The Pennsylvania State University

The Graduate School

Department of Psychology

SENTENTIAL CODESWITCHING AND COGNATE TRIGGERING: A NEUROCOGNITIVE STUDY

A Thesis in

Psychology

by

Kaitlyn Ann Litcofsky

Submitted in Partial Fulfillment

of the Requirements

for the Degree of

Master of Science

December 2013

The thesis of Kaitlyn Ann Litcofsky was reviewed and approved* by the following:

Janet van Hell
Professor of Psychology and Linguistics
Director of the Linguistics Program
Associate Director of the Center for Language Science
Thesis Advisor

Judith Kroll
Distinguished Professor of Psychology, Linguistics, and Women's Studies
Director, Center for Language Science

Koraly Perez-Edgar
McCoutney Family Early Career Professor in Psychology
Associate Professor of Psychology

Paola Dussias
Professor of Spanish, Linguistics and Psychology
Head, Department of Spanish, Italian and Portuguese

Melvin Mark
Professor of Psychology
Head of the Department of Psychology

*Signatures are on file in the Graduate School

ABSTRACT

A unique feature of bilingual speech is that bilinguals often produce utterances that switch between languages, such as "I ate *huevos para el desayuno* [eggs for breakfast]". While this switching occurs frequently in bilingual conversations, most neurocognitive research on language switching has actually focused on the switching of isolated, unrelated items. These studies have found that switching incurs a processing cost that is greater when switching into the dominant language, due to inhibition of the dominant language while processing the weaker language and the subsequent release of inhibition upon encountering a dominant language item. However, true codeswitching is language switching embedded in a larger, meaningful linguistic context, which may affect the processing of the switch. The few previous studies of sentential codeswitching also indicate a processing cost, but remain less clear on the possible asymmetry of this effect. The present study examined the comprehension of sentential codeswitching behaviorally using a self-paced reading paradigm (Experiment 1) and neurocognitively using event-related potentials (ERPs; Experiment 2) in Spanish-English bilinguals who codeswitch frequently in their daily life. The bilinguals read sentences that either contained a codeswitch or not, in both language switching directions. Reading times were longer for codeswitched, as compared to non-switched, sentences but this effect only appeared when switching from the dominant to weaker language. No effect was found for the reverse language switch, from the weaker to the dominant language. ERP results mirrored this pattern, with switches into the weaker language incurring a larger late positivity than non-switched sentences, and no differences when switching into the dominant language. These results indicate that meaningful sentential codeswitches do not rely on inhibition of the dominant language, but require sentence-level integration mechanisms related to the activation of the weaker language.

These two studies explored the mechanisms underlying the processing of sentential codeswitches. Experiment 3 focused on testing a linguistic theory, the triggering theory, which proposed a possible mechanism for why codeswitches occur. The triggering theory states that codeswitches are more likely to occur when in proximity to trigger words. Trigger words are words that activate both languages, such as *cognates* (words that share both form and meaning across languages, e.g., *piano/piano* in English and Spanish). Given the large psycholinguistic literature showing that cognates are often responded to faster than noncognates, we predicted that the presence of a cognate trigger would reduce the processing costs associated with codeswitching. In a self-paced reading task, Spanish-English bilinguals read codeswitched sentences that either contained a cognate trigger or a noncognate control word. A cognate facilitation effect was found in the weaker language, but there was no modulation at the point of the codeswitch in either language switching direction. Thus, cognate triggering does appear not influence the processing of sentential codeswitching in this paradigm.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

Thank you to Janet for being a wonderful mentor, my parents and brother for continued support and love, and countless labmates and friends who've helped me enormously.

Chapter 1

Introduction

A unique feature of bilingual speech is that bilinguals often produce utterances that switch between languages, such as "I ate *huevos para el desayuno* [eggs for breakfast]". This switching between languages, or *codeswitching*, has been shown to occur in various natural situations (e.g., Auer, 1999; Clyne, 1963, 2003; Grosjean, 1982, 2001). The phenomenon of codeswitching indicates that during conversations bilinguals have both languages active to some extent and are able to dynamically use both, but are also able to keep the languages separate in order to produce comprehensible utterances. While the question of language planning in codeswitching is of much interest (e.g., Wei & Milroy, 1995), it is also important to note that codeswitches occur in conversation and must be successfully comprehended by the interlocutor. This comprehension of codeswitches is the focus of the current project.

Codeswitching has been examined from two broad perspectives: the psycholinguistic and neurocognitive perspective that has focused mainly on the processing costs associated with switching, and the linguistic perspective that has focused mainly on the constraints governing when and where codeswitches can occur. Despite examining the same phenomenon, these bodies of research have remained largely separate. This thesis bridges these fields by examining codeswitching using psycholinguistic methods, while also experimentally testing one specific linguistic theory of codeswitching.

This thesis is outlined as follows. First I will discuss the key findings of psycholinguistic and neurocognitive research, then present results from one behavioral and one event-related potential study of the comprehension of codeswitching. Second, I will discuss one possible

mechanism of codeswitching proposed by the linguistic theory of triggering and present results from one behavioral study of cognate triggering. A general discussion will conclude this thesis.

Chapter 2

Part 1: Psycholinguistic and neurocognitive perspectives on codeswitching

The large majority of studies in the cognitive and neurocognitive literature examining switching between languages have focused on the processing of a series of single, unrelated items (e.g., unrelated words, numbers, or pictures) rather than switching between languages in a meaningful utterance (e.g., a sentence). Participants are either presented with items that switch between languages (in comprehension tasks) or must change the language of their response across trials (in production tasks). In both cases, switch trials are compared to non-switch trials (for a review, see, e.g., Meuter, 2009). While these paradigms are devoid of a rich linguistic context, these studies provide an experimentally-controlled foundation that may help better understand the mechanisms underlying the processing of more naturalistic codeswitching. Behavioral, event-related potential (ERP), and functional magnetic resonance imaging (fMRI) studies have focused on the finding that switches, as compared to non-switches, incur a processing cost and have sought to understand the mechanisms (e.g., inhibitory control) recruited during switching. First, I will discuss studies examining the switching of languages between isolated and unrelated items, followed by a discussion of switching within sentences.

Switching of isolated items

Studies of language switching in production consist of a series of trials of isolated items where the participant must respond in one or the other language, and the language of response may be the same as (non-switch trial) or different from (switch trial) the response language of the previous trial (e.g., Costa & Santesteban, 2004; Meuter & Allport, 1999; Philipp, Gade, & Koch 2007). In a seminal study, Meuter and Allport (1999) examined language switching in bilinguals

who spoke English as either their L1 or L2, and another European language as their other language. In a digit-naming task, participants saw a digit on a computer screen and were required to name the digit out loud. The response language (L1 or L2) was cued by a colored rectangle surrounding the digit. Two main findings resulted from this study. First, naming latencies for switch trials (e.g., naming in L2 following naming in L1) was longer than naming for non-switch trials (e.g., naming in L2 following naming in L2) indicating that switching required extra processing as compared to not switching. Second, this cost for switch trials was greater when switching into the L1 (i.e., naming in L2 and then in L1) than when switching into the L2 (i.e., naming in L1 then in L2). This asymmetric switch cost was surprising given that processing in L1 should be easier than in L2. However, it is thought to be a function of inhibition of the non-target language. That is, when performing a task in L2 the bilingual must inhibit the stronger L1 and then when an L1 trial is encountered, must release that inhibition. Less inhibition is required in the other direction: when performing a task in L1, less inhibition is needed to suppress the weaker L2 and thus less inhibition must be released to successfully perform in L2 on a subsequent trial.

In an extension of this finding, Philipp, Gade, and Koch (2007) found this asymmetric switch cost in trilinguals on a digit-naming task. Trilinguals (L1 German, and English and French as L2/L3 or L3/L2) performed a digit-naming task where language was cued by the shape of a frame. Participants were presented with three mixed blocks consisting of trials requiring naming in L1/L2, L2/L3, and L1/L3. In all mixed blocks, switch trials were slower and less accurate than non-switch trials (overall switch cost). Additionally, this switch cost was always greater when switching into the more dominant language, regardless of language pairing, indicating a reliance on inhibition that depends on the relative dominance of the language pair.

However, this asymmetric switch cost may only apply to low proficiency bilinguals. Costa and Santesteban (2004) replicated the asymmetric switch cost in two bilingual populations (Spanish learners of Catalan and Korean learners of Spanish), but not in a balanced Spanish-

Catalan group. All groups performed a picture-naming task in which the response language was cued by a color frame and could either switch between trials or not. Pictures were repeated 95 times throughout the task, similar to digits being frequently repeated in the previous digit naming studies. Results for all groups showed a switch cost, but this switch cost was asymmetric for the two L2 learner groups (greater switch cost when switching into L1 than into L2), but symmetric for the balanced bilinguals. Interestingly, these balanced bilinguals also showed a symmetric switch cost even when switching between their L1 and much weaker L3. Thus, it may be that once a bilingual has attained high proficiency in a second language, they are able to better navigate language switching, regardless of the relative dominance of the languages involved.

Studies of comprehension of language switching show a similar pattern to those of production (Finkbeiner, Forster, Nakamura, & Nicol, 2004; Grainger & Beauvillain, 1987; Jiang & Forster, 2001). In these studies, the language of the stimulus varies across trials. Similarly to the production studies, switch trials (trials in which the stimulus language differs from that of the previous trial) are compared to non-switch trials (trials in which the stimulus language remains the same as that of the previous trial).

In a between-language priming study, Grainger and Beauvillain (1987) presented pairs of unrelated stimuli (i.e., a prime stimulus followed by a target stimulus) to highly proficient French-English bilinguals. Participants read all items silently and had to decide whether the target item was a word or not (lexical decision) by pressing a button on a response box. Stimuli were presented in three types of blocks: all French, all English, and mixed (with stimuli in both French and English). An overall mixing cost was found, as in the production studies discussed above. Lexical decision reaction times (RTs) were slower to items in the mixed block than in the pure blocks, and RTs were slower to between-language trials (target words preceded by a word in the other language) than to within-language trials (target words preceded by a word in the same language) within the mixed block.

In a study with Chinese-English bilinguals, Jiang and Forster (2001) investigated language switching via translation priming, which involves presenting between-language prime-target pairs that are or are not translations of each other. Target words (in either L1 or L2) were preceded either by its translation in the other language or an unrelated word. To mask processing of the prime word, primes were preceded and followed by hash marks. Participants had to make a lexical decision to the target item. Results showed an asymmetrical effect on the lexical decision task in which L1 to L2 pairs did not result in significant translation priming (that is, L2 targets were responded to similarly when preceded by its L1 translation or by an unrelated L1 word), whereas L2 to L1 translation pairs showed significant priming as compared to unrelated L2 to L1 pairs.

Finkbeiner, Forster, Nicol, and Nakamura (2004) examined the impact of task on language switching. In a semantic categorization priming task, they found symmetric priming effects, unlike Jiang and Forster's (2001) results. However, in a lexical decision priming task, priming only occurred in the direction of "many-to-few" or "L1-to-L2" direction, but not the "few-to-many" or "L2-to-L1". That is, they tested within-language priming in monolingual English participants, comparing words that have many meanings (analogous to L1 words in an unbalanced bilingual) to words that have few meanings (analogous to L2 words in an unbalanced bilingual). The authors reconcile these task differences by arguing that the weaker representation of L2 does not offer sufficient information in a lexical decision task whereas in the semantic categorization task deeper processing is required, thus resulting in significant priming. These language switching comprehension studies reveal a switch cost similar to that found in production tasks. However, it should be noted that in the Jiang and Forster (2001) and the Finkbeiner et al. (2004) studies, related word pairs (e.g., translation pairs) were used whereas in the Grainger and Beauvillain (1987) and the production studies described above, unrelated word pairs were used.

Thus, an asymmetry in comprehension studies of language switching appears to occur, though the nature of this asymmetry seems to depend on the type of task (i.e., lexical or semantic).

In addition to behavioral studies, language switching has also been investigated using the neurocognitive technique of event-related potentials (ERPs). ERPs are an online measure of the electricity stemming from neuronal activity, and thus provide a fine-grained measure with temporal resolution on the order of milliseconds. ERPs represent the EEG signal time-locked to a specific cognitive event (e.g., presentation of a word), averaged over many trials. ERPs consist of components, which are systematic deflections of the waveform. These multidimensional components provide more information than reaction times: each component is defined by its polarity (negative or positive), amplitude (in microvolts), and latency from stimulus onset. For this proposal, we will be mainly concerned with the two ERP components that are most often found to be associated with the comprehension of language switching (see Van Hell & Witteman, 2009): the N400 and the Late Positivity Complex (LPC; also known as the P600).

The N400 is a negative-going component that peaks between 300 and 500 ms post-stimulus onset. It is thought to index the ease of semantic integration of a word into its preceding context (Kutas & Hillyard, 1980; Kutas & Hillyard, 1984), semantic relatedness in priming (Holcomb, 1993), as well as sentence constraints and world knowledge (Federmeier & Kutas, 1999). The LPC is a positive going component that begins roughly around 500 ms post-stimulus onset, lasts for several hundred milliseconds, is maximal over posterior sites, and has been associated with grammatical processing (e.g., Osterhout & Holcomb, 1992; Hahne & Friederici, 1999) or more general sentence-level reanalysis and reprocessing (e.g., Kaan, Harris, Gibson, & Holcomb 2000), and has been found in response to task-switching (Liotti, Woldorff, Perez III, & Mayberg, 2000) and language switching (Jackson, Swainson, Cunnington, & Jackson, 2001).

Only three studies have examined the ERPs related to language switching of isolated items in production (Christoffels, Firk, & Schiller, 2007; Jackson, Swainson, Cunnington, &

Jackson, 2001; Verhoef, Roelofs, & Chwilla, 2009) and five in comprehension (Alvarez, Holcomb, & Grainger, 2003; Chauncey, Grainger, & Holcomb, 2008; Chauncey, Holcomb, & Grainger, 2009; Jackson, Swainson, Mullin, Cunnington, & Jackson, 2004; Litcofsky, Midgley, Holcomb, & Grainger, 2009).

Jackson et al. (2001) had bilinguals (L1 English with varied L2s) perform a mixed-language digit-naming task while ERPs were recorded. For switch trials as compared to non-switch trials, participants showed an increased N2 component (a negative-going component peaking around 300 ms) when switching into L2, but not into L1 (opposite to the previous behavioral studies). The N2 is thought to index cognitive control (e.g., response suppression and strategic monitoring; see Folstein & Van Petten, 2008, for a review). In addition, switch trials elicited an LPC, reflecting reanalysis or general integration. However, these bilinguals did not show an asymmetric switch cost in their naming latencies. Instead, they were equally slow for naming on switch trials in the L1 and L2, but named non-switch trials more slowly in the L2 than the L1.

In another study of switching in language production, Christoffels et al. (2007) had German-Dutch bilinguals perform a picture-naming task. Behaviorally, naming was longer to switch trials than to non-switch trials, though this cost was not asymmetric. The ERPs revealed a surprising pattern of a larger N2 component to L1 non-switch trials as compared to switch trials, and no effect in L2. The authors explain this unexpected finding in terms of predictability of the language switch: in the Jackson et al. (2001) study, switches were predictable (i.e., every other trial) whereas switches were not predictable in the Christoffels et al. study. Additionally, participants were instructed to wait to name the pictures in the Jackson et al. (2001) study, but responded normally in the Christoffels et al. (2007) study. Delayed naming may make it more difficult to inhibit the dominant L1, resulting in the increased N2 when switching into L2 in Jackson et al. (2001). The increased N2 on L1 non-switch trials may be explained by a decrease

in accessibility of the L1 in a mixed-language context. Indeed, in a comparison of L1 non-switch trials in a mixed block with a pure L1 naming block, naming in the mixed language context was slower and elicited a frontal negativity, whereas this language context difference did not appear for L2.

Lastly, Verhoef et al. (2008) tested the effect of preparatory time for responding in a picture-naming task. Dutch-English bilinguals named pictures in both of their languages. A language cue was presented before the presentation of the picture, which appeared either 500 or 1200 ms after the cue. Behaviorally, participants showed an asymmetric switch cost at the shorter preparatory time, where it was harder to switch into L1 than L2, but a symmetric switch cost at the longer preparatory time. The ERPs showed an N2 effect for switching into the L1 at long preparation time, but not at the short preparation or for switching into the L2, which is somewhat similar to the results of Jackson et al. (2001) who had participants wait between 1 and 1.8s to respond. These studies show that in production, switch costs show different patterns behaviorally and neurocognitively and may relate to the inhibition of responses, though this may be modulated by task demands (e.g., delayed naming).

ERP studies of the comprehension of language switches show different ERP components than those for production, namely that switching elicits N400s and LPCs rather than N2s as seen in some production studies. Alvarez, Holcomb, and Grainger (2003) examined language switching in L2 learners who performed a semantic categorization task. Participants read a series of single words in both L1 and L2 and pressed a button whenever they saw a word referring to a body part. Contained in the word lists were within- and between-language repetitions that were expected to modulate the N400. Within-language repetitions produced the expected reduction in the N400 and between-language repetitions (i.e., translations) showed a similar, if smaller and extended effect. This N400 reduction for translations was slightly larger when switching into L2 than into L1. This pattern is opposite to the pattern found in the behavioral studies, but similar to

that in Jackson et al. (2001). Moreover, switching in both directions resulted in an LPC, indicating switching, regardless of language, results in the need for reanalysis.

In an extension of their 2001 work on digit naming, Jackson et al. (2004) examined the comprehension of language switches. Native English speakers who were L2 learners of various languages performed a digit judgment task of number words, in which a series of number words were presented in either L1 or L2 and participants had to press one button if the word was an odd number and another button if it was an even number. Behaviorally, an asymmetric switch cost was found where it was harder to switch into L1 than L2. Additionally, switch-related ERP effects were obtained, though these effects were not typically those found in language switching studies (e.g., N2, N400, or LPC components). Instead, they found an enhanced early temporo-parietal negativity to L2 switches and an early anterior negativity to L1 switches. Though they found switching effects in both directions, the surprising ERP may be due to the fact that the stimulus materials (names for single digits) were not well constructed. That is, names for single digits were often cognates (e.g., *one*/*uno* in English and Spanish), which are processed differently than noncognates (e.g., Dijkstra, Grainger, & Van Heuven, 1999) and some digits were interlingual homographs (e.g., the number *four* means *oven* in French).

Chauncey, Grainger, and Holcomb (2008) used masked priming to examine whether the processing of language switches is controlled or not. English-French bilinguals were presented with prime-target pairs of unrelated words in L1 and L2 such that there were within- and between-language pairs with targets in both L1 and L2. Participants' task was to press a button for words that referred to an animal. To avoid conscious knowledge of the manipulation, prime words were preceded with a mask of hash marks and followed by a mask of random letters. Language switches resulted in a larger N250 for switch as compared to non-switch trials when switching into L2, and larger N400s were found when switching into L1 than into L2. These

results suggest that even when primes are not consciously processed, language switching has an effect in both language switching directions.

In a subsequent picture naming task with within- or across-language masked primes, Chauncey, Holcomb, and Grainger (2009) found an earlier negativity (between 200-300ms) when switching languages, but only into L2, not into L1. Related primes (translation equivalents) produced significant priming effects when both L1 and L2 were the target languages, though priming into the L1 was weaker, given less robust processing of the L2 prime.

Finally, Litcofsky et al. (2009) had English-French bilinguals living in an L2 environment perform a mixed-language lexical decision task, where participants were presented with a series L1 English words, L2 French words, and non-words, and had to decide if the item was a word in either of their languages. Participants showed an asymmetric switch effect: a larger N400 when switching into L1 as compared to non-switch trials, but no effects when switching into the L2. These results mimic the Chauncey et al. (2008) results as well as the behavioral and ERP language switching production studies where increased processing is needed for switching into the L1, but not into the L2.

In addition to behavioral and ERP studies, language switching has been investigated using functional magnetic resonance imaging (fMRI). These studies allow for the investigation of the neural regions and networks underlying the ability to switch between languages. For example, L1 picture naming in bilingual contexts (mixed blocks of naming in L1 and L2) versus monolingual contexts (naming in L1 only) resulted in activity in the left caudate nucleus and the anterior cingulate cortex, regions that are recruited more when naming in L2 (Abutalebi, Annoni, Zimine, Pegna, Seghier, Lee-Jahnke et al. 2008). These findings indicate that the mechanism of naming in L1 can be modulated by overall context (i.e., switching). Additionally, language switching may rely, to some extent, on a network related to cognitive control (prefrontal cortex, anterior cingulate cortex, the caudate nucleus, and superior marginal gyrus), which is also

recruited during general task switching (Abutalebi & Green 2008). This recruitment of cognitive control areas relates to the growing literature showing that bilingualism may be associated with advantages in cognitive control (e.g., Bialystok, Craik, Klein & Viswanathan, 2004).

These studies of language switching have shown that switching between languages incurs a processing cost (in RTs, larger ERP effects, and different neural recruitment) in both production and comprehension. In unbalanced bilinguals, asymmetrical switching costs were found, whereas in balanced bilinguals switching costs were symmetrical. Moreover, in production switching costs were typically larger when switching into L1 than when switching into L2 (but see [Jackson, Swainson, Cunnington, & Jackson, 2001]. In comprehension, results are a bit more mixed, with some studies finding larger switching costs when switching into L1 than when switching into L2 (Alvarez, Holcomb, & Grainger, 2003; Jackson, Swainson, Mullin, Cunnington, & Jackson, 2004; Finkbeiner, Forster, Nicol, & Nakamura, 2004; Litcofsky, Midgley, Holcomb, & Grainger, 2009), but some studies found larger switching costs when switching into L2 than when switching into L1 (Chauncey, Holcomb, & Grainger, 2009; Jiang & Forster, 2001).

Switching within sentences

The studies reviewed above provide a foundation for examining switching between languages, but they have examined switching between a series of single, unrelated, isolated items. Natural codeswitches occur in conversations, and must be studied in larger linguistic contexts. Few neurocognitive studies have examined sentential codeswitching (Moreno, Federmeier, & Kutas, 2002; Proverbio, Leoni, & Zani, 2004; Van der Meij, Cuetos, Carreiras, & Barber, 2010; see Van Hell, Litcofsky, & Ting (submitted) for a review of psycholinguistic and neurocognitive studies on sentential codeswitching). Moreno, Federmeier, and Kutas (2002) studied whether codeswitches were processed similarly to lexical switches in sentences. Using ERPs, they

examined balanced English-Spanish bilinguals reading sentences in L1 English that ended in either a codeswitch into L2 (e.g., "Each night the campers built a *fuego* [fire]."), a lexical switch (e.g., "Each night the campers built a *blaze*."), or no switch (e.g., Each night the campers built a *fire*."). Lexical switches (as compared to no-switches) showed a classic N400, whereas codeswitches resulted in an effect more similar to a left anterior negativity (LAN) based on the scalp topography, which as been associated with working memory demands (King & Kutas, 1995), or even morphosyntactic processing (Gunter, Stowe, & Mulder, 1997). Codeswitches also resulted in an LPC. Based on the different ERP responses for the language switch and the lexical switch, it appears codeswitches are not simply lexical switches, but may require sentence-level integration.

Proverbio, Leoni, and Zani (2004) also examined sentential codeswitches, but here in professional simultaneous interpreters. Again using ERPs, they compared sentences that began in either L1 or L2 and whose sentence-final word was either a non-switch, a codeswitch, or a semantically incongruous word. Sentences switched in both language switching directions, both from L1 to L2 and from L2 to L1, and were blocked by type. Codeswitches resulted in an increased N400 that was larger when switching into L2 than into L1. RTs followed the same pattern of asymmetric switch cost.

These first two studies of sentential codeswitching indicate that codeswitching incurs a processing cost (increased ERP components as compared to non-switches) that may be related to lexico-semantic processing, working memory or morphosyntactic processing, and sentence-level integration. However they contain various methodological concerns. First, neither study controlled whether the codeswitched words were cognates or not which, given the large literature on the differential processing of cognates as compared to non-cognates (for reviews, see e.g., Dijkstra, 2005; Van Hell & Tanner, 2012), may have altered the relative activation of the two languages at the point of the codeswitch. Moreover, the codeswitched words were always in the

sentence-final position, which potentially contaminated the processing of the codeswitched word with sentence wrap-up effects. Additionally, in the Proverbio et al. (2004) study, the analyses of the codeswitches collapsed across semantically congruous and semantically incongruous final words, some of which were also an incongruous part of speech, which may have driven the N400 effect found for codeswitches. Finally, the Proverbio et al. (2004) study also presented the sentence in a manner that may have distorted processing. Specifically, the entire sentence (minus the final word) was presented at once for 1.8 seconds, followed by the final word (which could be codeswitched), which may have brought extra attention to the codeswitch, in addition to encouraging the use of strategic behavior as opposed to natural reading.

These various methodological issues were rectified in a recent study by Van der Meij, Cuetos, Carreiras, and Barber (2010) who explored how L2 proficiency affects the comprehension of codeswitches in a sentence context. Higher- and lower-proficiency Spanish-English bilinguals in Spain read sentences in L2 English that contained a sentence-medial adjective that could either be in L1 Spanish (switch) or in L2 English (non-switch). Codeswitched words showed different patterns in the two bilingual populations. Both groups showed an enhanced N400 and LPC (larger in the higher proficiency group) to codeswitched words. Additionally, both groups showed an early negativity that may be related to orthographic processing (left occipital N250) and a lasting frontal positivity that could be the onset of the LPC; the high proficiency group showed an additional LAN effect. These results indicate that bilinguals of both low and high proficiency show a processing cost related to lexico-semantic processing and sentence-level integration, but proficiency may modulate the degree of resources recruited for processing a codeswitch.

Current study

These three ERP studies of sentential codeswitching show that codeswitches do incur a neurocognitive processing cost that is distinct from simple lexical switches, occurs in both language directions (though to differing degrees), and is dependent on L2 proficiency. However, the exact ERP pattern evoked by codeswitches remains unclear given the paucity of studies and the methodological concerns noted above for the first two studies. More research, especially looking at codeswitching in both language directions in the same group of bilingual speakers is needed to better understand the neurocognition of the comprehension of sentential codeswitches. Experiments 1 and 2 fill this gap by examining sentence-medial codeswitching in highly proficient Spanish-English bilinguals, with switches in both language directions. Unlike the Van der Meij study which examined Spanish-English bilinguals who were living in an L1 environment where codeswitching is less common, the present study examines highly fluent Spanish-English bilinguals who are immersed in an L2 environment and who are part of an Hispanic community where codeswitching is very common. Moreover, Van der Meij et al. studied switching of an L1 word embedded in an L2 context, whereas the present study will study switching in both directions to examine whether an asymmetry effect also occurs in sentential codeswitching. Yet, like the Van der Meij study, the current project avoids the methodological concerns of the first two sentential codeswitching studies by Moreno et al. (2002) and Proverbio et al. (2004).

Experiment 1 examines the processing of sentential codeswitches using a self-paced reading paradigm. We expect to find that codeswitches will result in a processing cost (i.e., slower reading times) as compared to non-switched sentences. Additionally, we expect this switch cost might be asymmetric, based on the language switching literature (i.e., larger cost when switching into L1). If sentential codeswitching is processed similarly to language switching,

then we would expect to see that switching into the L1 would be more effortful than switching into the L2. If, however, sentential codeswitching does not rely on inhibition, but relies on relative proficiency, then we would expect to see a greater switching cost when switching into the less dominant language than into the more dominant language. Experiment 2 uses ERPs to explore the nature of processing when bilinguals read codeswitched sentences.

