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Investigating Bilingual Non-Selective Lexical Access Within A Reading Comprehension Framework

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INVESTIGATING BILINGUAL NON-SELECTIVE LEXICAL ACCESS WITHIN A READING
COMPREHENSION FRAMEWORK

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COMPREHENSION FRAMEWORK

by

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1. Introduction

In most parts of the world, bilingualism is the norm (Grosjean, 2010). In the United States, bilingualism is becoming increasingly more common, with an estimated 60 million Americans speaking a language other than English at home (U.S. Census Bureau, 2013). It is important to study bilingualism, particularly in terms of how knowledge of one language affects processing and lexical access in the other language. There is considerable research demonstrating that bilingual lexical access is non-selective. This means that both languages are always active even when a bilingual is cognitively engaged in only one of their languages (Brysbaert, Van Dyck, Van de Poel, 1999; Dijkstra, & van Heuven, 2002; Duyck, Van Assche, Drieghe, & Hartsuiker, 2007; Jared, & Kroll, 2001; Van Heuven, Dijkstra, & Grainger, 1998). The current study investigates the nature of this non-selective lexical activation and the possible effects and implications it may have on sentence comprehension.

1.1 Bilingual cross-language activation

Evidence for non-selective lexical access comes in part from the observation of facilitated processing of cognate words. Cognates are words that share form and meaning across languages (e.g. *piano-piano* in English and Spanish). Enhanced processing (faster and/or more accurate responding) of cognates has been observed across a variety of tasks such as lexical decision, translation, word naming and picture naming. (e.g. Dijkstra et al, 1999; Kroll & Stewart, 1994; Lemhöfer & Dijkstra, 2004; Schwartz, Kroll & Diaz, 2007; van Hell & De Groot, 2008). Cognate facilitation is also observed irrespective of whether a bilingual is communicating in the dominant (L1) or weaker (L2) language (e.g. Duyck, et al., 2007; Gollan, Forster, & Frost, 1997), and even in languages that do not share the same orthographic script (e.g. Hoshino & Kroll, 2008; Gollan, Forster, & Frost, 1997).

While earlier studies focused on processing of single words in isolation, more recent studies have demonstrated that the facilitation persists even when words are embedded in sentence context (Duyck, et al., 2007, Libbon & Titone, 2009; Schwartz & Kroll, 2006; Van Hell & Degroot, 2008). However, the magnitude of the facilitation is modulated by the extent to which the sentence strongly biases the meaning of the upcoming cognate (Libbon & Titone, 2009; Schwartz & Kroll, 2006; Van Hell & Degroot, 2008). Sentences that have high semantic constraint provide information that bias the specific

meaning of a target word, making it more predictable. Sentences that have low semantic constraint do not bias the meaning of the target word (a cognate or a matched non-cognate control) prior to its occurrence in the sentence. Cognate facilitation is observed in low semantic constraint sentence contexts. In highly constraining sentence, cognate effects are attenuated (Libben & Titone, 2009; Schwartz & Kroll, 2006; Van Hell & Degroot, 2008).

Cognates also facilitate selection and integration of low-frequency meanings of ambiguous words (e.g., the “weapons” meaning of *arms*). Specifically, when a low frequency meaning of an ambiguous word is shared across languages (e.g., *armas* in Spanish shares the “weapons” meaning with English), facilitation has been observed in selection of the correct meaning (Areas da Luz Fontes, & Schwartz, 2010), and its integration into context (Areas da Luz Fontes & Shwartz, 2011, 2014; Schwartz, Yeh & Shaw, 2008; Lauro, Baca, Schwartz, 2013).

According to the Bilingual Interactive Activation plus model (BIA+) of bilingual lexical access (van Heuven & Dijkstra, 2002), cognate facilitation effects are the result of convergent activation of shared lexical representations within an integrated lexicon in which activation flows automatically across languages. A key assumption of the BIA+ model is that bilingual lexical activation is fundamentally language non-selective, irrespective of task demands, participant task expectations or the surrounding linguistic environment. However, the linguistic stimuli (e.g. word, sentence, or picture) of the task modulates the relative strength of activation of word representations from the non-target language (i.e. the language not currently cognitively engaged in). When semantic information strongly biases a particular meaning, this allows activation to settle more quickly on a target representation. This in turn, decreases the observed influence of the non-target language.

1.2 Building a semantic representation of a sentence

The evidence is compelling that semantic information is co-activated across languages, thus producing reliable facilitation of cognate processing. What remains unknown is whether this facilitation extends to processing of larger units of text, such as overall comprehension of a sentence. This is an important issue because the goal of sentence comprehension is to build a coherent mental representation of the sentence’s meaning as a whole unit, rather than processing of each individual word (Gernsbacher

& Hargreaves, 1988). Take, for example, the sentence “The dog chased the cat, and it knocked over a chair.” To comprehend the sentence, one must build an accurate representation that the dog is doing the chasing, and that *it* can refer to the dog or the cat, one of which knocked over the chair.

The *Structure Building Framework* is a model that accounts for monolingual comprehension of sentences as a whole unit. This model assumes that a reader constructs a coherent representation of a sentence, which consists of various structures. A representation of a sentence is built through three processes. First, the reader creates a foundational representation based on the initial information coming from the sentence (e.g., .the dog chased). Second, through the process of mapping, additional information, or “structures,” are added to the existing foundation, if they cohere with that foundation. For example, the “cat” and “it knocked over the chair” are both mapped onto the foundation, “dog.” The third process occurs when incoming information is not semantically congruent. For example if the phrase “The dog chased the cat” is followed by “and it hissed,” a new sub-structure is created, mapping “and it hissed” onto the “cat.” This sub-structure serves as the temporary foundation because the incoming information is semantically incongruent with “dog” as the agent (Gernsbacher, 1991).

The foundation that is initially laid as the basis for comprehending the sentence is conceptualized as a set of nodes in memory. Incoming information that is semantically congruent maps on to the foundation through activation, or “enhancement,” of relevant memory nodes. When incoming information is incongruent with the existing foundation, readers create new sub-structures through suppression of the activated nodes of the existing foundation. In this way, a topic shift or change in a referent suppresses memory nodes of the current structure.

In English, the first element of a sentence is usually preferred as a starting point for the organization of a reader’s mental representation of text as a whole (MacWhinney, 1977). For example, the first word of a sentence is looked at longer than subsequent words in the sentence (Aaronson & Scarborough, 1976); the first sentence of a paragraph takes longer to read than subsequent paragraphs (Haberlandt, 1984); and the first paragraph in a chapter takes longer to read than subsequent paragraphs. Also, in reaction time (RT) studies readers will respond more quickly to the first mentioned noun of a sentence than to the second mentioned noun (Gernsbacher & Hargreaves, 1988). For example, if

participants read “Tina beat Lisa in the state tennis match,” they will respond faster when asked if Tina won the tennis match than if they read the sentence “Lisa was beaten by Tina in the state tennis match.” This effect is referred to as the advantage of first mentioned participants. According to the structure building framework, the first concrete element (i.e. the first mentioned argument of the verb; referred to as “participants”) in the sentence serves as the foundation for subsequent information to be mapped on to. It initially takes longer to “lay the foundation,” but afterwards, the foundation is accessed more easily than subsequent information in the sentence.

The advantage of first mentioned participants is not a simple primacy effect or a result of the linguistic layout of the English language. This effect occurs whether the first mentioned participant is the semantic role of agent or patient (e.g. “Lisa was beaten by Tina in the state tennis match”; “Tina beat Lisa in the state tennis match.”). It also occurs whether or not the first mentioned participant is the subject of the sentence (e.g. “Tina argued with Lisa during the meeting”; “Lisa argued with Tina during the meeting”). In addition, this effect still occurs whether the first mentioned participant is the initial word in the sentence, or if it is preceded by an adverb or prepositional phrase (e.g. “Two weeks ago Tina beat Lisa in the state tennis match.”) (Gernsbacher, 1991). The advantage of first mentioned participants also holds for languages which allow more freedom in word order, such as Spanish (Carreiras, Gernsbacher, & Villa, 1995). These findings support the idea that the advantage of first mentioned participants is a general cognitive phenomenon and not a reflection of the English language structure.

