Chapter 5

General Discussion

This study examined interactions between lexical access and syntactic information by examining bilingual participants' performance in responding to critical target items embedded in sentential context. By comparing performance on cognates and controls in syntactically language-specific and language-non-specific context, we explored whether syntactic specificity could function as a constraint on non-selective access across a bilingual's two lexicons in the same manner that semantic specificity has (Schwartz, 2003; Schwartz and Kroll, 2006). If this was the case, we predicted that a cross-linguistic cognate effect should be eliminated in context that constrained activation to only one lexicon, namely sentence stimuli containing grammatical elements unique to Spanish and unavailable in English. Because the critical condition featured Spanish-specific elements, we expected to see differential effects in that condition only. We also predicted that a cognate effect should be observed in language-non-specific context, in that the language of each sentence itself should not sufficiently constrain access to one lexicon (e.g. Schwartz & Kroll, 2006). However, the results of the experiments suggest that the effects of context may be more difficult to tease apart.

Individual Differences

Although an ideal experiment is conducted with a completely homogeneous population, it is difficult to locate participants who have identical language experiences and cognitive resources. The measures included with the critical experimental task (the Simon task, a memory span task, and the CARE questionnaire) were intended to chart those differences between participant groups, and to help determine whether effects observed in the data were due to bilingual language ability. To ensure relative homogeneity of cognitive resources, participants who scored more than two and a half standard deviations more or less than their group members were excluded from the study.

The results of the individual difference measures show that although the participants had similar working memory spans, each group performed differently on the Simon task as shown in Table **5-1** below.

Table 5-1: *Cognitive measure results and mean age for monolingual English speakers, bilinguals with English and Spanish dominance, and bilingual participants with high accuracy rates on the RSVP task. Small Simon effects imply less interference from irrelevant information and larger memory span results suggest a broader working memory. Means are provided with standard deviations in parentheses.*

Group	*Language Dominance*	*Age*	***Cognitive Measures***		
			Simon Effect	Memory Span	CARE total
MONOLINGUAL	English	**23** *(6)*	**46.78** *(21.88)*	**50** *(11)*	**42** *(10)*
BILINGUAL	English	**24** *(3)*	**30.16** *(23.04)*	**42** *(8)*	**43** *(7)*
	Spanish	**31** *(8)*	**37.68** *(22.91)*	**41** *(16)*	**42** *(10)*
	High-Accuracy	**30** *(8)*	**34.27** *(18.47)*	**40** *(12)*	**42** *(8)*

Consistent with evidence found by Bialystok and colleagues (Bialystok et al., 2004, 2005; Bialystok & Craik, 2007), bilinguals participants showed less interference from irrelevant information in the Simon task despite being older on average than their monolingual counterparts. A smaller Simon effect (the difference between RTs to neutral stimuli and RTs to stimuli with interference) suggests less susceptibility to that interference, and so it is important to note that the mean Simon effect for monolingual English speakers is not only greater than that for the age-matched English-dominant bilinguals, but also greater than that for the older Spanish-dominant bilinguals. Age differences and language experience also appeared to have a small effect on memory span, although it is important to remind the reader that the memory span task was in English; for bilingual individuals, the requirements of rapid plausibility judgment while navigating through two languages may have added additional difficulty to the task.

Participants did not differ in ratings calculated from the results of the CARE questionnaire across groups, and mean ratings for each participant group corresponded to percentiles for low risk of impulsivity and inattention.

Interestingly, although they showed a greater sensitivity to the experimental manipulations, the high-accuracy bilingual group differed only marginally from the English- and Spanish-dominant groups in these tasks, suggesting that an additional measure of cognitive resources that includes both the suppression of irrelevant competing information and sentence-internal reading comprehension would be helpful in future studies.

Summary of Results

Although performance differed in the critical Spanish-specific syntax condition relative to the other conditions, the results of Experiment 1 at first glance seem counterintuitive. Counter to the initial predictions, participants responded significantly more slowly to cognates than controls (potentially an inhibitory cognate effect) in all but the critical condition. Further investigation into individual differences and measures of context comprehension showed that Spanish syntactic specificity modulated performance especially for participants in the high comprehension group. The RSVP paradigm is cognitively taxing and requires a strong, rapid reading ability in the language(s) presented, so it is not surprising that the experimental manipulation of grammatical specificity was most salient to those in the high accuracy group.

Monolingual performance in Experiment 2 showed an apparent sensitivity to cognate status in that participants responded significantly more slowly to cognates than controls in both syntactic conditions. The uniformity of performance across the syntactic conditions suggests that the English translations were consistent, but cognate status should not have been salient to individuals with only one lexicon. Item analyses explored two possible alternatives: by comparing items across all conditions and by comparing monolingual data by item to data from the eLexicon project, we were able to evaluate whether lexical properties of the words themselves or previous language experience may have contributed to the results.

Differences between experimental and eLexicon data were anticipated, as the eLexicon data applied to single word naming out of context, but mean RTs showed a similar patter of slower responses to cognates than controls, suggesting that the participants in Experiment 2 were appropriately monolingual.

Comparison across items showed a significant length effect in that participants named longer words more slowly than shorter words. When word length was included in the analyses as a covariate, the main effect of cognate status was no longer significant for either the participants of Experiment 2 or of the eLexicon project. In the absence of specific linguistic constraints such as semantic predictability or syntactic information, word length appears to modulate naming performance.

Item Analyses: Bilinguals

As the bilinguals' performance in Experiment 1 was more heterogeneous, item analyses on their RTs were performed both for the bilingual groups and for the high-accuracy group and included word length across Spanish and English translations of the critical target items. Because Spanish words encode more morphosyntactic information than their English translations (for example, *banco* indicates case, number and gender in Spanish, whereas the English translation, *bank*, is ambiguous as to noun or verb status and across several meanings), it is possible that bilinguals are less susceptible to length effects than their monolingual counterparts.

