University of Nevada, Reno

Investigating Spanish-English Code-Switching at the Auxiliary Phrase: Un Análisis con Estudiantes L2

A thesis submitted in partial fulfillment
of the requirements for the degree of

Bachelor of Arts in Spanish and the Honors Program

by

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May 2018

UNIVERSITY
OF NEVADA
RENO

THE HONORS PROGRAM

We recommend that the thesis
prepared under our supervision by

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Entitled

Investigating Spanish-English Code-Switching at the Auxiliary Phrase: Análisis de Estudiantes L2

be accepted in partial fulfillment of the
requirements for the degree of

BACHELOR OF ARTS, SPANISH

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May, 2018

Abstract

Code-switching is the mixing of two languages such that a word or phrase from one language is substituted for a word or phrase from another language. A code-switch can occur at different locations in a sentence or phrase. For example: sometimes I'll start a sentence in English *y termino en español* 'Sometimes I'll start a sentence in English and end in Spanish.' (Poplack, 2013, p. 1).

This project examines Spanish-English intrasentential code-switches that occur at the auxiliary phrase with the goal of investigating whether low-proficiency second-language (L2) learners who are not code-switchers understand the difference between illicit and licit code-switches. Illicit refers to ungrammatical code-switches whereas licit refers to grammatical code-switches. More specifically, the objective of this project is to determine whether these two types of intrasentential code-switches are processed differently as shown by different patterns of reading times. The four conditions in this experiment compare sentences that are completely in English, sentences completely in Spanish, sentences with illicit (at the phrasal boundary) switches, and sentences with licit (between the auxiliary and the participle) switches.

The data collected shows that there are statistically significant differences in reading times between the locations of the code-switch, indicating that students can distinguish between the different code-switches. A peculiar finding, however, is that students took longer to process the sentences in complete English than the sentences containing a code-switch, which might be due to the surprisal effect. The findings of this study have meaningful applications in better understanding bilingual cognition, especially as the bilingual population continues to grow in the United States.

Acknowledgements

This work would not have been possible without the continued support, guidance, help, and expertise of Dr. Tania Leal, my thesis mentor, Assistant Professor in the World Languages and Literatures Department, and the Basic Spanish Language Program Director. Dr. Leal is a force to be reckoned with and her enthusiasm, interest, and commitment to the Spanish language, namely in the field of linguistics, is laudable.

I would like to express my sincere gratitude to Michelle Johnson, the Administrative Assistant in the World Languages and Literatures office, for taking the time to facilitate the collection of data for this study. She went out of her way to support my research and I would like to thank her for her dedication to helping meaningful research succeed on this campus.

I would like to thank Dr. Alison Johnson, the Honors writing consultant that I met with numerous times in the Fall 2017 and Spring 2018 semesters. Her straightforward, honest feedback and guidance were appreciated. Dr. Johnson helped me in the development of my ideas and making sure that the goals of my thesis project were conveyed in an appropriate manner. I appreciate Dr. Johnson being there bright and early for my 8:00 AM appointments on Friday morning, especially when I was her only appointment.

The Honors Undergraduate Research Award from the Office of Undergraduate Research in collaboration with the Honors Program provided financial support for this project. A huge thank you to both of them for encouraging academic research and allowing me to complete this thesis project.

I would like to thank Dr. Valentine for being understanding and encouraging throughout this thesis journey. Her support in my pursuit of completing two Honors theses was much appreciated.

I would like to thank the numerous participants who took time out of their schedules to participate in this study. A major part of my thesis would not be possible without their help.

Lastly, I would like to thank Dr. Casilde Isabelli (Department Chair and Associate Professor of the World Languages and Literatures Department) whose SPAN 312 (Spanish Phonetics & Phonology) course first piqued my interest in Spanish linguistics. I would like to thank again Dr. Leal for rekindling my interest in the subject and broadening my knowledge in the field of linguistics in her SPAN 451 (Seminar in Hispanic Theoretical and Applied Linguistics).

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Introduction

Code-switching is the mixing* of two languages such that a word or a phrase in one language substitutes for another phrase or word in another language (Heredia & Altarriba, 2001). Studying code-switching is valuable for understanding bilingual cognition, specifically with respect to language processing (comprehension) and the organization of the bilingual mind. Spanish-English code-switches occur when a speaker alternates between Spanish and English during conversation, such as in (1):

(1) Sometimes I'll start a sentence in English *y termino en español* 'Sometimes I'll start a sentence in English and end in Spanish.' (Poplack, 2013, p. 1).