Sentences that change the ongoing topic, viewpoint, or setting, take substantially longer to comprehend than those that continue it (Gernsbacher, 1991). Thus, according to the structure building framework, sentences with incongruent information (i.e. incoming information not directly relevant to the original foundational noun), the second mentioned participant acts as a temporary substructure. The sub-structure is initially more accessible and responded to faster than the original foundation. However, after a short delay, the first mentioned participant (original foundation) is responded to faster, when the entire sentence is processed as a whole unit (Gernsbacher, Hargreaves, & Beeman, 1989). Information presented before the change in topic is represented in one substructure, while information presented after the change is represented as another (Anderson, Garrod, & Sanford, 1983). For example, in the

sentence, “Now that the artists are working in oil, prints are rare,” a new sub-structure is created around *oil*. The memory nodes holding information available in the sub-structure are temporarily enhanced during, and immediately following, completion of the sentence. The sub-structure is then suppressed when the information from the sentence as a whole maps onto the original foundation (e.g. *artist* in the previous example). When test names were presented coincidentally with the last words of their sentences, initially target words in the most recently read clause was most accessible (e.g. *oil*) (Gernsbacher & Hargreaves, 1988). However, when the same stimuli was used, and the same test words had a delayed onset time of 150 ms., both the first mentioned and second mentioned participants were equally as accessible. When the onset time of the target word was delayed 1400 ms., the first mentioned participants were more accessible than second mentioned participants (Gernsbacher, Hargreaves, Beeman, 1989).

1.3 The Present Study

The current study aims to integrate findings regarding the nature of the bilingual lexicon and lexical access into the current *structure building framework* model of reading comprehension. The primary objective is to test whether cross-language activation affects processing times of the foundational word of a sentence when creating a structure of comprehension while reading. It has previously been demonstrated that cognates facilitate lexical access in sentence contexts. The central hypothesis is that creation of a sentence’s foundation will be influenced by the presence of a cognate noun. When the cognate noun is the subject of the pronoun co-activation of cognate will facilitate laying the foundation. When the cognate is the opposite noun, its co-activation will interfere with laying the foundation. Based on this hypothesis we predicted that when the pronoun refers to the cognate noun, reading times would be significantly shorter. We expected the reduction to be observed in processing of the cognate noun itself, the entire noun phrase and processing of the pronoun. This latter prediction is based on the *full-access hypothesis*, which states that lexical properties of the antecedent extend to the pronoun (Lago et al. 2011; Navarrette et al., 2006; Egusquiza et al., 2014).

2. Method

2.1 Participants

Sixty-six bilingual participants were selected from the Introductory Psychology subject pool at the University of Texas at El Paso. Participants' average age was 20 years old. Participant language proficiency was assessed through two measures. A subjective rating was measured using the ESPADA language background, usage, and proficiency rating questionnaire (Francis & Strobach, 2013). Responses on this measure indicated that participants rated themselves as equally proficient in English and Spanish. The average reading comprehension rating for participants was 8.6 out of 10 for English, and 7.6 out of 10 for Spanish. Overall ratings (averaged across reading, writing, speaking, and listening comprehension) of English proficiency was 8.65 out of 10. Average overall rating of Spanish proficiency was 8.41 out of 10. An objective measure of language proficiency was also obtained using the Woodcock-Muñoz language proficiency task, specifically the reading comprehension component. Performance on this measure reflected equal reading comprehension proficiency in both English and Spanish. Participants' average age equivalencies were 13.69 in English and 14.71 in Spanish. In addition, participants' relative proficiency indexes (RPI) were similar in both English and Spanish (64.80 and 64.28, respectively). RPI refers to how well participants would perform on an exam in which their average age/grade level peers would score a 90% (See Table 1.1 for a complete list of participant proficiency ratings). Participants received course credit for their participation.

2.2 Tasks and Materials

2.2.1 ESPADA

The ESPADA language background, usage, and proficiency rating questionnaire was used to provide a subjective rating of language proficiency in English and Spanish (Francis and Strobach, 2013). Participants provided age of acquisition for both English and Spanish, as well as proficiency ratings (1-10) in both languages across a variety of domains (e.g. reading, writing, speaking and speech comprehension). Participants rated their proficiency in both English and Spanish across a number of modalities (i.e. reading, writing, speaking, and listening comprehension).

2.2.2 Woodcock-Muñoz language survey-revised

The Woodcock-Muñoz language survey provided an objective measure of language proficiency in English and Spanish. For the purposes of the present study, participants completed the passage comprehension portion of the survey. In this section, participants read sentences that are missing one word, and asked to say aloud the missing word. Sentences get subsequently harder each trial. Participants completed the task when five consecutive responses are incorrect, or all sentences were completed. The Woodcock-Muñoz language survey provides two indices of proficiency; average age equivalency and relative proficiency index (RPI).

Table 1.1. *Self-Reported (ESPADA) and Objective Measures (Woodcock-Muñoz) of Language Proficiency (in English and Spanish) (N = 66)*

Proficiency Measures	Minimum	Maximum	Mean
ESPADA Questionnaire(Subjective Measure)			
English Comprehension (1-10)			
Reading Comprehension	6	10	8.6
Writing Comprehension	5	10	8.4
Speaking Comprehension	6	10	8.6
Listening Comprehension	5	10	9.0
Overall Comprehension	--	--	8.65
Spanish Comprehension (1-10)			
Reading Comprehension	3	10	7.6
Writing Comprehension	2	10	6.8
Speaking Comprehension	5	10	8.2
Listening Comprehension	3	10	8.9
Overall Comprehension	--	--	8.4
Age of acquisition (years old)			
English	1	17	6.3
Spanish	0	10	2.2
Woodcock-Muñoz (Objective Measure)			
Reading Comprehension			
English			
Age Equivalency (1- >30)	7.9	30	13.69
RPI (1-90)	7	100	64.80
Spanish			
Age Equivalency (1- >30)	8.1	30	14.74
RPI (1-90)	11	94	64.29

2.2.3 Stimuli

The present study was a 3 (noun phrase condition) by 2 (pronoun referent) design. The noun phrase either contained a cognate in the first word position (“cognate first”), cognate in the second word position (“cognate second”), or no cognates present (“no cognate”). The pronoun either referred to the first or the second noun of the sentence.

The word stimulus list consisted of a total of 126 words, 42 cognates and 84 non-cognates. The 126 words were divided into 42 word triads. Each triad consisted of one cognate and two non-cognates used to construct sentences for each of the three noun phrase conditions. Words in each triad were matched on frequency and length. Averaged lexical characteristics between English and Spanish for cognates, non-cognates and control words can be found in Table 2.1.

A total of 252 sentences were constructed; 42 sets of 6 sentences, one sentence per condition. For half of the sentences in each set, the pronoun referred to the first noun, and in the other half, it referred to the second noun. This was achieved by having one of the nouns in the noun phrase in plural form, so that the pronoun could only refer to one of the two nouns.

Two of the sentences in each set had a cognate in the first position, two with a cognate in the second position and two with no cognate present in the noun phrase. Experimental running lists consisted of 7 sentences per condition. Average sentence length and position of target words are reported in Table 2.2 for each condition.

Table 2.1. *Word Length, Mean Frequency (Sublex Frequency Database), and Orthographic similarity between English and Spanish words for Cognates, Non-Cognates, and matched Non-Cognate controls*

Stimuli Words			
Word Type	Number of Letters	Frequency	Orthographic Similarity
Cognate	6.29	52.70	0.72
Non-cognate	6.00	52.33	0.25
Control	5.59	60.94	0.20

Table 2.2 *Sentence Length, Position of the First Noun, and Position of the Second Noun for all Sentence Conditions*

Noun phrase condition (position 1; position 2)	Pronoun Reference	Sentence length (number of words)	Position of first noun (<i>n</i> th word)	Position of second noun (<i>n</i> th word)	Position of Pronoun
Cognate first	First noun	17.43	2.02	5.98	12.31
Cognate first	Second noun	17.19	2.02	5.98	12.43
Cognate second	First noun	17.07	2.05	6.02	12.33
Cognate second	Second noun	17.21	2.05	6.02	12.14
No cognate	First noun	17.24	2.05	6.07	12.43
No cognate	Second noun	17.40	2.05	6.07	12.45

2.2.4 Procedure

Participants first completed the ESPADA language background, usage, and proficiency rating questionnaire (Francis & Strobach, 2013). Then, participants completed the sentence reading task. Participants were instructed to read sentences on a computer screen for comprehension while their eye movements were monitored. Participants were instructed to read at their normal speed. Before each sentence, participants were prompted with a fixation point. They were instructed to look at the fixation point, and press spacebar so that the trial sentence would appear on the screen. Participants then read ten practice sentences. Following some sentences, participants responded to simple comprehension questions yes or no using by using the appropriate key on the keyboard. All experimental trials were randomized. Finally, participants completed the reading comprehension section of the Woodcock-Muñoz language proficiency test.