For the bilingual groups, a tentative item-by-item ANOVA was performed with RTs as the dependent factor and language dominance, context language, syntactic condition, and cognate status as independent factors. Word length was included as a covariate. While the participant group sizes decrease the statistical power, a trend interesting to future evaluations becomes clear. As illustrated in Figure **5-1** and **5-2**, the English-dominant participants were more sensitive to cognate status than their Spanish-dominant counterparts ($F(1,303) = 3.45$, $p = .064$). In addition, English-dominant participants appear to be differentially sensitive to cognates as compared to controls presented in Spanish in a Spanish-specific syntactic context; this difference neared significance ($F(1,303) = 2.63$, $p = .106$). All other interactions were not significant ($p > .10$).

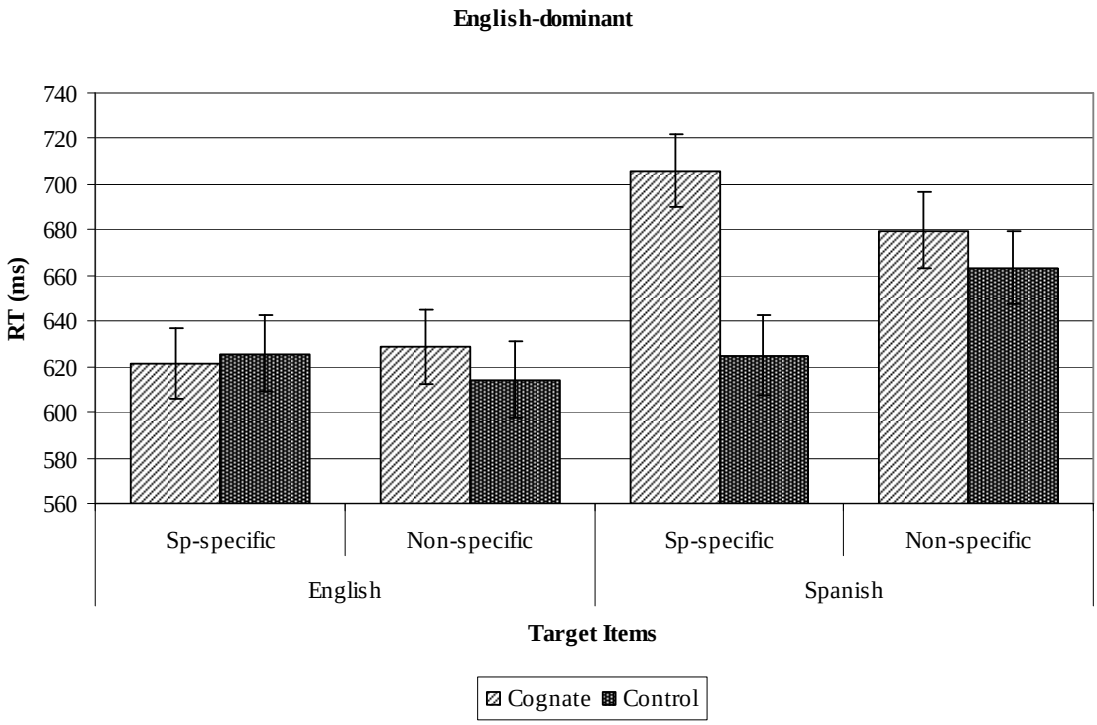

Figure **5-1**: *Naming RTs for English-dominant bilinguals for cognate and control targets across categories of sentence language and syntactic condition.*

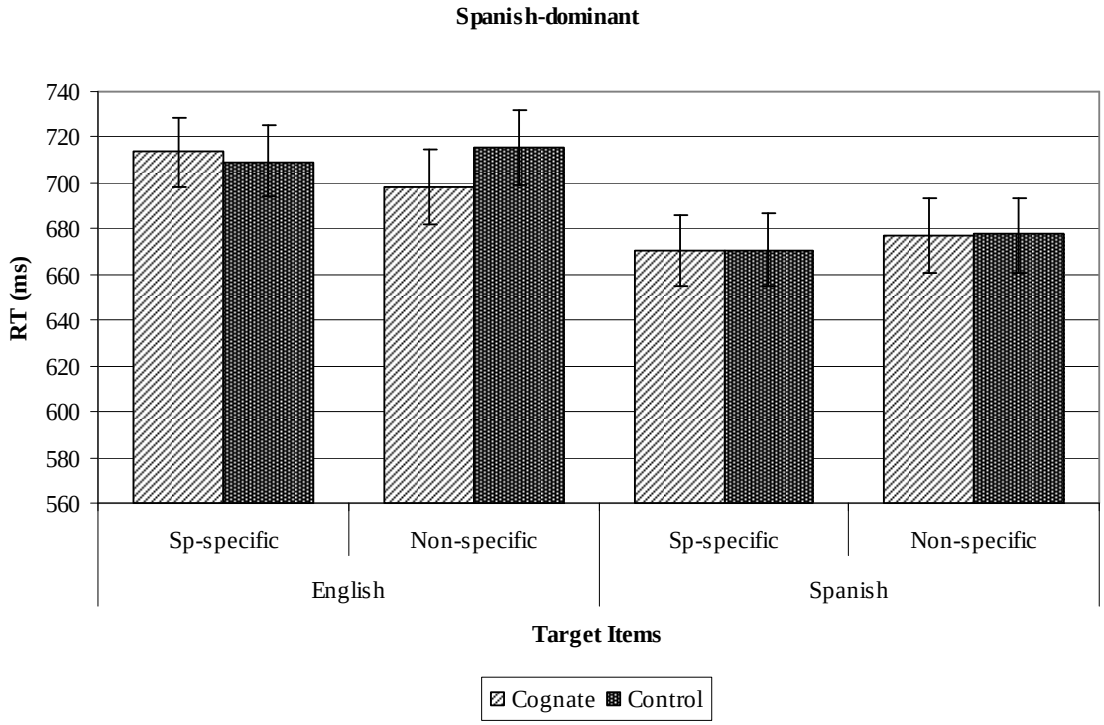

Figure 5-2: *Naming RTs for Spanish-dominant bilinguals for cognate and control targets across categories of sentence language and syntactic condition.*