Code-switching can occur with any two languages, but this project focuses on individuals who speak Spanish and English. Code-switching has rules, or constraints, meaning that a code-switch cannot occur at any location. This was very interesting to me as I code-switch in my daily life (between English and Tamil, my mother tongue). My desire to work with this population stems from my interest in the subject and prior class experience. This study is of interest to researchers within the field of linguistics, specifically for those investigating second-language acquisition, language processing, and bilingualism. Language processing refers to the manner by which individuals recognize, interpret, and synthesize speech (Jurafsky & Martin, 2014) and text.

This project examines Spanish-English intrasentential code-switches that occur at the auxiliary phrase. In English and Spanish declarative statements, the subject precedes the auxiliary phrase, and the auxiliary phrase includes the auxiliary verb and the participle. Auxiliary verbs are informally known as "helper" verbs and participles are verbs that are used as adjectives (or verbs in the gerund form), like in (5), where *está* ('to be') is the Spanish auxiliary verb and *trabajando* ('working') is the Spanish participle:

*Mixing is an older term but in this case refers to the same phenomenon as code-switching. Code-switching and code-mixing have not always been used as synonymous terms, however.

(1) *Mi marido está trabajando en su maestría* 'My husband is working on his Master's (Dussias, 2003, p. 8).

Whereas in English, for the same sentence, the auxiliary verb is 'is' and the participle is 'working.'

This project is a partial replication of Dussias (2003), but involving a different population, independent variable, and methodology. Dussias focused on a population of 12 bilingual participants using eye-movement data as the measurement tool. This project focuses on a population of 30 third- and fourth-semester college Spanish learners using a self-paced reading task as the measurement tool.

Literature Review

There are several types of code-switches, which can occur at certain defined points in speech, and for any amount of speech, following a set of linguistic constraints (Pfaff, 1997). For example, code-switches can comprise "single words, phrases, clauses, [and] sentences" (Grosjean, 1994, p. 4), and they can occur at the beginning, middle, or end of a sentence. Code-switches are generally classified into: intersentential, intrasentential, or tag-switches (Liu, 2006). Intersentential code-switches occur across sentence boundaries, or hard pauses marked by strong punctuation (i.e. periods, semicolons, exclamation points, question marks), such as in (2):

(2) *Mi nombre es Lourdes.* Now we turn to my sister. 'My name is Lourdes. Now we turn to my sister.' (Bullock & Toribio, 2009, p. 10).

In intrasentential code-switches, the shift in language is embedded within a single sentence or phrase such that there are "no interruptions, hesitations, or pauses indicating a shift" (Liu, 2006, p. 1). For example,

(3) *Anoche en el* executive committee *escribimos una carta.* 'Last night in the executive committee we wrote a letter.' (Pfaff, 1979, p. 305).

Finally, tag-switches involve inserting a "formulaic expression from language B into an utterance in language A" (Bullock & Toribio, 2009, p. 4). In other words, a tag switch is a word from one language that is "tagged" onto the beginning or end of a sentence in another language. For instance, in the following example *verdad*, 'true,' is the tag:

(4) She must have made a mistake, *¿verdad?* 'She must have made a mistake, right?'

For this project, only Spanish-English *intrasentential* code-switches were examined.

Intrasentential code-switches have been proposed to demonstrate the greatest level of fluency and understanding of the language involved because they require code-switchers to modify thoughts and syntax mid-sentence or mid-thought without pausing (Zirker, 2007). Intrasentential code-switching has grown in popularity such that this form of code-switching characterizes classic Hispanic-American speech (Fought, 2003). In fact, this inclusion of code-switching in speech may suggest that only the most fluent and proficient bilingual speakers participate in intrasentential code-switches. Several researchers believe that further exploring intrasentential code-switches has the potential to "yield the greatest fruits in the way of characterizing the linguistic organization of the bilingual cognitive apparatus" (Lipski, 1985, p. 3). Thus, investigating the implications, contexts, and uses of Spanish-English code-switching allows researchers to better understand code-switches in other languages as well as better understand bilingual cognition and language processing.

The difference in participant populations is that participants in this study have not been exposed to the Spanish language since birth; instead, these students are in their third- and fourth-

semester of Spanish. Because an eye-tracker is not available at the University of Nevada, Reno, self-paced reading times were used as the measurement tool instead.

Dussias (2003) investigated code-switching at the auxiliary phrase involving the Spanish auxiliary verbs *haber* ('to have') and *estar* ('to be') to test the grammaticality of each condition. The participants were Spanish learners from a young age, and they were all English-dominant.