2.2.5 Apparatus

Eye movement data were acquired using an Eye-Link 1000 tower mounted system (SR-Research). Viewing was binocular, but eye movements were recorded from participants' dominant eye. In the event that they did not know which eye is dominant, the right eye was used as a default. Definitions for eye tracking measures used in this study can be found in Table 2.3.

Table 2.3 *Definitions for Eye Tracking Measures, Including; First Fixation Duration, Gaze Duration, Total Reading Time, Regressions, and Cumulative Total Reading Time*

Stage	Eye Tracking Measure	Definition
Early	First fixation duration	The length of time the eyes fixate on the target word the first time they look at it
	Gaze duration	The sum of all fixation durations beginning the moment the eyes look at the target word until the moment they move away.
Late	Total reading time	The sum of all fixations made on the target word during a given trial.
	Regressions	The number of times the eyes regress back to the target word.
	Cumulative total reading time	The sum of total reading time fixations made on target nouns in the first and second noun positions

2.2.6 Analyses and Data Treatment

Six participants were determined to not have adequate proficiency levels in either English or Spanish. Their data were not included in the analyses. Six additional bilingual participants who did meet the minimum bilingual criteria ($RPI > 5$) completed the study.

Both early and late eye tracking measures of comprehension were used in the analyses. Early measures include first fixation duration, the first fixation made on a word, and gaze duration, the number of fixations made on a word before moving on to the next word. Early measures are assumed to reflect initial lexical access. Later stage measures are assumed to reflect higher order processes (e.g. semantic integration; ambiguity resolution) (Libbon & Titone, 2009). Late measures include total reading time,

the total number of fixations made on a word; the number of regressions made back to a word (regressions); and cumulative total reading time of the first and second nouns. Number of regressions reflects the total number of regressions, per condition, made back to the target word. Cumulative total reading time was calculated by adding total reading times of the first and second nouns of each sentence and averaged within conditions.

Fixations shorter than 100 ms. were removed from the analyses (8.5% of the data) (Morrison, 1984). An additional 1.5% of the data was removed from the analysis due a design error in which the pronoun was referring to the wrong noun position in one sentence of a particular experimental list. The error was corrected with minimal data loss.

3. Results

A series of 3 (noun phrase: cognate first, cognate second, no cognate) X 2 (Word position: first noun, second noun) X 2 (Pronoun Referent: First noun reference vs. second noun reference) repeated measures analyses of variance (ANOVAs). Statistics for the ANOVA analyses are provided in Table 3.1.

3.1 First and Second Noun Processing times

A 3 (Noun phrase: cognate first, cognate second, no cognate) X 2 (word position: first noun, second noun) repeated measures ANOVA was conducted on first fixation durations, gaze durations, and total reading time of the first position and second position nouns. A main effect of word position was observed in gaze duration and total reading time (Gaze duration: $F(1, 65) = 36.4, p = .000$; Total reading time: $F(1, 65) = 327.0, p = .000$). The main effect of cognate status was not significant nor was its interaction with noun phrase condition.

Another 3 (Noun phrase: cognate first, cognate second, no cognate) X 2 (word position: first noun, second noun) repeated measures ANOVA was conducted on trials in which the pronoun referenced the first noun (see figures 3.1, 3.2, and 3.3). Analyses were performed on measures of later processing only (total reading time, cumulative total reading time and number of regressions) because initial processing would not be affected by the later appearing pronoun. A main effect of word position was observed in total reading time and number of regressions (total reading time: $F(1, 62) = 181.1, p = .000$; number of regressions: $F(1, 62) = 688.9, p = .000$). Also, there was a main effect of cognate status, reflecting shorter fixations and fewer regressions back to cognates relative to non-cognates (total reading time: $F(1, 62) = 13.022, p = .001$; number of regressions: $F(1, 62) = 6.9, p = .014$). There were no significant differences between cognates and non-cognates occurring in the second position. There was a significant interaction between noun phrase and pronoun referent in total reading time and cumulative total reading time (total reading time: $F(1, 62) = 39.5, p = .000$; cumulative total reading time: $F(1, 62) = 6.4, p = .011$). When cognates were in the first position, both nouns were processed faster than if there was no cognate present (mean difference = $-113.3, p = .012$).

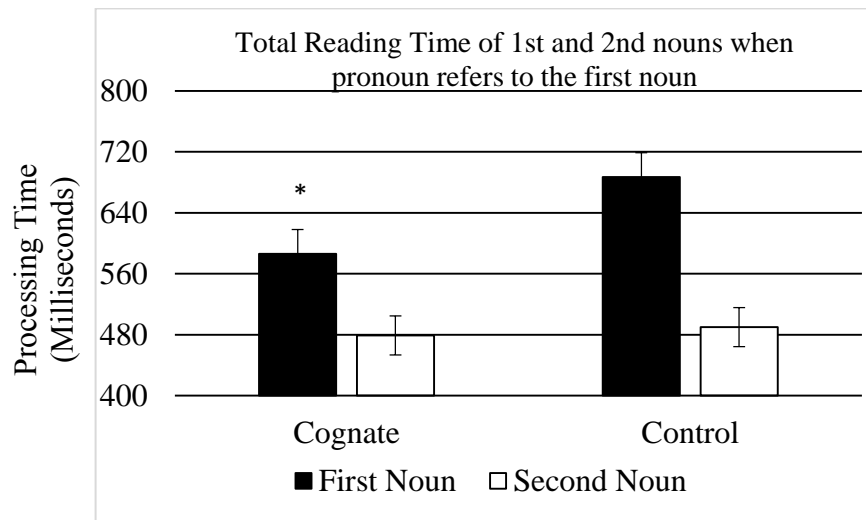


Figure 3.1 Average total reading time of cognates and control words in 1st and 2nd noun position

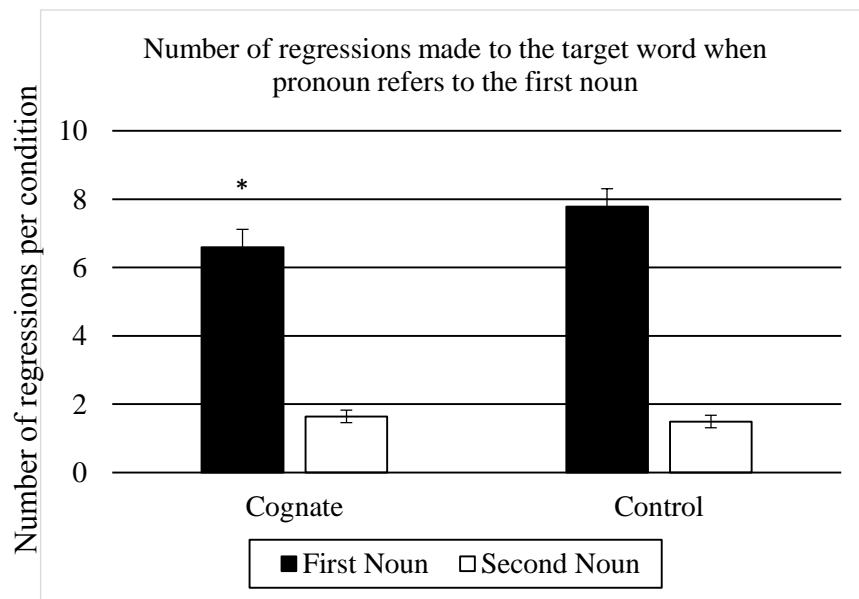


Figure 3.2 Number of regressions per condition made back to 1st and 2nd nouns when the pronoun referred to the first noun