Chapter 3

Experiment 1: Behavioral codeswitching

Methods

Participants

22 Spanish-English bilinguals were tested for this study. Data from two participants were discarded due to insufficient accuracy on the comprehension questions during the codeswitching task. 20 participants (16 female) remained (Age: $M = 22.95$, $SD = 4.5$). All were native speakers of Spanish who spoke English as an L2. Participants varied in the dialect of Spanish spoken, with the majority of individuals speaking Central or South American Spanish. Age of acquisition of L2 English varied across participants ($M = 8.10$, $SD = 6.0$). Participants' self-ratings of their English production and comprehension skills as well as objective measures of proficiency indicate that they were highly proficient speakers of English (see Table 3-2). All participants reported codeswitching in their daily life. Participants were recruited from the Penn State community via flyers and word-of-mouth and were paid $10/hour for their participation. All participants provided written informed consent before participating in the experiment.

Materials and Procedure

The stimuli were comprised of 160 sentences (see Table 3-1). Each "base" sentence appeared in four conditions, which manipulated the language in which the sentence started (English or Spanish) and the presence of a codeswitch (yes or no). All sentences were

semantically and grammatically correct. Sentences were created first in English and then translated into Spanish. Spanish versions of all sentences were checked by two native Spanish speakers (one from Argentina and one from Spain) to ensure grammaticality and semantic appropriateness for both continental and Latin American speakers of Spanish.

Sentences were created such that at least three words followed the codeswitched word to avoid confounding effects of codeswitching with sentence wrap-up effects. To ensure a full switch to the other language, all words following a codeswitch remained in the codeswitched language. This type of codeswitch has been termed an "alternation" that is often used in communities with two stable languages (for more details, see Muysken, 2000).

Additionally, the critical words (codeswitch and matched control) adhered to the following criteria: all were nouns and did not contain any diacritic markers. Previous research shows that the masculine determiner is processed more easily in determiner-noun codeswitches from Spanish to English for all nouns in an eye-tracking paradigm (Valdes Kroff, 2012). Thus, in the current study, in sentences switching from Spanish to English, masculine Spanish determiners were used before all codeswitched English words, even when the word is grammatically feminine in Spanish (e.g., *el fight* where the translation of *fight*, *lucha,* is grammatically feminine). No critical words were repeated anywhere in the task.

Table **3-1**: Experimental conditions. Codeswitched word: *toys* (Spanish: *juguetes*).

Language	**Codeswitch?**	**Example Sentence**
English	Yes	Every year, the shopkeeper makes his own *juguetes para los niños pequeños.*
English	No	Every year, the shopkeeper makes his own *toys for the young children.*
Spanish	Yes	Cada año, el tendero hace sus proprios *toys for the young children.*
Spanish	No	Cada año, el tendero hace sus proprios *juguetes para los niños pequeños*.

Length and frequency were measured for codeswitched words in English and Spanish, though were not matched across languages (Spanish words are typically longer than English words, Vitevitch & Rodríguez, 2004; different frequency corpora preclude matching across languages, but $r = .78$ for English and Dutch frequency of English-Dutch translation pairs drawn from comparable English and Dutch frequency counts in CELEX, see De Groot, Dannenburg, & Van Hell, 1994). Length of codeswitched words (number of letters) for English was $M = 6.07$, $SD = 1.93$ and for Spanish was $M = 7.15$, $SD = 1.24$. Frequency of codeswitched words for English was $M = 1.22$, $SD = 0.71$ and for Spanish was $M = 1.54$, $SD = 0.71$. Frequency counts for English codeswitched words were based on the log lemma frequencies from the Celex lexical database (http://celex.mpi.nl; Baayen, Piepenbrock, & Van Rijn, 1993). Frequencies for Spanish were based on the sum of the singular and plural noun frequencies from the Diccionario de frecuencias de las unidada lingüisticas del Castellano (Alameda & Cuetos, 1995).

An additional 12 sentences were created for practice materials. Five of these sentences were instructional (e.g., "Here you can practice how you will be reading the sentences."). The remaining seven sentences were identical in design to the experimental sentences, but did not repeat any critical words. The practice sentences were presented in the four conditions of the study, three sentences in each condition.

Four stimulus lists were created from the 160 sentences, each of which contained 40 sentences per condition. Each "base" sentence appeared in only one condition per list. Lists were pseudo-randomized such that there were no more than three sentences of the same condition in a row, no more than six sentences in a row beginning in either English or Spanish, no more than six sentences in a row containing a codeswitch or non-switch, and no more than nine sentences in a row without a given condition appearing.

To ensure participants actively read the sentences, their task was to answer "yes"/"no" comprehension questions that followed one quarter of the sentences. Questions were separated by

at least one sentence and at most by seven sentences. The comprehension questions were evenly spread across the four conditions within each list and half of the questions for sentences within a given condition required a "yes" response and half required a "no" response. Practice sentences included comprehension questions in the same manner as experimental trials.

Sentences were presented using a non-cumulative self-paced reading paradigm. Trials began with a fixation cross, followed by a participant-initiated word-by-word presentation of the sentence (see Figure 3-1). To advance from the fixation cross and between each word participants pressed a button on an E-prime response box. Time spent on each word (reading time; RTs) was used as the dependent measure. Each word was displayed in the center of the screen in black text (Arial font, size 18) on a white background. At the end of the sentence, there was either a fixation cross to signal the start of the next sentence or a question, to which the participant had to make a yes/no decision by pressing one of two buttons. The questions were displayed in full on a single screen. There was no time limit for responding to the questions. Participants were instructed to read as quickly as possible while reading for meaning such that they could successfully answer the comprehension questions.

The task consisted of four blocks, each containing 40 sentences and 10 comprehension questions (interspersed throughout the block). Each block lasted about 8 minutes, depending on participants' reading speed. Short breaks separated blocks during which participants could relax.

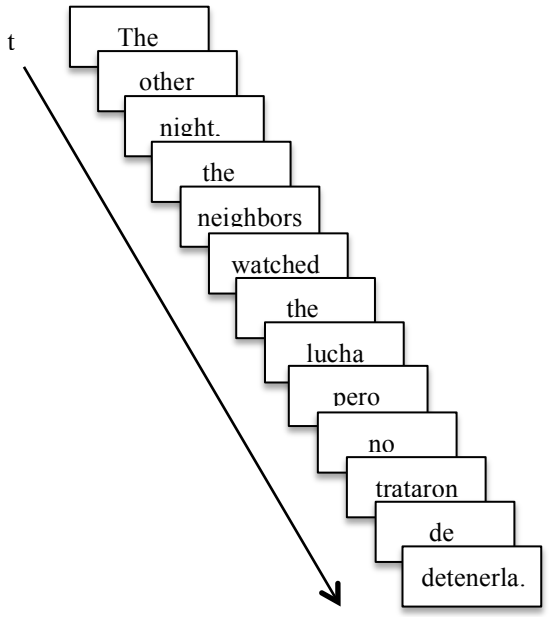

Figure **3-1**: Example trial in self-paced reading task. Participants pressed a button to advance between words.

Language proficiency measures

Language proficiency was measured in four ways: a language history questionnaire (LHQ), a sentence reading task in both Spanish and English, a lexical decision task (LDT) in both Spanish and English, and the Boston Naming test (BNT) in English and in Spanish (Kaplan, Goodglass, & Weintraub, 2001). These tasks provided subjective and objective measures of the participants' L1 and L2 vocabulary and reading proficiency.

The LHQ collected self-ratings of proficiency in reading, writing, speaking, and comprehension, as well as a detailed history of their language exposure, use, and learning history. It also included the twelve questions from the Bilingual Switching Questionnaire (BSWQ; Rodriguez-Fornells et al. 2012), which assesses an individual's codeswitching tendencies (i.e., how often a bilingual switches into their dominant language, how often a bilingual switches into

their weaker language, how often a bilingual switches in certain environments, and how often a bilingual switches without awareness). The LHQ was presented to participants as a Google Form.

The sentence reading task was designed to examine reading proficiency in each language separately. Sentences were presented in a self-paced reading paradigm, as in the codeswitching task described above. One hundred semantically and grammatically correct sentences were presented in 2 blocks. "Yes"/"No" comprehension questions followed each sentence. Participants completed this task in both English and Spanish (see Experimental Session section below for more on counterbalancing of list orders and dominant/weaker languages). Sentences were created separately for the English and Spanish version of the task. Spanish sentences were created first in English and then translated into Spanish, and were checked by two native Spanish speakers (one from Argentina and one from Spain) to ensure grammaticality and semantic appropriateness for both continental and Latin American speakers of Spanish. There were two dependent measures for this task: average word reading time and accuracy to the comprehension questions. Average word reading time was calculated by dividing the total reading time to all the words in a sentence by the number of words in the sentence.

The LDT presented letter strings to the participant who had to decide whether or not the string formed a word in the target language. The letter strings were presented in the center of the screen in black type (Courier New, size 18) on a white background. Participants pressed one button to indicate if the letter string is a word in the given language and another button to indicate it is not a word. There were two versions of this task, one in English and one in Spanish, with the same procedure except that the words and nonwords were language-specific. Each language version contained 50 words and 50 nonwords. Participants completed both versions (see Experimental Session section below for more on counterbalancing of list orders and dominant/weaker languages). Length of words (English: $M = 5.64$, $SD = 1.6$; Spanish: $M = 5.90$,

SD = 1.6) and nonwords (English: *M* = 5.88, *SD* = 1.6; Spanish: *M* = 5.98, *SD* = 1.3) were matched in English (*t*(98) = 0.75 *p* = .455) and Spanish (*t*(98) = 0.275 *p* = .784).

Trials began with a fixation cross presented in the center of the screen for 400 ms, followed by a blank screen for 250 ms, and then the letter string, which was presented until the participant responded or for a maximum of 5000 ms. There were two list orders, each of which contained two blocks of items. Each block contained 50 items, half of which were real words, half of which were non-words. Within each block, items were randomly ordered for each participant. There were an additional 10 practice items (5 words and 5 non-words), which were presented identically to the experimental trials.

The LDT task provides dependent measures based on response time (RT) to word stimuli, nonword stimuli, and across both types of stimuli. For accuracy, both overall accuracy and D-prime were calculated. D-prime, a signal detection measure, accounts for any bias related to responding with a given response (e.g., always responding "yes", regardless of the stimuli).

The BNT is a standardized vocabulary test that presented 60 images that participants must name out loud. The Spanish version of the BNT contained the Spanish translations of the English items. The images were black-and-white line drawings that are presented on a white background. Trials began with a fixation cross presented for 750 ms, followed by a 1500 ms blank screen and then the image, which remained on the screen until the participant responded or for a maximum of 5000 ms. There was a 600 ms blank ISI. An additional 8 items were presented for practice, identically to the experimental trials, but randomly ordered for each participant. Experimental items were always presented in the same order.

Oral responses were registered by a voice-key function of the E-prime response box. Because the voice key can trigger to extraneous noise (e.g., a cough or "um") or might not initiate until the middle of the response, the experimenter remained in the testing chamber throughout this task to record whether or not participant's responses were accurately registered. RTs for trials

with incorrect voice triggers were removed from analyses. The entire task was audio recorded for later transcription of the responses and determination of accuracy.

Like the LDT and Sentence Reading tasks, the BNT was performed twice, once in each language (see Experimental Session section below for more on counterbalancing of dominant/weaker languages).

Cognitive measures

Two measures were used to examine individual differences in cognitive functioning: the Flanker task (Emmorey, Luk, Pyers, & Bialystok, 2008), and the Operation Span ("O-Span"; Turner & Engle, 1989).

The Flanker task presents a red arrow pointing either leftward or rightward. This arrow can be "flanked" by various shapes indicating different responses. Participants' task was to press a button indicating the direction that the red arrow is pointing. The flanking objects can be black arrows, black diamonds, or black X's. The arrows can be facing the same direction as the red arrow, providing congruent information, or facing the opposite direction, providing incongruent information. The diamonds provide visual distraction to the participant, but no information on how to respond. The X's indicate that the participant should withhold their response.

The task builds in complexity, with each section containing instruction screens and practice trials (including feedback in the form of a green happy face or red sad face). Initially, just the red arrow is presented. There are 6 practice trials (3 left-facing, and 3 right-facing). There are then 12 test trials, half facing left, half facing right. Next, the red arrow is flanked by either diamonds ("Go" trials) or Xs ("No-Go" trials). There are 12 practice items (half Go, half No-Go) and 36 test items in this block (half Go, half No-Go). In this block, the position of the arrow within the array of items varies, but is never on either end. In the next block, the red arrow is

flanked by the congruous and incongruous black arrows. There are 12 practice trials (half congruent, half incongruent) and 36 test trials (half congruent/half incongruent). Again, the red arrow can vary position within the central 3 items. Next, a mixed block is presented, which contains all of the trial types seen previously. There are 12 practice trials (3 congruent, 3 incongruent, 3 Go trials, 3 No-Go trials) and 72 test trials (18 congruent, 18 incongruent, 18 Go trials, 18 No-Go trials). This mixed block is followed by another congruent/incongruent block, another Go/Nogo block, and finally another block of just the red arrow. In the second list order, the order of the congruent/incongruent and the Go/No-Go blocks are switched (See Procedure section below for more on counterbalancing of list orders). In all trials, a fixation cross is presented for 250 ms, followed by the image, which is presented until the participant responds or for a maximum of 2000 ms. Within blocks, items are randomly selected.

The Flanker effect is calculated by subtracting the RT of the congruent trials from the RT of the incongruent trials in the congruent/incongruent block. A smaller Flanker effect reflects better inhibitory control.

In the O-Span task, participants are asked to judge whether a simple arithmetic problem is correct or not and, at the same time, retain 2-6 words in memory that are presented interleaved in the math problems. Higher scores (indicated by more words correctly remembered and better judgment of math problems) reflect better working memory. This task is divided into 5 sections, increasing in complexity. In each section, there are 3 sets of trials. Sections start with 2 words and increase to 6 words. An initial practice block contains one set of 4 words and one set of 6 words. This task was run in the participants' subjectively-rated dominant language.

Math problems (e.g., "12/3 + 4 = 8") are presented in black type on a white background and participants must press one key to indicate that the problem is correct and a different key to indicate that the problem is incorrect. Trials begin with a fixation cross presented for 1000 ms, followed by a math problem, which is presented until the participant responds or for a maximum

of 3750 ms, and then a word, which is presented in the center of the screen for 1250 ms. At the end of a set, participants must type the words they recall, and are instructed not to begin with the last word presented. Items are always randomly selected within a set. The Spanish version uses the translation of the English words. The dependent measure for O-span is the recall score, which gives the number of words correctly remembered provided that the math problems have been correctly solved.

Experimental Session

Testing occurred in one experimental session, lasting approximately 2 hours. After providing consent, participants were seated in a sound-attenuated chamber in front of a PC computer. All tasks were presented using E-prime 2.0 software unless otherwise stated. For all tasks (unless otherwise specified above), the experimenter stayed in the testing chamber with the participant during the instructions and practice trials, and left for the experimental trials.

Counterbalancing: In order to reduce the number of testing order configurations, randomization of task versions was fixed to two orders: subjects who received lists 1 or 3 of Codeswitching also received list 1 of Sentence Reading, LDT, and Flanker, and performed Sentence Reading, BNT, and LDT first in their subjectively-rated dominant language and second in their subjectively-rated weaker language; subjects who received lists 2 or 4 of Codeswitching received list 2 of Sentence Reading, LDT, and Flanker, and perform Sentence Reading, BNT, and LDT first in their subjectively-rated weaker language and second in their subjectively-rated dominant language.

Participants completed the tasks in the following order: LHQ, Codeswitching task, O-span, Sentence Reading, BNT, LDT, Flanker, Sentence Reading, BNT, and LDT.

Table **3-2**: Individual difference measures for participants' dominant and weak languages. Means are reported; standard deviations are in parentheses.

Language Proficiency Measures		
	Dominant	Weak
Self-rated production (out of 10)	9.1 (*1.1*)	8.4 (*1.3*)
Self-rated comprehension (out of 10)	9.5 (*1.0*)	9.2 (*0.8*)
Sentence Reading Question Accuracy (%)	89.9% (*9.7*)	88.0% (*10.2*)
Sentence Reading Average RT (ms)	346 (*100*)	409 (*116*)
LDT Accuracy (%)	92.0% (*2.7*)	89.7% (*6.5*)
LDT Overall RT (ms)	737 (*107*)	854 (*229*)
BNT Accuracy (%)	66.3% (*8.8*)	47.0% (*18.8*)
BNT RT (ms)	1097 (*169*)	1308 (*256*)
Cognitive Measures		
Flanker Effect (ms)	49.66 (*25.0*)	
O-span Recall (out of 60)	39.95 (8.8)	

Data Analysis

Codeswitching task: To ensure that participants were successfully performing the task, accuracy on the comprehension questions was calculated. Participants who scored lower than 75% were excluded from analysis (2 participants).

Reading times (RTs) were collected to all words in the sentences. Analyses were performed on RTs to words in the critical region only: the two words before the codeswitched word, the codeswitched word, and the three words following the codeswitched word. The two words before the codeswitched word were analyzed to ensure that the sentences do not differ across conditions prior to the switch manipulation. The three words following the codeswitched word were analyzed given that effects often spillover into neighboring words in the self-paced reading task. RTs faster than 100 ms and relative outliers (RTs greater than 2.5 standard deviations from the mean) were removed by subject and condition (Dominant-Weak codeswitch: two words before codeswitched word: 4.4%, one word before codeswitched word: 4.1%, codeswitched word: 4.0%, one word after codeswitched word: 3.4%, two words after

codeswitched word: 3.1%, three words after codeswitched word: 3.6%; Dominant non-switch: two words before codeswitched word: 3.9%, one word before codeswitched word: 3.8%, codeswitched word: 3.8%, one word after codeswitched word: 4.8%, two words after codeswitched word: 4.3%, three words after codeswitched word: 3.5%; Weak-Dominant codeswitch: two words before codeswitched word: 4.9%, one word before codeswitched word: 4.3%, codeswitched word: 3.8%, one word after codeswitched word: 3.5%, two words after codeswitched word: 3.6%, three words after codeswitched word: 3.5%; Weak non-switch: two words before codeswitched word: 4.4%, one word before codeswitched word: 4.0%, codeswitched word: 2.6%, one word after codeswitched word: 3.8%, two words after codeswitched word: 3.4%, three words after codeswitched word: 4.1%) as they reflect non-typical processing.

Analyses first examined if there was a general switch cost, across both directions of language switching. To do this, RTs were compared for all critical items in sentences containing codeswitches (conditions 1 and 3) to non-switched sentences (conditions 2 and 4). Second, we examined switch costs as a function of the direction of the language switch. Instead of comparing L1 and L2, we focused on the individuals' relative dominant and weak languages. That is, examining effects of switching from the weak to dominant language, and from the dominant to weak language. This was done given that the population includes heritage speakers from the United States as well as individuals who grew up in a Spanish-speaking country and immigrated to the United States who vary in their relative proficiencies of English and Spanish.

Dominance was determined by a composite measure of the language proficiency tasks. In addition to self-reported dominance, the following measures were used: self-rated proficiency in production and comprehension, accuracy and RT to real words in the LDT, accuracy and RT in the BNT, and average RT and comprehension question accuracy in the sentence reading task. For each measure, the dominant language was determined (e.g., higher rated proficiency, faster or

more accurate performance). Overall language dominance for a participant was determined to be the language that they were dominant in for the majority of measures. In this study, 11 participants were English dominant and 9 were Spanish dominant. This dominant language was then used in the analysis of the codeswitching task.

Results

Comprehension Questions

Participants averaged 86.1% (*SD* = 4.1) accuracy on the comprehension questions, indicating that they understood the sentences and were sufficiently engaged in the task.

Overall Switch versus Non-switch sentences

Figure 3-2 shows the reading times for sentences containing codeswitches as compared to sentences without codeswitches. A 2 Start language (Dominant, Weaker) by 2 Switch (Switch, No Switch) ANOVA was conducted separately for each critical word in the sentence (two words before the codeswitch, one word before the codeswitch, the codeswitched word, one word after the codeswitch, two words after the codeswitch, and three words in the codeswitch). Follow-up one-way ANOVAs were conducted for each language switching direction.

Beginning at the word of the codeswitch and lasting for several words, there was a main effect of switch such that codeswitched words were read more slowly than non-switched words (codeswitched word: $F(1, 19) = 3.612$, $p = .073$; one word after codeswitch: $F(1, 19) = 7.987$, $p = .011$; two words after codeswitch: $F(1,19) = 4.461$, $p = .048$; three words after codeswitch: $F(1,19) = 5.992$, $p = .024$; see Figure 3-2). There was no effect of switch at the first two critical

words, which come directly before the codeswitch (*p*s > .59). There was an effect of the start language on the two words prior to the codeswitch (two words before codeswitch: $F(1,19) = 9.509$, $p = .006$; one word before codeswitch: $F(1,19) = 3.236$, $p = .088$) and the codeswitched word ($F(1,19) = 3.69$, $p = .07$), but not for subsequent words (all *p*s > .5)

The main effects of switch and start language were qualified by significant interactions between these factors at the codeswitched word ($F(1, 19) = 7.453$, $p = .013$), one word after codeswitch ($F(1, 19) = 12.112$, $p = .003$), two words after codeswitch ($F(1,19) = 7.584$, $p = .013$), three words after codeswitch ($F(1,19) = 3.352$, $p = .083$), but not prior to the codeswitch (all *ps* > .32), indicating that the effect of the switch differed by the language switching direction. Next we will examine the codeswitch effect in the two language switching directions separately.

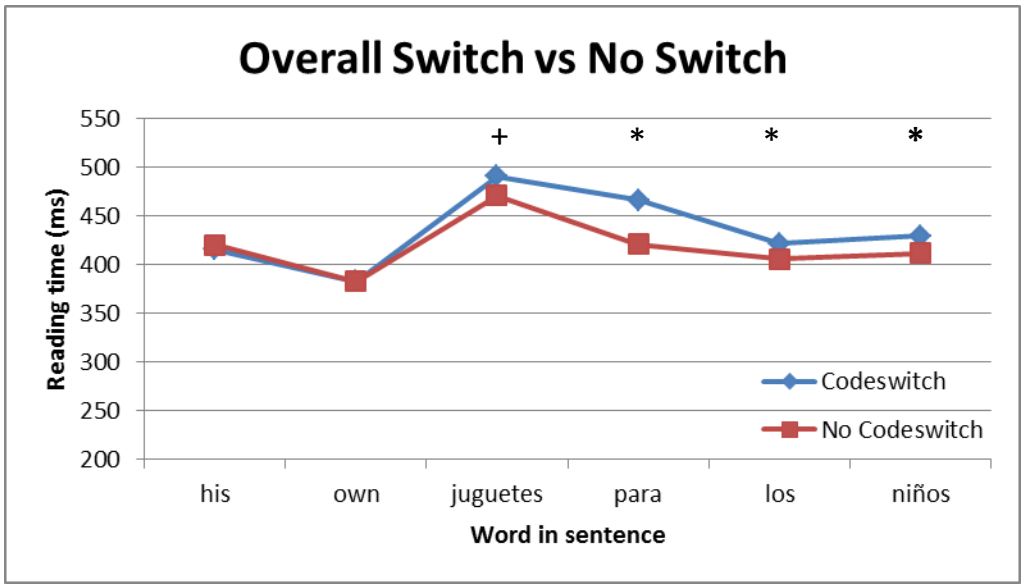

Figure **3-2**: Reading times to codeswitched (blue) and non-switched sentences (red). Here, *juguetes* indicates the onset of the codeswitch. +: $p < .10$; *: $p < .05$; **: $p < .01$; ***: $p < .001$.

Switching from Weaker into Dominant language

When switching into the dominant language (weak to dominant switch compared with weak non-switch), codeswitched words were read similarly to non-switched words (all *p*s > .13; see Figure 3-3). There were also no differences between the conditions prior to the codeswitched word (all *p*s > .65).

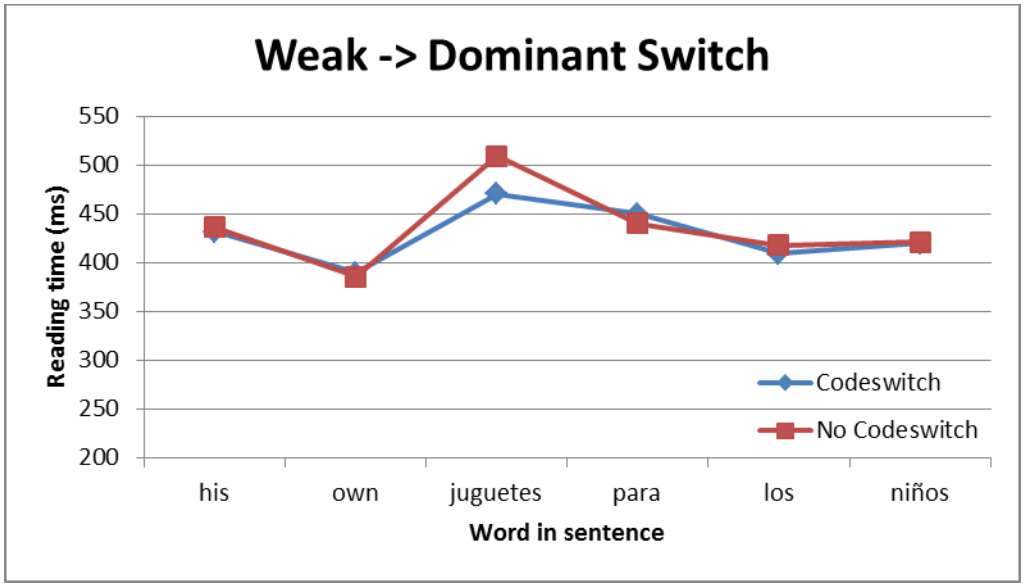

Figure **3-3**: Reading times to weak to dominant codeswitched (blue) and non-switched sentences (red). Here, *juguetes* indicates the onset of the codeswitch. +: $p < .10$; *: $p < .05$; **: $p < .01$; ***: $p < .001$.

Switching from Dominant into Weaker language

In contrast, when switching into the weaker language (dominant to weak switch compared with dominant non-switch), codeswitched words were read more slowly than non-switched words (codeswitched word: $F(1, 19) = 11.901$, $p = .003$; one word after codeswitch: $F(1, 19) = 11.423$, $p = .003$; two words after codeswitch: $F(1,19) = 10.532$, $p = .004$; three words after codeswitch:

$F(1,19) = 6.488$, $p = .02$; see Figure 3-4). There were no differences between the conditions before the codeswitched word (all ps > .34).