Dussias (2003) examined eye-movement data collected from an eye-tracker for 12 participants. She reported gaze durations, which are "the sum of all left-to-right eye-fixations on the critical region, excluding re-reading" (Dussias, 2003, p. 18), where the critical region (or region of interest) was the auxiliary and verb junction. Gaze durations were examined to discover whether participants spent more time, or fixed their gaze, in the critical region. Dussias (2003) concluded that Spanish-English bilingual speakers treat switches at the auxiliary phrase differently, as evidenced by the eye-movement data, depending on what verbs (either *estar* or *haber*) were present at the auxiliary node. Dussias (2003) claimed that "switches at the auxiliary phrase are processed differently, depending on the lexical items that fill the auxiliary node" (p. 2).

The objective of my project is to determine whether two different types of code switches (at the phrasal boundary and between the auxiliary and the participle) are processed differently as shown by different patterns of reading times. Dussias (2003) based her work on experimental findings reporting that speakers avoid switching at the auxiliary juncture. She argued that this inconsistency in switching may not be a fluke or error. Thus, further examination of this juncture is necessary.

Recall that intrasentential code-switches involve smooth transitions. Studies have shown that specific "junctures are more prone to undergo language switching, and that syntactic boundaries are permeable to intrasentential shifts" (Dussias, 2003, p. 8). The auxiliary phrase is a notable location to study a code-switch because there is a debate in the literature on Spanish-English switching occurring at the auxiliary-verb location (Dussias, 2003), a debate that I discuss further in the literature review. Thus, the rule-governed constraints for code-switching are unclear at this location.

Two conditions of different code-switches were explored in this study (denoted by the vertical dash in examples (6) and (7)): the first code-switch is located at the phrasal boundary, which occurs between the noun and the auxiliary verb, and the second type of code-switch is between the auxiliary and participle (examples from Dussias, 2003, p. 32):

(5) *El arquitecto piensa que los pintores are | painting the wall* 'The architect thinks that the painters are painting the wall.'

(6) *El arquitecto piensa que los pintores están | painting the wall* 'The architect thinks that the painters are painting the wall.'

The critical region in this case includes the word preceding the vertical dash and the word following the vertical dash. These encompass the illicit and licit code-switch types. Recall that the term 'licit' refers to grammatical code-switches while the term 'illicit' refers to ungrammatical code-switches. Unlike Dussias' experiment, this study only focuses on the verb *haber* ('to be') rather than on both *haber* and *estar* due to consideration of the volunteers' time.

Code-switching is a crucial area of research (Poplack, 2013; Toribio, 2002; Skiba, 1997) to understand bilingual speech processing, especially as the bilingual population continues to grow in the United States (Basnight-Brown & Altarriba, 2007). The typical code-switching belief

among the general non-linguist population posits that code-switchers are not proficient in either language, and that code-switching serves a coping mechanism for lack of knowledge (Heredia & Brown, 2008; Liu, 2006; Cheng & Butler, 1989; Skiba, 1997; Grosjean, 1994). However, linguists often find that the opposite is true because a given individual code-switches only when they are comfortable and proficient in both languages because code-switching does not indicate a lack of proficiency, but rather competency in both languages because a code-switcher is able to alternate between two separate linguistic systems, where the alterations can serve as an advantage to the speaker (Heredia & Brown, 2008). In other words, code-switching is not antithetical to language proficiency, as it "provides a continuity in speech rather than presenting an interference in language" (Skiba, 1997, p. 1). Code-switching allows speakers express the culture and nuances of one language that might not be available in the other (Skiba, 1997). When a speaker utilizes a code-switch, he or she demonstrates *communicative competence,* which is the understanding of "the knowledge of linguistic and sociolinguistic conventions" (Bagarić & Djigunović, 2007, p. 95). To put it simply, bilingual speakers switch languages at the appropriate time and in the appropriate setting to best communicate and express their thoughts. Code-switching is systematic, and it occurs at specific locations and contexts (Liu, 2006; Belazi, Rubin, & Toribio, 1994; Pfaff, 1979). As mentioned earlier, linguists agree that there are different types of code-switches (Poplack, 2013; Liu, 2006; Skiba, 1997; Belazi, Rubin, & Toribio, 1994), like intersentential or intrasentential.