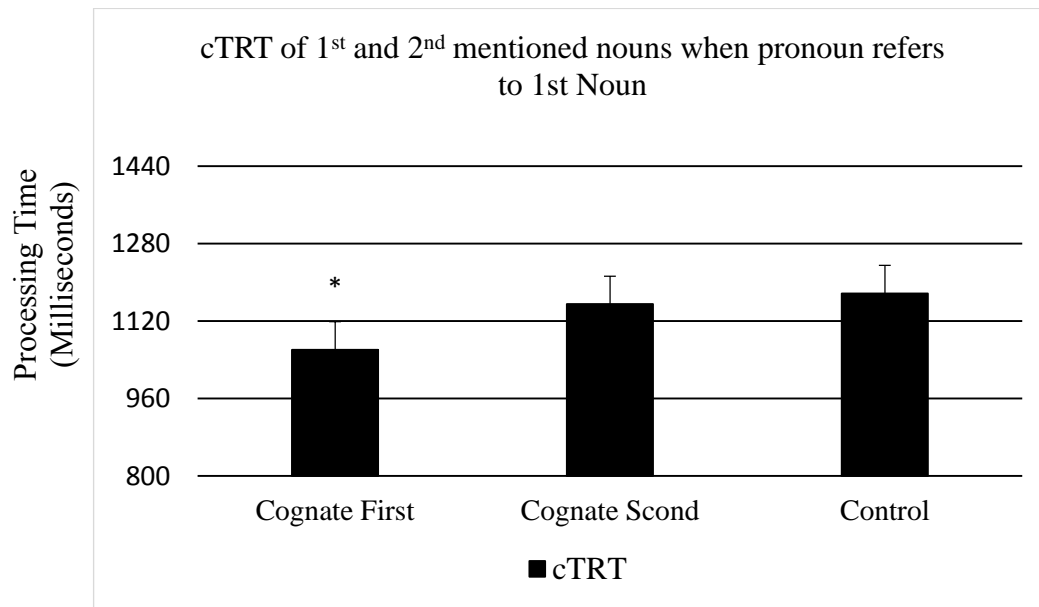


Figure 3.3 average cumulative total reading time (cTRT) of noun phrase when the pronoun refers to the first noun

A final 3 (noun phrase: cognate first, cognate second, no cognate) X 2 (word position: first noun, second noun) repeated measures ANOVA was conducted on trials in which the pronoun referenced the second noun. A main effect of word position was observed in total reading time and number of regressions, with longer processing times and fewer regressions made to the first noun relative to the second noun (total reading time: $F(1,62) = 91.4, p = .000$; number of regressions: $F(1, 62) = 315.6, p = .000$). There was no significant main effect of cognate status, nor was the interaction between cognate status and word position significant. Table 3.3 provides mean values and effect sizes for early measures of analyses, while Table 3.4 describes mean values and effect sizes for late measures of analysis.

Table 3.1. *Results of 3 (Noun phrase: Cognate first, Cognate second, and no cognates) X 2 (Word position) X 2 (pronoun referent: First noun vs. Second Noun)*

	Measure	Effect	df	F value	p value
1 st and 2 nd Position Nouns (averaged across pronoun referent condition)	First Fixation Duration	Cognate status	(1, 65)	.829	ns
		Word Position	(1, 65)	12.409	.000**
		Interaction	(1, 65)	3.140	.081
	Gaze Duration	Cognate status	(1, 65)	.526	ns
		Word Position	(1, 65)	36.366	.000**
		Interaction	(1, 65)	.557	ns
	Total Reading Time	Cognate status	(1, 65)	.034	ns
		Word Position	(1, 65)	327.039	.000**
		Interaction	(1, 65)	2.106	ns
1 st and 2 nd position nouns (Referent to first noun)	Total Reading Time	Cognate status	(1, 62)	13.022	.001**
		Word Position	(1, 62)	181.194	.000**
		Interaction	(1, 62)	39.475	.000**
	Regressions	Cognate status	(1, 62)	6.871	.014**
		Word Position	(1, 62)	688.90	.000**
		Interaction	(1, 62)	175.669	.000**
	Cumulative Total Reading Time	Cognate status	--	--	--
		Word Position	--	--	--
		Interaction	(1, 62)	6.371	.011**
1 st and 2 nd position nouns (Referent to second noun)	Total Reading Time	Cognate status	(1, 62)	1.542	ns
		Word Position	(1, 62)	91.393	.000**
		Interaction	(1, 62)	42.944	.000**
	Regressions	Cognate status	(1, 62)	.276	ns
		Word Position	(1, 62)	315.646	.000**
		Interaction	(1, 62)	142.669	.000**
	Cumulative Total Reading Time	Cognate status	--	--	--
		Word Position	--	--	--
		Interaction	(1, 62)	2.344	ns

3.2 Pronoun Analyses

A 3 (word referent type: cognate with competing non-cognate in noun phrase, non-cognate with competing cognate in noun phrase, and non-cognate with no competing cognate) X 2 (position of referent: first position, second position) was conducted on the actual pronoun itself. There were no significant main effects or interactions in early measures of analysis (first fixation duration and gaze duration). However, there was a significant main effect of word referent type in total reading time ($F(1, 65) = 9.1, p = .004$). Pronouns that referred to cognate antecedents were processed faster than pronouns

that refer to control noun antecedents. Furthermore, pronouns with non-cognate antecedents had slower processing times when a cognate was present in the noun phrase.

Although the interaction was not significant, a planned pairwise comparison revealed that pronouns referencing cognates in the first position ($M = 290$ ms) were processed faster than pronouns referencing non-cognates words ($M = 323$) (mean difference = -32.9 , $p = .011$). However, when the pronoun referenced the second position word (the non-preferred referent), and a cognate was present in the first position, slower processing of the pronoun was observed ($M = 373$) relative to when there were no cognates in the noun phrase ($M = 324$) (mean difference = 49.547 , $p = .009$). Mean values and effect sizes for pronoun processing times can be found in Table 3.5.

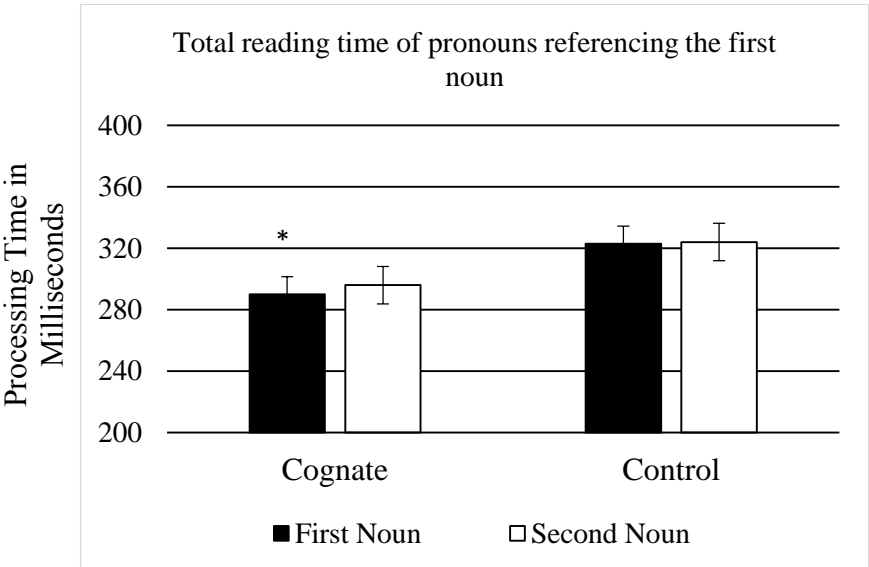


Figure 3.4 *Total reading time of pronouns referring to the first noun, when that noun is a cognate or control word*

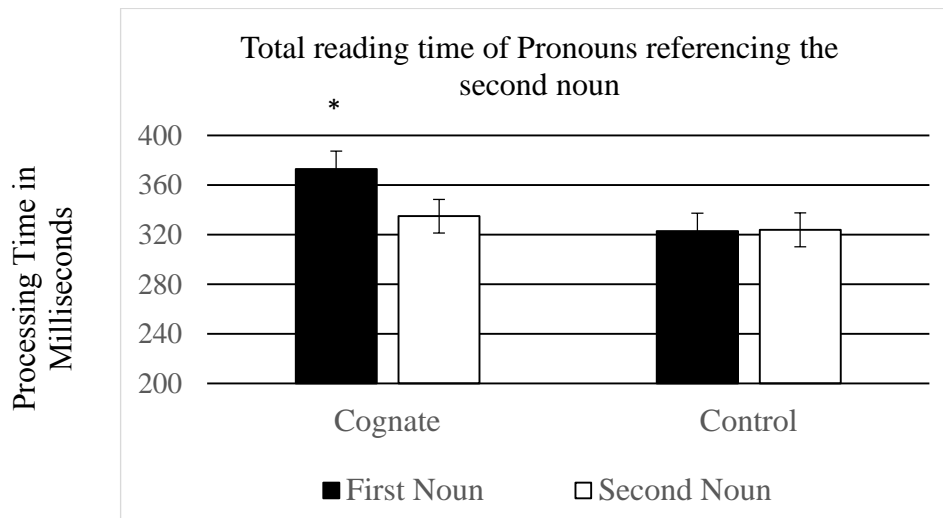


Figure 3.5 Total reading time of pronouns referring to the second noun

Table 3.2. Results of 3 (Word Type: Cognate, Non-cognate (with cognate present), and Non-cognate controls) X 2 (Word Position: First position noun vs. Second Position Noun) X 2 (Pronoun Reference: References the First Position Noun vs. References the Second Position Noun)