An item-by-item ANOVA was also performed for the small high-accuracy group with RTs as the dependent factor and context language, syntactic condition, and cognate status as independent factors. As above, word length was included as a covariate. The high-accuracy group, as described in Chapter 3, included both English-dominant and Spanish-dominant participants who performed well on the RSVP task. As shown in Figure 5-3 , the high-accuracy group seemed to be sensitive to cognate status ($F(1,311) = 2.82$, $p = .094$), especially in contexts containing Spanish-specific syntax ($F(1,311) = 3.02$, $p = .083$), although these difference were marginally significant. However, the high-accuracy group's observed sensitivity to cognates in the syntactic conditions did not

significantly differ across sentence language ($F(1,311) = 1.54$, $p = .215$). All other interactions were not significant ($p > .10$).

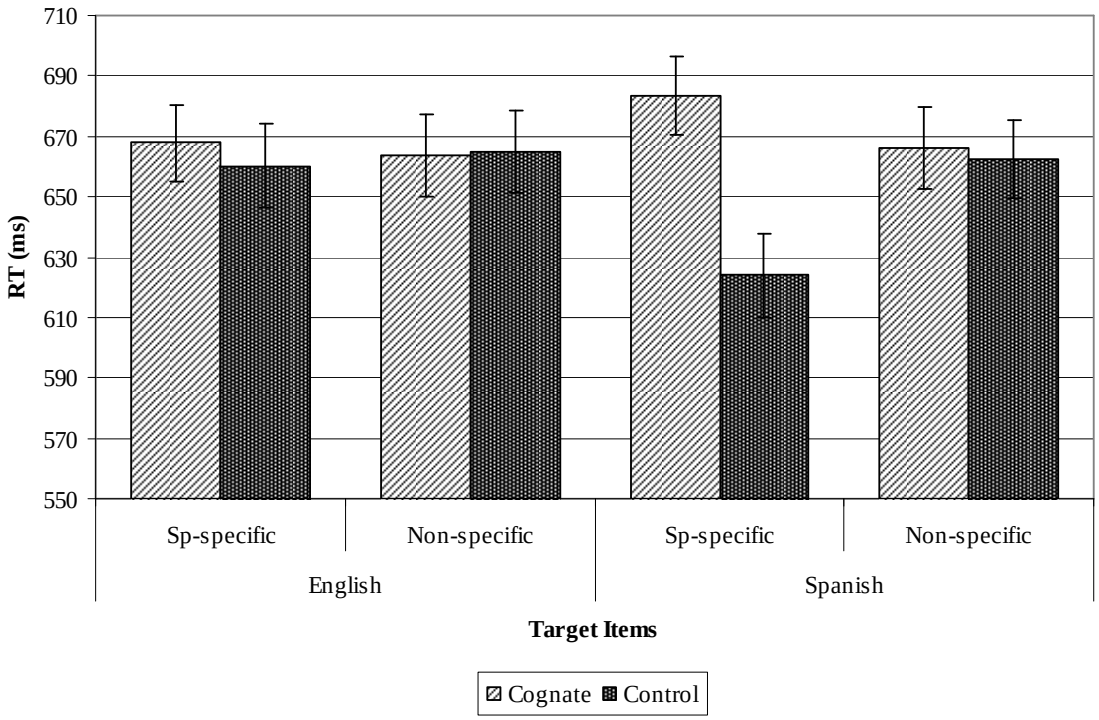

Figure **5-3**: *Naming RTs for bilinguals in the high-accuracy group for cognate and control targets across categories of sentence language and syntactic condition.*

The trend emerging from these results suggests that language experience interacts with sensitivity to syntactic information to affect bilingual cross-lexical access, although the apparent inhibitory effect of cognate status continues to seem counterintuitive given the removal of co-variation due to word length effects. Bachoud-Lévi and colleagues (1998) did not find evidence from word naming tasks to support length effects. Instead, they proposed a two-route model (lexical/phonological planning and a more direct grapheme-to-phoneme conversion) for speech production in a reading task such that naming RTs reflect interactions between word frequency, number of syllables, individual

differences in memory span, hierarchically-organized articulatory planning, and visual processing; these factors were not controlled *a priori* in the present study, but may be considered in future studies of this nature.

Equivalent Specificity

Hartsuiker and colleagues (2004) suggest a shared or non-specifically accessed syntactic store which would allow for phenomena like cross-language syntactic priming as well as the process of fluid language-switching reflected in Poplack's Equivalence Constraint (1980, Sankoff & Poplack, 1981), which posits that between-language switches occur where the two syntaxes match and no violations occur for either language. As an approach to the effects of syntactic context, the design of this study was such that three of the four experimental conditions were syntactically language-non-specific (despite overt presentations in English or Spanish). That is, they provided grammatical frames where the two syntaxes ostensibly matched with no violations for either language, providing for non-selective lexical access without complication as reflected in similar responses to cognates relative to controls in the three more syntactically language-non-specific conditions. However, sentences in the critical condition contained morphosyntactic elements that are Spanish-specific and unavailable in English and were therefore not equivalent. As shown in Figure **5-3**, participant RTs to controls (i.e., language-specific target items) differed from cognates only in the critical condition, in that participants named controls more quickly than cognates or controls in other conditions and named cognates more slowly than cognates in the other conditions. If the

concept of equivalence necessitates open interaction between syntaxes and suggests a meta-language of shared elements, then a mismatch would occur when a speaker encounters language-specific grammatical elements and language non-specific lexical entries. This mismatch of specificity or equivalence may have led to the slowing of RTs for cognate items in Spanish-specific frames, whereas the high degree of specificity for control items in a language-specific frame led to monolingual-like RTs. Evidence from grammatical mismatch literature (see Sunderman & Kroll, 2006, for a review) suggests that both monolinguals and bilinguals alike are sensitive to morphosyntactic differences between stimuli, so it is possible that the participants of this study were sensitive to the lexical/syntactic mismatch (cognates preceded by language-specific grammatical elements) in the critical condition.