Intersentential code-switching provides linguists with insight into bilingual cognition by studying how bilinguals comprehend and process language changes (Dussias, 2003). There have been several experiments focusing on intersentential code-switches. For example, Hughes et. al. (2006) investigated code-switching among bilinguals and low proficiency English students as a

marker for giftedness, positing that code-switchers are at an intellectual advantage and are overlooked in the single-language oriented identification of giftedness. Qu (2010) observed the code-switching practices of teachers of non-English majors to help raise their awareness of their own code-switching practices, ultimately finding that teachers code-switch in specific contexts like to better communicate a concept, build a relationship with the student, and expression emotion

It has been established that phrases or sentences containing code-switches take a longer amount of time to process compared to phrases or sentences in one language (Heredia & Altarriba, 2001; Dussias, 2003). Bilinguals can operate in bilingual mode, where they activate one language system, but suppress the other (Toribio, 2004; Heredia & Altarriba, 2001). Both Spanish and English linguistic systems cannot be active simultaneously (Heredia & Altarriba, 2001), especially for a single word, which suggests that the bilingual brain organizes each language-specific linguistic system separate from one another. Heredia & Brown (2008) describe the switch to be responsible for helping determine which "mental dictionary" to use when reading and understanding a sentence. Thus, we expect that participants take a longer time processing the code-switch at the phrasal boundary because they will have to switch from one lexical registry to another. Each participant should likely spend some extra milliseconds upon encountering the code-switch, as their "English linguistic system is "turned on," [and] the Spanish linguistic system is "turned off"" (Heredia & Altarriba, 2001, p. 166).

Dussias (2003) concluded that Spanish-English bilingual speakers treat switches at the auxiliary phrase differently, as evidenced by the eye-movement data, depending on what words (either *estar* or *haber*) are present at the auxiliary node. If the auxiliary and verb are in the same language, there is significantly less processing time required, compared to when the auxiliary

and verb are a in a different language. An auxiliary and verb in the same language is less burdensome to the processor, implying that language processing in a single language is simpler, because the processor is not required to switch between two mental dictionaries, a notion that will be addressed further.

Code-switching can occur for a host of reasons, like improved comprehension or communication (Heredia & Altarriba, 2001). Irrespective of the purpose of the code-switch, a study in further detail helps us to obtain an overall understanding of bilingual cognition and processing. Regardless of the native language, the more dominant language "determines which mental dictionary is going to be accessed faster" (Heredia & Brown, 2008, p. 1).

Methodology

Participants

The 17 participants in this study were volunteer Spanish college students from third- and fourth-semester Spanish classes at UNR. The participants included 4 male and 13 female students, ranging from 18-26 years of age, most of whom were enrolled in undergraduate courses. I chose this select group, as opposed to first- and second-semester students, because these more advanced students had been exposed to more vocabulary and grammar; they were continuing their "emphasis on proficiency in listening, speaking, reading, and writing" (MyNevada, 2017). Second-semester, third-semester, and graduate Spanish students were recruited from various sections of the following courses:

- SPAN 212: Second Year Spanish II
- SPAN 305: Spanish Composition I
- SPAN 323: Chicano/U.S. Latino Culture
- SPAN 350: Introduction to the Study of Hispanic Literature

- SPAN 461/661: History of the Spanish Language

SPAN 212 (Second Year Spanish II)-enrolled, second-semester second-year Spanish students start demonstrating their basic understanding of the language. As for the other courses, my familiarity with the professors in SPAN 323 (Chicano/U.S. Latino Culture), SPAN 350 (Introduction to the Study of Hispanic Literature), and SPAN 461/661 (History of the Spanish Language) allowed me to solicit participation of their students more easily.

This specific age and ability group (i.e. college-aged L2 learners) were intentionally chosen over other populations such as elementary-school, middle school, or high school students. Students in first through sixth grade would experience issues with the lexicon and reading. Moreover, comprehension difficulties may stem from inexperience with the language. These difficulties would greatly affect the results, and thus only college-level students were recruited. For example, if an elementary or middle school student does not know how to read very well, his/her difficulty with the language would make it hard to measure the variable of interest, to ultimately determine if two different types of code switches (at the phrasal boundary and between the auxiliary and the participle) are processed differently as shown by different patterns of reading times.

Comprehension and lexical difficulties can still exist among third- and fourth-semester college students, but a proficiency test was included to screen these students prior to their participation in the research study. Because Spanish-English code-switches are prevalent in bilingual speech, Spanish heritage speakers were purposely not included in the study. Bilingual speakers frequently code-switch in their speech, whereas the sample of third- and fourth-semester Spanish learners should see a difference in processing times in code-switches. In other

words, the findings are being extended to a population that does not code-switch. This particular population had not been exposed to code-switches prior to this study.

Software

Linger, a software package for performing sentence-processing experiments at MIT (Rohdes, 2003), was utilized for the self-paced reading experiments. Participants were provided with instructions (Appendix A).