	Measure	Effect	df	F value	p value
Pronoun References	First Fixation Duration	Word reference type	(1, 65)	.026	ns
		Position of referent	(1, 65)	2.817	.096
		Interaction	(1, 63)	1.119	ns
	Gaze Duration	Word reference type	(1, 65)	2.893	.094
		Position of referent	(1, 65)	1.243	ns
		Interaction	(1, 63)	.299	ns
	Total Reading Time	Word reference type	(1, 65)	9.120	.004*
		Position of referent	(1, 65)	1.959	ns
		Interaction	(1, 63)	.063	ns

Table 3.3. *Mean processing times (and standard deviations) of cognates and controls in first and second noun positions for early measures of analysis (first fixation duration & gaze duration) across all sentence trials.*

		First Fixation Duration		Gaze Duration	
	Word Position	Cognate	Control	Cognate	Control
1 st and 2 nd nouns (averaged across all trials)	1 st Noun	218 (3.3)	219 (2.9)	292 (4.8)	298 (5.3)
	2 nd Noun	223 (2.98)	228 (2.85)	272 (5.3)	275 (4.9)

Table 3.4. *Mean processing times (and standard deviations) of cognates and controls in first and second noun positions for late measures of analysis (total reading time, cumulative total reading time, number of regressions).*

		Total Reading Time		Cumulative Total Reading Time		Number of regressions	
	Word Position	Cognate	Control	Cognate	Control	Cognate	Control
1 st and 2 nd nouns (averaged across pronoun referent condition)	1 st Noun	602 (24.8)**	674 (15.3)	1069 (37.5)	1167 (42.8)	--	--
	2 nd Noun	483 (17.7)	493 (10.7)	1137 (40.5)	1167 (42.8)	--	--
1 st and 2 nd nouns (Referent to first noun)	1 st Noun	586 (32.9)**	687 (42.6)	1061 (53.5)**	1177 (63.6)	6.59 (0.5)**	7.78 (0.6)
	2 nd Noun	479 (26.7)	490 (25.0)	1155 (61.2)	1177 (63.6)	1.64 (0.2)	1.49 (0.2)
1 st and 2 nd nouns (Referent to second noun)	1 st Noun	635 (39.0)	679 (41.8)	1103 (56.5)	1178 (62.2)	7.05 (0.5)	6.79 (0.5)
	2 nd Noun	491 (25.7)	499 (26.4)	1142 (58.1)	1178 (62.2)	1.79 (.25)	1.84 (.20)

** denotes statistical significance at the .01 level

Table 3.5. *Mean processing times (and standard deviations) of pronoun fixations referencing cognates and control words in the first and second noun positions.*

		First Fixation Duration		Gaze Duration		Total Reading Time	
	Word Position	Cognate	Control	Cognate	Control	Cognate	Control
Pronouns (Reference to first nouns)	1 st Noun	222 (5.0)	223 (5.9)	233 (5.9)	243 (7.9)	290 (10.1)*	323 (12.78)
	2 nd Noun	230 (6.6)	228 (6.2)	238 (6.6)	247 (7.8)	296 (11.6)	324 (13.03)
Pronouns (reference to second nouns)	1 st Noun	223 (6.0)	223 (5.96)	255 (8.9)	243 (7.9)	373 (17.22)	323 (12.78)
	2 nd Noun	218 (4.4)	228 (6.24)	246 (7.96)	247 (7.8)	335 (14.18)	324 (13.04)

4. General Discussion

The first noun of a sentence generally serves as the foundation for subsequent information to map on to. Consistent with previous monolingual studies, nouns in the first position had longer processing times than nouns in the second position (MacWhinney, 1977; Aaronson & Scarborough, 1976; Gernsbacher & Hargreaves, 1988). This indicates that, like monolinguals, bilinguals typically use the first noun as the foundation of the sentence.

The central hypothesis of the present study was the cross-language activation of cognates would affect the process of laying a sentence's foundation. This hypothesis was supported by several findings. First, when the pronoun referred to a cognate noun in the first position, processing times of that cognate were reduced. Additionally, cognates in the first noun position facilitated processing of the entire noun phrase (cumulative total reading time). Facilitation was also observed on pronouns referring to first nouns when the antecedent was a cognate. This is consistent with the *Full-access hypothesis* of anaphoric reference, which states that processing of anaphors mirror processing of their antecedents (Navarette et al., 2006; Egusquiza, Navarrete, & Zawiszewski, 2014; Lago, Chow, & Phillips, 2011). These findings provide evidence that cognate facilitation extends beyond processing of a single word.

Cognates positioned in the less preferred, second noun position did not facilitate processing. This null finding was observed even when pronouns referred to the second noun. This does not support our initial hypothesis that cognates facilitate the creation of a sub-structure when the pronoun refers to the second noun. The absence of facilitation may be due to earlier completion of lexical access for cognate nouns embedded in sentence context. Previous research has demonstrated that sentences with high semantic constraint decrease the ambiguity of target words (cognate or non-cognate control), activating the semantically appropriate lexical item and thus increasing processing time of both cognates and non-cognates; attenuating cognate facilitation (Libben & Titone, 2009; Schwartz & Kroll, 2006; Van Hell & Degroot, 2008). In the present study, the foundation of the sentence (first noun) has already

been established. Therefore, there is more semantic information available to influence lexical access of subsequent nouns, speeding up retrieval of lexical items while attenuating cognate facilitation.

A second hypothesis was that co-activation of a competing cognate noun would interfere with construction of a sentence's foundation. This was supported by the observation of increased processing times on pronouns when these referred to the second positioned noun with a cognate noun in the first position. Since it is harder for readers to refer pronouns to nouns in the second position, when the preferred, first noun is a cognate, there is increased activation of the incorrect referent. Readers must then reject two mechanisms simultaneously pulling them towards the incorrect referent.

Findings from the present study are consistent with the BIA+ model of bilingual lexical representation. A major assumption of this model is that bilinguals have an integrated lexicon, with automatic activation of lexical items in both languages. Another assumption is that identical cognates have a single, lexical representation, whereas non-identical cognates have separate representations with overlapping units. Therefore, facilitated processing of non-identical cognates is not simply due to pooled frequency of occurrence of a single word across languages. According to the model, cognate facilitation occurs because of co-activation of orthographic and semantic representations from both languages. Therefore, cognates are retrieved more quickly than non-cognates (Dijkstra, Miwa, Brummelhuis, Sappelli, & Baayen, 2010). Consistent with these assumptions, processing was facilitated for non-identical cognate nouns. The present study builds upon existing literature on cognate effects by demonstrating that the facilitation extends to larger units of meaning. Previous studies have examined the effects of semantic context on cognate processing, however, none have investigated the effects of cognates on processing entire sentences. Processing of the sentence (cumulative total reading time of the noun phrase and total reading time of pronouns) was facilitated when a cognate was the first noun mentioned (and the pronoun referred to that noun). Once the foundation of the sentence was established,

ambiguity of the semantic representation of the sentence as a whole unit decreased, thus attenuating cognate facilitation in the second noun position.

4.1 Future directions

It is important to continue to integrate bilingual models of language comprehension with previously established monolingual models of reading comprehension. The present study supports order of mention effects assumed by the *Structure Building Framework* of sentence comprehension, moderated by bilingual non-selective lexical access, but only in terms of processing times. First nouns serve as the foundation of the sentence, and thus take longer to process. However, another major assumption of the *structure building framework* is that foundational nouns are more salient, and subsequently responded to faster following a short delay after the sentence. Does bilingualism only affect processing during reading? Or might cognates also affect how participants subsequently respond to questions following sentences?