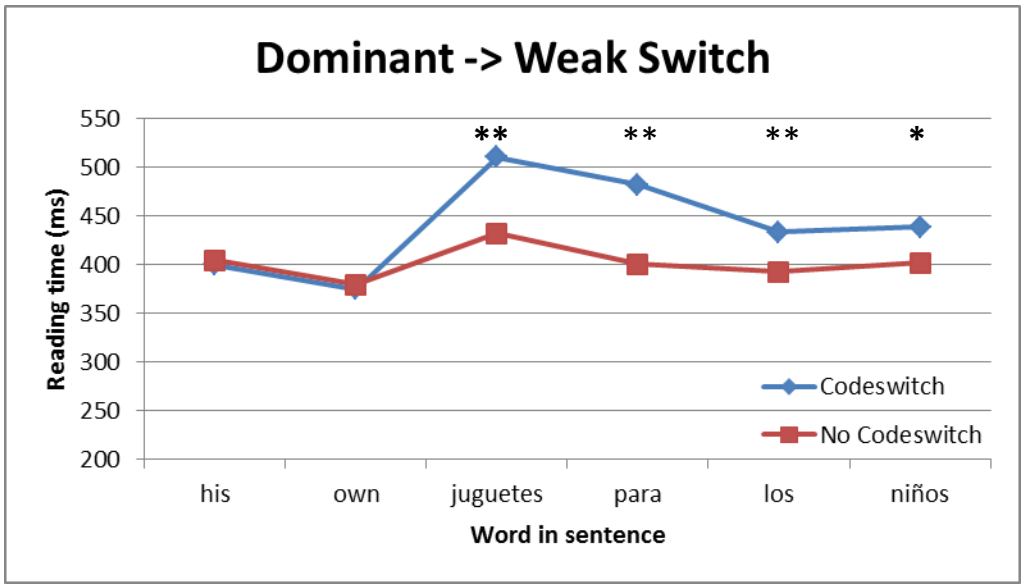

Figure **3-4**: Reading times to dominant to weak codeswitched (blue) and non-switched sentences (red). Here, *juguetes* indicates the onset of the codeswitch. +: $p < .10$; *: $p < .05$; **: $p < .01$; ***: $p < .001$.

Discussion

This experiment investigated how Spanish-English bilinguals read sentences that contain intrasentential codeswitches in both language switching directions. In a word-by-word self-paced reading task, bilinguals read sentences that either switched languages or not. The results show that there is an overall effect of codeswitching such that the codeswitched word and the 3 subsequent words that remained in the codeswitched language were read more slowly than non-switches, but subsequent analyses showed that these switching costs were only significant when switching from the dominant into the weaker language, and not vice versa.

The observation that switching costs are larger when switching into the weaker language differs from the earlier language switching research presenting a series of single, unrelated items

(words, digits, pictures). In these studies, a larger switch cost is found when switching into the dominant language (e.g., Meuter & Allport, 1999), which is thought to be the result of inhibition of the dominant language while processing in the weaker language. In the case of sentential codeswitching, however, where words are embedded in a meaningful context, inhibition does not appear to play the same role. Rather than having to exert inhibition on a trial-by-trial basis, bilinguals work to incorporate the information they receive throughout the sentence to form a coherent message. They must dynamically manage the relative levels of activation of words from their two languages to ensure successful comprehension.

However, because the switch from dominant to weak was compared to dominant non-switch sentences, these results could simply reflect weaker sentence reading comprehension in the weaker language than in the dominant language. Indeed, there is an effect of proficiency on reading times. When comparing dominant and weak unilingual (i.e., non-switched) sentences, words were read faster in the dominant language than in the weaker language (first critical word: $F(1,19) = 7.367$, $p = .014$; second critical word: $F(1,19) = .800$, $p = .382$; third critical word: $F(1,19) = 9.168$, $p = .007$; fourth critical word: $F(1,19) = 20.424$, $p < .001$; fifth critical word: $F(1,19) = 6.309$, $p = .021$; sixth critical word: $F(1,19) = 3.691$, $p = .07$), confirming that participants really were more dominant in their dominant language. We therefore conducted an additional analysis in which dominant to weak switching was compared with unilingual (i.e., non-switched) weak sentences. With the exception of the codeswitched word itself, these analyses yielded a comparable pattern of switching costs (codeswitched word: $F(1,19) = .002$, $p = .967$; one word after codeswitched word: $F(1,19) = 4.063$, $p < .058$; two words after codeswitched word: $F(1,19) = 6.338$, $p = .021$; three words after codeswitched word: $F(1,19) = 2.608$, $p = .123$). Therefore, the observed switching effect represents a true interaction between the effect of an intrasentential language switch and proficiency the effect of switching into the weaker language, not just reading in the weaker language.

Next, we will use ERPs to examine the neural mechanism underlying the comprehension of intra-sentential code-switching, and to study to what extent the neural response to codeswitches matches that found in the behavioral reading times.

Chapter 4

Experiment 2: ERP codeswitching

Experiment 2 used ERPs to investigate the nature of processing of sentential codeswitches in the same materials as in Experiment 1. Previous ERP studies of sentential codeswitching suggest that switches incur extra processing effort as compared to non-switches. Two studies (Moreno et al., 2002; Van der Meij, 2010) suggest that codeswitched words will elicit a biphasic response consisting of an N400 followed by a late positivity. These two studies each examined codeswitching in only one direction, removing the ability to determine if direction modulates the switch cost. Proverbio et al. (2004) included both directions of switching and found only an N400 response, but their sentences were blocked by type. The current experiment seeks to improve upon the previous literature by examining the processing of sentential codeswitching in both language switching directions using current ERP methodology practices.

If ERP responses follow the pattern found in the self-paced reading study, we expect to find that codeswitches will incur extra processing effort, but only when switching into the weaker language. Given the previous literature, we expect a biphasic response. However, given that these bilinguals are highly proficient and codeswitch frequently in their daily lives, we might not find the N400 effect as they should have less difficulty integrating the codeswitched word at a lexical level.

Methods

Participants

28 Spanish-English bilinguals were tested. Data from two participants were discarded due to excessive blink artifact in the EEG signal and data from another participant was discarded due to insufficient accuracy on the comprehension questions during the codeswitching task. Data from the remaining 25 participants (20 female) were analyzed (Age: $M = 23.08$, $SD = 4.8$). All were native speakers of Spanish who spoke English as an L2. All were right-handed and reported normal or corrected-to-normal vision, and no brain trauma. Participants varied in the dialect of Spanish spoken, with the majority of individuals speaking Central or South American Spanish. Age of acquisition of L2 English varied across participants ($M = 6.88$, $SD = 4.4$). Participants' self-ratings of their English production and comprehension skills as well as objective measures of proficiency indicate that they were highly proficient speakers of English (see Table 4-1). All but 4 participants reported codeswitching frequently in their daily life. Participants were recruited from the Penn State community via flyers and word-of-mouth and were paid $10/hour for their participation. All participants provided informed consent before participating in the experiment.

Table **4-1**: Individual difference measures for participants' dominant and weak languages. Means are reported; standard deviations are in parentheses.

Language Proficiency Measures		
	Dominant	Weak
Self-rated production (out of 10)	9.1 (*0.9*)	7.9 (*1.4*)
Self-rated comprehension (out of 10)	9.6 (*0.6*)	8.7 (*1.0*)
Sentence Reading Question Accuracy (%)	88.7% (*8.1*)	83.8% (*10.5*)
Sentence Reading Average RT (ms)	320 (*87*)	401 (*128*)
LDT Accuracy (%)	91.6% (*5.7*)	86.6% (*6.5*)
LDT Overall RT (ms)	656 (*112*)	851 (*283*)
BNT Accuracy (%)	67.0% (*10.4*)	50.9% (*15.6*)
BNT RT (ms)	1109 (*262*)	1290 (*278*)
Cognitive Measures		
Flanker Effect (ms)	54.80 (*23.3*)	
O-span Recall (out of 60)	34.37 (*12.9*)	

Materials and Procedure

Materials for Experiment 2 were identical to Experiment 1, including the codeswitching task as well as the language proficiency and cognitive measures (see Table 4-1 for individual difference measures).

For Experiment 2, the codeswitching task was performed while ERPs were recorded. Participants were seated in a comfortable chair about 3 feet from the computer in a sound-attenuated darkened chamber. An elastic cap (Brain Products ActiCap) with 31 active Ag/AgCl electrodes was placed on the participant's head. Electrode locations consisted of five sites along the midline (Fz, FCz, Cz, Pz, Oz) and 26 lateral electrodes: FP1/2, F7/8, F3/4, FC5/6, FC1/2, T7/8, C3/4, CP5/6, CP1/2, P7/8, P3/4, O1/2, PO9/10. In order to monitor vertical eye movements/blinks, bipolar recordings were made above and below the left eye, and the outer canthus of each eye. Electrodes were referenced to a vertex reference (electrode FCz) and re-referenced offline to an average of the left and right mastoids.

The electroencephalogram (EEG) was amplified by a NeuroScan SynampsRT amplifier using a .05hz-100hz bandpass filter and continuously sampled at a rate of 500hz. An off-line 30Hz low-pass filter was applied. Electrode impedances were kept below 10 kΩ. For each participant, separate ERPs are averaged off-line at each electrode site for each experimental condition, relative to a 200 ms prestimulus baseline. Trials contaminated with eye artifact or amplifier blockage (dominant to weak codeswitch: 10.7%; dominant non-switch: 11.2%; weak to dominant codeswitch: 11.7%; weak non-switch: 11.4%) were not included.

In contrast to Experiment 1, the sentences in the ERP experiment were presented using rapid serial visual presentation (RSVP). Trials began with a self-paced "Ready?" screen to allow

participants to blink and prepare for the upcoming sentence. Next, a fixation cross appeared for 300 ms, followed by the sentence presented word-by-word automatically: words were presented for 300 ms with a 200 ms blank interstimulus interval (ISI). Following the final word of the sentence, a blank screen appeared for 700 ms. All other details remained the same.

Participants completed the LHQ during setup of the EEG cap. Following the codeswitching task, participants completed the language proficiency and cognitive measures in the same manner as in Experiment 1.

Data analysis

Analyses of the critical words were conducted on mean amplitude values with a baseline of 200 ms activity preceding word onset. In accordance with previous studies and visual inspection of the data, two time windows were analyzed, corresponding to the epochs of the N400 and LPC: 300-500 ms and 500-900 ms post word onset.

For all comparisons of interest, two repeated measures analyses of variance (ANOVA) were performed to examine the scalp distribution of the ERP effect. One ANOVA focused on midline electrodes and included a factor of electrode group that had three levels: midline (Fz, Cz, Pz). The second ANOVA included a factor of anteriority (anterior, posterior) and laterality (right, left hemisphere). For these factors, electrodes were grouped into regions of interest: right frontal hemisphere ("RF"; F4, F8, FC2, FC6); left frontal hemisphere ("LF"; F3, F7, FC1, FC5); right posterior hemisphere ("RP"; CP2, CP6, P4, P8); left posterior hemisphere ("LP"; CP1, CP5, P3, P7).

A Greenhouse-Geisser correction was applied to analyses with more than one degree of freedom in the numerator. Significant interactions were examined further with simple effects tests and planned comparisons.

Analyses first examined if there was a general switch cost, across both directions of language switching. To do this, mean amplitudes, separately for the two time windows, were compared for the codeswitched words (and matched controls) in sentences containing codeswitches (conditions 1 and 3) to non-switched sentences (conditions 2 and 4). Second, we examined switch costs as a function of the direction of the language switch. As in Experiment 1, all analyses were done based on participants' dominant and weak languages. That is, examining effects of switching from the dominant to the weak language, and from the weak to the dominant language. Dominance was again determined by a composite measure of the language proficiency tasks. In this study, 14 participants were English dominant and 11 were Spanish dominant.

Results

Behavioral Results

Participants averaged 87.0% (*SD* = 4.4) accurate on the comprehension questions, indicating that they understood the sentences and were sufficiently engaged in the task.

Overall ERP Switch versus Non-switch sentences

Grand mean waveforms for switch and non-switch conditions are plotted in Figure 4-1. Two ANOVAs were conducted to examine the effect of codeswitching and the scalp distribution of the effects for both the 300 – 500 ms (N400) and 500–900ms (LPC) time windows. A midline 3-way ANOVA consisted of the factors Start Language (2; Dominant, Weak), Switch (2; Switch, No Switch), and Electrode (3; Fz, Cz, Pz). A lateral 4-way ANOVA consisted of the factors Start

Language (2; Dominant, Weak), Switch (2; Switch, No Switch), Anteriority (2; Anterior, Posterior), and Hemisphere (2; Left, Right).

Visual inspection reveals no differences between the two conditions in either time window. Additionally, there were no significant effects in the 300 – 500ms time window (all *p*s > .17) or main effects in the 500 – 900ms time window (all *p*s > .12). However, there was a significant interaction between start language and switch in the 500 - 900ms time window (midline: $F(1, 24) = 4.85$, $p = .037$; lateral: $F(1, 24) = 4.381$, $p = .047$). Given this interaction and our *a priori* hypotheses about differences related to direction of language switch, we will examine each language direction separately below.

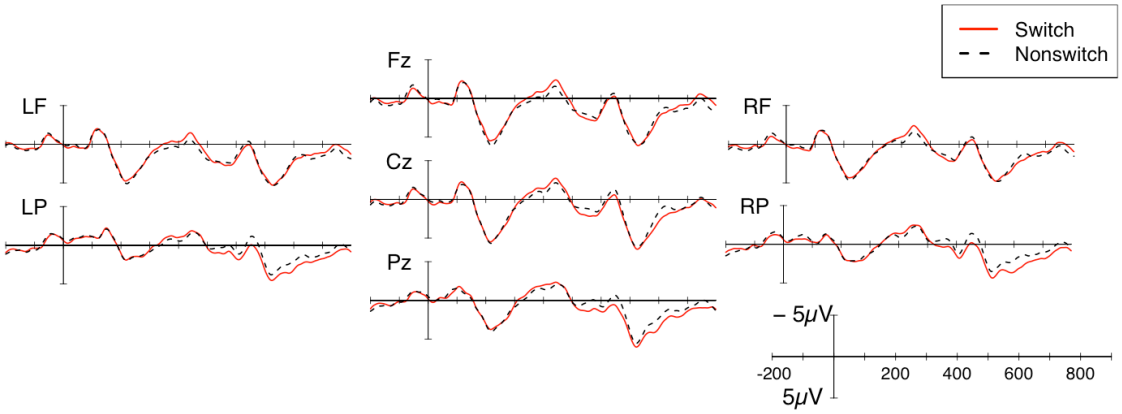

Figure **4-1**: Grand mean waveforms for switch (red) and non-switch (dashed black) conditions. Onset of codeswitched word is indicated by vertical bar. The calibration plot shows amplitude is plotted on the y-axis (negative plotted up). Time is plotted on the x-axis; each tick mark indicates 100ms. LF = left frontal; RF = Right frontal; LP = left posterior; RP = right posterior.

ERP Switching from Weak into Dominant language

Grand mean waveforms for switch and non-switch conditions in the weak to dominant direction are plotted in Figure 4-2. Visually, there are no differences between the conditions. In the 300 – 500ms time window, there were no significant differences between the conditions (all

*p*s >.13). In the 500 – 900ms time window, there was an interaction between switch and anteriority ($F(1, 24) = 7.675$, $p = .011$), but follow-up ANOVA analyses revealed no significant differences (all *p*s > .27). In the weak to dominant direction, there were no significant differences between switched and non-switched sentences.

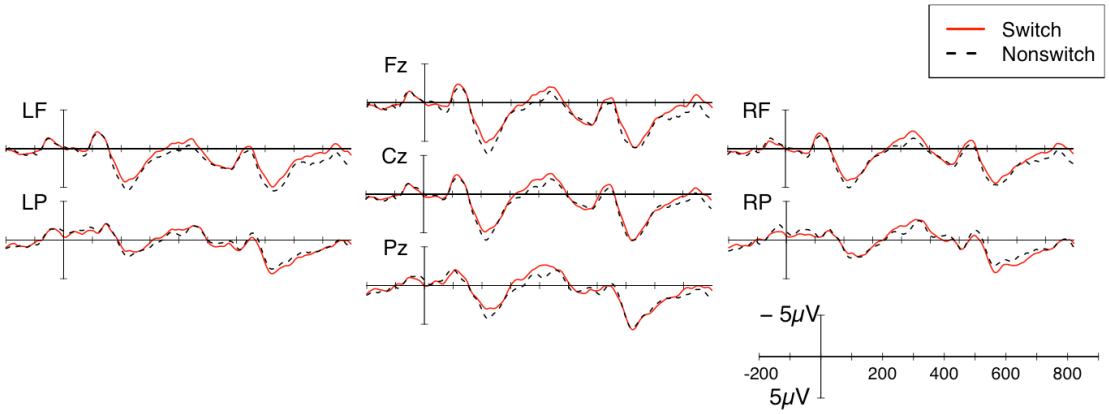

Figure **4-2**: Grand mean waveforms for switch (red) and non-switch (dashed black) conditions in the weak to dominant direction. Onset of codeswitched word is indicated by vertical bar. The calibration plot shows amplitude is plotted on the y-axis (negative plotted up). Time is plotted on the x-axis; each tick mark indicates 100ms. LF = left frontal; RF = Right frontal; LP = left posterior; RP = right posterior.

ERP Switching from Dominant into Weak Language

Grand mean waveforms for switch and non-switch conditions for the dominant to weak direction are plotted in Figure 4-3. Visual inspections reveal a late positivity over posterior sites starting around 500ms. In the 300 - 500ms time window, there was a switch by electrode interaction ($F(2, 48) = 4.841$, $p = .026$), but follow-up ANOVAs revealed no differences (all *p*s > .16). However, in the 500 - 900ms time window, there were main effects of switch (midline: $F(1, 24) = 5.583$, $p = .027$; lateral: $F(1, 24) = 6.221$, $p = .02$) wherein the switch condition is more positive than the non-switch condition. Additionally, there were interactions with scalp topography (midline switch by electrode: $F(2, 48) = 3.506$, $p = .065$; lateral switch by anteriority:

$F(1, 24) = 3.276$, $p = .083$). Follow-up ANOVAs show that the switch condition is more positive than the non-switch condition at Cz ($F(1,24) = 5.916$, $p = .023$), Pz ($F(1, 24) = 7.732$, $p = .01$), and lateral posterior sites ($F(1, 24) = 8.332$, $p = .008$). In the dominant to weak direction, there is a late, posterior positivity to codeswitches.

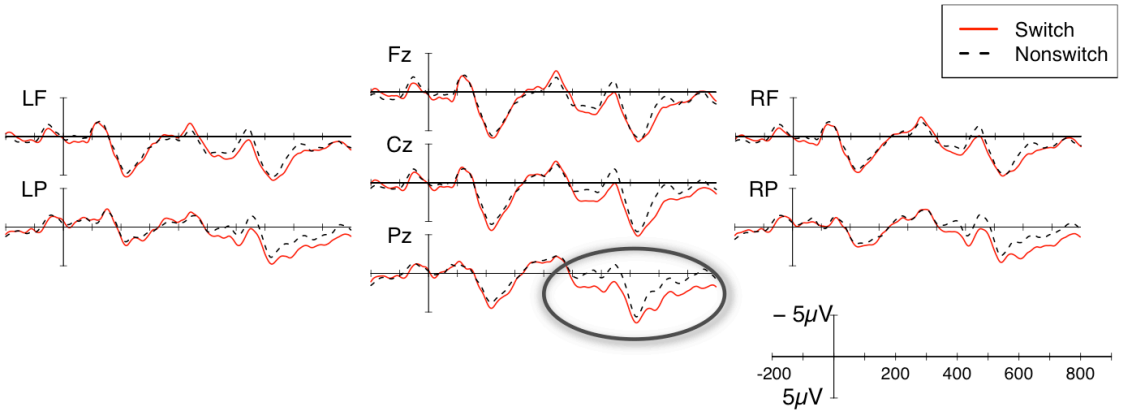

Figure **4-3**: Grand mean waveforms for switch (red) and non-switch (dashed black) conditions in the dominant to weak direction. Onset of codeswitched word is indicated by vertical bar. The calibration plot shows amplitude is plotted on the y-axis (negative plotted up). Time is plotted on the x-axis; each tick mark indicates 100ms. The circle highlights the late positivity effects. LF = left frontal; RF = Right frontal; LP = left posterior; RP = right posterior.

Discussion

In this experiment, Spanish-English bilinguals read codeswitched and non-switched sentences while ERPs were recorded. ERPs at the first codeswitched word across both language switching directions revealed no apparent effects of the codeswitch. However, differences emerged when each language switching direction was analyzed separately. As in Experiment 1, there was no effect of the codeswitch when switching from the weaker into the dominant language, but there was an increased LPC component to switched sentences when going from the dominant into the weaker language.

The LPC has been linked to the processing of unexpected stimuli or updating of mental representations (sometimes referred to as the P3; Donchin, 1981; Polich, 2007). In the current study, switched and non-switched sentences were presented in a mixed fashion where participants' could not predict whether a codeswitch would occur on a given trial. Moreover, the codeswitches appeared at different points in the sentences (occurring anywhere between word 7 and word 16). Given that this LPC effect only occurred when switching into the weaker language, this extra processing due to the unexpectedness is only required when there is also a need to activate the weaker language. Even though switches into the dominant language are also unexpected, there is no cost, possibly because the words from the dominant language are more readily available to the bilingual.

Of the three previous ERP intrasentential studies, the two studies that found LPC modulations also had unpredictable codeswitches (Moreno et al, 2002; Van der Meij, 2010), whereas the Proverbio et al (2004) study did not find an LPC effect most likely because their sentences were presented in blocked list and participants thus knew that a codeswitch was going to appear on every trial of a given block. Moreover, the codeswitch was always on the sentence-final word.

Alternatively, this positivity could be a manifestation of the P600 (e.g., Osterhout & Holcomb, 1992), which overlaps in latency and scalp distribution with the LPC, but is most typically associated with syntactic violations (see also Van der Meij et al., 2010). Despite the fact that codeswitches do not constitute syntactic violations, it is possible that the P600 merely reflects the language-specific properties of the more domain-general LPC or P3 effect (Coulson, King, & Kutas, 1998), which indexes integration at a higher level, e.g., across the entire sentence.

A final possibility is that this late positivity reflects error monitoring (Kolk & Chwilla, 2007), namely the interaction between the executive control and linguistic systems. In the case of codeswitches, it could be that the first word of the switch could appear to the comprehender to be

a speech error given the difference in language. To test this explanation, we correlated the magnitude of the LPC (at site Pz) with the magnitude of the Flanker effect and the O-span score. If this LPC reflects error monitoring, there should be a positive relationship between the LPC and the Flanker effect where a larger LPC is related to worse inhibitory control (larger Flanker effect), and a negative relationship between the LPC and O-span recall, where a larger LPC is related to worse working memory (fewer items recalled). No support was found for this idea (Flanker: $r(25) = -.198$, $p = .342$; O-span: $r(25) = .255$, $p = .228$). Obviously, we cannot entirely rule out the error monitoring hypothesis as a possible explanation on the basis of this correlational analysis, but the analysis does suggest that there is not a strong relationship between the magnitude of the switch-related late positivity component and executive functioning as measured by the Flanker test and the O-span test.

While the current study did not find a switch-relatad modulation of the N400, previous studies have found modulations of the N400 (Moreno et al, 2002; Proverbio et al, 2004; Van der Meij, 2010), implicating lexico-semantic access in the comprehension of codeswitches. The N400 in the Proverbio et al study was likely due to the fact that half of the codeswitched words were actually semantically incongruous with the sentence context, resulting in a classic N400 to the implausibility manipulation. In the Van der Meij et al and Moreno et al studies, however, both lower and higher proficiency bilinguals showed an N400 to the codeswitches without any semantic implausibility manipulation, but might relate to accessing the codeswitched word. The distribution of the N400 in non-constrained sentences in Moreno et al. (2002) was actually more left frontal, resembling a LAN effect (e.g., Friederici, Pfeifer, & Hahne, 1993; King & Kutas, 1995). Moreover, the higher proficiency bilinguals in Van der Meij et al (2010) showed a LAN effect in addition to the N400 effect found in both proficiency groups. The LAN is thought to reflect automatic syntactic processing, or working memory demands.

Moreno et al (2002) took this LAN effect to indicate that codeswitches do not require similar lexical access demands as a within-language switch, but might require some processing relating to integrating the grammatical properties of the two languages. However, grammatical integration is not exactly necessary in the case of a codeswitch on a sentence-final noun (all codeswitched words were sentence final words in Moreno et al.), except as a by-product of accessing a word from the other language and its associated grammatical properties. In the case of the codeswitches in Van der Meij (2010), this grammatical integration makes sense given that the switches occurred on adjectives, which differ in their placement across English (before the noun) and Spanish (after the noun). That only the higher proficiency speakers showed this LAN effect indicates that lower proficiency bilinguals may not be as sensitive to word order differences across languages.

A possible explanation for the absence of an N400-like negativity in the present study is that the bilinguals we tested were habitual codeswitchers. The lack of a negativity may be a function of the bilinguals' habitual codeswitching in their daily life and that they are used to processing codeswitched sentences. To test this hypothesis, I examined the processing of intrasentential codeswitches in Spanish-English bilinguals in Granada, Spain who do not codeswitch in their daily lives (Litcofsky & Van Hell, in prep). These bilinguals were native Spanish speakers who were highly proficient in English, though more unbalanced than the bilinguals in Experiment 2. Moreover, given that English is somewhat uncommon in Granada, these bilinguals do not codeswitch frequently. The same materials as in Experiments 1 and 2 were used, and ERPs were recorded. A modulation of the LPC was found when switching into the weaker language, but no effect of switching was found when switching into the dominant language. These results show that the LPC is found in both habitual (Experiment 2) and non-habitual (Spain bilinguals) codeswitchers and that in both groups there is no evidence of an N400 modulation. Moreover, the same asymmetry effect was found where switching from the dominant

to weaker language incurred switching costs, but switching from the weak to dominant language incurred no extra processing. Thus, the basic mechanism of processing codeswitches appears to reflect an interaction between the processing of an unexpected language switch and the bilinguals' relative proficiency in their two languages, which occurs in both bilinguals who codeswitch frequently and those that do not.

Chapter 5

Part 1: General Discussion for Experiments 1 and 2

Experiments 1 and 2 investigated how intrasentential codeswitches are processed at a behavioral level (self-paced reading paradigm; Experiment 1) and a neurocognitive level (ERPs; Experiment 2). Across these studies, consistent evidence of an asymmetry was found in which more effortful processing is required when switching into the weaker language, but no extra processing is required to switch into the dominant language. This pattern is opposite to that found in the single item language switching studies (e.g., Meuter & Allport, 1999).

The dominant theory regarding the mechanism underlying language switching suggests that the costs arise due to inhibition of the lexical system of one language by the extra-linguistic control system while processing the other language (Green, 1998). The asymmetry arises from having to exert more control when inhibiting the dominant language (often L1) while processing the weaker language (often L2) and subsequently releasing this inhibition when the dominant language is encountered than when inhibiting the weaker language while processing the dominant language.

Another account of the asymmetry, as discussed by Bobb and Wodniecka (2013) in their review of language switching studies, is based on persistent activation, rather than inhibition (Philipp, Gade, & Koch, 2007). That is, when processing any given trial, there is a certain amount of activation needed to complete the task, and then when a switched trial is subsequently encountered, this activation of the other task persists and this interference must be resisted. In this case of switching from weak to dominant, because the weaker language task is more difficult, more activation is needed, and thus more activation persists into the switch trial. Conversely, a relatively smaller amount of activation is needed for dominant-language trials, so there is less persisting activation that will interfere on a dominant to weak switch.