Proficiency Test

Prior to beginning the self-paced reading portion of the experiment, volunteer students took a Proficiency Test (Appendix B). The proficiency test was vital for verifying that participants were proficient in the Spanish language; if they were not, exposing them to code-switches would not be of value because they would not be able to comprehend the sentences. The proficiency test is used as a tool that allows for assessment of the participant's background in the language and self-reported proficiency.

Self-Paced Reading Task

The experimental tokens (Appendix C) consisted of sentences that were controlled for complexity, length, syllables, and grammaticality, and were borrowed from Dussias' experiment after being examined for lexical abnormalities. Filler sentence tokens with a similar structure and length were interspersed throughout the experiment to serve as distracters such that the participants would not understand the structure of interest. The four experimental conditions in this experiment are demonstrated below, with the critical site, or site where the switch occured,

underlined. These were sentences that: (A) switched immediately before the auxiliary, (B) contained a switch between the Spanish auxiliary and English participle, (C) were completely in English, and (D) were completely in Spanish, respectively, in which the amount of time that it took participants to read the words at the critical site were examined:

A. The officer thinks that the terrorists have injured the man. (All English)
B. El oficial piensa que los terroristas | have injured the man. (Switch before auxiliary) [illicit switch]
C. El oficial piensa que los terroristas han | injured the man. (Switch after auxiliary) [licit switch]
D. El oficial piensa que los terroristas han herido al hombre. (All Spanish)

The experimental task in this study consisted of an online, self-paced reading task. This task was used to determine whether Spanish students were able distinguish between the two types of code-switches as presented above: illicit and licit. As noted in previous sections, the differences between the illicit and licit code-switches depend on the location of the code-switch at the auxiliary phrase.

The stimuli were presented on a computer screen (Appendix D) using a word-by-word moving window display. Participants read each word of the sentence at their own pace. All token and filler sentences were followed by a "yes"/"no" comprehension question, which was based on the sentence that the participant had just read. The vocabulary employed in this study, including the vocabulary that appeared in the comprehension questions, were screened to ensure that they were not lexically abnormal and were frequently used. I based this information on a frequency dictionary (Davies, 2006).

A sample trial proceeded as follows: a participant read the instructions (Appendix A) and completed six trial sentences, during which the participant was encouraged to ask any questions or raise any concerns. The participant was presented with a sentence, where all the characters were replaced by dashes, excluding spaces. The participant was required to press the space bar to view the next word after they had read one word. The previous word would be replaced by a dash upon pressing the spacebar and the next word would appear. The participant was not permitted to reread words or view more than one word at a time. The software (Rohdes, 2003) recorded the amount of time the participant took between the space-bar presses (in milliseconds). After each sentence was read, the participant was asked to answer a "yes"/"no" comprehension question, where the answer was either "yes" (F key) or "no" (J key).

The presentation was done in a Latin square, meaning that each participant encountered only one out of the four conditions of each item in the study. There were 36 experimental sentences, and each participant only saw one condition of each sentence. Altogether, each participant was presented with 120 sentences, in which 360 experimental sentences were in one of the four conditions (9 sentences for each experimental condition), including fillers. Every participant saw the sentences in a random order.

Vocabulary Quiz

The participants completed a Vocabulary Quiz (Appendix E) that I developed after they had completed the self-paced reading portion of the experiment. This quiz determined if the participant was able to recognize and understand the meaning of the vocabulary words employed in this study. Any significant deviation that can be attributed to lack of recognition and comprehension of vocabulary terminology was removed from the final analyses.

Recruitment

I sent an e-mail to the instructors of the aforementioned courses (Appendix F) to first determine if they would be willing to offer extra credit in their respective courses if students participated in my senior thesis research. If these professors expressed interest, then I followed up with them to provide them with either: 1) my contact information so that their students could reach out to me for further information, or 2) the links with the surveys that students are required to complete prior to participating in the study.

Several students reached out and completed the surveys which were facilitated by SurveyMonkey to which an online subscription was purchased. If students were determined to be low-proficiency second-language (L2) learners, they were provided with a schedule of times during which they could sign up to participate in the Linger portion of the study, after which a Vocabulary Quiz would follow. Upon completion of both of these, the appropriate instructor was notified that the student should be awarded extra credit.

Results

The data for the Proficiency Test are reported in terms of percentages. The descriptive statistics are provided in Table 1.

I observed that the population of students surveyed were of low-proficiency in Spanish as evidenced by their scores on the Proficiency Test (Appendix A).