In addition, cognate facilitation has been observed in both L1 and L2. Investigating how bilingual readers comprehend sentences in both languages would serve to expand knowledge of the nature of bilingualism. Order of mention effects have been observed in multiple languages (Carreiras, Gernsbacher, & Villa, 1995; Egusquiza, Navarrete, & Zawiszewski, 2014). However, it is still unclear how bilingualism affects sentence comprehension in languages other than English.

The structure building framework has been a prominent model in reading comprehension for more than twenty years. Thus far, it has not included any insight as to how the nature of bilingualism might interact with forming a mental representation of a sentence as a whole. The current study serves as a foundation to begin integrating bilingual cognitive processes with a current monolingual model of reading comprehension. The results of the present study provide evidence that cognate's aide in the reader's ability to lay the foundation of the sentence. In addition, cognates interfere with anaphoric

references to other words in the sentence. With the growing number of bilinguals in the United States and worldwide, it is important to update the literature to account for this population.

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Appendices

Appendix A: cognates and matched Non-cognates (Frequency, Length, & Orthographic Similarity)

Cognate	Frequency	Length	Orthographic Similarity	Non-cognate	Frequency	Length	Orthographic Similarity
sofa	5.86	4	.66	chairs	9.88	6	.28
tourist	5.41	7	.45	sharks	7.35	6	.22
terrorist	12.10	9	.78	troops	19.27	6	.80
secretary	33.22	9	.76	manager	39.96	7	.16
Criminals	12.00	9	.97	Hostage	14.57	7	.06
Camera	57.00	6	.75	Glasses	33.12	7	.34
restaurant	46.53	10	.75	Church	69.67	6	.04
Computer	59.04	8	.71	Kitchen	58.31	7	.08
Doctor	263.94	6	1	Boys	224.16	4	.27
Cable	21.73	5	1	Rope	22.71	4	.08
Theater	11.41	7	.66	towers	5.39	6	.70
Garden	26.55	6	.46	River	55.47	5	.35
Bottle	50.75	6	.57	Keys	51	4	.26
Soup	25.2	4	.53	Eggs	38.65	4	.24
Person	212.88	6	.78	girls	208.35	5	.27
Animal	45.49	6	1	Horses	40.92	6	.19
Offices	6.59	7	.66	Restroom	2.45	8	.07
President	140.67	9	.76	Parents	140.73	7	.75
indian	3.43	6	.66	cowboys	4.53	7	.24
Baby	509.37	4	.33	Mother	479.92	6	.41
University	23.59	10	.75	Newspaper	23.69	9	.09
Hotel	103.22	5	1	Buildings	99.57	9	.38
coast	26.69	5	.62	cliff	21.57	5	.05
Park	72.12	4	.58	Stores	81.92	6	.25
Fruit	21.73	5	.6	Trees	30.69	5	.25
Plate	25.65	5	.7	Bowl	21.45	4	.05
guitar	15.59	6	.74	drums	7.2	5	.05
Tomato	5.9	6	.82	Pepper	8.8	6	.31
Artist	28.63	6	.78	Singer	15.69	6	.05
Tiger	18.53	5	.68	Cats	19.73	4	.41
Alcohol	16.57	7	1	Soda	19.84	4	.33
Lemon	12.02	5	.56	Apples	8.29	6	.22
Market	36.24	6	.37	Meat	43.65	4	.09
Tobacco	6.98	7	.80	Lighters	8.96	8	.25
Boots	19.16	5	.75	Purse	19.76	5	.07
Train	95.06	5	.67	Ship	98.88	5	.04
Banks	15.9	5	.75	Owner	23.24	5	.09
Telephone	32.37	9	.56	Magazines	33.2	9	.26
Zebra	2.51	5	.61	Hunters	4.84	7	.23
Taxi	25.84	4	1	Guests	25.71	6	.20
Governor	26.84	8	.80	Partners	24.16	8	.77
senator	33.16	7	.83	students	30.67	8	.28

Appendix B: Experimental Sentence Stimuli Set

Condition	SentenceSet
CN1	The sofa was next to the chairs that were made of wood, but it was old and needed to be replaced.
CN2	The sofa was next to the chairs that were made of wood, but they were old and needed to be replaced
NC1	The chairs were next to the sofa that was made of leather, but they were old and needed to be replaced
NC2	The chairs were next to the sofa that was made of leather, but it was old and needed to be replaced.
NN1	The chairs were next to the heater that was fixed yesterday, but they were old and needed to be replaced.
NN2	The chairs were next to the heater that was fixed yesterday, but it was old and needed to be replaced.
CN1	The tourist saw the sharks swimming around in circles, but he did not get out of the water.
CN2	The tourist saw the sharks swimming around in circles, but they did not attack him.
NC1	The sharks saw the tourist swimming around in circles, but they did not attack him.
NC2	The sharks saw the tourist swimming around in circles, but he did not get out of the water.
NN1	The sharks saw the seal swimming around in circles, but they did not attack it.
NN2	The sharks saw the seal swimming around in circles, but it did not see them.
CN1	The terrorist kidnapped the troops when they were sleeping, so he could ask for a ransom in the morning.
CN2	The terrorist kidnapped the troops when they were sleeping, so they could be held for a ransom in the morning.
NC1	The troops kidnapped the terrorist when he was sleeping, so they could charge him with war crimes.
NC2	The troops kidnapped the terrorist when he was sleeping, so he could be held accountable for war crimes.
NN1	The warrior kidnapped the troops when they were sleeping, so that he could ask for a ransom.
NN2	The warrior kidnapped the troops when they were sleeping, so they could be held for ransom.
CN1	The secretaries hated the manager that was promoted last week, so they tried to have him fired.
CN2	The secretaries hated the manager that was promoted last week, so he tried to have them fired.
NC1	The manager hated the secretaries that were promoted last week, so he tried to have them fired.
NC2	The manager hated the secretaries that were promoted last week, so they tried to have him fired.

NN1	The attorneys hated the manager that was promoted last week, so they lost the case on purpose.
NN2	The attorneys hated the manager that was promoted last week, so he fired them all.
CN1	The criminal did not hurt the hostages who had been kidnapped, so that he would not be charged with murder.
CN2	The criminal did not hurt the hostages who had been kidnapped at the bank, so that they would be calm and cooperative.
NC1	The hostages attacked the criminal who had been caught, so that they could stop the robbery.
NC2	The hostages attacked the criminal who had been caught, so that he could not get away safely.
NN1	The hostages attacked the robber who had been caught, so that they could stop the robbery.
NN2	The hostages attacked the robber who had been caught, so that he could not get away safely.
CN1	The camera was next to the glasses that I had just cleaned, but it was hidden from plain sight.
CN2	The camera was next to the glasses that I had just cleaned, but they were hidden from plain sight.
NC1	The glasses were next to the camera that I had just bought, but they were hidden from plain sight.
NC2	The glasses were next to the camera that I had just bought, but it was hidden from plain sight.
NN1	The glasses were next to the clock that I had just bought, but they were hidden from plain sight.
NN2	The glasses were next to the clock that I had just bought, but it was hidden from plain sight.
CN1	The restaurant was next to the churches where a lot of people attended, and it received a lot of business on Sundays.
CN2	The restaurant was next to the churches where a lot of people attended, and they had a lot of members that came on Sundays.
NC1	The churches were next to the restaurant where a lot people went to eat, and they had a lot of members that came on Sundays.
NC2	The churches were next to the restaurant where a lot of people went to eat, and it received a lot of business on Sundays.
NN1	The churches were next to the school that had just been opened, and they had a lot of members that came on Sundays.
NN2	The churches were next to the school that had just been opened, and it was empty on Sundays because it was a weekend.
CN1	The computer monitored the kitchens to quickly track orders, but it was not working.
CN2	The computer monitored the kitchens to quickly track orders, but they still ran inefficiently.
NC1	The kitchen had some computers to quickly take in orders, but it still ran inefficiently.