However, in the case of intrasentential codeswitching, the language switches occur within an item, rather than across a series of items, and the goal is always to extract meaning from the linguistic input. In comprehending the input, it is necessary to integrate both the lexical and syntactic information in order to extract the higher-level sentence structure and meaning. What mechanism then results in the cost for switches from the dominant to weaker language?

While the persistent activation account (Bobb & Wodniecka, 2013; Philipp et al, 2007) does not extend directly to the processing of intrasentential codeswitching as the switches occur within an item, the idea of differential activation with respect to the two languages may explain the asymmetry found in the current study. In order to successfully comprehend a codeswitched sentence, bilinguals must dynamically manage the activation of the two languages. When processing the dominant language, some amount of activation or effort is needed to process the words. When the bilingual then encounters words from the weaker language, the activiation levels of the two languages need to be adjusted and the weaker language must be activated more strongly. Given that proficiency in the weaker language is lower than in the dominant language, the resting state activation level of the weaker language is lower and activating the weaker language is more taxing, resulting in a large switch cost. When switching from the weaker into the dominant language, the bilingual switches to a language with a high resting state activation level, so the switch will be cognitively less demanding and less costly.

If this account can explain the results found in Experiments 1 and 2, it would follow that individuals who are more unbalanced in their two languages show a larger switch cost going into the weaker language since they would need to exert even more effort to activate the weaker language. This prediction was tested by correlating the magnitude of the switch cost (both behavioral reading times and the ERP LPC effect) with the degree of relative proficiency on three measures, the Boston Naming task (BNT), the lexical decision task (LDT), and the unilingual self-paced sentence reading task. For the behavioral self-paced reading task, the magnitude of the

switch cost at the codeswitched word in the dominant to weak condition correlated significantly with BNT Accuracy relative dominance (r = .597, p < .001), LDT Accuracy relative dominance (r = .662, p = .001), and LDT RT relative dominance (r = .495, p = .026). The relationship between the magnitude of the behavioral switch cost and relative dominance persists throughout the subsequent words in the codeswitched sentences (correlations between one word after the codeswitch word and LDT RT relative dominance (r = .432, p = .06); between the second word after the codeswitch word and BNT Accuracy relative dominance (r = .489, p = .034), LDT Accuracy relative dominance (r = .581, p = .007), LDT RT relative dominance (r = .713, p < .001), and sentence reading average RT relative dominance (r = .453, p = .045); between the third word after the codeswitch word and BNT Accuracy relative dominance (r = .562, p = .012), LDT Accuracy relative dominance (r = .428, p = .06), and LDT RT relative dominance (r = .484, p = .03). This relationship between the magnitude of the switch cost in the dominant to weak condition and relative language proficiency also held for the ERP study (correlation between the magnitude of the LPC effect and BNT Accuracy relative dominance r = .494, p = .023, LDT RT relative dominance r = .429, p = .033). Similarly, Moreno et al. (2002) found a correlation between proficiency in Spanish (the codeswitched language) and the timing and magnitude of the LPC where individuals who were less proficient in Spanish showed a later onset and larger magnitude of the LPC. These correlation analyses suggests that the switching costs found for sentential codeswitches going from dominant to weak relate to the effortful activation of the weaker language.

Codeswitching represents an extreme flexibility of the languages, especially given the claim that bilinguals inhibit one language in order to speak in the other (e.g., Green, 1998; Misra, Guo, Bobb, & Kroll, 2012). Does codeswitching, then, exercise control mechanisms and result in enhanced cognitive functions in bilinguals who codeswitch frequently as compared to those who do not codeswitch?

There are suggestions that there is a relationship between switching and executive function. Abutalebi and Green (2008) argue that the neural network underlying language switching (e.g., Meuter & Allport, 1999) is the same as that underlying more general task switching and control tasks. Thus, it is plausible that by exercising this network through language switching, it would become more efficient in other domains. However, the current findings are inconclusive (e.g., Prior & MacWhinney, 2010; Prior & Gollan, 2011; Soveri, Rodriguez-Fornells, & Laine, 2011; Yim & Bialystok, 2012; Weissberger, Wierenga, Bondi, & Gollan, 2012). For example, Soveri, Rodriguez-Fornells, and Laine (2011) found a significant relationship between the amount of reported codeswitching in daily life and mixing costs in a set shifting task, but not with switching costs. In the present study, we examined whether there were significant relationships between measures of executive function (O-span task, a measure of working memory, and Flanker task, a measure of inhibitory control) and self-reports of frequency of daily switching (switching into the dominant language, switching into the weaker language, contextual switching, and unintended switching, as determined via the Bilingual Switching Questionnaire; Rodriguez-Fornelles et al., 2012). Additionally, we examined whether the processing of codeswitches (in terms of the magnitude of the LPC in dominant to weak switches) correlated with self-reports of frequency of daily switching and measures of executive function.

There was a positive correlation between O-span recall score and self-reported frequency of switching into the weaker language (Expt 2 participants: $r(20) = .602$, $p = .005$, but not in Expt 1 participants: $p = .46$), such that individuals with better working memory more frequently switch into their weaker language. However, correlations between O-span and the other codeswitching measures (switching into L1, contextual switching, and unintended switch) as well as between Flanker and the codeswitching measures were not significant (O-Span and other switching measures: Expt 1 all ps > .59, Expt 2 all ps > .36; Flanker and all switching measures: Expt 1 all ps > .14, Expt 2 all ps > .31). That there was a correlation between O-span, a measure of working

memory, and switching into the weaker language (but not switching into the dominant language) may suggest that switching into the weaker language requires extra cognitive processing. This asymmetry parallels the ERP finding that codeswitching into the weaker language necessitates extra processing. Additionally, we tested whether the magnitude of the switch-related LPC was correlated with executive function or daily switching measures. It turned out that none of these correlations were significant in the dominant to weak condition (magnitude of the LPC and reports of frequency of daily switching (all *p*s > .63), LPC magnitude and O-span ($p = .228$); LPC magnitude and Flanker ($p = .173$). Likewise, in the weak to dominant condition none of the correlations between LPC magnitude and executive function measures were significant (*r*'s ranged from .014 to .245, all *p*s > .28). Thus, in the present data there is weak evidence for a relationship between codeswitching and executive function.

In summary, codeswitches in this study elicited LPC responses when switching from the dominant to weaker language, which may reflect the intersection of incorporating an unexpected event and activating the weaker language. Yet, all of this research addresses how codeswitches are processed, but does not speak to why the switches occur. Next we will examine one prominent linguistic theory, namely the triggering theory, which proposes a mechanism for why codeswitches occur.

Chapter 6

Part 2: Linguistic perspectives on codeswitching

While the psycholinguistic and neurocognitive research on language switching and codeswitching focused mainly on processing costs associated with switching, these studies do not address the question of *why* codeswitching occurs and what the mechanisms are that drive bilinguals to switch into the other language. Linguistic approaches to codeswitching focuses mainly on describing the structural (Clyne 1967; Clyne 2003; Deuchar, 2005; Dussias, 2003; MacSwan, 2000; Myers-Scotton, 1993; Myers-Scotton, 2006; Poplack, 1980; Toribio, 2001) and situational (Gardner-Chloros, 2001; Gumperz, 1982) factors governing the occurrence of codeswitches. For the most part, these theories describe codeswitches as they naturally occur in bilingual speech, but do not rely on experimental manipulation as in the behavioral and neurocognitive studies discussed above. Here, we will first give an overview of linguistic theories addressing codeswitching, and then focus the triggering theory (Clyne, 1967, 2003), which will be tested in this proposal, and its implications for the processing of codeswitches.

Two theories of the structural aspects of codeswitching focus on the requirement for a similarity of the syntax in each language. The equivalence constraint (Poplack, 1980) states that codeswitches occur only when the word order is the same across languages. For example, in a confederate-scripted dialogue codeswitching experiment, Kootstra, Van Hell, and Dijkstra (2010) found that bilinguals produced more codeswitches when both Dutch and English called for subject-verb-object (SVO) order as compared to when Dutch called for SOV order and English for SVO order. Similarly, the congruence theory (Deuchar, 2005) emphasizes that codeswitches are likely to occur when there is equivalence across both the grammatical category and the word order of the element. That is, the item to be expressed must be represented by the same

grammatical class (e.g., adjective) in both languages and the element must be placed in the same location in both languages (e.g., after the noun). When only one of these criteria are met, codeswitches are less likely to occur, and when neither of these are met, codeswitching should not occur.

Also describing the structural features of codeswitched utterances, the 4M/Matrix Language Framework (MLF) model of Myers-Scotton (1993, 2006) focuses on the syntactic frame of the utterance. The MLF claims that one language acts as the "matrix language" which provides the morphosyntactic structure of the utterance and the other language acts as the "embedded language" which provides linguistic constituents that are embedded in the matrix language. For example, in the sentence "Ils passont des petites notes *back and forth* à *each other*," French is the matrix language and English the embedded language (Myers-Scotton, 2006). Finally, generative approaches (MacSwan, 2000; Toribio, 2001) claim that codeswitching is governed by the same syntactic rules as monolingual speech. For example, the Functional Head Constraint (Toribio, 2001) states that linguistic elements (e.g., a functional head and its complement) must be drawn from the same lexicon (i.e., the same language). According to this theory, codeswitching can only occur between functional elements.

Finally, the permissibility of structural boundaries for switching can be affected by the nature of the lexical items involved in the switch. That is, Dussias (2003) found that English-Spanish bilinguals read sentences more slowly when there was a codeswitch between the auxiliary verb and the participle, but only when the auxiliary verb was *haber*, not when it was *estar*. These results suggest that the processing of codeswitching involves interaction between lexical and syntactic factors.

Focusing on the situational factors of codeswitching, socio-linguistic theories claim that codeswitching acts as a strategic resource for conveying social and rhetoric information (Auer, 1998; Gumperz, 1982), where the codeswitch is meaningful and reflects important information

about either the speaker or the discourse, and that codeswitching represents the flexibility of speech and the continuum between the languages and constituents (Gardner-Chloros, 1991).

These linguistic theories describe the structural aspects of codeswitching, but do not relate to psycholinguistic and neurocognitive research on language switching or codeswitching, or to functional and neural models of language processing. One linguistic theory of codeswitching that relates to psycholinguistic research, and that will be the focus of this project, is the triggering theory (Clyne, 1967; Clyne, 2003). Borne from qualitative observations of a corpus of German-English bilinguals in Australia, Clyne proposed that codeswitches are more likely to occur when in proximity to trigger words than not near triggers. Trigger words are words that activate both languages, such as *cognates* (words that share both form and meaning across languages, e.g., *piano/piano* in English and Spanish), *interlingual homophones* (words that share only form across languages, e.g., *pan/pan,* where *pan* means *bread* in Spanish), or *proper nouns* (e.g., *Barcelona*).

Broersma and de Bot (2006) quantitatively examined the triggering theory by examining a bilingual speech corpus drawn from three Dutch-Moroccan Arabic bilinguals. They counted the number of codeswitches occurring in clauses as a function of the presence of a trigger and found that there was a larger percentage of codeswitches in clauses that contained a trigger word than in clauses not containing a trigger word. Broersma (2009) replicated this finding of more codeswitches present in clauses that contain a trigger in the speech of a single Dutch-English bilingual. These results provide support for the triggering theory, and given that Dutch and English share more cognates than Dutch and Moroccan Arabic, the combined studies suggest that the triggering mechanism persists in the face of a large amount of co-activation of a bilingual's two languages. Despite this support of the triggering theory, these studies have focused only on corpus data and these corpora have only included a handful of bilingual speakers; experimental support for the triggering theory is needed in order to determine the cognitive and neural processes associated with the triggering mechanism as it relates to codeswitching.

The basic mechanism of the triggering theory, namely that trigger words increase the likelihood of codeswitches, lines up well with current psycholinguistic theories of language co-activation by cognates, one of the types of trigger words as postulated by the triggering theory. That is, cognate words are recognized faster than noncognate words in both production (e.g. Costa, Caramazza, & Sebastián-Gallés, 2000; Gollan, Forster, & Frost, 1997; Hoshino & Kroll, 2008) and comprehension (e.g., Dijkstra, Grainger, & Van Heuven, 1999; Midgley, Holcomb, & Grainger, 2011; Van Hell & Dijkstra, 2002). In production, Costa, Caramazza, and Sebastián-Gallés (2000) had highly proficient Catalan-Spanish bilinguals perform a picture-naming task in which half of the images depicted a cognate word and half a noncognate word. Bilinguals named the cognate pictures faster than the noncognate pictures, while comparable Spanish monolinguals named the two types of pictures similarly.

A similar cognate advantage has been found in comprehension studies. For example, Gollan et al. (1997) presented Hebrew-English and English-Hebrew bilinguals with between-language word pairs. In each pairing, the first word, or prime, was preceded by a string of hash marks to limit conscious awareness of the prime, and then immediately followed by a target word. In addition to nonword targets, half of the target words were cognates between Hebrew and English and half were noncognate translations. These target words were preceded by either the repetition (within-language)/translation (between-language) or an unrelated control prime. Participants' task was to decide whether the target item was a word or not (lexical decision task). Hebrew-dominant bilinguals showed stronger priming for cognate translations than noncognate translations (though noncognates did produce significant priming) when the prime was in L1 Hebrew and the target in L2 English. When the language was reversed (i.e., L2 English prime and L1 Hebrew target), there was no differential priming for cognate as compared to noncognate translations. English-dominant bilinguals showed a similar pattern of stronger between-language priming for cognate translations than noncognate translations in L1→L2 priming, and no

translation priming for L2→L1 pairs. Thus, there is significant cognate priming (across orthographic scripts), but only in the L1→L2 direction. Dijkstra, Grainger & Van Heuven (1999) investigated cognate processing in Dutch-English bilinguals using a progressive demasking task, where participants had to identify a word as it was slowly appearing on a screen, and a lexical decision task. Using L2 English words that shared orthography, phonology, and/or semantics with the L1 Dutch translations as well as unrelated controls, participants responded more quickly in the progressive demasking and lexical decision tasks to L2 words that had some overlap with their L1 translations than words without such overlap.

Importantly, in addition to showing facilitation in L2, cognates also show this effect in the L1. Van Hell and Dijkstra (2002) showed L1 cognate facilitation in Dutch-English-French trilinguals using a lexical decision task, where participants have to decide whether a string of letters constitutes a word or not, and a word association task, where participants have to come up with a word associated with the presented word. Stimuli were L1/Dutch words that were either cognates with L2/English or L3/French, or noncognates with either language. The trilinguals were faster on the word association and lexical decision tasks for words that were cognates with L2 than noncognates, but not for L3 cognates. Interestingly, trilinguals who were more proficient in their L3 did show facilitation for cognates with both L2 and L3, indicating that weaker languages (i.e., L2 or L3) can affect processing in L1, provided that proficiency in L2 or L3 is sufficiently high.

This effect of faster processing for cognates holds in sentences as well, though this effect can be mitigated in high constraint sentences (Schwartz & Kroll, 2006; Van Assche, Duyck, Hartsuiker, and Diependale, 2009; Van Hell & De Groot, 2008). Schwartz and Kroll (2006) examined the interaction of the processing of cognates and reading of high- and low-constraint sentences. Spanish-English bilinguals read L2 English sentences, presented word-by-word on a computer screen, and had to name out loud a critical item (indicated by red text). The sentences

were classified as high constraint if the sentence context was highly biased to the target word, and low constraint if it was not biased to the target word. Target words were either cognates or noncognates. Participants who were living in an L2 environment and those living in an L1 environment named cognates faster than noncognates, but only in low-constraint sentences. Similarly, Van Hell and De Groot (2008) found that cognates were responded to faster than noncognates in a lexical decision task and produced faster L1→L2 and L2→L1 translation, but only when presented in isolation or preceded by a low-constraint sentence, but not a high-constraint sentence. Importantly, this cognate facilitation effect was also found during processing of L1 sentences (Van Assche et al. 2009).

Chapter 7

Experiment 3: Behavioral cognate triggering

Experiment 3 examines the effect of cognate triggering on the processing of codeswitches in a self-paced reading task. If Clyne's (1967; 2003) triggering theory reflects a general cognitive mechanisms, it would predict that the presence of a cognate trigger will reduce the switch cost, i.e., codeswitches that are preceded by cognate triggers should be read more quickly than codeswitches preceded by noncognate controls. Moreover, we expect that this effect will be modulated by the direction of the language switch such that there will be a larger cognate triggering effect (i.e., larger reduction of RTs) when switching from the weaker into the dominant language, given that there are often larger cognate facilitation effects in the weaker language.

Methods

Participants

23 Spanish-English bilinguals were tested for this study. Data from two participants were discarded due to insufficient accuracy on the comprehension questions during the codeswitching task and data from one participant was discarded due to software error. 20 participants (10 female) remained (Age: M = 22.55, *SD* = 4.5). All were native speakers of Spanish who spoke English as an L2. Participants varied in the dialect of Spanish spoken, with individuals speaking Central or South American Spanish. Age of acquisition of L2 English varied across participants (M = 7.9, *SD* = 4.3). Participants' self-ratings of their English production and comprehension skills as well as objective measures of proficiency indicate that they were highly proficient speakers of English (see Table 7-1). All but 2 participants reported codeswitching in their daily

life. Participants were recruited from the Penn State community via flyers and word-of-mouth and were paid $10/hour for their participation. All participants provided written informed consent before participating in the experiment.

Table **7-1**: Individual difference measures for participants' dominant and weak languages. Means are reported; standard deviations are in parentheses.

Language Proficiency Measures		
	Dominant	Weak
Self-rated production (out of 10)	9.5 (*0.5*)	8.0 (*0.9*)
Self-rated comprehension (out of 10)	9.8 (*0.4*)	8.9 (*1.0*)
Sentence Reading Question Accuracy (%)	87.8% (*5.2*)	87.4% (*6.0*)
Sentence Reading Average RT (ms)	349 (*87*)	452 (*149*)
LDT Accuracy (%)	90.1% (*5.3*)	85.6% (*7.0*)
LDT Overall RT (ms)	716 (*130*)	887 (*237*)
BNT Accuracy (%)	73.3% (*9.6*)	43.5% (*12.3*)
BNT RT (ms)	1053 (*163*)	1349 (*260*)
Cognitive Measures		
Flanker Effect (ms)	61.3 (*21.5*)	
O-span Recall (out of 60)	41.75 (*8.0*)	

Materials and Procedure

Materials for the triggering task in Experiment 3 were drawn from the same set of materials as for Experiments 1 and 2. In addition to the four conditions described for Experiments 1 and 2 manipulating starting language and the presence of a codeswitch, an additional two conditions were created for the triggering task. One of the conditions started in English and one in Spanish, but both contained codeswitches. Critically, these conditions contained a cognate trigger prior to the codeswitch (see Table 7-2).

Table **7-2**: Experimental conditions. Cognate trigger = *carpenter* (Spanish: *carpintero*); non-cognate trigger = *shopkeeper* (Spanish: *tendero*); codeswitch = *toys* (Spanish: *juguetes*).

Condition	Language	Cognate Trigger?	Codeswitch?	Example
1	English	Yes	Yes	Every year, the carpenter makes his own *juguetes para los niños pequeños.*
2	English	No	Yes	Every year, the shopkeeper makes his own *juguetes para los niños pequeños.*
3	English	No	No	Every year, the shopkeeper makes his own *toys for the young children.*
4	Spanish	Yes	Yes	Cada año, el carpintero hace sus proprios *toys for the young children*
5	Spanish	No	Yes	Cada año, el tendero hace sus proprios *toys for the young children.*
6	Spanish	No	No	Cada año, el tendero hace sus proprios *juguetes para los niños pequeños.*

Constraints on sentence creation for the triggering conditions were as follows: the trigger word and codeswitched word appeared in the same clause; the trigger word and codeswitched word were separated by a minimum of two and maximum of five words; there were at least three words prior to the trigger. Additionally, cognate triggers did not contain any diacritic markers, but noncognate controls could have diacritics (21 out of 160 noncognate controls had diacritics). No cognate triggers or control words were repeated anywhere in the task.

Cognate triggers and noncognate control words were matched on length (number of letters) within and across languages, and frequency within language (see Table 7-3). Frequency counts for English words were based on the log lemma frequencies from the Celex lexical database (http://celex.mpi.nl; Baayen, Piepenbrock, & Van Rijn, 1993). Frequencies for Spanish were based on the sum of the singular and plural noun frequencies from the Diccionario de frecuencias de las unidada lingüisticas del Castellano (Alameda & Cuetos, 1995). Length was

measured as number of letters. Additionally, cognates and noncognate triggers for each base sentence were subjectively matched on animacy (animate vs. inanimate) and plausibility.

Table **7-3**: Mean length and frequency of cognate and noncognate triggers. Standard deviations are in parentheses.

	Cognate	**Noncognate**	**T-test**
Length			
English	7.26 (*1.96*)	6.94 (*2.01*)	$t(318) = 1.4632$ $p = .145$
Spanish	7.61 (*2.13*)	7.26 (*1.88*)	$t(312.92) = 1.557$ $p = 0.12$
T-test	$t(318) = 1.499$ $p = 0.135$	$t(318) = 1.465$ $p = 0.144$	
Frequency			
English	1.07 (*0.66*)	1.04 (*0.65*)	$t(318) = 0.498$ $p = 0.618$
Spanish	1.44 (*0.66*)	1.47 (*0.65*)	$t(318) = 0.477$ $p = 0.634$

The number of words between the trigger and codeswitched words (2-5) were also matched across conditions in comparisons of interest (condition 1 vs. 2: $t(318) = 0.00$, $p = 1.00$; condition 4 vs. 5: $t(318) = 0.058$, $p = .954$).

Norming studies were conducted with Spanish-English bilinguals to confirm that the subjective ratings of cognates and noncognate triggers as well as the plausibility of the sentences containing cognates and noncognate triggers. Bilinguals either did not complete any of the codeswitching or triggering experiments, or completed the ratings study after completing the codeswitching or triggering experiment. Ratings were made on a 7-point Likert scale with, for the cognate ratings, 7 indicating a high level of similarity between the Spanish and English words in orthographic and phonological form and 1 indicating no overlap on these dimensions. Cognate pairs were rated more similar ($M = 5.39$, $SD = 0.73$) than noncognate pairs ($M = 1.44$, $SD = 0.43$; $t(317) = 58.732$, $p < .001$). For the sentence plausibility ratings, a 7 indicated that the sentence was semantically coherent and 1 indicated semantic incoherence. Confirming subjective ratings,

sentences containing cognate triggers (M = 5.9, SD = 0.66) were rated equally plausible as those containing noncognate triggers (M = 5.9, SD = .73; $t(318)$ = .6, p = .549).

Stimulus lists for the triggering task were made in the same manner as for the codeswitching task. The triggering task was presented identically to the codeswitching task. The language proficiency and cognitive measures were the same as in Experiments 1 and 2.

Experimental session

The experimental session was conducted identically to that of Experiment 1 with the substitution of the triggering task for the codeswitching task.

Data analysis

Triggering task: To ensure that participants were reading the sentences with attention, accuracy on the comprehension questions was calculated. Participants who scored lower than 75% were excluded from analysis (2 participants).

Like for the codeswitching task, RTs were collected to each word in the sentence. In addition to examining words surrounding the codeswitched word (2 before and 3 after), the cognate trigger (or matched control word), one before the trigger and one after were also examined. RTs faster than 100 ms and relative outliers (RTs greater than 2.5 standard deviations from the mean) were removed by subject and condition (Dominant-Weak cognate condition: one word before the trigger word: 5.3%, trigger word: 5.4%, one word after trigger word: 4.0%, two words before codeswitched word: 4.0%, one word before codeswitched word: 3.4%, codeswitched word: 5.3%, one word after codeswitched word: 5.0%, two words after codeswitched word: 4.4%, three words after codeswitched word: 4.9%; Dominant-Weak non-

cognate condition: one word before the trigger word: 4.4%, trigger word: 4.0%, one word after trigger word: 3.8%, two words before codeswitched word: 3.6%, one word before codeswitched word: 4.6%, codeswitched word: 4.4%, one word after codeswitched word: 5.0%, two words after codeswitched word: 5.5%, three words after codeswitched word: 4.0%; Weak-Dominant cognate condition: one word before the trigger word: 5.0%, trigger word: 3.6%, one word after trigger word: 4.3%, two words before codeswitched word: 4.5%, one word before codeswitched word: 4.1%, codeswitched word: 4.0%, one word after codeswitched word: 4.4%, two words after codeswitched word: 3.6%, three words after codeswitched word: 3.5%; Weak-Dominant non-cognate: one word before the trigger word: 4.9%, trigger word: 3.9%, one word after trigger word: 4.0%, two words before codeswitched word: 4.4%, one word before codeswitched word: 4.1%, codeswitched word: 4.0%, one word after codeswitched word: 3.3%, two words after codeswitched word: 3.8%, three words after codeswitched word: 4.1%) as they reflect non-typical processing.

Analyses focused on whether the codeswitched word was read differently depending on whether a cognate trigger or non-cognate control word preceded it. This was first done across both language switching directions, and then separately for each language switching direction. Like for the codeswitching task, analyses were done based on participants' relative dominance in the languages rather than L1/L2. That is, examining the effect of cognate triggering from the weak to dominant language and from the dominant to weak language. Dominance was determined by a composite measure of the language proficiency tasks. In this study, 14 participants were English dominant and 6 were Spanish dominant.

Results

Comprehension questions

Participants averaged 85.5% (*SD* = 5.5) accurate on the comprehension questions, indicating that they understood the sentences and were sufficiently engaged in the task.

Overall Cognate Triggering effect

Figure 7-1 shows the reading times for words in sentences containing cognate triggers as compared to noncognate controls prior to the codeswitch. A 2 Start language (Dominant, Weaker) by 2 Trigger (Cognate, Noncognate) ANOVA was conducted separately for each critical word in the sentence (one word before the trigger, the trigger word, one word after the trigger, two words before the codeswitch, one word before the codeswitch, the codeswitched word, one word after the codeswitch, two words after the codeswitch, and three words in the codeswitch). Follow-up one-way ANOVAs were conducted for each language switching direction.

There was no overall effect of cognate triggering on the processing of codeswitched words. There was no main effect of the trigger at the codeswitched words, such that codeswitched words were read no differently when preceded by a cognate trigger as compared to a noncognate trigger (all *p*s > .41). This effect did not differ by language switching direction (all *p*s > .13). However, there was a main effect of the trigger at the trigger words, such that cognate trigger words were read more quickly than noncognate words ($F(1,19) = 9.765$, $p = .006$), resulting in cognate facilitation. This effect differed by language switching direction ($F(1,19) = 6.305$, $p = .021$).

There was a main effect of start language such that words in the dominant language were read more quickly than words in the weaker language prior to the codeswitch (one word before

trigger: $F(1,19) = 7.898$, $p = .011$; trigger word: $F(1,19) = 14.363$, $p = .001$; one word after trigger word: $F(1,19) = 20.960$, $p < .001$; two words before codeswitched word: $F(1,19) = 24.101$, $p < .001$; one word before codeswitched word: $F(1,19) = 8.381$, $p = .009$), and also marginally after the codeswitch (codeswitched word: $F(1,19) = 2.85$, $p = .108$; one word after the codeswitched word: $F(1,19) = 3.825$, $p = .065$l; two words after the codeswitched word: $F(1,19) = 3.558$, $p = .075$; three words after the codeswitched word: $F(1,19) = 3.253$, $p = .087$).