The general reading speed for each participant was computed by fitting their average reading time per character (sentences of interest and filler sentences) to a regression line.

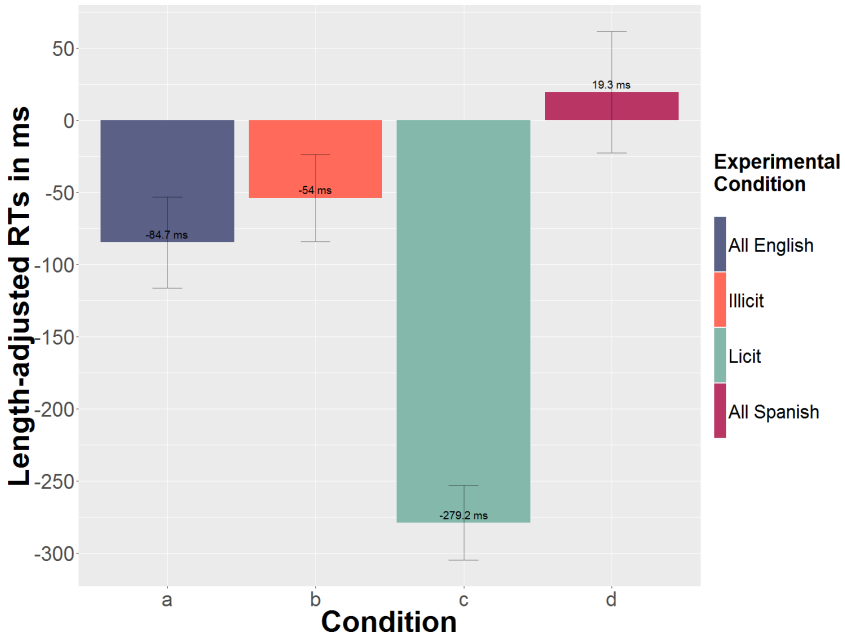
Table 1

Descriptive Statistics Computed for Proficiency Test

Survey Type	*Mean Score*	*Minimum Score*	*Maximum Score*	*Standard Deviation*
Proficiency Test	47% (23.03/49)	39.5% (19.36/49)	68% (33.32/49)	0.129

For the analysis, filler sentences were removed and only the critical site was analyzed (Words 7 and 8 in the sentence). The corresponding reaction times were summed to produce an aggregate of times for all 16 participants. Outliers were removed from the analysis by eliminating any reading times outside of 3 standard deviations, a process that resulted in no outliers. Data were trimmed for 100 ms. and 10,000 ms. At 100 ms, participants are perceptually not registering the word and at 10,000 ms, participants might have been distracted or even sneezed.

Figure 1. Residual Times for Corresponding Experimental Conditions. The error bars represent standard error.



IBM SPSS, a statistical data package, was used to compute the descriptive statistics, including the mean of the reaction times (in milliseconds) and the standard deviation. The mean provided the average value that was used as a standard for comparisons. The standard deviation provided a "typical amount that each score varies, or deviates, from the mean" (Nolan & Heinzen, 2017, p. 80). The inferential statistics included an Analysis of Variance (ANOVA), which helped to determine whether there were any differences in processing times between the location of the code-switch and determine if there were any statistically significant differences between the mean values by analyzing the variance.

The data were analyzed using a Repeated-Measures Analysis of Variance (ANOVA) as a within-groups research design (Table 2), using the residuals of the reading times. To elaborate, the baseline was assigned at the zero mark and the residual times were graphed (Fig. 1). As seen in Figure 1, participants were able to clearly distinguish between the illicit and licit code-switches (Conditions B and C, respectively). The bar graph indicates that for Condition A (All English sentences), participants took 84.7 ms. fewer than predicted to read the sentence. For Condition B (illicit code-switch), participants took 54 ms. fewer than predicted to interpret the critical region. For Condition C (licit code-switch), participants took 279.2 ms. shorter than predicted to read the aggregate of words presented in the critical region. Finally, Condition D (all Spanish) took participants 19.3 ms longer to process than expected. There was a significant effect of conditions on length-adjusting reading times (ms.), Wilks' Lambda = .342, F (3, 14) = 8.998, p = .001. Pairwise comparisons were performed with Bonferroni corrections to keep the Type I error rate at 5% altogether. There were significant differences between Condition A (all English) and Condition C (licit code-switch) (p = .001), between Condition B (illicit code-

switch) and Condition C (licit code-switch) (p = .002), and between Condition C (licit code-switch) and Condition D (all Spanish) (p = .005). No other comparisons were significant.