NC2	The kitchen had some computers to quickly take in orders, but they were not working.
NN1	The kitchen had several clocks to keep track of the time, but it still ran inefficiently.
NN2	The kitchen had several clocks to keep track of the time, but they were not working.
CN1	The doctor calmed the boys during the visit, but he could not treat them separately.
CN2	The doctor calmed the boys during the visit, but they were too nervous.
NC1	The boys listened to the doctor during the visit, but they did not follow his advice.
NC2	The boys listened to the doctor during the visit, but he could not calm them down.
NN1	The boys listened to the lawyer during the visit, but they did not follow his advice.
NN2	The boys listened to the lawyer during the visit, but he could not calm them down.
CN1	The cables were next to the rope that had been left outside, and they had to be wrapped up.
CN2	The cables were next to the rope that had been left outside, and the man used it to tie them together.
NC1	The rope was next to the cables that had been left outside, and the man used it to tie them together.
NC2	The rope was next to the cables outside, and they had to be wrapped up.
NN1	The ropes were next to the snake that had come near the door, and they blocked him from coming in.
NN2	The ropes were next to the snake that had come near the door side, and it slithered between them.
CN1	The theater was next to the towers on the edge of town, but it was destroyed in the storm.
CN2	The theater was next to the towers on the edge of town, but they were destroyed in the storm.
NC1	The towers were next to the theater on the edge of town, but they were destroyed in the storm.
NC2	The towers were next to the theater on the edge of town, but it was destroyed in the storm.
NN1	The towers were next to the shed on the edge of town, but they were destroyed in the storm.
NN2	The towers were next to the shed on the edge of town, but it was destroyed in the storm.
CN1	The gardens were near the river that flowed through town, and that is why they became flooded.
CN2	The gardens were near the river that flowed through town, and that is why it was full of pollen.
NC1	The river was near the gardens that were planted last year, and that is why it was full of pollen.
NC2	The river was near the gardens that were planted last year, and that is why they became flooded.
NN1	The river was near the trees that were planted last year, and that is why it was full of pollen.
NN2	The river was near the trees that were planted last year, and that is why they grew so

	tall.
CN1	The bottle was next to the keys that had been carelessly thrown, and it had a crack.
CN2	The bottle was next to the keys that had been carelessly thrown, and they were hard to find.
NC1	The keys were next to the bottle that had been filled, and they were hard to find.
NC2	The keys were next to the bottle that had been filled, and it blocked them from view.
NN1	The treat was next to the keys that had been carelessly thrown, and it was hard to find.
NN2	The treat was next to the keys that had been carelessly thrown, and they blocked it from view.
CN1	The soup was made with eggs brought fresh from the farm, and it was delicious.
CN2	The soup was made with eggs brought fresh from the farm, and they added a good flavor.
NC1	The eggs were added to the soup made just that morning, and they added a good flavor.
NC2	The eggs were added to the soup made just that morning, and it was delicious.
NN1	The drink was made with beaten eggs brought fresh from the farm, but it tasted odd.
NN2	The drink was made with beaten eggs brought fresh from the farm, but they added an odd flavor.
CN1	The person followed the girls walking along as they sang loudly, but he eventually lost interest.
CN2	The person followed the girls walking along as they sang loudly, but they did not notice.
NC1	The girls followed the person walking along in a daze, but they eventually lost interest.
NC2	The girls followed the person walking along in a daze, but he did not notice.
NN1	The girls followed the woman walking along in a daze, and they eventually lost interest.
NN2	The girls followed the woman walking along in a daze, but she did not notice.
CN1	The animal growled at the horses who had been tied, but it was harmless.
CN2	The animal growled at the horses who had been tied, but they did not seem afraid.
NC1	The horses feared the animal who had approached, but they had nowhere to run.
NC2	The horses feared the animal who had approached, but it was harmless.
NN1	The horses whinnied at the chicken who was running around, but they were harmless.
NN2	The horses whinnied at the chicken who was running around, but it was harmless.
CN1	The offices next to the restroom always smelled bad, but they were very spacious.
CN2	The offices next to the restroom always smelled bad, but it was cleaned every day.
NC1	The restroom next to the offices always smelled bad, but it was cleaned every day.
NC2	The restroom next to the offices always smelled bad, but they were very spacious.
NN1	The restroom next to the lockers always smelled bad, but it was cleaned every day.
NN2	The restroom next to the lockers always smelled bad, but they were very spacious.
CN1	The president spoke to the parents after the tragedy, but he could not console them.

CN2	The president spoke to the parents after the tragedy, but they could not be consoled.
NC1	The parents spoke to the president after the tragedy, but they could not be consoled.
NC2	The parents spoke to the president after the tragedy, but he could not console them.
NN1	The parents spoke to the boss after the tragedy, but they could not be consoled.
NN2	The parents spoke to the boss after the tragedy, but he could not console them.
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CN1	The Indian chased the cowboys who were riding on horseback, but he could never catch them.
CN2	The Indian chased the cowboys who were riding on horseback, but they got away from him.
NC1	The cowboys chased the Indian who was riding on horseback, but they could never catch him.
NC2	The cowboys chased the Indian who was riding on horseback, but he got away from them.
NN1	The cowboys chased the robber who was riding on horseback, but they could never catch him.
NN2	The cowboys chased the robber who was riding on horseback, but he got away from them.
<hr/>	
CN1	The babies loved the mother, but last night they were crying for hours.
CN2	The babies loved the mother, but last night she could not calm them.
NC1	The mother loved the babies, but last night she could not calm them.
NC2	The mother loved the babies, but last night they were crying for hours.
NN1	The children loved the mother, but last night they were crying for hours.
NN2	The children loved the mother, but last night she could not calm them.
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CN1	The university stored the newspapers published years ago, but it did not file them for long in the library.
CN2	The university stored the newspapers published years ago, but they were not kept for long in the library.
NC1	The newspapers advertised the university established a year ago, but they charged them for the publicity.
NC2	The newspapers advertised the university established a year ago, but it was a small school with low enrollment.
NN1	The journalists edited the newspaper that was a top seller, but they wanted to write for someone else.
NN2	The newspaper hired the journalists who had a great reputation, but they wanted to write for someone else.
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CN1	The hotel was next to the buildings that were many stories high, and it did not have a good view.
CN2	The hotel was next to the buildings that were many stories high, and they blocked the view.
NC1	The buildings were next to the hotel that attracted many guests, and they blocked the view.
NC2	The buildings were next to the hotel that attracted many guests, and it did not have a

	good view.
NN1	The buildings were next to the warehouse that we were searching for, and they made it hard to find.
NN2	The buildings were next to the warehouse that we were searching for, and it was hard to find.
CN1	The coast had several cliffs that were beginning to erode, and it had a very rocky shore.
CN2	The coast had several cliffs that were beginning to erode, and they looked beautiful.
NC1	The cliffs were along the coast that we were visiting, and they looked beautiful.
NC2	The cliffs were along the coast that we were visiting, and it had a very rocky shore.
NN1	The cliffs were next to the sea that we were visiting, and they looked beautiful.
NN2	The cliffs were next to the sea that we were visiting, and it had big boulders under the surface.
CN1	The park was by the stores that had recently been opened, and it was a great spot to rest.
CN2	The park was by the stores that had recently been opened, and they got a lot of business.
NC1	The stores were by the park that had recently been built, and they got a lot of business.
NC2	The stores were by the park that had recently been built, and it was a great spot to rest.
NN1	The stores were by the pond that had formed last year, and they got a lot of business.
NN2	The stores were by the pond that had formed last year, and it was a great spot to rest.
CN1	That fruit grew on trees that were planted last spring but it was too high to pick.
CN2	That fruit grew on trees that were planted last spring, but they were too tall to reach anything.
NC1	The trees provided fruit of many different colors, but they were too tall to reach anything.
NC2	The trees provided fruit of many different colors, but it was poisonous.
NN1	The tree had leaves of many colors, but it did not survive the winter.
NN2	The tree had leaves of many colors, but they did not last for long.
CN1	The plate was next to the bowls that my grandmother gave me, but it belonged in the other cabinet.
CN2	The plate was next to the bowls that my grandmother gave me, but they belonged in the other cabinet.
NC1	The bowls were next to the plate that my grandmother gave me, but they belonged in the other cabinet.
NC2	The bowls were next to the plate that my grandmother gave me, but it belonged in the other cabinet.
NN1	The bowl was next to the cups that my grandmother gave me, but it belonged in the other cabinet.
NN2	The bowl was next to the cups that my grandmother gave me, but they belonged in the other cabinet.
CN1	The guitar was louder than the drums, so it was put at a lower volume.