Despite the lack of interaction at the codeswitch, we will examine the effect of cognate triggering in each language switching directions based on our *a priori* asymmetry hypotheses.

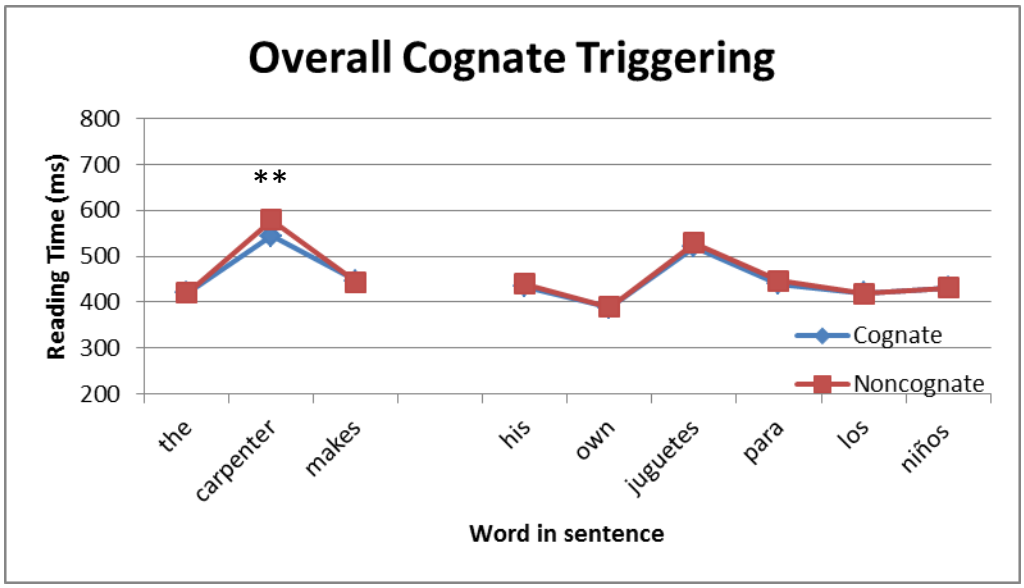

Figure **7-1**: Reading times to codeswitched sentences containing cognate triggers (blue) and noncognate triggers (red). Here, *carpenter* represents the trigger word and *juguetes* the codeswitched word. +: $p < .10$; *: $p < .05$; **: $p < .01$; ***: $p < .001$.

Cognate Triggering from Weak into Dominant language

When switching from the weak to dominant language, there was no effect of the cognate trigger on the codeswitched word (all *p*s > .10; see Figure 7-2), but there was an effect at the

trigger. Cognate words were read faster than noncognate words, here in the weaker language ($F(1,19) = 9.175$, $p = .007$).

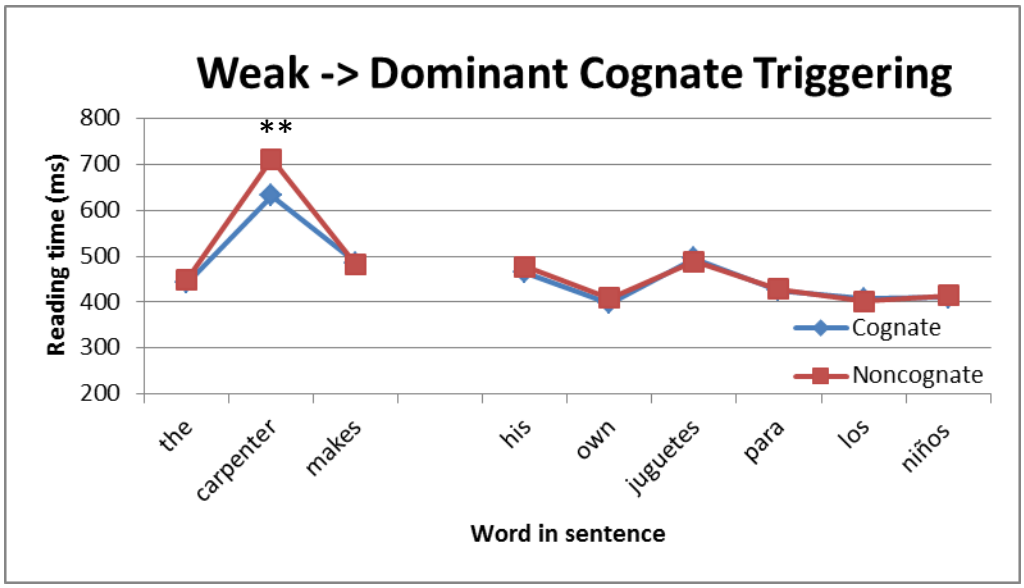

Figure **7-2**: Reading times to weak to dominant codeswitched sentences containing cognate triggers (blue) and noncognate triggers (red). Here, *carpenter* represents the trigger word and *juguetes* the codeswitched word. +: $p < .10$; *: $p < .05$; **: $p < .01$; ***: $p < .001$.

Cognate Triggering from Dominant into Weak language

In the direction from dominant to weak, there was no difference between the sentences that contained a cognate and those with a noncognate either at the point of the codeswitch (all *p*s > .24) or at the trigger (all *p*s > .44; see Figure 7-3). Thus, in this direction, there is no effect of triggering on the processing of the codeswitch and there is no evidence for cognate facilitation.

That cognate facilitation appears in the weaker, but not the dominant language is consistent with previous literature, which finds larger cognate effects in the (generally weaker) L2 than in the (generally dominant) L1 (e.g., Gollan et al., 1997).

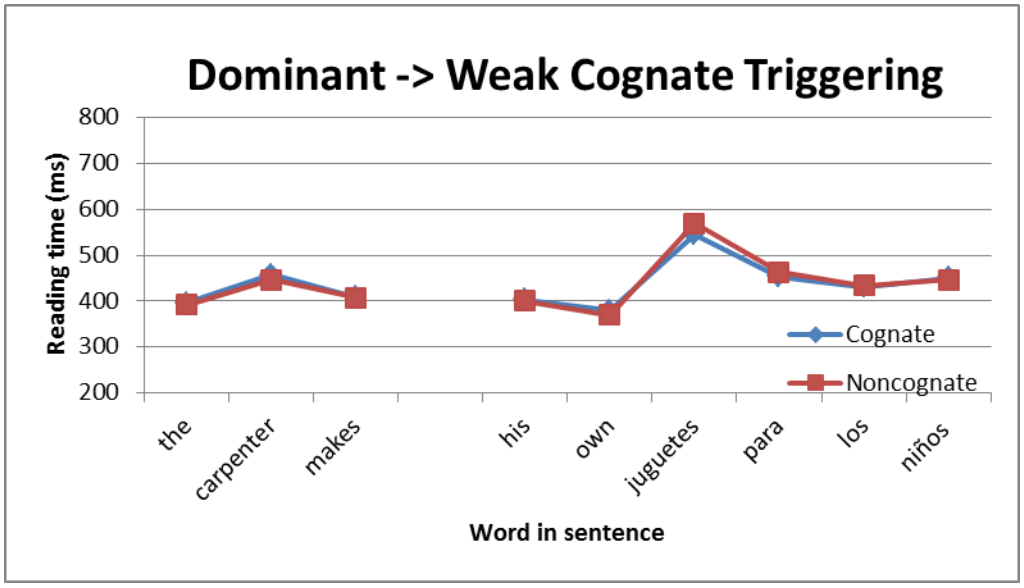

Figure **7-3**: Reading times to dominant to weak codeswitched sentences containing cognate triggers (blue) and noncognate triggers (red). Here, *carpenter* represents the trigger word and *juguetes* the codeswitched word. +: $p < .10$; *: $p < .05$; **: $p < .01$; ***: $p < .001$.

Discussion

Experiment 3 examined whether the comprehension of codeswitches is influenced by the presence of a cognate trigger that appears prior to the codeswitch. Based on Clyne's (1967; 2003) triggering theory, we predicted that codeswitches would be easier to process (i.e., read faster) when preceded by a cognate trigger than a noncognate trigger. However, we found no modulation of reading times to codeswitched words based on trigger type.

Yet, a significant cognate facilitation effect was found in the weaker language, which carried into the overall analysis. The bilinguals did notice and process the cognates, but this did not affect the later processing of the codeswitch. Finding a cognate facilitation effect replicates the large literature showing differential processing for cognates than noncognates in single word studies (e.g., Costa, Caramazza, & Sebastián-Gallés, 2000; Midgley, Holcomb, & Grainger, 2011;

Van Hell & Dijkstra, 2002) and sentences (e.g., Schwartz & Kroll, 2006; Van Assche, Duyck, Hartsuiker, and Diependale, 2009; Van Hell & De Groot, 2008).

The current study only found a cognate facilitation effect in the weaker language, but not in the dominant language. Larger cognate effects in the (weaker) L2 than the (dominant) L1 have been reported (e.g., Costa, Caramazza, & Sebastián-Gallés, 2000), which is explained by assuming that dominant language lexical items have higher resting state activation and are thus less affected by the addition of activation from the weaker language. In the reverse case, weaker language lexical items have lower resting state activation and benefit more strongly from the addition of the high activation of the dominant language translation. This parallels the finding of a switch cost only into the weaker language in Experiments 1 and 2, where the weaker language needs additional resources, but switching into the dominant language needs no such additional activation.

However, cognate facilitation has also been found in the dominant L1 in a single-word task (Van Hell & Dijkstra, 2002) and sentence comprehension task (Van Assche et al., 2009). Possibly, processing in the dominant language in the current study was sufficiently fast (i.e. at ceiling) that the addition of weaker language activation does not aid in processing. Indeed, dominant language trigger words were read more quickly than weaker language triggers regardless of cognate status ($F(1,19) = 14.363$, $p = .001$).

Despite the cognate facilitation effect, there was no modulation of the comprehension of the codeswitch by the cognate status of the trigger word. Codeswitched words were read similarly regardless of the nature of the trigger word in both language switching directions. Why did cognate trigger not influence processing here, but has support from both experimental work (Kootstra, van Hell, & Dijkstra, in revision) and corpus analysis (Broersma & de Bot, 2006; Broersma, 2009; Clyne, 1967; 2003)?

One possibility is that the cognate facilitation effect and switch cost effects of Experiments 1 and 2 are not aligned. That is, cognate facilitation was found in the weaker language. But switches from the weak to dominant language showed no switch cost. Therefore, processing of the switch in that direction may already be sufficiently efficient. In the dominant to weak direction, which showed large switch costs, there was no cognate facilitation in the dominant language that could help mitigate the switch costs.

Another possibility for the lack of a cognate triggering effect could be due to the task demands and situations. Previous findings of cognate triggering have come from conversational contexts. The corpus studies (Broersma & de Bot, 2006; Broersma, 2009; Clyne, 1967; 2003) all record naturally occurring conversations and the experimental study (Kootstra, van Hell, & Dijkstra, in revision) used a confederate-scripted picture naming paradigm which mimicked a conversational environment. In this task, participants were given the choice of codeswitching while describing their picture and the pictures contained either objects that had cognate, homograph, or control word names. Participants were more likely produce a codeswitch when the picture contained a cognate or homograph than a control word, but only when the confederate had codeswitched on the previous trial.

Moreover, in a task that lies between perception and production, a shadowing task, Bultena, Dijkstra, and van Hell (in revision) found no evidence for cognate triggering. Dutch-English bilinguals listened to codeswitched sentences that contained a verb cognate trigger or non-cognate control prior to the codeswitch. Bilinguals had to repeat aloud what they heard as fast as possible ('shadow'). The latencies between the onset of the presented word and the onset of the reproduced shadow revealed a switching cost (i.e., longer latencies) when switching from L1 into L2, but not from L2 into L1 (as in Experiments 1 and 2 in the current study), but that there was no effect of the verb cognate trigger in either language switching direction.

Thus, the presence of a cognate alone is not sufficient to trigger a codeswitch; only when combined with the interactional context of dialogue situation did triggering have an effect. Kootstra, van Hell, and Dijkstra (in revision) suggested this effect might reflect interactive alignment processes where conversational partners tend to align at all levels of language processing (Pickering & Garrod, 2004). The current null result suggests that cognate triggering may not be a basic psychological mechanism that occurs no matter what, but is constrained to certain contexts (e.g., conversations).

Chapter 8

General Discussion

The three experiments reported in this thesis examined how highly proficient Spanish-English bilinguals from a codeswitching community comprehend intrasentential codeswitches. In Experiments 1 and 2, we used a behavioral self-paced reading task and ERPs to explore how codeswitches are processed in both language switching directions, from the dominant to the weaker language and from the weaker to the dominant language. Across both studies, codeswitches incurred extra processing costs, in terms of slower reading times and a larger late positive ERP component when switching into the weaker language. No switching costs were found when switching into the dominant language. This effect was taken to indicate that intrasentential codeswitches are processed via an interaction between sentence-level integration mechanisms relating to the unexpectedness of the switch and the fact that activating the weaker language requires more processing effort than activating the dominant language.

Experiment 3 examined whether one possible mechanism of codeswitching, namely cognate triggering, could influence the processing of the codeswitches. Specifically, it sought to determine whether the behavioral switch cost could be modulated by the presence of a cognate trigger prior to the switch. While cognate triggers showed the expected facilitation in comparison to noncognate triggers in the weaker language, there was no effect on the codeswitched part of the sentence. The lack of cognate triggering may be due to either the interaction between the language of cognate facilitation and the language switching direction that incurs processing costs, or the fact that this study was not in a dialogue context where interactive alignment between conversational partners could enhance the effects of the cognate triggers.

The current study adds to the small psycholinguistic literature on the comprehension intrasentential codeswitching and on experimental evaluation of linguistic theories of

codeswitching, but much work remains to be done to fully understand the processes involved in the comprehension and production of intrasentential codeswitching.

First, the current study found an LPC in response to codeswitches (Experiment 2), but no modulation of the N400 component, as has been found in previous studies (Moreno et al., 2002; Proverbio et al., 2004; Van der Meij et al., 2011). At first, this difference appeared to be due to proficiency in the weaker language and frequency of daily codeswitching, but a related study in which we presented the same materials to non-habitual switchers also found an LPC without an N400 (Litcofsky & van Hell, in prep). Furthermore, the degree of relative dominance across the two languages correlated with the magnitude of the LPC, indicating that proficiency effects were captured in the current study, but that they did not result in lexical-level processing.

Second, the codeswitches in this study were alternation switches (see Muysken, 2000) in which all words following the first codeswitched word remained in that language. Future studies could examine whether the mechanism underlying the processing of codeswitches remains in other types of switching, namely insertions. Insertions are when one word or phrase is inserted into a sentence of the other language. These insertions may reflect switching between typologically-distant languages, or when there is a great disparity between the proficiency of a bilingual's two languages (Deuchar, Muysken, & Wang, 2007). Given that these insertion codeswitches pattern differently than alternations, comprehension of these insertions may rely on different mechanisms. However, since relative proficiency plays a role in the production of insertions, they may be processed similarly as found here. If that is the case, this would argue that the fundamental mechanism for processing codeswitches in a meaningful context (i.e., a sentence), regardless of motivation for the codeswitch or the bilinguals' experience with codeswitching, relates to the relative proficiency of a bilingual's two languages and the effort involved in activating the weaker language.

Third, it has been suggested that experience with switching between languages may confer benefits in the realm of cognitive control. Recently, Green and Abutalebi (2013) proposed the Adaptive Control hypothesis, which states that the cognitive control profile of a bilingual depends on their lifetime experience with codeswitching – the frequency and the nature of the switching. While they do not specifically address alternation codeswitching as tested in this thesis, they propose that the closest approximation, the dense codeswitching context which assumes intrasentential codeswitching with morphosyntactic integration of words from one language into the other, involves only opportunistic planning, but no other aspects of cognitive control. If true, given the circumscribed cognitive control demands in this type of codeswitching, it is unlikely that there would be large differences in cognitive control between habitual and non-habitual codeswitchers.

Fourth, the current study found no effect of cognate triggering, possibly because it lacked a conversational component that was present in previous studies finding evidence for cognate triggering (Broersma & de Bot, 2006; Broersma, 2009; Clyne, 1967; Clyne, 2003; Kootstra, van Hell, & Dijkstra, in revision; but see Van Hell, Sánchez-Casas, & Ting, in prep). If, in these studies, cognate triggering occurs via an interaction between lexical processes and interactive alignment, future studies could more stringently examine how the interactive alignment allows bilinguals to not only notice the cognates, but also use them predictively to produce a codeswitch. Additionally, the previous studies focused on the production of codeswitches in a conversational context. It would also be beneficial to study whether in this context, the comprehension of codeswitches is modulated by cognates. It is possible that this mechanism only functions to facilitate production of codeswitches, but is not strong enough of an influence on processing to affect comprehension.

Finally, future studies should continue to integrate psycholinguistic and linguistic perspectives on codeswitching. With the benefits of each research program, results from this type

of integrative work will provide a richer understanding of the online mechanisms underlying codeswitching in an ecologically valid context.

References

Abutalebi, J., & Green, D. W. (2008). Control mechanisms in bilingual language production: Neural evidence from language switching studies. Language and Cognitive Processes, 23(4), 557–582.

Abutalebi, J., Annoni, J. M., Zimine, I., Pegna, A. J., Seghier, M. L., Lee-Jahnke, H., Lazeyras, F., et al. (2008). Language Control and Lexical Competition in Bilinguals: An Event-Related fMRI Study. Cerebral Cortex, 18(7), 1496–1505.

Alameda, J. R., & Cuetos, F. (1995). Diccionario de frecuencias de las unidades linguisticas del castellano. Oviedo: Servicio de Publicaciones Universidad de Oviedo.

Alvarez, R. P., Holcomb, P. J., & Grainger, J. (2003). Accessing word meaning in two languages: An event-related brain potential study of beginning bilinguals. Brain and Language, 87(2), 290–304.

Auer, P. (1998). Codeswitching in conversation. London: Routledge.

Auer, P. (1999). From codeswitching via language mixing to fused lects: Toward a dynamic typology of bilingual speech. International Journal of Bilingualism, 3(4), 309–332.

Bialystok, E., Craik, F. I. M., Klein, R., & Viswanathan, M. (2004). Bilingualism, Aging, and Cognitive Control: Evidence From the Simon Task. Psychology and Aging, 19(2), 290–303.

Bobb, S. C., & Wodniecka, Z. (2013). Language switching in picture naming: What asymmetric switch costs (do not) tell us about inhibition in bilingual speech planning. *Journal of Cognitive Psychology*, *25*(5), 568–585.

Broersma, M. (2009). Triggered codeswitching between cognate languages. Bilingualism: Language and Cognition, 12(04), 447.

Broersma, M., & de Bot, K. (2006). Triggered codeswitching: A corpus-based evaluation of the original triggering hypothesis and a new alternative. Bilingualism: Language and Cognition, 9(01), 1.

Bultena, S., Dijkstra, T., & Van Hell, J.G. (revision submitted). Switch cost modulations in bilingual sentence processing: Evidence from shadowing.

Chauncey, K., Grainger, J., & Holcomb, P. J. (2008). Code-switching effects in bilingual word recognition: A masked priming study with event-related potentials. Brain and Language, 105(3), 161–174.

Christoffels, I. K., Firk, C., & Schiller, N. O. (2007). Bilingual language control: An event-related brain potential study. Brain Research, 1147, 192–208.

Clyne, M. G. (1967). Transference and triggering: Observations on the language assimilation of postwar German-speaking migrants in Australia. Den Haag: Martinus Nijhoff.

Clyne, M. G. (1980). Triggering and Language Processing. Canadian Journal of Psychology, 34(3), 400–406.

Clyne, M. G. (2003). Dynamics of Language Contact. Camridge, UK.

Costa, A., & Santesteban, M. (2004). Lexical access in bilingual speech production: Evidence from language switching in highly proficient bilinguals and L2 learners. Journal of Memory and Language, 50(4), 491–511.

Costa, A., Caramazza, A., & Sebastián-Gallés, N. (2000). The Cognate Facilitation Effect: Implications for Models of Lexical Access. Journal of Experimental Psyhcology: Learning, Memory, and Cognition, 26(5), 1283–1296.

Coulson, S., King, J. W., & Kutas, M. (1998). Expect the Unexpected: Event-related Brain Response to Morphosyntactic Violations. *Language and Cognitive Processes*, *13*(1), 21–58.

Kolk, H., & Chwilla, D. (2007). Late positivities in unusual situations. *Brain and Language*, *100*(3), 257–261.

Deuchar, M. (2005). Congruence and Welsh–English code-switching. Bilingualism: Language and Cognition, 8(03), 255.

Deuchar, M., Muysken, P., & Wang, S.-L. (2007). Structured Variation in Codeswitching: Towards an Empirically Based Typology of Bilingual Speech Patterns. *International Journal of Bilingual Education and Bilingualism*, *10*(3), 298–340.

Dijkstra, A. (2005). Bilingual visual word recognition and lexical access. In J.F. Kroll & A. De Groot (Eds.), *Handbook of Bilingualism: Psycholinguistic Approaches* (pp. 178-201). Oxford University Press.

Dijkstra, T., Grainger, J., & van Heuven, W. J. B. (1999). Recognition of Cognates and Interlingual Homographs: The Neglected Role of Phonology. Journal of Memory and Language, 41, 496–518.

Donchin, E. (1981). Surprise!… surprise?. *Psychophysiology*, *18*(5), 493-513.

Dussias, P. E. (2003). Spanish-English code-mixing at the Auxiliary Phrase: Evidence from eye-movement data. *Revista Internacional de Linguistica Iberoamericana*, *1*(2), 7–34.

Emmorey, K., Luk, G., Pyers, J. E., & Bialystok, E. (2008). The Source of Enhanced Cognitive Control in Bilinguals: Evidence From Bimodal Bilinguals. Psychological Science, 19(12), 1201–1206.

Federmeier, K. D., & Kutas, M. (1999). A rose by any other name: Long-term memory structure and sentence processing. Journal of Memory and Language, 41, 469–495.

Finkbeiner, M., Forster, K., Nicol, J., & Nakamura, K. (2004). The role of polysemy in masked semantic and translation priming. Journal of Memory and Language, 51(1), 1–22.

Folstein, J. R., & Van Petten, C. (2008). Influence of cognitive control and mismatch on the N2 component of the ERP: A review. Psychophysiology, 45, 152–170.

Friederici, A. D., Pfeifer, E., & Hahne, A. (1993). Event-related brain potentials during natural speech processing: effects of semantic, morphological and syntactic violations. *Cognitive Brain Research*, *1*, 183–192.

Gardner-Chloros, P. (1991). Language selection and switching in Strasbourg. Oxford: Oxford University Press.

Gollan, T. H., Forster, K. I., & Frost, R. (1997). Translation Priming With Different Scripts: Masked Priming With Cognates and Noncognates in Hebrew-English Bilinguals. Journal of Experimental Psychology: Learning, Memory, and Cognition, 23(5), 1122–1139.

Grainger, J., & Beauvillain, C. (1987). Language blocking and lexical access in bilinguals. The Quarterly Journal of Experimental Psychology Section A, 39(2), 295–319.

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

Green, D. W. (2011). Language control in different contexts: the behavioral ecology of bilingual speakers. Frontiers in Psychology, 1–4.

Green, D. W., & Abutalebi, J. (2013). Language control in bilinguals: The adaptive control hypothesis. *Journal of Cognitive Psychology*, 1–16.

Grosjean, F. (1982). Life with two languages: An introduction to bilingualism. Cambridge, MA: Harvard University Press.

Grosjean, F. (2001). The bilingual's langauge modes. In J. Nicol (Ed.), One mind, two languages: Bilingual language processing (pp. 1–22). Oxford: Blackwell.

Gumperz, J. (1982). Discourse strategies. Cambridge, UK: Cambridge University Press.

Gunter, T. C., Stowe, L. A., & Mulder, G. (1997). When syntax meets semantics. Psychophysiology, 34, 660–676.

Hahne, A., & Friederici, A. D. (2001). Processing a second language: Late learners' comprehension mechanisms as revealed by event-related brain potentials. Bilingualism: Language and Cognition, 4(2), 123–141.

Holcomb, P. J. (1993). Semantic priming and stimulus degradation: Implications for the role of the N400in language processing. Psychophysiology, 30, 47–61.

Hoshino, N., & Kroll, J. F. (2008). Cognate effects in picture naming: Does cross-language activation survive a change of script? Cognition, 106(1), 501–511.

Jackson, G. M., Swainson, R., Cunnington, R., & Jackson, S. R. (2001). ERP correlates of executive control during repeated language switching. Bilingualism: Langauge and Cognition, 4(2), 169–178.

Jackson, G. M., Swainson, R., Mullin, A., Cunnington, R., & Jackson, S. R. (2004). ERP correlates of a receptive language-switching task. The Quarterly Journal of Experimental Psychology Section A, 57(2), 223–240.

Jiang, N., & Forster, K. I. (2001). Cross-Language Priming Asymmetries in Lexical Decision and Episodic Recognition. Journal of Memory and Language, 44(1), 32–51.

Kaan, E., Harris, A., Gibson, E., & Holcomb, P. J. (2000). The P600 as an index of syntactic integration difficulty. Language and Cognitive Processes, 15(2), 159–201.

Kaplan, E., Goodlass, H., & Weintraub, S. (2001). Boston Naming Test (Second.). Philadelphia, PA: Lippincott Williams & Wilkins Publishers.

King, J. W., & Kutas, M. (1995). Who Did What and When? Using Word- and Clause-Level ERPs to Monitor Working Memory Usage in Reading. *Journal of Cognitive Neuroscience*, *7*(3), 376–395.

Kolk, H., & Chwilla, D. (2007). Late positivities in unusual situations. *Brain and Language*, *100*(3), 257–261.

Kootstra, G. J., van Hell, J. G., & Dijkstra, T. (2010). Syntactic alignment and shared word order in code-switched sentence production: Evidence from bilingual monologue and dialogue. Journal of Memory and Language, 63(2), 210–231.

Kootstra, G. J., van Hell, J. G., & Dijkstra, T. (in revision). You say tomato, I say TOMAAT: How socio-interactional and lexical factors influence code-switching in bilingual dialogue.

Kutas, M., & Hillyard, S. A. (1980). Reading senseless sentences: Brain potentials reflect semantic incongruity. Science, 207(4427), 203–205.

Kutas, M., & Hillyard, S. A. (1984). Brain potentials during reading reflect word expectancy and semantic association. Nature, 307, 161–163.

Liotti, M., Woldorff, M. G., Perez, R., III, & Mayberg, H. S. (2000). An ERP study of the temporal course of the Stroop color-word interference effect. Neuropsychologia, 38, 701–711.

Litcofsky, K. A., Midgley, K. J., Holcomb, P. J., & Grainger, J. (2009). Exploring Language Switching with Lexical Decision and Event Related Potentials. Presented at the Annual Meeting of the Psychonomic Society.

Litcofsky, K. A., Bajo, M. T., & Van Hell, J. G. (In preparation). Sentential codeswitching in non-habitual codeswitchers.