Table 2

Analysis of Variance (ANOVA) Between Conditions. These include the multivariate tests[a].

Effect	*Value*	*F*	*Hypothesis df*	*Error df*	*Sig.*	*Partial Eta Squared*
Condition						
Wilks' Lambda	.342	8.998[b]	3.000	14.000	.001	.658

a. Design: Intercept
Within Subjects Design: condition
b. Exact Statistic

The differences in these conditions demonstrated that participants were able to notice that there was a difference in the conditions. The pairwise comparisons show the specific significant differences between conditions, which suggests that participants noticed, structurally, that the sentences were different. This is important considering that the population of participants in this study was not regularly exposed to code-switches.

Upon completion of the self-paced reading task, participants took a Vocabulary Quiz. The descriptive statistics from this Vocabulary Quiz are reported below (Table 3). As evidenced by the Vocabulary Quiz, the participants did not experience any significant struggle in interpreting the vocabulary employed in the study. This means that lexical deficiencies did not unduly affect the results.

Table 3

Descriptive Statistics Computed for Vocabulary Quiz

Survey Type	*Mean Score*	*Minimum Score*	*Maximum Score*	*Standard Deviation*
Vocabulary Quiz	81% (12.96/16)	56% (8.96/16)	94% (15.04/16)	0.107

Discussion

The picture that develops here is that these participants, who were not regularly exposed to code-switching, were nevertheless able to show structural sensitivity to the switches and the code-switching constraints; in other words, it mattered to them where the code-switch occurred even if they had not been exposed to code-switching prior to the experiment. They were able to notice the difference, as evidenced by the difference in their reading times. As expected, participants, because they have low proficiency, took longer than expected to process Condition D (all Spanish sentences). This study of implicit comprehension calls into question then why participants did not take a shorter amount of time than expected to process Condition A (all English sentences) compared to Condition B or Condition C, as evidenced by the pairwise comparisons reported previously.

It is important to keep in mind that verb phrases (which is the phrase present in the critical region) are read faster than noun phrases or other phrases in general because of the frequency of certain lexical items, like auxiliary verbs. The large standard error bar in the all English condition suggests that the students' variability in the reading times of the critical region was high. This difference can be attributed mainly to the structure of the methodology. That is, prior to participating in the study, participants completed a Proficiency Test in Spanish. They

completed the Linger portion of the study, which was also in Spanish. In some sense, the students had been primed to look for Spanish. All the conditions (Conditions B, C, D) except for the first condition included a Spanish component. Condition A contained no code-switches and thus, participants could have hesitated because they were expecting a Spanish component to the sentence; more specifically, participants could have been expecting a code-switch, which never occurred.

This phenomenon could be due to the surprisal effect, the cognitive effort for an individual to process a word in a sentence, depending on its context (Levy, 2013). Evidence for the "surprisal effect" comes from the difference in processing difficulty due to the case of the all English Condition A compared to the remaining conditions containing Spanish.

Exploring the limitations of this project allow for the future experimental plans. This project was limited because this experiment could not be applied to a population of higher-proficiency students to investigate if the results would be similar or different. It is difficult to determine without further information and data if students of a higher class of proficiency would perform significantly better than the current population of low-proficiency L2 students. The import of this project is that it shows sensitivity to syntax even when participants had not been exposed to code-switching. That is, sentence structure was important for L2 learners, even at low-proficiency levels.

This project was highly controlled because it did not involve any sociolinguistic applications, but rather focused solely on sentence structure. Thus, this project indirectly addresses the question of: Can code-switching be taught? The results from this experiment reveal that the rules of code-switching do not need to be taught because even low-proficiency students who were not exposed to code-switching prior to this experiment know the code-switching

constraints. What needs to be taught, though, is the social situations in which code-switching is appropriate because a second-language learner would not have learned the specific contexts in which a code-switch is favored.

APPENDIX A: Linger Participation Instructions

Welcome. In this experiment, you'll be reading some sentences on the computer screen. You will first see 1 or 2 rows of dashes like this:

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These dashes are covering the words in the sentence. When you press the space bar, the first word will appear. With every press of the space bar, a new word will appear and the last word will become dashes again.

You should try to read as naturally as possible, making sure that you understand what you read.

When you finish reading the last word, press the space bar again. The dashes will go away and you will see a question about the sentence you just read. To answer the question, press the "F" key for YES or the "J" key for NO. You will be reminded which key is yes and which is no. Try to answer as quickly and accurately as possible.

If you are unsure of the answer (or if you think that both answers are right), try to pick the better answer.