The results from Experiments 1 and 2 suggest that, like semantic predictability, syntactic specificity can modulate cross-lexical activation in individuals bilingual in Spanish and English, especially those to whom grammatical information is most salient. Although the language of the sentences itself does not seem to constrain non-selective lexical access, contextual linguistic contributions guide processing and retrieval, which are in turn modulated by proficiency and available cognitive resources. While lexical properties of critical target items such as word length can affect the speed of naming when in an unconstrained framework, benefits from cross-linked lexicons and syntactic systems can interact with those effects. Because lexical property effects remain when context constrains non-selectivity, it is possible to view contextual constraints as either occurring earlier in the time-course of processing or as top-down influences on the bottom-up aspects of word comprehension and production.

Explorations of lexical ambiguity resolution and cross-linguistic activation provide support for a shared-systems model of bilingualism in that speakers benefit from overlapping lexicons but can access and produce the appropriate language with ease. A shared system, however, implies measures of internal control, as bilinguals can capably and, critical to this study, comprehend fluid switching between their languages. In models like the BIA+ and RAM, linguistic and non-linguistic information modulate the lexical system, but do not speak to the role of syntactic specificity as a potential constraint.

The BIA+ model (Figure **1-2**) presents lexical processing as interactions between spreading activation internal to the word identification system and a task schema module incorporating external and non-linguistic information into that identification process. Hermans and colleagues (Figure **1-1**) envision constraint on spreading activation at the lemma level of production based on word identification. However, these two models do not present the lexicon as including morphosyntactic elements or interacting with syntactic systems when evidence from this study suggests that word recognition and production are affected by language-specific syntactic information.

Models of lexical access and sentence processing attempt to locate elements of the language faculty along a time-course and within a hierarchy of relevant linguistic and non-linguistic components. The BIA+ model focuses on the hierarchical organization of components, whereas the Reordered Access Model (Duffy et al., 1988) focuses on the time-course over which co-activation of multiple meanings is resolved. The current incarnation of the model for monolingual processing posits that selection of the most appropriate meaning is influenced by the relative time at which each competing meaning was accessed, and that this time-course is modulated by the number and frequency of

competing meanings as well as the context of the target item. Schwartz and Yeh (submitted) call for a revision of the RAM that includes the additional resources and constraints available to bilinguals in resolving the co-activation of meanings both within and across languages; the results of this study suggest that syntactic elements must also be included in the revision.

The nature of constraints on within- and cross-linguistic activation is especially relevant for models of code-switching behavior, as such rapid and easy cycling between languages seems to necessitate a system of activation and selection. Evidence from this and other studies on a potentially-shared syntactic store (Hartsuiker et al., 2004; Desmet & Declercq, 2006; Schoonbaert et al., 2007) suggest that degrees of equivalence and matching (or mismatching) across both lexical and syntactic systems can allow for fluid code-switching. While the theory itself is hotly debated, the concept of equivalence gains new meaning in these explorations of cross-lexical activation and grammatical constraints on the bilingual language system.

Future Directions

From the growing literature available, it is clear that conceptualizing sentence processing and lexical access must include at least a nod to the role of syntax, as morphosyntactic and grammatical information from context impact lexical non-selectivity. Many currently models, like the BIA+, started as monolingual models and have been rebuilt to better reflect how two languages might interact in one brain. It is possible that this study can help inform the current incarnations of these models to

include the relevance of overlapping and non-overlapping grammatical elements of input at the sentence and discourse levels, as well as the effects of language dominance in the course of cross-linguistic lexical activation.

Hahne and Friederici (2001; Friederici, 1996) put forth a model of sentence comprehension in three phases which offers a framework for future investigation with event-related potentials (ERPs). In this model, the first-pass parse of a sentence allows for construction of the input's initial structure; errors in this phase are generally reflected as early anterior negativity effects. The second phase involves processing of lexical, semantic, and syntactic agreement elements; it is during this phase that errors correspond to N400 and left anterior negativity effects are observable. The third phase allows for a second parse, during which any reanalysis of the input may be reflected in P600 effects. A redefinition of the variables of the current study would allow for insight into interactions between semantic and syntactic specificity within Hahne and Friederici's model, especially in the second and third phases of integration and reprocessing. Potential ERP effects that would be of interest are those relating to matches and mismatches between lexico-semantic specificity (a non-cognate would thereby be language-specific, for example) and syntactic specificity (such as Spanish-specific grammar), as they would allow both a window on the time-course of disambiguation and an evaluation of Poplack's equivalence concept in both lexical and syntactic terms.

Additionally, future studies and replications may look more closely at the degree of overlap for cognates, including not only meaning and written form, but also phonology, word length, complexity of onset, number of synonyms, number of syllables and frequency across both languages. Evidence suggests that bilingual participants

respond differently to cognates depending on how closely the pairs are matched (c.f., Dijkstra 1999; Duyck et al., 2007; Schwartz, Kroll & Diaz, 2007).

From the results of this and other upcoming studies, future models of bilingual language processing may include constraint systems at the semantic and syntactic levels in both bottom-up and top-down manners. This study continues the discussion on the nature of non-selectivity in lexical access, and may even begin a new dialogue on the relationship of lexical stores to syntactical stores in bilinguals.