Macswan, J. (2000). The architecture of the bilingual language faculty: evidence from intrasentential code switching. Bilingualism: Language and Cognition, 3(1), 37–54.

Meuter, R. F. I. (2009). Language selection and performance optimisation in multilinguals. In L. Isurin, D. Winford, & K. de Bot (Eds.), Multidisciplinary approaches to code switching (pp. 27–52). Amsterdam/Philadelphia: John Benjamins.

Meuter, R. F. I., & Allport, A. (1999). Bilingual language switching in naming. Journal of Memory and Language, Asymmetrical Costs of Language Selection, 40, 25–40.

Midgley, K. J., Holcomb, P. J., & Grainger, J. (2011). Effects of cognate status on word comprehension in second language learners: An ERP investigation. Journal of Cognitive Neuroscience, 23(7), 1634–1647.

Misra, M., Guo, T., Bobb, S. C., & Kroll, J. F. (2012). When bilinguals choose a single word to speak: Electrophysiological evidence for inhibition of the native language. *Journal of Memory and Language*, *67*(1), 224–237.

Moreno, E. M., Federmeier, K. D., & Kutas, M. (2002). Switching Languages, Switching Palabras (Words): An Electrophysiological Study of Code Switching. Brain and Language, 80(2), 188–207.

Muysken, P. (2000). Bilingual Speech: A Typology of Code Mixing. Cambridge: Cambridge University Press.

Myers-Scotton, C. (1993). Dueling Languages: Grammatical Structure in Code-switching. Oxford: Clarendon Press.

Myers-Scotton, C. (2006). Natural codeswitching knocks on the laboratory door. Bilingualism: Language and Cognition, 9(02), 203.

Oldfield, R. C. (971AD). Oldfield_Neuropsychologia_1971. Neuropsychologia, 9, 97–113.

Osterhout, L., & Holcomb, P. J. (1992). Event-related brain potentials elicited by syntactic anomaly. Journal of Memory and Language, 31, 785–806.

Philipp, A. M., Gade, M., & Koch, I. (2007). Inhibitory processes in language switching: Evidence from switching language-defined response sets. European Journal of Cognitive Psychology, 19(3), 395–416.

Pickering, M. J., & Garrod, S. (2004). Toward a mechanistic psychology of dialogue. *Behavioral and Brain Sciences*, *27*, 169–226.

Polich, J. (2007). Updating P300: An integrative theory of P3a and P3b. *Clinical Neurophysiology*, *118*(10), 2128–2148.

Poplack, S. (1980). Sometimes I'll start a sentence in Spanish Y TERMINO EN ESPANOL: Toward a typology of code-switching. Linguistics, 18, 581–618.

Prior, A., & Gollan, T. H. (2011). Good Language-Switchers are Good Task-Switchers: Evidence from Spanish–English and Mandarin–English Bilinguals. *Journal of the International Neuropsychological Society*, *17*(04), 682–691.

Prior, A., & MacWhinney, B. (2010). A bilingual advantage in task switching. *Bilingualism: Langauge and Cognition*, *13*(02), 253.

Proverbio, A. M., Leoni, G., & Zani, A. (2004). Language switching mechanisms in simultaneous interpreters: an ERP study. Neuropsychologia, 42(12), 1636–1656.

Rodriguez-Fornells, A., Kramer, U. M., Lorenzo-Seva, U., Festman, J., & Münte, T. F. (2012). Self-assessment of individual differences in language switching. Frontiers in Psychology, 2, 1–15.

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

Soveri, A., Rodriguez-Fornells, A., & Laine, M. (2011). Is there a relationship between language switching and executive functions in bilingualism? Introducing a within-group analysis approach. *Frontiers in Psychology*, *2*, 1–8.

Toribio, A. J. (2001). Accessing bilingual code-switching competence. International Journal of Bilingualism, 5(4), 403–436.

Turner, M. L., & Engle, R. W. (1989). Is working memory capacity task dependent? Journal of Memory and Language, 28(2), 127–154.

Valdes Kroff, J. (2012). *Using eye-tracking to study auditory comprehension in codeswitching: Evidence for the link between comprehension and production*. State College, PA.

van Assche, E., Duyck, W., Hartsuiker, R. J., & Diependaele, K. (2009). Does bilingualism change native-language reading? Psychological Science, 20(8), 923–927.

van der Meij, M., Cuetos, F., Carreiras, M., & Barber, H. A. (2010). Electrophysiological correlates of language switching in second language learners. Psychophysiology, Electrophysiological correlates of language switching, 48(1), 44–54.

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

van Hell, J. G., & Dijkstra, T. (2002). Foreign language knowledge can influence native language performancein exclusively native contexts. Psychonomic Bulletin & Review, 9(4), 780–789.

van Hell, J. G., Sánchez-Casas, R., & Ting, C. Y. (in prep). Socio-contextual triggering in Spanish-English bilinguals.

van Hell, J. G., & Tanner, D. (2012). Second Language Proficiency and Cross-Language Lexical Activation. *Language Learning*, 1–24.

van Hell, J. G., & Witteman, M. J. (n.d.). The neurocognition of switching between languages: A review of electrophysiological studies. In L. Isurin, D. Winford, & K. de Bot (Eds.), Interdisciplinary approaches to code switching (pp. 1–43). John Benjamins.

Verhoef, K., Roelofs, A., & Chwilla, D. J. (2009). Role of inhibition in language switching: Evidence from event-related brain potentials in overt picture naming. Cognition, 110(1), 84–99.

Vitevitch, M. S., & Rodríguez, E. (2004). Neighborhood density effects in spoken word recognition in Spanish. Journal of Multilingual Communication Disorders, 3(1), 64–73.

Wei, L., & Milroy, L. (1995). Conversational code-switching in a Chinese community in Britain: A sequential analysis. Journal of Pragmatics, 23, 281–299.

Weissberger, G. H., Wierenga, C. E., Bondi, M. W., & Gollan, T. H. (2012). Partially overlapping mechanisms of language and task control in young and older bilinguals. *Psychology and aging*, *27*(4), 959.

Yim, O., & Bialystok, E. (2012). Degree of conversational code-switching enhances verbal task switching in Cantonese–English bilinguals. *Bilingualism: Language and Cognition*, *15*(04), 873–883.

Appendix

Codeswitching and Triggering Sentence Stimuli

Table **A-1**: Conditions: 1) English, Cognate, Codeswitch; 2: English Noncognate, Codeswitch; 3) English, Noncognate, No Codeswitch; 4) Spanish, Cognate, Codeswitch; 5) Spanish, Noncognate, Codeswitch; 6) Spanish, Noncognate, No Codeswitch.

Condition	Sentence
1	This morning, a wild panther bit a conejo que pasaba corriendo muy rápido.
2	This morning, a wild vulture bit a conejo que pasaba corriendo muy rápido.
3	This morning, a wild vulture bit a rabbit who ran past very quickly.
4	Esta mañana, una pantera salvaje mordió a un rabbit who ran past very quickly.
5	Esta mañana, un buitre salvaje mordió a un rabbit who ran past very quickly.
6	Esta mañana, un buitre salvaje mordió a un conejo que pasaba corriendo muy rápido.
1	After the felony, a harsh sentence was given to the ladrones por el juez.
2	After the felony, a harsh punishment was given to the ladrones por el juez.
3	After the felony, a harsh punishment was given to the thieves by the judge.
4	Después del delito, una dura sentencia les fue dado a los thieves by the judge.
5	Después del delito, un duro castigo les fue dado a los thieves by the judge.
6	Después del delito, un duro castigo les fue dado a los ladrones por el juez.
1	The girl saw some nice pants in the tienda frente a su escuela.
2	The girl saw some nice shirts in the tienda frente a su escuela.
3	The girl saw some nice shirts in the shop across the street from her school.
4	La niña vio unos pantalones bonitos en el shop across the street from her school.
5	La niña vio unas camisas bonitas en el shop across the street from her school.
6	La niña vio unas camisas bonitas en la tienda frente a su escuela.
1	Every Sunday, she reads a short poem related to ajedrez para mejorar sus habilidades.
2	Every Sunday, she reads a short book related to ajedrez para mejorar sus habilidades.
3	Every Sunday, she reads a short book related to chess to improve her skills.
4	Todos los domingos, ella lee un poema corto sobre el chess to improve her skills.
5	Todos los domingos, ella lee un libro corto sobre el chess to improve her skills.
6	Todos los domingos, ella lee un libro corto sobre el ajedrez para mejorar sus habilidades.
1	A lot of pamphlets were handed out by the manifestantes antes de su protesta.
2	A lot of brochures were handed out by the manifestantes antes de su protesta.
3	A lot of brochures were handed out by the protesters before their rally.
4	Un montón de panfletos fueron repartidos por los protesters before their rally.
5	Un montón de folletos fueron repartidos por los protesters before their rally.
6	Un montón de folletos fueron repartidos por los manifestantes antes de su protesta.
1	Next week, the young engineer will begin his trabajo con gran entusiasmo.
2	Next week, the young waiter will begin his trabajo con gran entusiasmo.

3	Next week, the young waiter will begin his job with great excitement.
4	La semana próxima, el ingeniero joven comenzará su job with great excitement.
5	La semana próxima, el camarero joven comenzará su job with great excitement.
6	La semana próxima, el camarero joven comenzará su trabajo con gran entusiasmo.
1	The old men got together to watch an episode about the pandillas en su ciudad.
2	The old men got together to watch a movie about the pandillas en su ciudad.
3	The old men got together to watch a movie about the gangs in their city.
4	Los ancianos se reunieron para ver un episodio sobre los gangs in their city.
5	Los ancianos se reunieron para ver una película sobre los gangs in their city.
6	Los ancianos se reunieron para ver una película sobre las pandillas en su ciudad.
1	In its basement, the airport collects hundreds of maletas perdidas de diversos visitantes.
2	In its basement, the building collects hundreds of maletas perdidas de diversos visitantes.
3	In its basement, the building collects hundreds of suitcases lost by the various visitors.
4	En su sótano, el aeropuerto guarda cientos de suitcases lost by the various visitors.
5	En su sótano, el edificio guarda cientos de suitcases lost by the various visitors.
6	En su sótano, el edificio guarda cientos de maletas perdidas de diversos visitantes.
1	The other night, the spectators watched the lucha pero no trataron de detenerla.
2	The other night, the neighbors watched the lucha pero no trataron de detenerla.
3	The other night, the neighbors watched the fight but did not try to stop it.
4	La otra noche, los espectadores miraron el fight but did not try to stop it.
5	La otra noche, los vecinos miraron el fight but did not try to stop it.
6	La otra noche, los vecinos miraron la lucha pero no trataron de detenerla.
1	Tomorrow, Aaron and his colleagues will build some escudos para usar en un juego de rol.
2	Tomorrow, Aaron and his friends will build some escudos para usar en un juego de rol.
3	Tomorrow, Aaron and his friends will build some shields to use in a fantasy game.
4	Mañana, Aarón y sus colegas construirán unos shields to use in a fantasy game.
5	Mañana, Aarón y sus amigos construirán unos shields to use in a fantasy game.
6	Mañana, Aarón y sus amigos construirán unos escudos para usar en un juego de rol.
1	Very angrily, the recruiter pounded on his teclado para quitarse el estrés.
2	Very angrily, the businessman pounded on his teclado para quitarse el estrés.
3	Very angrily, the businessman pounded on his keyboard to get rid of stress.
4	Muy enojado, el reclutador golpeó su keyboard to get rid of stress.
5	Muy enojado, el empresario golpeó su keyboard to get rid of stress.
6	Muy enojado, el empresario golpeó su teclado para quitarse el estrés.
1	He is best known as an author of an assortment of cuentos y poesía hermosa.
2	He is best known as a writer of an assortment of cuentos y poesía hermosa.
3	He is best known as a writer of an assortment of stories and beautiful poetry.
4	Él es más conocido como autor de un surtido de stories and beautiful poetry.
5	Él es más conocido como escritor de un surtido de stories and beautiful poetry.
6	Él es más conocido como escritor de un surtido de cuentos y poesía hermosa.

1	While running her errands, the secretary stopped at the quiosco a recoger el periódico de hoy.
2	While running her errands, the consultant stopped at the quiosco a recoger el periódico de hoy.
3	While running her errands, the consultant stopped at the newsstand to pick up today's paper.
4	Mientras hacía sus mandados, la secretaria se detuvo en el newsstand to pick up today's paper.
5	Mientras hacía sus mandados, la asesora se detuvo en el newsstand to pick up today's paper.
6	Mientras hacía sus mandados, la asesora se detuvo en el quiosco a recoger el periódico de hoy.
1	She was on her way to a theater with a cantante a quien había admirado durante mucho tiempo.
2	She was on her way to a parade with a cantante a quien había admirado durante mucho tiempo.
3	She was on her way to a parade with a singer whom she had admired for a long time.
4	Ella se dirigía a un teatro con un singer whom she had admired for a long time.
5	Ella se dirigía a un desfile con un singer whom she had admired for a long time.
6	Ella se dirigía a un desfile con un cantante a quien había admirado durante mucho tiempo.
1	Even though it was a dreary day, Ann's friendly personality ensured a sonrisa en el público.
2	Even though it was a dreary day, Ann's friendly parrot ensured a sonrisa en el público.
3	Even though it was a dreary day, Ann's friendly parrot ensured a smile with the audience.
4	A pesar de que era un día gris, la personalidad amigable de Ana aseguró un smile with the audience.
5	A pesar de que era un día gris, el amigable loro de Ana aseguró un smile with the audience.
6	A pesar de que era un día gris, el amigable loro de Ana aseguró una sonrisa en el público.
1	Christina was uneasy because of the rats spotted around the vecindario a principios de esta semana.
2	Christina was uneasy because of the dogs spotted around the vecindario a principios de esta semana.
3	Christina was uneasy because of the dogs spotted around the neighborhood earlier this week.
4	Cristina estaba inquieta a causa de las ratas encontradas en el neighborhood earlier this week.
5	Cristina estaba inquieta a causa de los perros encontrados en el neighborhood earlier this week.
6	Cristina estaba inquieta a causa de los perros encontrados en el vecindario a principios de esta semana.
1	Everyone at the gala whispered about the cintas que decoraban toda la habitación.
2	Everyone at the party whispered about the cintas que decoraban toda la habitación.
3	Everyone at the party whispered about the ribbons that decorated the entire room.
4	Todos en la gala susurraban sobre los ribbons that decorated the entire room.
5	Todos en la fiesta susurraban sobre los ribbons that decorated the entire room.

6	Todos en la fiesta susurraban sobre las cintas que decoraban toda la habitación.
1	Arthur hoped that the package would not be filled with calcetines y corbatas feas.
2	Arthur hoped that the gift would not be filled with calcetines y corbatas feas.
3	Arthur hoped that the gift would not be filled with socks and ugly ties.
4	Arthur esperaba que el paquete no estuviera lleno de socks and ugly ties.
5	Arthur esperaba que el regalo no estuviera lleno de socks and ugly ties.
6	Arthur esperaba que el regalo no estuviera lleno de calcetines y corbatas feas.
1	Please put the extra soup in the congelador cuando termines de comer.
2	Please put the extra meat in the congelador cuando termines de comer.
3	Please put the extra meat in the freezer when you are done eating.
4	Por favor, pon la sopa sobrante en el freezer when you are done eating.
5	Por favor, pon la carne sobrante en el freezer when you are done eating.
6	Por favor, pon la carne sobrante en el congelador cuando termines de comer.
1	Yesterday, George found out that a bank will replace the bodega que fue demolida el año pasado.
2	Yesterday, George found out that a jail will replace the bodega que fue demolida el año pasado.
3	Yesterday, George found out that a jail will replace the warehouse that was demolished last year.
4	Ayer, Jorge descubrió que un banco reemplazará al warehouse that was demolished last year.
5	Ayer, Jorge descubrió que una cárcel reemplazará al warehouse that was demolished last year.
6	Ayer, Jorge descubrió que una cárcel reemplazará a la bodega que fue demolida el año pasado.
1	Every morning, Sarah gets her blouse caught in the cremallera de su chaqueta.
2	Every morning, Sarah gets her gloves caught in the cremallera de su chaqueta.
3	Every morning, Sarah gets her gloves caught in the zipper of her jacket.
4	Cada mañana, a Sara se le enganchan la blusa en el zipper of her jacket.
5	Cada mañana, a Sara se le enganchan los guantes en el zipper of her jacket.
6	Cada mañana, a Sara se le enganchan los guantes en la cremallera de su chaqueta.
1	Suddenly, I remembered that the dentist had warned us about the tempestad que se avecinaba.
2	Suddenly, I remembered that the woman had warned us about the tempestad que se avecinaba.
3	Suddenly, I remembered that the woman had warned us about the storm that was coming.
4	De repente, me acordé de que la dentista nos había advertido sobre el storm that was coming.
5	De repente, me acordé de que la mujer nos había advertido sobre el storm that was coming.
6	De repente, me acordé de que la mujer nos había advertido sobre la tempestad que se avecinaba.
1	Sadly, the young athlete sprained his tobillo y no pudo competir en la ronda final.
2	Sadly, the young winner sprained his tobillo y no pudo competir en la ronda final.
3	Sadly, the young winner sprained his ankle and could no longer compete in the final round.
4	Tristamente, el joven atleta se torció el ankle and could no longer compete in the

	final round.
5	Tristamente, el joven ganador se torció el ankle and could no longer compete in the final round.
6	Tristamente, el joven ganador se torció el tobillo y no pudo competir en la ronda final.
1	Last week, a motorcycle overturned in the carretera y derramó muchos litros de combustible.
2	Last week, a truck overturned in the carretera y derramó muchos litros de combustible.
3	Last week, a truck overturned in the road and spilled many gallons of fuel.
4	La semana pasada, una motocicleta volcó en el road and spilled many gallons of fuel.
5	La semana pasada, un camión volcó en el road and spilled many gallons of fuel.
6	La semana pasada, un camión volcó en la carretera y derramó muchos litros de combustible.
1	Staring into the sky, the gardener thought about his esperanzas y sueños para el futuro.
2	Staring into the sky, the dreamer thought about his esperanzas y sueños para el futuro.
3	Staring into the sky, the dreamer thought about his hopes and dreams for the future.
4	Mirando al cielo, el jardinero pensaba en sus hopes and dreams for the future.
5	Mirando al cielo, el soñador pensaba en sus hopes and dreams for the future.
6	Mirando al cielo, el soñador pensaba en sus esperanzas y sueños para el futuro.
1	For the winter, Angela's shawl was made out of lana para mantenerla caliente.
2	For the winter, Angela's scarf was made out of lana para mantenerla caliente.
3	For the winter, Angela's scarf was made out of wool to keep her warm.
4	Para el invierno, el chal de Angela fue hecho de wool to keep her warm.
5	Para el invierno, la bufanda de Angela fue hecha de wool to keep her warm.
6	Para el invierno, la bufanda de Angela fue hecha de lana para mantenerla caliente.
1	This morning, the therapist brought the muletas a Ana y le mostró cómo usarlas.
2	This morning, the orderly brought the muletas a Ana y le mostró cómo usarlas.
3	This morning, the orderly brought the crutches to Anne and showed her how to use them.
4	Esta mañana, el terapista le trajo los crutches to Anne and showed her how to use them.
5	Esta mañana, el camillero le trajo los crutches to Anne and showed her how to use them.
6	Esta mañana, el camillero le trajo las muletas a Ana y le mostró cómo usarlas.
1	Last year, the avalanche destroyed all of the aldea y sus alrededores.
2	Last year, the earthquake destroyed all of the aldea y sus alrededores.
3	Last year, the earthquake destroyed all of the village and the surrounding areas.
4	El año pasado, la avalancha destruyó todo el village and the surrounding areas.
5	El año pasado, el terremoto destruyó todo el village and the surrounding areas.
6	El año pasado, el terremoto destruyó toda la aldea y sus alrededores.
1	For tomorrow, bring a calculator for the prueba de física y astronomía.
2	For tomorrow, bring an eraser for the prueba de física y astronomía.
3	For tomorrow, bring an eraser for the quiz on physics and astronomy.

4	Para mañana, trae una calculadora para el quiz on physics and astronomy.
5	Para mañana, trae una goma para el quiz on physics and astronomy.
6	Para mañana, trae una goma para la prueba de física y astronomía.
1	The other night, the tiger wandered into a prado que era muy peligroso.
2	The other night, the rooster wandered into a prado que era muy peligroso.
3	The other night, the rooster wandered into a meadow that was very dangerous.
4	La otra noche, el tigre vagó en un meadow that was very dangerous.
5	La otra noche, el gallo vagó en un meadow that was very dangerous.
6	La otra noche, el gallo vagó en un prado que era muy peligroso.
1	Looking over the crowd, the rebel stood atop of the escaleras y gritó su oposición.
2	Looking over the crowd, the supporter stood atop of the escaleras y gritó su oposición.
3	Looking over the crowd, the supporter stood atop of the stairs and shouted his opposition.
4	Mirando sobre la gente, el rebelde se paró encima de los stairs and shouted his opposition.
5	Mirando sobre la gente, el partidario se paró encima de los stairs and shouted his opposition.
6	Mirando sobre la gente, el partidario se paró encima de las escaleras y gritó su oposición.
1	Adam wanted to pick pears and lots of ciruelas en la granja cercana.
2	Adam wanted to pick peaches and lots of ciruelas en la granja cercana.
3	Adam wanted to pick peaches and lots of plums at the nearby farm.
4	Adán quería recoger peras y un montón de plums at the nearby farm.
5	Adán quería recoger melocotones y un montón de plums at the nearby farm.
6	Adán quería recoger melocotones y un montón de ciruelas en la granja cercana.
1	Being lazy, the boys threw rocks into the estanque para pasar el tiempo.
2	Being lazy, the boys threw stones into the estanque para pasar el tiempo.
3	Being lazy, the boys threw stones into the pond to pass the time.
4	Con pereza, los chicos tiraron rocas en el pond to pass the time.
5	Con pereza, los chicos tiraron piedras en el pond to pass the time.
6	Con pereza, los chicos tiraron piedras en el estanque para pasar el tiempo.
1	Some people at the aquarium watch all the peces nadando entre los corales.
2	Some people at the beach watch all the peces nadando entre los corales.
3	Some people at the beach watch all the fish swimming amongst the coral.
4	Alguna gente en el acuario ve todos los fish swimming amongst the coral.
5	Alguna gente en la playa ve todos los fish swimming amongst the coral.
6	Alguna gente en la playa ve todos los peces nadando entre los corales.
1	Once a month, celebrities mingle with the jugadores antes de que empiece el juego.
2	Once a month, referees mingle with the jugadores antes de que empiece el juego.
3	Once a month, referees mingle with the players before the game starts.
4	Una vez al mes, las celebridades se entremezclan con los players before the game starts.
5	Una vez al mes, los árbitros se entremezclan con los playes before the game starts.
6	Una vez al mes, los árbitros se entremezclan con los jugadores antes de que empiece

	el juego.
1	Sometimes, young people enjoy eating bananas during a descanso de sus clases.
2	Sometimes, young people enjoy eating grapes during a descanso de sus clases.
3	Sometimes, young people enjoy eating grapes during a break from their classes.
4	A veces, los jóvenes disfrutan comiendo bananas durante el break from their classes.
5	A veces, los jóvenes disfrutan comiendo uvas durante el break from their classes.
6	A veces, los jóvenes disfrutan comiendo uvas durante el descanso de sus clases.
1	Elizabeth brought her servant on a caminata a lo largo del río.
2	Elizabeth brought her granddaughter on a caminata a lo largo del río.
3	Elizabeth brought her granddaughter on a walk along the river.
4	Elena llevó a su sirvienta en un walk along the river.
5	Elena llevó a su nieta en un walk along the river.
6	Elena llevó a su nieta en una caminata a lo largo del río.
1	In the fall, some people put flowers in the ventanas de sus casas.
2	In the fall, some people put skulls in the ventanas de sus casas.
3	In the fall, some people put skulls in the windows of their houses.
4	En el otoño, la gente pone flores en los windows of their houses.
5	En el otoño, la gente pone calaveras en los windows of their houses.
6	En el otoño, la gente pone calaveras en las ventanas de sus casas.
1	After the couple's wedding, their apartment was covered in carteles, guirnaldas y globos.
2	After the couple's wedding, their church was covered in carteles, guirnaldas y globos.
3	After the couple's wedding, their church was covered in posters, streamers, and balloons.
4	Después de la boda de la pareja, su apartamento estaba cubierto de posters, streamers, and balloons.
5	Después de la boda de la pareja, su iglesia estaba cubierta de posters, streamers, and balloons.
6	Después de la boda de la pareja, su iglesia estaba cubierta de carteles, guirnaldas y globos.
1	Since Danielle was homesick, her family bought her a boleto para volver de visita.
2	Since Danielle was homesick, her boyfriend bought her a boleto para volver de visita.
3	Since Danielle was homesick, her boyfriend bought her a ticket to come visit.
4	Dado que Daniela añoraba su casa, su familia le compró un ticket to come visit.
5	Dado que Daniela añoraba su casa, su novio le compró un ticket to come visit.
6	Dado que Daniela añoraba su casa, su novio le compró un boleto para volver de visita.
1	Charlie will soon be an architect with his own velero como su padre.
2	Charlie will soon be a lawyer with his own velero como su padre.
3	Charlie will soon be a lawyer with his own sailboat just like his father.
4	Carlos pronto será un arquitecto con su propio sailboat just like his father.
5	Carlos pronto será un abogado con su propio sailboat just like his father.
6	Carlos pronto será un abogado con su propio velero como su padre.
1	At last, the sergeant saw the preso cuando salía de su casa.

2	At last, the squad saw the preso cuando salía de su casa.
3	At last, the squad saw the inmate as he left his house.
4	Por fin, el sargento vio al inmate as he left his house.
5	Por fin, la cuadrilla vio al inmate as he left his house.
6	Por fin, la cuadrilla vio al preso cuando salía de su casa.
1	Thankfully, the ignited restaurant was saved by the bomberos que fueron muy valientes.
2	Thankfully, the ignited skyscraper was saved by the bomberos que fueron muy valientes.
3	Thankfully, the ignited skyscraper was saved by the firemen who are very brave.
4	Con agradecimiento, el restaurante incendiado se salvó por los firemen who are very brave.
5	Con agradecimiento, el rascacielos incendiado se salvó por los firemen who are very brave.
6	Con agradecimiento, el rascacielos incendiado se salvó por los bomberos que fueron muy valientes.
1	People say that adolescence brings some of the best recuerdos de la vida.
2	People say that childhood brings some of the best recuerdos de la vida.
3	People say that childhood brings some of the best memories of your life.
4	La gente dice que la adolescencia trae algunos de los mejores memories of your life.
5	La gente dice que la niñez trae algunos de los mejores memories of your life.
6	La gente dice que la niñez trae algunos de los mejores recuerdos de la vida.
1	The woman at the altar bowed her cabeza para rezar en silencio.
2	The woman at the tombstone bowed her cabeza para rezar en silencio.
3	The woman at the tombstone bowed her head to pray in silence.
4	La mujer en el altar bajó su head to pray in silence.
5	La mujer en la lápida bajó su head to pray in silence.
6	La mujer en la lápida bajó su cabeza para rezar en silencio.
1	She likes to watch the canaries rather than the patos que viven cerca del embalse.
2	She likes to watch the sparrows rather than the patos que viven cerca del embalse.
3	She likes to watch the sparrows rather than the ducks that live near the reservoir.
4	Le gusta ver los canarios en vez de los ducks that live near the reservoir.
5	Le gusta ver los gorriones en vez de los ducks that live near the reservoir.
6	Le gusta ver los gorriones en vez de los patos que viven cerca del embalse.
1	The stove was leaking gas into the entire cocina y se incendió.
2	The stove was leaking smoke into the entire cocina y se incendió.
3	The stove was leaking smoke into the entire kitchen and caught on fire.
4	La estufa emanaba gas en todo el kitchen and caught on fire.
5	La estufa emanaba humo en todo el kitchen and caught on fire.
6	La estufa emanaba humo en toda la cocina y se incendió.
1	The dust rose off of the pavement in lots of remolinos de calor y suciedad.
2	The dust rose off of the sidewalk in lots of remolinos de calor y suciedad.
3	The dust rose off of the sidewalk in lots of swirls of heat and dirt.
4	El polvo se levantó fuera del pavimento en un montón de swirls of heat and dirt.