CN2	The guitar was louder than the drums, so they were put further up on stage.
NC1	The drums were louder than the guitar, so they were put somewhere else.
NC2	The drums were louder than the guitar, so it was put further up on stage.
NN1	The drum belonged to the band who was about to leave, so it was loaded inside the van.
NN2	The drum belonged to the band who was about to leave, so they loaded it inside the van.
CN1	The tomato grew next to the peppers we were about to pick, but it wasn't red yet.
CN2	The tomato grew next to the peppers we were about to pick, but they weren't ripe yet.
NC1	The peppers grew next to the tomato we were about to pick, but they weren't ripe yet.
NC2	The peppers grew next to the tomato we were about to pick, but it wasn't red yet.
NN1	The peppers grew next to the cucumber we were about to pick, but they weren't ripe yet.
NN2	The peppers grew next to the cucumber we were about to pick, but it wasn't ripe yet.
CN1	The artist lived with the singers who were just starting out, and he was always painting portraits of the band.
CN2	The artist lived with the singers who were just starting out, and they were always interrupting his work.
NC1	The singers lived with the artist who was just starting out, and they were always interrupting his work.
NC2	The singers lived with the artist who was just starting out, and he was always painting portraits of the band.
NN1	The singers lived with the thief who would sneak around, and they were careful around him.
NN2	The singers lived with the thief who would sneak around, and he was tried to steal their things.
CN1	The tiger saw the cats sleeping peacefully together, but it did not do any harm.
CN2	The tiger saw the cats sleeping peacefully together, but they ran away quickly.
NC1	The cats saw tiger pacing in circles and growling, but they ran away quickly.
NC2	The cats saw the tiger pacing in circles and growling, but it did not do any harm.
NN1	The cats saw the dog pacing in circles and growling, but they ran away quickly.
NN2	The cats saw the dog pacing in circles and growling, but it did not do any harm.
CN1	The alcohols were mixed with soda that was fizzing and bubbly, but they were cheap brands and not very tasty.
CN2	The alcohols were mixed with soda that was fizzing and bubbly, but it was flat and not very tasty.
NC1	The soda was mixed with the alcohols from the pantry, but it was flat and not very tasty.
NC2	The soda was mixed with the alcohols from the pantry, but they were cheap brands and not very tasty.
NN1	The soda was added to the beverages we were about to serve, but it was flat and not very tasty.

NN2	The soda was added to the beverages we were about to serve, but they were cheap brands and not very tasty.
CN1	The lemon was next to the apples that had recently ripened, and it was added to the salad.
CN2	The lemon was next to the apples that had recently ripened, and they were eaten for dessert.
NC1	The apples were next to the lemon that had recently ripened, and they were eaten for dessert.
NC2	The apples were next to the lemon that had recently ripened, and it was added to the salad.
NN1	The apples were next to the orange that had recently ripened, and they were eaten for dessert.
NN2	The apples were next to the orange that had recently ripened, and it was added to the fruit salad.
CN1	The market sold meats that were from local farmers, but it was closed on Sundays.
CN2	The market sold meats that were from local farmers, but they expensive.
NC1	The meats were in the market we liked to buy from, but they were expensive.
NC2	The meats were in the market we liked to buy from, but it was closed on Sundays.
NN1	The meats were in the freezer that was about to break, but they were old and looked unsafe to eat.
NN2	The meats were in the freezer that was about to break, but it was no longer working.
CN1	The tobacco was next to the lighters he was about to buy, and it was placed in his bag.
CN2	The tobacco was next to the lighters he was about to buy, and they were placed in his bag.
NC1	The lighters were next to the tobacco he was about to buy, and they were placed in his bag.
NC2	The lighters were next to the tobacco he was about to buy, and it was placed in his bag.
NN1	The lighters were next to the drink he was about to buy, and they were placed in his bag.
NN2	The lighters were next to the drink he was about to buy, and it was served to the client.
CN1	She bought boots and a purse that was just put on sale, but they were a size too big for her.
CN2	She bought boots and a purse that was just put on sale, but it didn't match her outfit.
NC1	She bought a purse and boots that were just put on sale, but it didn't match her outfit.
NC2	She bought a purse and boots that were just put on sale, but they were a size too big for her.
NN1	She bought a purse and shirts that were just put on sale, but it didn't match her outfit.
NN2	She bought a purse and shirts that were just put on sale, but they didn't match her normal style.
CN1	The train was faster than the ships that were built in Italy, but it was delayed on the tracks.

CN2	The train was faster than the ships that were built in Italy, but they were more reliable.
NC1	The ships were faster than the train, that was built in Italy, but they were delayed on the docks.
NC2	The ships were faster than the train that was built in Italy, but it was more reliable.
NN1	The ships were bigger than the truck that was built in Italy, but they were slower.
NN2	The ships were bigger than the truck that was built in Italy, but it was faster.
CN1	The banks called the owner a few days ago, and they gave him more time to pay.
CN2	The banks called the owner a few days ago, and he decided to pay.
NC1	The owner called the banks a few days ago, and he decided to pay.
NC2	The owner called the banks a few days ago, and they gave him more time to pay.
NN1	The owner called the investors a few days ago, and he decided to pay.
NN2	The owner called the investors a few days ago, and they gave him more time to pay.
CN1	The telephone was next to the magazines that were delivered that day, and it stopped ringing before he could reach over.
CN2	The telephone was next to the magazines that were delivered that day, and they were knocked down when he reached over.
NC1	The magazines were next to the telephone that was delivered that day, and they were knocked down when he reached over.
NC2	The magazines were next to the telephone on the counter, and it stopped ringing before he could reach over.
NN1	The magazines were next to the book delivered that day, and they were knocked down when he reached over.
NN2	The magazines were next to the book delivered that day, and it was knocked down when he reached over.
CN1	The zebra saw the hunters approaching very quickly, and then it ran away.
CN2	The zebra saw the hunters approaching very quickly, and they got ready to shoot.
NC1	The hunters saw the zebra approaching very quickly, and they got ready to shoot.
NC2	The hunters saw the zebra approaching very quickly, and then it ran away.
NN1	The hunters saw the moose approaching very quickly, and they got ready to shoot.
NN2	The hunters saw the moose approaching very quickly, and then it ran away.
CN1	The taxi waited for the guests who had called; it was bright yellow and hard to miss.
CN2	The taxi waited for the guests who had called; they were staying at the hotel for the weekend.
NC1	The guests waited for the taxi they had called; they were staying at the hotel for the weekend.
NC2	The guests waited for the taxi they had called; it was bright yellow and hard to miss.
NN1	The guests waited for the driver they had called; they were staying at the hotel for the weekend.
NN2	The guests waited for the driver they had called; he was late picking them up from the hotel.

CN1	The governor spoke to the partners to close the deal; he was selling city property at a discount rate.
CN2	The governor spoke to the partners to close the deal; they were buying city property at a discount rate.
NC1	The partners spoke to the governor to close the deal; they were buying city property at a discount rate.
NC2	The partners spoke to the governor to close the deal; he was selling city property at a discount rate.
NN1	The partners spoke to the defendant; they were representing him in a civil suit about selling city property.
NN2	The partners spoke to the defendant; he was accused of selling city property at a discount rate.
CN1	The senator spoke to the students at career day; he talked about a career in politics.
CN2	The senator spoke to the students at career day; they wanted to know about a career in politics.
NC1	The students spoke to the senator at career day; they wanted to know about a career in politics.
NC2	The students spoke to the senator at career day; he told them all about a career in politics.
NN1	The students spoke to the mayor at career day; they wanted to know about a career in politics.
NN2	The students spoke to the mayor at career day; he told them all about a career in politics.

Vita

Justin Gerald Lauro graduated from the University of Pittsburgh with a B.S. in Psychology in 2012. He graduated with Honors in Psychology for his thesis examining language learning techniques in adult second language learners. He moved to El Paso, Texas in order to pursue a Ph.D. in Psychology at the University of Texas at El Paso.

Mr. Lauro has presented his research at professional conferences, including the Psychonomic Society annual meeting in 2013. He has also served as a graduate assistant in the Psychology and Education departments at UTEP. In 2014, Mr. Lauro defends his masters thesis under the supervision of Dr. Ana I. Schwartz. He intends to pursue a Ph.D. in Psychology at UTEP with an emphasis on language acquisition and bilingualism. He hopes to attain a career in academia and continue with his line of research in bilingualism and reading.

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This thesis/dissertation was typed by Justin Lauro.