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Appendix A

English-Spanish Cognates

accomplice	cómplice
athlete	atleta
audience	audiencia
Canadians	canadienses
capitals	capitales
caramels	caramelos[3]
carpenter	carpintero
colonel	coronel
composer	compositor
decision	decisión
detectives	detectives
director	directora
documents	documentos
engineer	ingeniero
equipment	equipo
evidence	evidencia
explosion	explosión
family	familia
generals	generales
idea	idea
institute	instituto
manuscript	manuscrito
museum	museo

[3] Excluded due to a grammatical error.

offer	oferta
official	oficial
organizer	organizadora
patient	paciente
police	policía
president	presidente
problem	problema
professor	profesora
project	proyecto
publicist	publicista
receptionist	recepcionista
reporter	reportero
restaurant	restaurante
roses	rosas
strategy	estrategia
tourists	turistas
vendors	vendedores[4]
victim	víctima

[4] Also excluded.

Appendix B

English-Spanish Controls

assistants	ayudantes
bathrooms	baños
book	libro
boss	jefe
box	caja
boy	niño
brother	hermano
buyer	comprador
car	coche
cellmate	compañeros
classroom	aula
coins	monedas
friend	amigo
girl	chica
glass	vaso
grandmother	abuela
husband	esposo
interview	entrevista
journalist	periodista
judge	juez
lady	señora
man	hombre
manager	encargado
movie	película
newspapers	periódicos

priest	cura
report	informe
robbery	robo
roommate	compañera
seamstress	modista
shower	ducha
sister	hermana
son	hijo
taxes	impuestos
trash	basura
wife	esposa
windows	ventanas
woman	mujer
workers	trabajadores

Appendix C

Stimuli with Spanish-specific grammar and translation into English

Each pair contains a sentence with syntax specific to Spanish as well as a close English translation. Cognates are indicated in **bold**, whereas non-cognates are indicated in ***bold italic***.

1	a. Los señores le entregaron las esculturas que encontraron la semana pasada al **museo** en Madrid.
	b. The men returned the sculptures that they found last week to the **museum** in Paris.
2	a. El espía le facilitó los planos que encontró en el cajón al **oficial** en Iran.
	b. The spy turned over the sketches that he found in the drawer to the **official** in Iran.
3	a. Las monjas le llevaron las mantas que no usaban más a la **directora** del orfanato.
	b. The nuns took the quilts that they no longer used to the **director** of the orphanage.
4	a. Los agricultores le vendieron las manzanas que cosecharon ayer a los **vendedores** en el mercado.
	b. The farmers sold the apples that they harvested yesterday to the **vendors** at the market.
5	a. Susana le mostró la casa que quiere renovar al **carpintero** de de barrio.
	b. Susan showed the house that she wants to renovate to the **carpenter** from her neighborhood.
6	a. El científico le propuso el plan que había ideado a los **generales** durante la reunión.
	b. The scientist proposed the plan that he had devised to the **generals** during the meeting.
7	a. El biólogo le dio las fotografías que encontró en el suelo a los **detectives** que estaban investigando el asesinato.
	b. The biologist gave the pictures that he found on the floor to the **detectives** who were investigating the crime.
8	a. El artista le envió los cuadros que terminó en su estudio a la **organizadora** del evento benéfico.
	b. The artist sent the paintings that he finished at his studio to the **organizer** of the fundraiser.

9	a. Los estudiantes le contaron el cuento que leyeron la semana pasada a la **profesora** de literatura inglesa.
	b. The students recounted the story that they read last week to the **professor** of English literature.
10	a. El geólogo le mandó las piedras que analizó al **instituto** de historia natural.
	b. The geologist sent the stones that he analyzed to the **institute** of natural history.
11	a. El terapeuta le describió la casa que quería restaurar al **ingeniero** durante la conversación telefónica.
	b. The therapist described the house that he wanted to renovate to the **engineer** during the phone conversation.
12	a. La enfermera le dio la medicina que disolvió en agua a la **atleta** con dolor de cabeza.
	b. The nurse gave the medicine that she dissolved in water to the **athlete** with a headache.
13	a. El cocinero le ofreció un trozo del pavo que había rellenado a la **audiencia** durante el programa televisivo.
	b. The cook offered a piece of the turkey that he had stuffed to the **audience** during the TV program.
14	a. El terapeuta le recomendó la dieta que él misma había seguido a la **paciente** durante la consulta.
	b. The therapist recommended the diet that he had followed himself to the **patient** during the appointment.
15	a. El fotógrafo le envió los anuncios que seleccionó al **publicista** en Madrid.
	b. The photographer sent the advertisements that he selected to the **publicist** in Madrid.
16	a. El abogado le mostró las pruebas que recogió durante la investigación a la **víctima** del crimen.
	b. The lawyer showed the evidence that he gathered during the investigation to the **victim** of the crime.
17	a. El criminal le entregó el dinero que tenía ingresado en su cuenta a la **policía** después del interrogatorio.
	b. The criminal gave the money that he had deposited in his account to the **police** after the interrogations.
18	a. El guía le mostró el camino que conocía a los **turistas** que estaban esperando.
	b. The guide showed the trail that he knew about to the **tourists** who were waiting.
19	a. Los británicos le cedieron el territorio que habían colonizado a los **canadienses** en 1865.
	b. The British gave up the territory that they had colonized to the **Canadians** in 1865.
20	a. El soldado le describió el castigo que recibió al **coronel** de su escuadrón.
	b. The soldier described the punishment that he received to the **colonel** of his division.