5	El polvo se levantó fuera de la acera en un montón de swirls of heat and dirt.
6	El polvo se levantó fuera de la acera en un montón de remolinos de calor y suciedad.
1	Emilie and her aunt love apple tart served with nueces en el lado.
2	Emilie and her aunt love apple dumplings served with nueces en el lado.
3	Emilie and her aunt love apple dumplings served with walnuts on the side.
4	Carolina y su tía aman la tarta de manzana servida con walnuts on the side.
5	Carolina y su tía aman los bollos de manzana servidos con walnuts on the side.
6	Carolina y su tía aman los bollos de manzana servidos con nueces en el lado.
1	Her expansive and beautiful terrace was covered with faroles y gnomos de jardín.
2	Her expansive and beautiful lawn was covered with faroles y gnomos de jardín.
3	Her expansive and beautiful lawn was covered with lanterns and garden gnomes.
4	Su amplia y hermosa terraza estaba cubierta con lanterns and garden gnomes.
5	Su amplio y hermoso césped estaba cubierto con lanterns and garden gnomes.
6	Su amplio y hermoso césped estaba cubierto con faroles y gnomos de jardín.
1	The king instructed that his palace be made of oro y de bronce solamente.
2	The king instructed that his blade be made of oro y de bronce solamente.
3	The king instructed that his blade be made of gold and bronze only.
4	El rey ordenó que su palacio fuera de gold and bronze only.
5	El rey ordenó que su hoja fuera de gold and bronze only.
6	El rey ordenó que su hoja fuera de oro y de bronce solamente.
1	He decided to become a pastor after the muerte de su abuelo.
2	He decided to become a clergyman after the muerte de su abuelo.
3	He decided to become a clergyman after the death of his grandfather.
4	Él eligió ser pastor después del death of his grandfather.
5	Él eligió ser sacerdote después del death of his grandfather.
6	Él eligió ser sacerdote después de la muerte de su abuelo.
1	Even though her manuscript was turned down by the revista, ella la public independientemente.
2	Even though her review was turned down by the revista, ella la publicó independientemente.
3	Even though her review was turned down by the journal, she published it independently.
4	A pesar de que su manuscrito fue rechazado por el journal, she published it independently.
5	A pesar de que su reseña fue rechazada por el journal, she published it independently.
6	A pesar de que su reseña fue rechazada por la revista, ella la publicó independientemente.
1	Brittney cleaned up the plates with a trapo después del enorme derrame.
2	Brittney cleaned up the counter with a trapo después del enorme derrame.
3	Brittney cleaned up the counter with a rag after the huge spill.
4	Bibiana limpió los platos con un rag after the huge spill.
5	Bibiana limpió el mostrador con un rag after the huge spill.
6	Bibiana limpió el mostrador con un trapo después del enorme derrame.
1	She brought her poncho along with her gabardina para mantenerse seca de la fuerte

	lluvia.
2	She brought her umbrella along with her gabardina para mantenerse seca de la fuerte lluvia.
3	She brought her umbrella along with her raincoat to keep her dry from the heavy rain.
4	Ella trajo su poncho junto con su raincoat to keep her dry from the heavy rain.
5	Ella trajo su paraguas junto con su raincoat to keep her dry from the heavy rain.
6	Ella trajo su paraguas junto con su gabardina para mantenerse seca de la fuerte lluvia.
1	Sophia lounged around in her pajamas with a resfriado mientras estaba encerrada en su casa.
2	Sophia lounged around in her slippers with a resfriado mientras estaba encerrada en su casa.
3	Sophia lounged around in her slippers with a cold while she was stuck at her house.
4	Sofía holgazaneó en sus pijamas con un cold while she was stuck at her house.
5	Sofía holgazaneó en sus pantuflas con un cold while she was stuck at her house.
6	Sofía holgazaneó en sus pantuflas con un resfriado mientras estaba encerrada en su casa.
1	Paul asked to see the pearls in the vitrina de la joyería.
2	Paul asked to see the ring in the vitrina de la joyería.
3	Paul asked to see the ring in the showcase at the jewelry store.
4	Pablo pidió ver las perlas en el showcase at the jewelry store.
5	Pablo pidió ver el anillo en el showcase at the jewelry store.
6	Pablo pidió ver el anillo en la vitrina de la joyería.
1	Roger took the uniform to his sastre para hacer alteraciones.
2	Roger took the overcoat to his sastre para hacer alteraciones.
3	Roger took the overcoat to his tailor to get alterations.
4	Rodrigo llevó el uniforme a su tailor to get alterations.
5	Rodrigo llevó el abrigo a su tailor to get alterations.
6	Rodrigo llevó el abrigo a su sastre para hacer alteraciones.
1	Nicholas bought some cream for the ampolla en su mano.
2	Nicholas bought some ointment for the ampolla en su mano.
3	Nicholas bought some ointment for the blister on his hand.
4	Nicolás compró una crema para el blister on his hand.
5	Nicolás compró una pomada para el blister on his hand.
6	Nicolás compró una pomada para la ampolla en su mano.
1	Luckily, Victoria had no lesions except a sarpullido que preocupó a los paramédicos.
2	Luckily, Victoria had no wounds except a sarpullido que preocupó a los paramédicos.
3	Luckily, Victoria had no wounds except a rash that worried the paramedics.
4	Por suerte, Victoria no tuvo lesiones salvo un rash that worried the paramedics.
5	Por suerte, Victoria no tuvo heridas salvo un rash that worried the paramedics.
6	Por suerte, Victoria no tuvo heridas salvo un sarpullido que preocupó a los paramédicos.
1	Jessica will learn more about her doctor during a cita la próxima semana.
2	Jessica will learn more about her midwife during a cita la próxima semana.

3	Jessica will learn more about her midwife during an appointment in the next few weeks.
4	Jessenia va a saber más sobre su doctor durante un appointment in the next few weeks.
5	Jessenia va a saber más sobre su comadrona durante un appointment in the next few weeks.
6	Jessenia va a saber más sobre su comadrona durante una cita la próxima semana.
1	She did her thesis on the birth of the estrellas según como se ven en varios países.
2	She did her homework on the birth of the estrellas según como se ven en varios países.
3	She did her homework on the birth of the stars as seen from various countries.
4	Ella hizo su tesis sobre el nacimiento de los stars as seen from various countries.
5	Ella hizo su tarea sobre el nacimiento de los stars as seen from various countries.
6	Ella hizo su tarea sobre el nacimiento de las estrellas según como se ven en varios países.
1	Filled with anger, the troll slayed the bruja en la torre.
2	Filled with anger, the knight slayed the bruja en la torre.
3	Filled with anger, the knight slayed the witch in the high tower.
4	Lleno de enojo, el trol mató al witch in the high tower.
5	Lleno de enojo, el caballero mató al witch in the high tower.
6	Lleno de enojo, el caballero mató a la bruja en la torre.
1	Out of sympathy, the volunteer told the mendigo dónde encontrar ayuda.
2	Out of sympathy, the traveler told the mendigo dónde encontrar ayuda.
3	Out of sympathy, the traveler told the beggar where to find some help.
4	Por lástima, el voluntario le dijo al beggar where to find some help.
5	Por lástima, el viajero le dijo al beggar where to find some help.
6	Por lástima, el viajero le dijo al mendigo dónde encontrar ayuda.
1	They found out that the assistant liked her jefe por su generosidad.
2	They found out that the nurse liked her jefe por su generosidad.
3	They found out that the nurse liked her boss because of his generosity.
4	Ellos se enteraron de que a la assistente le gustaba su boss because of his generosity.
5	Ellos se enteraron de que a la enfermera le gustaba su boss because of his generosity.
6	Ellos se enteraron de que a la enfermera le gustaba su jefe por su generosidad.
1	I think that gerbils are scared of aspiradoras porque hacen mucho ruido.
2	I think that puppies are scared of aspiradoras porque hacen mucho ruido.
3	I think that puppies are scared of vacuums because they are loud.
4	Creo que los gerbos tienen miedo de los vacuums because they are loud.
5	Creo que los cachorros tienen miedo de los vacuums because they are loud.
6	Creo que los cachorros tienen miedo de las aspiradoras porque hacen mucho ruido.
1	From what I've noticed, mosquitoes often hate abejas con una pasión violenta.
2	From what I've noticed, wasps often hate abejas con una pasión violenta.
3	From what I've noticed, wasps often hate bees with a violent passion.
4	Por lo que he notado, los mosquitos a menudo odian a los bees with a violent passion.
5	Por lo que he notado, las avispas a menudo odian a los bees with a violent passion.

6	Por lo que he notado, las avispas a menudo odian a las abejas con una pasión violenta.
1	In the old days, trains had fewer asientos, pero había más lujos.
2	In the old days, planes had fewer asientos, pero había más lujos.
3	In the old days, planes had fewer seats, but had more luxuries.
4	En los viejos tiempos, los trenes tenían menos seats, but had more luxuries.
5	En los viejos tiempos, los aviones tenían menos seats, but had more luxuries.
6	En los viejos tiempos, los aviones tenían menos asientos, pero había más lujos.
1	Eleanor could not believe the atrocity and sadness of the hambruna que ocurría por todo el lugar.
2	Eleanor could not believe the wickedness and sadness of the hambruna que ocurría por todo el lugar.
3	Eleanor could not believe the wickedness and sadness of the famine occuring all over the place.
4	Eleanor no podía creer la atrocidad y tristeza del famine occuring all over the place.
5	Eleanor no podía creer la maldad y tristeza del famine occuring all over the place.
6	Eleanor no podía creer la maldad y tristeza de la hambruna que ocurría por todo el lugar.
1	The girl set the novel on the mesa con la intención de finalmente comenzar su investigación.
2	The girl set the notebook on the mesa con la intención de finalmente comenzar su investigación.
3	The girl set the notebook on the table with the intent of finally starting her research.
4	La niña dejó la novela sobre el table with the intent of finally starting her research.
5	La niña dejó el cuaderno sobre el table with the intent of finally starting her research.
6	La niña dejó el cuaderno sobre la mesa con la intención de finalmente comenzar su investigación.
1	After seeing Molly's horror from the broma, Franco se arrepintió de haberla planeado.
2	After seeing Molly's distress from the broma, Franco se arrepintió de haberla planeado.
3	After seeing Molly's distress from the prank, Frank regretted planning it.
4	Después de ver el horror de Amelia por el prank, Frank regretted planning it.
5	Después de ver la angustia de Amelia por el prank, Frank regretted planning it.
6	Después de ver la angustia de Amelia por la broma, Franco se arrepintió de haberla planeado.
1	When Nathan is sick, he pours some chocolate into his leche para sentirse mejor.
2	When Nathan is sick, he pours some honey into his leche para sentirse mejor.
3	When Nathan is sick, he pours some honey into his milk to feel better.
4	Cuando Alberto está enfermo, él echa un poco de chocolate en su milk to feel better.
5	Cuando Alberto está enfermo, él echa un poco de miel en su milk para to feel better.
6	Cuando Alberto está enfermo, él echa un poco de miel en su leche para sentirse mejor.
1	Scott likes playing golf instead of esgrima para mantenerse en forma.
2	Scott likes playing basketball instead of esgrima para mantenerse en forma.
3	Scott likes playing basketball instead of fencing in order to stay in shape.
4	A Sergio le gusta jugar al golf en lugar de hacer fencing in order to stay in shape.

5	A Sergio le gusta jugar al baloncesto en lugar de hacer fencing in order to stay in shape.
6	A Sergio le gusta jugar al baloncesto en lugar de hacer esgrima para mantenerse en forma.
1	This morning, the agent received the impresora de la oficina principal.
2	This morning, the manager received the impresora de la oficina principal.
3	This morning, the manager received the printer from the main office.
4	Esta mañana, el agente recibió el printer from the main office.
5	Esta mañana, el gerente recibió el printer from the main office.
6	Esta mañana, el gerente recibió la impresora de la oficina principal.
1	Soon after arriving, the pilot found her equipaje y se dirigió al coche.
2	Soon after arriving, the stewardess found her equipaje y se dirigió al coche.
3	Soon after arriving, the stewardess found her luggage and headed to the car.
4	A poco de llegar, la piloto encontró su luggage and headed to the car.
5	A poco de llegar, la azafata encontró su luggage and headed to the car.
6	A poco de llegar, la azafata encontró su equipaje y se dirigió al coche.
1	That morning, the surfers watched the ola cuando llegaba a la costa.
2	That morning, the lifeguards watched the ola cuando llegaba a la costa.
3	That morning, the lifeguards watched the wave as it hit the shore.
4	Essa mañana, los surfistas vieron el wave as it hit the shore.
5	Essa mañana, los salvavidas vieron el wave as it hit the shore.
6	Essa mañana, los salvavidas vieron la ola cuando llegaba a la costa.
1	Last week, Marcus hung a calendar next to the espejo en su habitación.
2	Last week, Marcus hung a clock next to the espejo en su habitación.
3	Last week, Marcus hung a clock next to the mirror in his room.
4	La semana pasada, Manuel colgó un calendario al lado del mirror in his room.
5	La semana pasada, Manuel colgó un reloj al lado del mirror in his room.
6	La semana pasada, Manuel colgó un reloj al lado del espejo en su habitación.
1	Yesterday we agreed that the striped curtains match the alfombra en la sala de estar.
2	Yesterday we agreed that the striped pillows match the alfombra en la sala de estar.
3	Yesterday we agreed that the striped pillows match the rug in the living room.
4	Ayer acordamos que las cortinas de rayas coinciden con el rug in the living room.
5	Ayer acordamos que las almohadas de rayas coinciden con el rug in the living room.
6	Ayer acordamos que las almohadas de rayas coinciden con la alfombra en la sala de estar.
1	Bryan will spend a week at the lake as part of a viaje con su compañía.
2	Bryan will spend a week at the wharf as part of a viaje con su compañía.
3	Bryan will spend a week at the wharf as part of a trip with his company.
4	Armando pasará una semana en el lago como parte de un trip with his company.
5	Armando pasará una semana en el embarcadero como parte de un trip with his company.
6	Armando pasará una semana en el embarcadero como parte de un viaje con su compañía.
1	All summer long, Chris collected cockroaches and other muestras para examinar en su microscopio nuevo.

2	All summer long, Chris collected spiders and other muestras para examinar en su microscopio nuevo.
3	All summer long, Chris collected spiders and other specimens to view under his new microscope.
4	Todo el verano, Lucas recogió cucarachas y otros specimens to view under his new microscope.
5	Todo el verano, Lucas recogió arañas y otros specimens para to view under his new microscope.
6	Todo el verano, Lucas recogió arañas y otros muestras para examinar en su microscopio nuevo.
1	Luckily for me, the employee can cut any cabello en los últimos estilos.
2	Luckily for me, the hairdresser can cut any cabello en los últimos estilos.
3	Luckily for me, the hairdresser can cut any hair in the latest styles.
4	Por suerte para mí, el empleado puede cortar cualquier hair in the latest styles.
5	Por suerte para mí, el peluquero puede cortar cualquier hair in the latest styles.
6	Por suerte para mí, el peluquero puede cortar cualquier cabello en los últimos estilos.
1	Feeling very tired, the soldier took a siesta para recuperar su energía.
2	Feeling very tired, the baker took a siesta para recuperar su energía.
3	Feeling very tired, the baker took a nap to boost his energy.
4	Sintiéndose muy cansado, el soldado tomó un nap to boost his energy.
5	Sintiéndose muy cansado, el panadero tomó un nap to boost his energy.
6	Sintiéndose muy cansado, el panadero tomó una siesta para recuperar su energía.
1	When night fell, the coyote howled at the luna lo más fuerte que pudo.
2	When night fell, the wolf howled at the luna lo más fuerte que pudo.
3	When night fell, the wolf howled at the moon as loudly as he could.
4	Al caer la noche, el coyote aulló al moon as loudly as he could.
5	Al caer la noche, el lobo aulló al moon as loudly as he could.
6	Al caer la noche, el lobo aulló a la luna lo más fuerte que pudo.
1	I enjoy eating fruit with my desayuno porque es saludable.
2	I enjoy eating cinnamon with my desayuno porque es saludable.
3	I enjoy eating cinnamon with my breakfast because it is healthy.
4	Me gusta comer fruta con el breakfast because it is healthy.
5	Me gusta comer canela con el breakfast because it is healthy.
6	Me gusta comer canela con el desayuno porque es saludable.
1	Having learned that insects have so many patas y pueden morder, Gloria les tiene miedo.
2	Having learned that beetles have so many patas y pueden morder, Gloria les tiene miedo.
3	Having learned that beetles have so many legs and can bite, Gloria is now very scared of them.
4	Al enterarse de que los insectos tienen tantos legs and can bite, Gloria is now very scared of them.
5	Al enterarse de que los escarabajos tienen tantos legs and can bite, Gloria is now very scared of them.
6	Al enterarse de que los escarabajos tienen tantas patas y pueden morder, Gloria les tiene miedo.
1	They could not carry the piano through the small puerta de la casa de la pareja.

2	They could not carry the mattress through the small puerta de la casa de la pareja.
3	They could not carry the mattress through the small door of the couple's house.
4	Ellos no podían llevar el piano a través del pequeño door of the couple's house.
5	Ellos no podían llevar el colchón a través del pequeño door of the couple's house.
6	Ellos no podían llevar el colchón a través de la pequeña puerta de la casa de la pareja.
1	She hung her towels on the tendedero y se le volaron todos.
2	She hung her dresses on the tendedero y se le volaron todos.
3	She hung her dresses on the clothesline and they all blew away.
4	Ella colgó sus toallas en el clothesline and they all blew away.
5	Ella colgó sus vestidos en el clothesline and they all blew away.
6	Ella colgó sus vestidos en el tendedero y se le volaron todos.
1	The cat chased the salamander through the entire alcantarilla hasta que finalmente la atrapó.
2	The cat chased the squirrel through the entire alcantarilla hasta que finalmente la atrapó.
3	The cat chased the squirrel through the entire sewer until he finally caught it.
4	El gato persiguió a la salamandra por toda el sewer until he finally caught it.
5	El gato persiguió a la ardilla por toda el sewer until he finally caught it.
6	El gato persiguió a la ardilla por toda la alcantarilla hasta que finalmente la atrapó.
1	He hoped that the drugs could cure his sick caballo enfermo antes del concurso la semana siguiente.
2	He hoped that the pills could cure his sick caballo enfermo antes del concurso la semana siguiente.
3	He hoped that the pills could cure his sick horse before the show the following week.
4	Él esperaba que las drogas pudieran curar a su horse before the show the following week.
5	Él esperaba que las pastillas pudieran curar a su horse before the show the following week.
6	Él esperaba que las pastillas pudieran curar a su caballo enfermo antes del concurso la semana siguiente.
1	Madeline wrote some narratives about two palomas, los símbolos de la paz y el amor.
2	Madeline wrote some folktales about two palomas, los símbolos de la paz y el amor.
3	Madeline wrote some folktales about two doves, the symbols of peace and love.
4	Marcela escribió alguns narraciones sobre dos doves, the symbols of peace and love.
5	Marcela escribió algunas leyendas sobre dos doves, the symbols of peace and love.
6	Marcela escribió algunas leyendas sobre dos palomas, los símbolos de la paz y el amor.
1	Tyler will only eat pasta with butter and repollo desde que él concoció la comida polaca.
2	Tyler will only eat noodles with butter and repollo desde que él concoció la comida polaca.
3	Tyler will only eat noodles with butter and cabbage ever since he was introduced to Polish cuisine.
4	Tito sólo come pasta con mantequilla y cabbage ever since he was introduced to Polish cuisine.
5	Tito sólo come fideos con mantequilla y cabbage ever since he was introduced to

	Polish cuisine.
6	Tito sólo come fideos con mantequilla y repollo desde que él concoció la comida polaca.
1	After the blizzard, communities provided some alivio a las víctimas.
2	After the blizzard, helpers provided some alivio a las víctimas.
3	After the blizzard, helpers provided some relief for the victims.
4	Después de la ventisca, comunidades proporcionaron algo de relief for the victims.
5	Después de la ventisca, ayudantes proporcionaron algo de relief for the victims.
6	Después de la ventisca, ayudantes proporcionaron algo de alivio a las víctimas.
1	Kristy loves to have plants in her hogar porque traen buena suerte.
2	Kristy loves to have ferns in her hogar porque traen buena suerte.
3	Kristy loves to have ferns in her home because they bring her good luck.
4	A Celia le encanta tener plantas en su home because they bring her good luck.
5	A Celia le encanta tener helechos en su home because they bring her good luck.
6	A Celia le encanta tener helechos en su hogar porque traen buena suerte.
1	Very repulsed, the chef removed all the anacardos de su ensalada.
2	Very repulsed, the shopper removed all the anacardos de su ensalada.
3	Very repulsed, the shopper removed all the cashews from his salad.
4	Muy asqueado, el chef quitó todos los cashews from his salad.
5	Muy asqueado, el parroquiano quitó todos los cashews from his salad.
6	Muy asqueado, el parroquiano quitó todos los anacardos de su ensalada.
1	On the hill there is a monastery where the monjas honran su virtud.
2	On the hill there is a nursery where the monjas honran su virtud.
3	On the hill there is a nursery where the nuns honor their virtue.
4	En la colina hay un monasterio donde los nuns honor their virtue.
5	En la colina hay una guardería donde los nuns honor their virtue.
6	En la colina hay una guardería donde las monjas honran su virtud.
1	I like eating hamburgers with a side of papitas y un batido.
2	I like eating chicken with a side of papitas y un batido.
3	I like eating chicken with a side of fries and a milkshake.
4	Me gusta comer hamburguesas con una guarnición de fries and a milkshake.
5	Me gusta comer pollo con una guarnición de fries and a milkshake.
6	Me gusta comer pollo con una guarnición de papitas y un batido.
1	Tori and Jess went to a banquet for the becarios que vienen de Europa.
2	Tori and Jess went to a dance for the becarios que vienen de Europa.
3	Tori and Jess went to a dance for the scholars visiting from Europe.
4	Tonya y Josefina fueron a un banquete para los scholars visiting from Europe.
5	Tonya y Josefina fueron a un baile para los scholars visiting from Europe.
6	Tonya y Josefina fueron a un baile para los becarios que vienen de Europa.
1	Alexa stuffed a bunch of coupons into her bolsillo antes de ir al supermercado.
2	Alexa stuffed a bunch of coins into her bolsillo antes de ir al supermercado.
3	Alexa stuffed a bunch of coins into her pocket before heading to the supermarket.
4	Alejandra metió un montón de cupones en su pocket before heading to the

	supermarket.
5	Alejandra metió un montón de monedas en su pocket before heading to the supermarket.
6	Alejandra metió un montón de monedas en su bolsillo antes de ir al supermercado.
1	According to Peter, no bistro will provide a cena tan tarde por la noche.
2	According to Peter, no brewery will provide a cena tan tarde por la noche.
3	According to Peter, no brewery will provide a meal so late at night.
4	Según Pedro, ningún bistro servirá un meal so late at night.
5	Según Pedro, ninguna cervecería servirá un meal so late at night.
6	Según Pedro, ninguna cervecería servirá una cena tan tarde por la noche.
1	This morning, they approved the program for this primavera después de muchas reuniones.
2	This morning, they approved the budget for this primavera después de muchas reuniones.
3	This morning, they approved the budget for this spring after many meetings.
4	Esta mañana, ellos aprobaron el programa para este spring after many meetings.
5	Esta mañana, ellos aprobaron el presupuesto para este spring after many meetings.
6	Esta mañana, ellos aprobaron el presupuesto para esta primavera después de muchas reuniones.
1	Early this morning, the university acknowledged their elogios por el comportamiento de los aficionados durante el partido del campeonato.
2	Early this morning, the board acknowledged their elogios por el comportamiento de los aficionados durante el partido del campeonato.
3	Early this morning, the board acknowledged their praise for the behavior of the fans during the championship game.
4	Temprano esta mañana, la universidad reconoció su praise for the behavior of the fans during the championship game.
5	Temprano esta mañana, la junta reconoció su praise for the behavior of the fans during the championship game.
6	Temprano esta mañana, la junta reconoció sus elogios por el comportamiento de los aficionados durante el partido del campeonato.
1	Because we were not tired, we ordered cannoli for our postre y hablamos un poco más.
2	Because we were not tired, we ordered cupcakes for our postre y hablamos un poco más.
3	Because we were not tired, we ordered cupcakes for our dessert and talked some more.
4	Debido a que no estabamos cansados, pedimos cannoli para el dessert and talked some more.
5	Debido a que no estabamos cansados, pedimos magdalenas para el dessert and talked some more.
6	Debido a que no estabamos cansados, pedimos magdalenas para el postre y hablamos un poco más.
1	Naively, Doug gave his tortoise a bunch of dulce que lo hizo caer gravemente enfermo.
2	Naively, Doug gave his stepbrother a bunch of dulce que lo hizo caer gravemente enfermo.
3	Naively, Doug gave his stepbrother a bunch of candy that made him get very sick.
4	Ingenuamente, Alfredo le dio a su tortuga un montón de candy that made him get

	very sick.
5	Ingenuamente, Alfredo le dio a su hermanastro un montón de candy that made him get very sick.
6	Ingenuamente, Alfredo le dio a su hermanastro un montón de dulce que lo hizo caer gravemente enfermo.
1	Carol was very proud that her potatoes fit so well with the pavo y otros platillos este Acción de Gracias.
2	Carol was very proud that her stuffing fit so well with the pavo y otros platillos este Acción de Gracias.
3	Carol was very proud that her stuffing fit so well with the turkey and other entrees this Thankgiving.
4	Camila estaba muy orgullosa de que sus patatas quedaron tan bien con el turkey and other entrees this Thankgiving.
5	Camila estaba muy orgullosa de que su relleno quedara tan bien con el turkey and other entrees this Thankgiving.
6	Camila estaba muy orgullosa de que su relleno quedara tan bien con el pavo y otros platillos este Acción de Gracias.
1	The Bradleys like to buy herbs and garlic from the granjero cada semana en el mercado local.
2	The Bradleys like to buy onions and garlic from the granjero cada semana en el mercado local.
3	The Bradleys like to buy onions and garlic from the farmer each week at the local market.
4	A los García les gusta comprar hierbas y ajo del farmer each week at the local market.
5	A los García les gusta comprar cebollas y ajo del farmer each week at the local market.
6	A los García les gusta comprar cebollas y ajo del granjero cada semana en el mercado local.
1	Jack and Amanda handed out announcements for the venta muy temprano esta mañana.
2	Jack and Amanda handed out flyers for the venta muy temprano esta mañana.
3	Jack and Amanda handed out flyers for the sale very early this morning.
4	Alma y Alejo repartieron anuncios para el sale very early this morning.
5	Alma y Alejo repartieron volantes para el sale very early this morning.
6	Alma y Alejo repartieron volantes para la venta muy temprano esta mañana.
1	Sadly, Cheryl forgot the photo for her hija y tuvo que encontrarse con ella con las manos vacías.
2	Sadly, Cheryl forgot the basket for her hija y tuvo que encontrarse con ella con las manos vacías.
3	Sadly, Cheryl forgot the basket for her daughter and had to meet her empty handed.
4	Tristemente, Cheryl olvidó la foto para su daughter and had to meet her empty handed.
5	Tristemente, Cheryl olvidó la canasta para su daughter and had to meet her empty handed.
6	Tristemente, Cheryl olvidó la canasta para su hija y tuvo que encontrarse con ella con las manos vacías.
1	The young parents bought a lot of bottles and enough ropa para durar hasta el tercer cumpleaños de su bebé.