21	a. El acusado le reveló la información que había oído al **reportero** durante la rueda de prensa.
	b. The accused revealed the information that he had heard to the **reporter** during the press conference.
22	a. La novia le enseñó el vestido que escogió esta mañana a una ***modista*** de Los Angeles.
	b. The bride showed the dress that she chose this morning to a ***seamstress*** from Los Angeles.
23	a. El jugador de poker le dio el dinero que no gastó en el casino a su ***hijo*** para comprarse una motocicleta nueva.
	b. The poker player gave the money that he didn't spend at the casino to his ***son*** to buy a new motorcycle.
24	a. El sherif le reveló la información que tenía al ***periodista*** durante la entrevista.
	b. The sheriff revealed the information that he had to the ***journalist*** during the interview.
25	a. El astronauta le describió el paisaje de la luna a la ***aula*** llenas de niños que escuchaba.
	b. The astronaut described the view from the moon to the ***classroom*** full of children who were listening.
26	a. El arqueólogo le mostró el tesoro que encontró durante las excavaciones a sus ***ayudantes*** en la universidad.
	b. The archeologist showed the treasure that he found during the excavations to his ***assistants*** at the university.
27	a. María le dio el regalo que tenía envuelto con papel rosado a su ***abuela*** antes de la cena.
	b. Maria gave the present that she had wrapped with pink paper to her ***grandmother*** before dinner.
28	a. El alumno le dejó los apuntes que había utilizado para estudiar a un ***amigo*** de su clase.
	b. The student gave the notes that he had used to study to a ***friend*** in his class.
29	a. Paula le prestó los pantalones que había escogido en la tienda a su ***hermana*** antes de la fiesta.
	b. Paula lent the pants that she had chosen at the store to her ***sister*** before the party.
30	a. La secretaria le entregó el certificado que recibió por correo a su ***jefe*** antes de salir.
	b. The secretary gave the certificate that she received in the mail to her ***boss*** before he left.
31	a. El gobernador filtró la información que había obtenido de sus informantes a los ***periódicos*** de los países europeos.
	b. The governor leaked the information that she had obtained from her informants to the ***newspapers*** of the European countries.
32	a. El vendedor le envió el poema que había encontrado entre las cartas a su ***esposa*** para celebrar su aniversario.

	b. The salesman sent the poem that he had found among some letters to his ***wife*** to celebrate their anniversary.
33	a. El traficante de drogas le envió la cocaína que había robado al ***comprador*** que lo llamó.
	b. The drug dealer sent the cocaine that he had stolen to the ***buyer*** who called earlier.
34	a. El contable le enseñó los papeles que había corregido a su ***encargado*** durante la reunión.
	b. The accountant showed the papers that he had corrected to his ***manager*** during the meeting.
35	a. La abogada le mencionó las pruebas que iba a examinar al ***juez*** encargado del asesinato.
	b. The lawyer mentioned the evidence that she was going to examine to the ***judge*** in charge of the murder case.
36	a. El prisionero le reveló el plan que había elaborado a sus ***compañeros*** el día antes del escape.
	b. The prisoner revealed the plan that he had devised to his ***cellmates*** the night before the escape.
37	a. El criminal le confesó el asesinato que había cometido al ***cura*** de la parroquia.
	b. The criminal confessed the murder that he had committed to the ***priest*** in his neighborhood.
38	a. El chef le dio la galleta que recubrió con chocolate al ***niño*** que lo saludó.
	b. The chef gave the cookie that he iced with chocolate to the ***boy*** that greeted him.
39	a. La enfermera le envió el regalo que envolvió anoche a la ***chica*** en el hospital.
	b. The nurse sent the present that she wrapped last night to the ***girl*** in the hospital.
40	a. El senador le entregó el dinero que había retirado de su cuenta a su ***hermano*** antes de que fuera arrestado.
	b. The senator gave the money that he had withdrawn from his account to his ***brother*** before he was arrested.

Appendix D

Stimuli with language non-specific grammar in Spanish and English

Each pair contains a sentence with language non-specific syntax such that the English sentence is a direct, one-to-one translation of the Spanish. In a few instances, concepts reflected in a single word in Spanish, such as “anoche,” were translated into English as two words, such as “last night.” Cognates are indicated in **bold**, whereas non-cognates are indicated in ***bold italic***.

41	a. El teniente que regresó de Afganistán habló con el **presidente** durante la reunión.
	b. The lieutenant who returned from Afghanistan spoke with the **president** during the meeting.
42	a. La española que juega baloncesto aceptó la reciente **oferta** que recibió del entrenador de Houston.
	b. The Spaniard who plays basketball accepted the recent **offer** that she received from the coach in Houston.
43	a. El especialista que estaba estudiando el caso analizó toda la **evidencia** que recibió del laboratorio.
	b. The specialist who was studying the case analyzed all the **evidence** that she received from the lab.
44	a. Los italianos que llegaron a la isla anoche cenaron en el **restaurante** y después fueron al teatro.
	b. The Italians who arrived at the island last night had dinner at the **restaurant** and later went to the theater.
45	a. El cartero que trabaja en nuestra vecindad dejó las **caramelos** enfrente de la puerta de mi casa.
	b. The postman who works in our neighborhood left the **caramels** outside my front door.
46	a. El historiador que trabaja en la biblioteca consiguió un viejo **manuscrito** que explica el conflicto en el medio oriente.
	b. The historian who works at the library found an old **manuscript** that explains the conflict in the Middle East.

47	a. Los bomberos que llegaron al sitio del accidente extinguieron el fuego causado por la **explosión** de las bombas.
	b. The fireman who arrived at the scene of the accident extinguished the fire caused by the **explosion** of the bombs.
48	a. El historiador que estaba sentado en la esquina sabía todas las **capitales** de los países africanos.
	b. The historian who was sitting in the corner knew all the **capitals** of the African countries.
49	a. La actriz que estudió en Madrid cenó con el **compositor** de San Francisco.
	b. The actress who studied in Madrid had dinner with the **composer** from San Francisco.
50	a. El jardinero que fue contratado por la escuela cortó todas las **rosas** para que los niños no se hicieran daño.
	b. The gardener who was hired by the school cut all the **roses** so that the kids wouldn't get hurt.
51	a. El ladrón que robó el banco dio el nombre de su **cómplice** a cambio de una sentencia menor.
	b. The thief who robbed the bank gave the name of his **accomplice** in exchange for a lighter sentence.
52	a. El oficial de seguridad que estaba en el aeropuerto inspeccionó todos los **documentos** antes de dejarnos pasar.
	b. The security guard who was at the airport inspected all the **documents** before letting us through.
53	a. El entrenador que trabaja en la escuela cree que su **estrategia** dará buenos resultados.
	b. The trainer who works for the school believes that his **strategy** will give good results.
54	a. El decorador que escribe para la revista predijo que el **problema** con la pintura sería difícil de resolver.
	b. The decorator who writes for the magazine predicted that the **problem** with the paint would be hard to solve.
55	a. El mecánico que viaja frecuentemente a California verificó que el **equipo** estuviera en perfectas condiciones.
	b. The mechanic who travels frequently to California verified that the **equipment** was in perfect condition.
56	a. El congresista que vive en Arizona argumentó que su **decisión** ha sido correcta.
	b. The congressman who lives in Arizona argued that his **decision** is the correct one.
57	a. El técnico que fue contratado en el laboratorio insistió que su **idea** aumentaría las ganancias.
	b. The technician who was hired by the lab insisted that his **idea** would increase the profits.
58	a. El explorador que fue entrevistado anoche dijo que el **proyecto** requería más dinero.

	b. The explorer who was interviewed last night said that the **project** required more funds.
59	a. El instructor que enseña en la universidad dijo que la **recepcionista** es muy incompetente.
	b. The instructor who teaches at the university said that the **receptionist** is very incompetent.
60	a. El mayordomo que trabaja con la mafia sospecha que su **familia** estaba en peligro.
	b. The butler who works for the mafia suspects that his **family** is in danger.
61	a. María comentó que el dietista que estudió en Boston escribió un excelente ***libro*** sobre el peligo del colesterol.
	b. Mary said that the dietitian who studied in Boston wrote an excellent ***book*** about the dangers of cholesterol.
62	a. La actriz que estaba en el balcón tomó un pequeño ***vaso*** de vino antes de seguir filmando.
	b. The actress who was on the balcony had a small ***glass*** of wine before continuing with the filming.
63	a. El señor que había organizado la fiesta limpió todos los ***baños*** antes de que llegaran los invitados.
	b. The man who had organized the party cleaned all the ***bathrooms*** before the guests arrived.
64	a. El abogado que llamó a la oficina pidió el ***informe*** que escribió el cirujano.
	b. The lawyer who called the office requested the ***report*** that the surgeon wrote.
65	a. La peluquera que había vivido en Chile censuró la ***película*** que estrenaron la semana pasada.
	b. The hairdresser who had lived in Chile censured the ***movie*** that came out last week.
66	a. Los estudiantes que viven en el dormitorio tiraron toda su ***basura*** en el pipote de los vecinos.
	b. The students who live in the dorm threw away all of their ***trash*** in the neighbors' cans.
67	a. El marinero que entró al supermercado recogió todas las ***monedas*** que se cayeron al suelo.
	b. The sailor who walked in the supermarket picked up all of the ***coins*** that fell on the floor.
68	a. Cuando la lluvia empezó a caer, la criada cerró todas las ***ventanas*** para que no entrara el agua.
	b. When the rain began to fall, the maid shut all of the ***windows*** to stop the water from coming in.
69	a. El testigo dijo que el terrorista entró al banco con un ***hombre*** que estaba herido.
	b. The witness said that the terrorist entered the bank with a ***man*** who was hurt.
70	a. El esquiador que ganó la medalla en la competencia compró un costoso ***coche*** con el dinero que recibió.

	b. The skier who won the medal in the competition bought an expensive ***car*** with the money that he received.
71	a. El escritor admitió que su madre estaba enfadada con la ***señora*** en la tienda.
	b. The writer admitted that his mother was angry with the ***lady*** at the store.
72	a. La cajera que trabaja en el banco explicó que el ***robo*** había ocurrido el martes.
	b. The teller who works at the bank explained that the ***robbery*** had occurred on Tuesday.
73	a. La enfermera que trabaja con el cardiólogo dijo que la ***mujer*** había sido tratada injustamente.
	b. The nurse who works with the cardiologist said that the ***woman*** had been treated unfairly.
74	a. Los chicos que estaban en el supermercado golpearon al carnicero con una ***caja*** de cereal.
	b. The kids who were at the supermarket hit the butcher with a ***box*** of cereal.
75	a. El dueño de la empresa sospechó que los ***trabajadores*** harían huelga.
	b. The owner of the company suspected that the ***workers*** would go on strike.
76	a. El dentista que está solicitando el trabajo creía que la ***entrevista*** había salido muy bien.
	b. The dentist who is applying for the job believed that the ***interview*** went very well.
77	a. El contable que trabaja para el gobierno opina que los ***impuestos*** no deben ser aumentados.
	b. The accountant who works for the government thinks that the ***taxes*** should not be increased.
78	a. El invitado que vino de Nueva York pensó que la ***ducha*** estaba sucia.
	b. The guest who came from New York thought that the ***shower*** was dirty.
79	a. La asistente que enseña en la escuela supone que su ***compañera*** no está diciendo la verdad.
	b. The assistant who teaches at the school supposes that her ***roommate*** is not telling the truth.
80	a. La mujer que fue secuestrada sospechó que su ***esposo*** tenía algo que ver con el crimen.
	b. The woman who was kidnapped suspected that her ***husband*** had something to do with the crime.

Appendix E

Independent Analyses

As noted in Chapter X, the coding system allowed for two sets of data analyses: while the more conservative data (conditional on comprehension question performance) were included above, the data below reflect participant RT (ms) and accuracy rates (%) across all trials where the target was produced correctly regardless of performance on any accompanying comprehension questions. As the results are similar to those in the conditional analyses, the data that follow provide a comparison between the two approaches.