2	The young parents bought a lot of pacifiers and enough ropa para durar hasta el tercer cumpleaños de su bebé.
3	The young parents bought a lot of pacifiers and enough clothes to last until their baby's third birthday.
4	Los jóvenes padres compraron un mónton de botellas y bastante clothes to last until their baby's third birthday.
5	Los jóvenes padres compraron un mónton de chupetes y bastante clothes to last until their baby's third birthday.
6	Los jóvenes padres compraron un mónton de chupetes y bastante ropa para durar hasta el tercer cumpleaños de su bebé.
1	Thomas, look at the carousel next to the columpios en el extremo este del campo de juego.
2	Thomas, look at the ditch next to the columpios en el extremo este del campo de juego.
3	Thomas, look at the ditch next to the swings on the east end of the playground.
4	Tomás, mira el carrusel al lado de los swings on the east end of the playground.
5	Tomás, mira la zanja al lado de los swings on the east end of the playground.
6	Tomás, mira la zanja al lado de los columpios en el extremo este del campo de juego.
1	Corey didn't realize he left his pail on the muelle hasta que fue demasiado tarde.
2	Corey didn't realize he left his cooler on the muelle hasta que fue demasiado tarde.
3	Corey didn't realize he left his cooler on the pier until it was too late.
4	César no se dio cuenta de que dejó su pala en el pier until it was too late.
5	César no se dio cuenta de que dejó su hielera en el pier until it was too late.
6	César no se dio cuenta de que dejó su hielera en el muelle hasta que fue demasiado tarde.
1	Valerie left her wet sculpture next to the caballete mientras sus niños pequeños corrían alrededor.
2	Valerie left her wet canvas next to the caballete mientras sus niños pequeños corrían alrededor.
3	Valerie left her wet canvas next to the easel while her young kids were running around.
4	Valentina dejó su escultura mojada al lado del easel while her young kids were running around.
5	Valentina dejó su lienzo mojado al lado del easel while her young kids were running around.
6	Valentina dejó su lienzo mojado al lado del caballete mientras sus niños pequeños corrían alrededor.
1	Greg put some markers on his escritorio en cuanto llegó a clase.
2	Greg put some pencils on his escritorio en cuanto llegó a clase.
3	Greg put some pencils on his desk as soon as he got to class.
4	Gabriel puso algunos marcadores en su desk as soon as he got to class.
5	Gabriel puso algunos lápices en su desk as soon as he got to class.
6	Gabriel puso algunos lápices en su escritorio en cuanto llegó a clase.
1	He was angry because the adapter for his plancha no estaba funcionando correctamente.
2	He was angry because the plug for his plancha no estaba funcionando correctamente.
3	He was angry because the plug for his iron was not working properly.

4	Él estaba enojado porque el adaptador de su iron was not working properly.
5	Él estaba enojado porque el enchufe de su iron was not working properly.
6	Él estaba enojado porque el enchufe de su plancha no estaba funcionando correctamente.
1	She thoroughly enjoyed the temperature and the paisaje de la cordillera.
2	She thoroughly enjoyed the snow and the paisaje de la cordillera.
3	She thoroughly enjoyed the snow and the landscape of the mountain range.
4	Ella disfrutó plenamente de la temperatura y del landscape of the mountain range.
5	Ella disfrutó plenamente de la nieve y del landscape of the mountain range.
6	Ella disfrutó plenamente de la nieve y del paisaje de la cordillera.
1	The men always choose to drink liquor with the guiso en lugar de vino.
2	The men always choose to drink water with the guiso en lugar de vino.
3	The men always choose to drink water with the stew rather than wine.
4	El hombre siempre elige beber licor con el stew rather than wine.
5	El hombre siempre elige beber agua con el stew rather than wine.
6	El hombre siempre elige beber agua con el guiso en lugar de vino.
1	The coach emphasized that attitude, ruthlessness, and fuerza eran las claves para ganar.
2	The coach emphasized that fearlessness, ruthlessness, and fuerza eran las claves para ganar.
3	The coach emphasized that fearlessness, ruthlessness, and strength were the keys to winning.
4	El entrenador subrayó que la actitud, la misericodia y el strength were the keys to winning.
5	El entrenador subrayó que la valentía, la misericodia y el strength were the keys to winning.
6	El entrenador subrayó que la valentía, la misericodia y la fuerza eran las claves para ganar.
1	Tiffany wanted for herself the elegance of the kings and reinas de toda Europa.
2	Tiffany wanted for herself the jewels of the kings and reinas de toda Europa.
3	Tiffany wanted for herself the jewels of the kings and queens of all of Europe.
4	Teresa quería para ella la elegancia de los reyes y queens of all of Europe.
5	Teresa quería para ella las alhajas de los reyes y queens of all of Europe.
6	Teresa quería para ella las alhajas de los reyes y reinas de toda Europa.
1	He had been a resident in the condado durante los últimos cinco años.
2	He had been a locksmith in the condado durante los últimos cinco años.
3	He had been a locksmith in the county for the last five years.
4	Él había sido un residente en el county for the last five years.
5	Él había sido un cerrajero en el county for the last five years.
6	Él había sido un cerrajero en el condado durante los últimos cinco años.
1	Karina learned about veins, bones, and dientes en su clase de biología.
2	Karina learned about moles, bones, and dientes en su clase de biología.
3	Karina learned about moles, bones, and teeth in her biology class.
4	Carmen aprendió sobre las venas, los huesos y los teeth in her biology class.
5	Carmen aprendió sobre los lunares, los huesos y los teeth in her biology class.

6	Carmen aprendió sobre los lunares, los huesos y los dientes en su clase de biología.
1	For ten years, the old crocodile lived in my cobertizo, comiendo ratones y espantando a otras criaturas del pantano.
2	For ten years, the old lizard lived in my cobertizo, comiendo ratones y espantando a otras criaturas del pantano.
3	For ten years, the old lizard lived in my shed, eating mice and scaring away the other swamp creatures.
4	Por diez años, el cocodrilo viejo vivió en mi shed, eating mice and scaring away the other swamp creatures.
5	Por diez años, el lagarto viejo vivió en mi shed, eating mice and scaring away the other swamp creatures.
6	Por diez años, el lagarto viejo vivió en mi cobertizo, comiendo ratones y espantando a otras criaturas del pantano.
1	She was taken aback by the majesty of all the grabados de la exposición de arte.
2	She was taken aback by the ugliness of all the grabados de la exposición de arte.
3	She was taken aback by the ugliness of all the engravings in the art exhibit.
4	Ella se sorprendió de la majestad de todos los engravings in the art exhibit.
5	Ella se sorprendió de la fealdad de todos los engravings in the art exhibit.
6	Ella se sorprendió de la fealdad de todos los grabados de la exposición de arte.
1	Every year, the carpenter makes his own juguetes para los niños pequeños.
2	Every year, the shopkeeper makes his own juguetes para los niños pequeños.
3	Every year, the shopkeeper makes his own toys for the young children.
4	Cada año, el carpintero hace sus propios toys for the young children.
5	Cada año, el tendero hace sus propios toys for the young children.
6	Cada año, el tendero hace sus propios juguetes para los niños pequeños.
1	One of the actors broke through the muro mientras cantaba y bailaba.
2	One of the clowns broke through the muro mientras cantaba y bailaba.
3	One of the clowns broke through the wall while singing and dancing.
4	Uno de los actores rompió el wall while singing and dancing.
5	Uno de los payasos rompió el wall while singing and dancing.
6	Uno de los payasos rompió el muro mientras cantaba y bailaba.
1	The teachers take the kids to the museums and the piscinas para darles a concocer la cultura local.
2	The teachers take the kids to the libraries and the piscinas para darles a concocer la cultura local.
3	The teachers take the kids to the libraries and the pools to acquaint them with the local culture.
4	Los maestros llevan a los niños a los museos y los pools to acquaint them with the local culture.
5	Los maestros llevan a los niños a las bibliotecas y los pools to acquaint them with the local culture.
6	Los maestros llevan a los niños a las bibliotecas y las piscinas para darles a concocer la cultura local.
1	Very little remained of the monument and all the setos después de las fuertes lluvias.
2	Very little remained of the path and all the setos después de las Fuertes lluvias.
3	Very little remained of the path and all the hedges after the heavy rain.

4	Muy poco quedaba del monumento y todos los hedges after the heavy rain.
5	Muy poco quedaba del sendero y todos los hedges after the heavy rain.
6	Muy poco quedaba del sendero y todos los setos después de las fuertes lluvias.
1	Olivia tried to find her lost bracelet in the pasillo de aquel hotel tan grande.
2	Olivia tried to find her lost earring in the pasillo de aquel hotel tan grande.
3	Olivia tried to find her lost earring in the hallway of the very large hotel.
4	Olivia trató de encontrar su brazalete perdido en el hallway of the very large hotel.
5	Olivia trató de encontrar su arete perdido en el hallway of the very large hotel.
6	Olivia trató de encontrar su arete perdido en el pasillo de aquel hotel tan grande.
1	They raced from the auditorium to the gradas diez veces antes de decidir quién era más rápido.
2	They raced from the fence to the gradas diez veces antes de decidir quién era más rápido.
3	They raced from the fence to the bleachers ten times before deciding who was faster.
4	Ellos corrieron del auditorio a los bleachers ten times before deciding who was faster.
5	Ellos corrieron de la cerca a los bleachers ten times before deciding who was faster.
6	Ellos corrieron de la cerca a las gradas diez veces antes de decidir quién era más rápido.
1	She looked at the map next to the pizarra y alzó la mano para contestar la pregunta.
2	She looked at the screen next to the pizarra y alzó la mano para contestar la pregunta.
3	She looked at the screen next to the chalkboard and raised her hand to answer the question.
4	Ella miró el mapa junto al chalkboard and raised her hand to answer the question.
5	Ella miró la pantalla junto al chalkboard and raised her hand to answer the question.
6	Ella miró la pantalla junto a la pizarra y alzó la mano para contestar la pregunta.
1	This morning, Joel was craving waffles with some tocino o salchichas al lado.
2	This morning, Joel was craving eggs with some tocino o salchichas al lado.
3	This morning, Joel was craving eggs with some bacon or sausage on the side.
4	Esta mañana, a Joel se le antojaban wafles con un poco de bacon or sausage on the side.
5	Esta mañana, a Joel se le antojaban huevos con un poco de bacon or sausage on the side.
6	Esta mañana, a Joel se le antojaban huevos con un poco de tocino o salchichas al lado.
1	He won't eat anything but vegetables with those costillas y se niega a pedir algo diferente.
2	He won't eat anything but mushrooms with those costillas y se niega a pedir algo diferente.
3	He won't eat anything but mushrooms with those ribs and refuses to order something different.
4	Él no quiere comer nada sino vegetales con esos ribs and refuses to order something different.
5	Él no quiere comer nada sino champiñones con esos ribs and refuses to order something different.
6	Él no quiere comer nada sino champiñones con esas costillas y se niega a pedir algo diferente.

1	Heather only dares to make tilapia on the parrilla cuando su marido está alrededor para venir al rescate.
2	Heather only dares to make pork on the parrilla cuando su marido está alrededor para venir al rescate.
3	Heather only dares to make pork on the grill when her husband is around for damage control.
4	Guadalupe sólo se atreve a hacer tilapia en el grill when her husband is around for damage control.
5	Guadalupe sólo se atreve a hacer cerdo en el grill when her husband is around for damage control.
6	Guadalupe sólo se atreve a hacer cerdo en la parrilla cuando su marido está alrededor para venir al rescate.
1	They were not expecting the humidity or the granizada y tuvieron que correr rápidamente por seguridad.
2	They were not expecting the lightning or the granizada y tuvieron que correr rápidamente por seguridad.
3	They were not expecting the lightning or the hailstorm and had to quickly run to safety.
4	Ellos no esperaban la humedad o el hailstorm and had to quickly run to safety.
5	Ellos no esperaban los relámpagos o el hailstorm and had to quickly run to safety.
6	Ellos no esperaban los relámpagos o la granizada y tuvieron que corer rápidamente por seguridad.
1	By learning from battles and performance in siglos pasados, hemos mejorado nuestras estrategias militares de manera exponencial.
2	By learning from wars and performance in siglos pasados, hemos mejorado nuestras estrategias militares de manera exponencial.
3	By learning from wars and performance in centuries past, we have improved our military strategies exponentially.
4	Al aprender de las batallas y del desempeño en centuries past, we have improved our military strategies exponentially.
5	Al aprender de las guerras y del desempeño en centuries past, we have improved our military strategies exponentially.
6	Al aprender de las guerras y del desempeño en siglos pasados, hemos mejorado nuestras estrategias militares de manera exponencial.
1	In the fall, Michael harvests alfalfa and other siembras para vender en el mercado.
2	In the fall, Michael harvests wheat and other siembras para vender en el mercado.
3	In the fall, Michael harvests wheat and other crops to sell in the market.
4	En el otoño, Miguel cosecha alfalfa y otros crops to sell in the market.
5	En el otoño, Miguel cosecha trigo y otros crops to sell in the market.
6	En el otoño, Miguel cosecha trigo y otras siembras para vender en el mercado.
1	After the noise complaint, the supervisor spoke to the inquilino en privado y le dio una severa advertencia.
2	After the noise complaint, the landlord spoke to the inquilino en privado y le dio una severa advertencia.
3	After the noise complaint, the landlord spoke to the tenant privately and gave him a severe warning.
4	Después de la queja por ruidos, el supervisor habló con el tenant privately and gave him a severe warning.

5	Después de la queja por ruidos, el dueño habló con el tenant privately and gave him a severe warning.
6	Después de la queja por ruidos, el dueño habló con el inquilino en privado y le dio una severa advertencia.
1	He likes having his tractor next to the huerta porque facilita mantener un ojo en todo.
2	He likes having his livestock next to the huerta porque facilita mantener un ojo en todo.
3	He likes having his livestock next to the orchard because it makes it easier to keep an eye on everything.
4	A él le gusta tener su tractor al lado del orchard because it makes it easier to keep an eye on everything.
5	A él le gusta tener su granado al lado del orchard because it makes it easier to keep an eye on everything.
6	A él le gusta tener su granado al lado de la huerta porque facilita mantener un ojo en todo.
1	She always stores the barrels under a estante en su granero enorme.
2	She always stores the wheelbarrow under a estante en su granero enorme.
3	She always stores the wheelbarrow under a shelf in her enormous barn.
4	Ella siempre pone los barriles abajo de un shelf in her enormous barn.
5	Ella siempre pone la carretilla abajo de un shelf in her enormous barn.
6	Ella siempre pone la carretilla abajo de un estante en su granero enorme.
1	Sammy was displeased that the alarm next to the buzones aún estaba roto a pesar de muchas llamadas al encargado.
2	Sammy was displeased that the loudspeaker next to the buzones aún estaba roto a pesar de muchas llamadas al encargado.
3	Sammy was displeased that the loudspeaker next to the mailboxes was still broken despite many calls to the superintendent.
4	Salvador estaba molesto porque la alarma al lado de los mailboxes was still broken despite many calls to the superintendent.
5	Salvador estaba molesto porque el altavoz al lado de los mailboxes was still broken despite many calls to the superintendent.
6	Salvador estaba molesto porque el altavoz al lado de los buzones aún estaba roto a pesar de muchas llamadas al encargado.
1	The Greeks felt a great magnitude of achievement and orgullo después de que derrotaran a los persas.
2	The Greeks felt a great surge of achievement and orgullo después de que derrotaran a los persas.
3	The Greeks felt a great surge of achievement and pride after they defeated the Persians.
4	Los griegos sintieron una gran magnitud de logro y pride after they defeated the Persians.
5	Los griegos sintieron una gran oleada de logro y pride after they defeated the Persians.
6	Los griegos sintieron una gran oleada de logro y orgullo después de que derrotaran a los persas.
1	She bought these pastels for the retrato que se volvió muy famoso.
2	She bought these paintbrushes for the retrato que se volvió muy famoso.
3	She bought these paintbrushes for the portrait that became very famous.

4	Ella compró estos pasteles para el portrait that became very famous.
5	Ella compró estos pinceles para el portrait that became very famous.
6	Ella compró estos pinceles para el retrato que se volvió muy famoso.
1	The left lane of the interstate is closed due to inundaciones por el resto de la semana.
2	The left lane of the highway is closed due to inundaciones por el resto de la semana.
3	The left lane of the highway is closed due to flooding for the rest of the week.
4	El carril izquierdo de la interstatal está cerrado debido al flooding for the rest of the week.
5	El carril izquierdo de la autopista está cerrado debido al flooding for the rest of the week.
6	El carril izquierdo de la autopista está cerrado debido a las inundaciones por el resto de la semana.
1	Even though he was in pain, the painter climbed to the techo para trabajar desde un ángulo mejor.
2	Even though he was in pain, the handyman climbed to the techo para trabajar desde un ángulo mejor.
3	Even though he was in pain, the handyman climbed to the roof to work from a better angle.
4	A pesar de que estaba dolorido, el pintor se subió al roof to work from a better angle.
5	A pesar de que estaba dolorido, el manitas se subió al roof to work from a better angle.
6	A pesar de que estaba dolorido, el manitas se subió al techo para trabajar desde un ángulo mejor.
1	Yesterday, Jennifer purchased sponges for the ducha del baño de arriba.
2	Yesterday, Jennifer purchased soaps for the ducha del baño de arriba.
3	Yesterday, Jennifer purchased soaps for the shower in the upstairs bathroom.
4	Ayer, Jenifer compró esponjas para el shower in the upstairs bathroom.
5	Ayer, Jenifer compró jabones para el shower in the upstairs bathroom.
6	Ayer, Jenifer compró jabones para la ducha del baño de arriba.
1	They carefully lifted the candelabra onto the montacargas y se alejaron lentamente.
2	They carefully lifted the bookcase onto the montacargas y se alejaron lentamente.
3	They carefully lifted the bookcase onto the forklift and slowly drove away.
4	Ellos levantaron cuidadosamente el candelabro en el forklift and slowly drove away.
5	Ellos levantaron cuidadosamente la estantería en el forklift and slowly drove away.
6	Ellos levantaron cuidadosamente la estantería en el montacargas y se alejaron lentamente.
1	The king rode an elephant across the puente hacia las tierras adyacentes.
2	The king rode an ostrich across the puente hacia las tierras adyacentes.
3	The king rode an ostrich across the bridge into the adjacent lands.
4	El rey montó un elefante a través del bridge into the adjacent lands.
5	El rey montó un avestruz a través del bridge into the adjacent lands.
6	El rey montó un avestruz a través del puente hacia las tierras adyacentes.
1	The loose sheets fell out of her dictionary into the charco mientras caminaba por la calle.
2	The loose sheets fell out of her briefcase into the charco mientras caminaba por la calle.
3	The loose sheets fell out of her briefcase into the puddle while walking down the

	street.
4	Las hojas sueltas se cayeron de su diccionario en el puddle while walking down the street.
5	Las hojas sueltas se cayeron de su maletín en el puddle while walking down the street.
6	Las hojas sueltas se cayeron de su maletín en el charco mientras caminaba por la calle.
1	This year, his editor wants a helmet and patines para su cumpleaños.
2	This year, his niece wants a helmet and patines para su cumpleaños.
3	This year, his niece wants a helmet and skates for her birthday.
4	Este año, su editor quiere un casco y skates for her birthday.
5	Este año, su sobrina quiere un casco y skates for her birthday.
6	Este año, su sobrina quiere un casco y patines para su cumpleaños.
1	He turned on the radio in the lavadero y continuó con su proyecto.
2	He turned on the heater in the lavadero y continuó con su proyecto.
3	He turned on the heater in the washroom and continued his project.
4	Él prendió la radio en el washroom and continued his project.
5	Él prendió el calentador en el washroom and continued his project.
6	Él prendió el calentador en el lavadero y continuó con su proyecto.
1	To make matters worse, he found termites in addition to the hormigas que ya estaban causando problemas a los propietarios.
2	To make matters worse, he found bedbugs in addition to the hormigas que ya estaban causando problemas a los propietarios.
3	To make matters worse, he found bedbugs in addition to the ants that were already causing problems for the homeowners.
4	Para empeorar las cosas, él encontró termitas además de los ants that were already causing problems for the homeowners.
5	Para empeorar las cosas, él encontró chinches además de los ants that were already causing problems for the homeowners.
6	Para empeorar las cosas, él encontró chinches además de las hormigas que ya estaban causando problemas a los propietarios.
1	Phil and Jamie played with their blocks on the colcha hasta que fue hora de ver la televisión.
2	Phil and Jamie played with their puzzles on the colcha hasta que fue hora de ver la televisión.
3	Phil and Jamie played with their puzzles on the quilt until it was time to watch television.
4	Adriana y Liliana jugaron con sus bloques en el quilt until it was time to watch television.
5	Adriana y Liliana jugaron con su rompecabezas en el quilt until it was time to watch television.
6	Adriana y Liliana jugaron con su rompecabezas en la colcha hasta que fue hora de ver la televisión.
1	She didn't want to leave the crayons with the gemelos por miedo a que hubiera un gran lío cuando regresara.
2	She didn't want to leave the snacks with the gemelos por miedo a que hubiera un gran lío cuando regresara.

3	She didn't want to leave the snacks with the twins for fear that there would be a huge mess when she returned.
4	Ella no quería dejar los crayones con los twins for fear that there would be a huge mess when she returned.
5	Ella no quería dejar las meriendas con los twins for fear that there would be a huge mess when she returned.
6	Ella no quería dejar las meriendas con los gemelos por miedo a que hubiera un gran lío cuando regresara.
1	Anne was overwhelmed by the finances on her hipoteca pero no había nada que pudiera hacer al respecto.
2	Anne was overwhelmed by the loan on her hipoteca pero no había nada que pudiera hacer al respecto.
3	Anne was overwhelmed by the loan on her mortgage but there was nothing she could do about it.
4	Ana estaba abrumada por las finanzas de su mortgage but there was nothing she could do about it.
5	Ana estaba abrumada por el préstamo de su mortgage but there was nothing she could do about it.
6	Ana estaba abrumada por el préstamo de su hipoteca pero no había nada que pudiera hacer al respecto.
1	He walked outside to find drenched hammocks near the rociadores y su ánimo al instante se volvió agrio.
2	He walked outside to find drenched furniture near the rociadores y su ánimo al instante se volvió agrio.
3	He walked outside to find drenched furniture near the sprinklers and his mood instantly turned sour.
4	Él salió y encontró las hamacas empapadas cerca de los sprinklers and his mood instantly turned sour.
5	Él salió y encontró los muebles empapados cerca de los sprinklers and his mood instantly turned sour.
6	Él salió y encontró los muebles empapados cerca de los rociadores y su ánimo al instante se volvió agrio.
1	With the help of a crane, he moved pallets full of herramientas y materiales de construcción.
2	With the help of a crane, he moved boxes full of herramientas y materiales de construcción.
3	With the help of a crane, he moved boxes full of tools and building supplies.
4	Con la ayuda de una grúa, él trasladó paletas llenas de tools and building supplies.
5	Con la ayuda de una grúa, él trasladó cajas llenas de tools and building supplies.
6	Con la ayuda de una grúa, él trasladó cajas llenas de herramientas y materiales de construcción.
1	She bought more conditioner as well as afeitadoras ya que estaba a punto de quedarse sin los dos.
2	She bought more hairspray as well as afeitadoras ya que estaba a punto de quedarse sin los dos.
3	She bought more hairspray as well as razors since she was close to running out of both.
4	Ella compró más acondicionador además de razors since she was close to running out of both.
5	Ella compró más laca además de razors since she was close to running out of both.

6	Ella compró más laca además de afeitadoras ya que estaba a punto de quedarse sin los dos.
1	Whether it's the detergent or the secadora, Consuelo odia todo lo que tiene que ver con la limpieza.
2	Whether it's the dishwasher or the secadora, Consuelo odia todo lo que tiene que ver con la limpieza.
3	Whether it's the dishwasher or the dryer, Kathy hates everything to do with cleaning.
4	Ya sea el detergente o el dryer, Kathy hates everything to do with cleaning.
5	Ya sea el lavaplatos o el dryer, Kathy hates everything to do with cleaning.
6	Ya sea el lavaplatos o la secadora, Consuelo odia todo lo que tiene que ver con la limpieza.
1	She fixed the ripped collar of the sudadera porque no pudo soportar desprenderse de ella.
2	She fixed the ripped sleeve of the sudadera porque no pudo soportar desprenderse de ella.
3	She fixed the ripped sleeve of the sweatshirt because she couldn't bear to part with it.
4	Ella arregló el cuello rasgado del sweatshirt because she couldn't bear to part with it.
5	Ella arregló la manga rasgada del sweatshirt because she couldn't bear to part with it.
6	Ella arregló la manga rasgada de la sudadera porque no pudo soportar desprenderse de ella.
1	Gabriella ended up with a tattoo on her espalda después de una noche escandalosa.
2	Gabriella ended up with a bruise on her espalda después de una noche escandalosa.
3	Gabriella ended up with a bruise on her back after a rowdy night out.
4	Gabriella acabó con un tatuaje en su back after a rowdy night out.
5	Gabriella acabó con un moretón en su back after a rowdy night out.
6	Gabriella acabó con un moretón en su espalda después de una noche escandalosa.
1	They rushed to the hospital after the tiroteo que causó estragos en muchas personas.
2	They rushed to the courthouse after the tiroteo que causó estragos en muchas personas.
3	They rushed to the courthouse after the shooting that caused havoc for many people.
4	Ellos corrieron al hospital después del shooting that caused havoc for many people.
5	Ellos corrieron al juzgado después del shooting that caused havoc for many people.
6	Ellos corrieron al juzgado después del tiroteo que causó estragos en muchas personas.
1	He was given a certificate for his deportividad durante el torneo.
2	He was given an award for his deportividad durante el torneo.
3	He was given an award for his sportsmanship during the tournament.
4	A él le dieron un certificado por su sportsmanship during the tournament.
5	A él le dieron un premio por su sportsmanship during the tournament.
6	A él le dieron un premio por su deportividad durante el torneo.