For the bilingual participants of Experiment 1, Table **E-1** provides independent data for RT analyses, whereas Table **E-2** applies to data for accuracy analyses. Tables **E-3** and **E-4** report data for monolingual RT and accuracy analyses, respectively.

Table **E-1**: *Conditional and independent analyses of bilingual reaction time data. Significance is indicated with italics and double-starred* p *values, whereas marginal significance is indicated with single-starred* p *values; α = .05.*

RT	Conditional			Independent		
	F Value	MSE	*p* Value	*F* Value	MSE	*p* Value
MAIN EFFECTS						
Cognate status	2.29	1841.01	0.144	1.87	1967.92	0.185
Language	0.93	6495.39	0.344	1.16	6129.03	0.294
Syntax	0.17	1693.24	0.687	0.55	1394.50	0.465
INTERACTIONS						
Cognate status x Dominance	*3.46*	*6372.92*	*0.076**	*4.16*	*8180.77*	*0.053**
Language x Cognate status	2.81	1586.55	0.107	2.18	1051.29	0.153
Language x Dominance	*10.06*	*65354.20*	*0.004***	*9.83*	*60264.60*	*0.005***
Language x Syntax	0.00	2331.68	0.956	0.00	2024.61	0.952
Syntax x Cognate status	*9.77*	*1189.42*	*0.005***	*10.67*	*1089.82*	*0.003***
Syntax x Dominance	0.02	37.06	0.884	0.09	125.15	0.767
Language x Cog. x Dom.	0.50	790.17	0.487	0.35	364.57	0.562
Language x Syntax x Cog.	2.30	1491.20	0.143	0.29	1031.91	0.594
Language x Syntax x Dom.	0.00	9.71	0.949	0.17	343.13	0.684
Syntax x Cognate x Dom.	0.02	22.71	0.891	0.11	123.53	0.739
Lang. x Syn. x Cog. x Dom.	0.36	532.00	0.556	0.16	169.47	0.689

Table **E-2**: *Conditional and independent analyses of bilingual accuracy data. Significance is indicated with italics and double-starred* p *values; α = .05.*

Accuracy	Conditional			Independent		
	F Value	MSE	*p* Value	*F* Value	MSE	*p* Value
MAIN EFFECTS						
Cognate status	6.56	119.71	0.017	0.01	58.01	0.913
Language	1.18	461.66	0.288	2.52	90.72	0.126
Syntax	*21.38*	*84.77*	*0.000***	1.43	66.80	0.244
INTERACTIONS						
Cognate status x Dominance	2.03	243.47	0.167	0.06	3.67	0.804
Language x Cognate status	0.02	122.50	0.888	0.13	35.84	0.726
Language x Dominance	0.56	260.74	0.460	*6.74*	*611.75*	*0.016***
Language x Syntax	0.42	171.18	0.522	1.36	65.41	0.255
Syntax x Cognate status	*9.81*	*175.47*	*0.005***	0.01	86.15	0.905
Syntax x Dominance	0.14	12.05	0.710	0.00	0.32	0.946
Language x Cognate x Dom.	0.93	113.94	0.345	0.01	0.39	0.918
Language x Syntax x Cognate	0.01	87.71	0.931	0.24	47.72	0.626
Language x Syntax x Dom.	0.71	121.04	0.409	0.45	29.70	0.507
Syntax x Cognate status x Dom.	2.19	383.65	0.153	0.00	0.09	0.974
Lang. x Syntax x Cog. x Dom.	*5.91*	*518.53*	*0.023***	1.15	55.01	0.294

Table **E-3**: *Conditional and independent analyses of monolingual reaction time data. Significance is indicated with italics and double-starred* p *values; α = .05.*

RT	**Conditional**			**Independent**		
	F Value	MSE	*p* Value	*F* Value	MSE	*p* Value
MAIN EFFECTS						
Cognate status	*12.47*	*476.28*	*0.002***	*9.80*	*478.73*	*0.005***
Syntax	0.38	365.37	0.545	0.20	332.42	0.662
INTERACTIONS						
Syntax x Cognate status	1.22	345.24	0.281	1.36	310.26	0.256

Table **E-4**: *Conditional and independent analyses of monolingual accuracy data. Significance is indicated with italics and double-starred* p *values; α = .05.*

Accuracy	**Conditional**			**Independent**		
	F Value	MSE	*p* Value	*F* Value	MSE	*p* Value
MAIN EFFECTS						
Cognate status	0.03	56.73	0.869	0.89	16.68	0.354
Syntax	*6.50*	*15.59*	*0.018***	2.49	3.86	0.128
INTERACTIONS						
Syntax x Cognate status	*13.54*	*40.65*	*0.001***	*8.48*	*9.82*	*0.008***

Appendix F

Language History Questionnaire

The language history questionnaire was presented to participants on-screen via a form created in Microsoft Access: the following is a transcription of that form.

1. Participant Number:
2. Gender:
3. Age:
4. Handedness:
5. Where were you born?
6. What do you consider your native or dominant language?
7. What other languages have you been exposed to? Please try to be as specific as possible as to your level of proficiency, years of exposure, etc.
8. Have you ever studied or lived abroad? If so, where, and for how long?
9. For how many years have you spoken English?
10. Please rate your English reading proficiency.[5]
11. Please rate your English writing proficiency.
12. Please rate your English speaking ability.
13. Please rate your English speech comprehension.
14. How often, and where, do you use English?
15. For how many years have you spoken Spanish?
16. What is your primary Spanish dialect? Secondary?
17. Please rate your Spanish reading proficiency.
18. Please rate your Spanish writing proficiency.
19. Please rate your Spanish speaking ability.
20. Please rate your Spanish speech comprehension.
21. How often, and where, do you use Spanish?
22. Do you have any health concerns, including fatigue, which may have affected your participation today?
23. Have you participated in other language experiments?
24. If so, please describe the previous experiment(s).

[5] Ratings of proficiency were presented as an integer choice between 1 (none) and 10 (native-like).