To be able to read and answer quickly, you should keep your fingers resting on the space bar and the "F" and "J" keys, so that you don't have to look down at the keys to answer. You can use whichever hand is most comfortable for you to press the keys, or use both hands if you like.}

You can take breaks as you need them, but please try to do so before you have started reading a new item, when the screen just shows dashes.

That's all there is to it. Just to review, this is how the experiment goes:

1. Some dashes will appear on the screen and you must press the space bar to see each new word of the sentence.

2. Read at a natural rate, comprehending what you read. Don't read out loud unless that's the way you normally read.

3. You'll see a question about the sentence and should answer by pressing the "F" key for YES or the "J" key for NO. You will be told if your answer was incorrect. You should take this as an indication to read more slowly and carefully.

4. After the question, the computer will automatically go on to the next sentence.

When the experiment is over, a screen will appear telling you to stop. At that point, you should let the experimenter know you are finished. After you have finished the experiment, you will be asked to complete a Vocabulary Quiz (link on desktop). Complete this and you are welcome to leave.

If you have any questions about the procedure, ask the experimenter now. Thank you!

APPENDIX B: Proficiency Test

Name _____ # _____

Instructions: In the following text, some of the words have been replaced by spaces which are numbered from 1 to 20. First, read the complete text in order to understand it. Then reread it and choose, from the list of words on the answer sheet, the correct word for each space. Mark your answers by circling your choice on the answer sheet, not on the text.

El sueño de Juan Miró

Hoy se inaugura en Palma de Mallorca la Fundación Pilar y Joan Miró, en el mismo lugar en donde el artista vivió sus últimos treinta y cinco años. El sueño de Joan Miró se ha _____ (1). Los fondos donados a la ciudad por el pintor y su esposa en 1981 permitieron que el sueño se _____ (2); más tarde, en 1986, el Ayuntamiento de Palma de Mallorca decidió _____ (3) al arquitecto Rafael Moneo un edificio que _____ (4) a la vez como sede de la entidad y como museo moderno. El proyecto ha tenido que _____ (5) múltiples obstáculos de carácter administrativo. Miró, coincidiendo _____ (6) los deseos de toda su familia, quiso que su obra no quedara expuesta en ampulosos panteones de arte o en _____ (7) de coleccionistas acaudalados; por ello, en 1981, creó la fundación mallorquina. Y cuando estaba _____ (8) punto de morir, donó terrenos y edificios, así como las obras de arte que en ellos _____ (9).

El edificio que ha construido Rafael Moneo se enmarca en _____ (10) se denomina "Territorio Miró", espacio en el que se han _____ (11) de situar los distintos edificios que constituyen la herencia del pintor.

El acceso a los mismos quedará _____ (12) para evitar el deterioro de las obras. Por otra parte, se _____ (13), en los talleres de grabado y litografía, cursos _____ (14) las distintas técnicas de estampación. Estos talleres también se cederán periódicamente a distintos artistas contemporáneos, _____ (15) se busca que el "Territorio Miró" _____ (16) un centro vivo de creación y difusión del arte a todos los _____ (17).

La entrada costará 500 pesetas y las previsiones dadas a conocer ayer aspiran _____ (18) que el centro acoja a unos 150.000 visitantes al año. Los responsables esperan que la institución funcione a _____ (19) rendimiento a principios de la _____ (20) semana, si bien el catálogo completo de las obras de la Fundación Pilar y Joan Miró no estará listo hasta dentro de dos años.

Instructions: Each of the following sentences contains a blank space ___ indicating that a word or phrase has been omitted. From the four choices select the one which, when inserted in the space ___, best fits in with the meaning of the sentence as a whole.

1. Al oír del accidente de su buen amigo, Paco se puso _____ . a. alegre b. fatigado c. hambriento d. desconsolado	**2**. No puedo comprarlo porque me _____ dinero. a. falta b. dan c. presta d. regalan
3. Tuvo que guardar cama por estar _____ . a. enfermo b. vestido c. ocupado d. parado	**4**. Aquí está tu café, Juanito. No te quemes, que está muy _____ . a. dulce b. amargo c. agrio d. caliente
5. Al romper los anteojos, Juan se asustó porque no podía _____ sin ellos. a. discurrir b. oír c. ver d. entender	**6**. ¡Pobrecita! Está resfriada y no puede _____ . a. salir de casa b. recibir cartas c. respirar con pena d. leer las noticias
7. Era una noche oscura sin _____ . a. estrellas b. camas c. lágrimas d. nubes	**8**. Cuando don Carlos salió de su casa, saludó a un amigo suyo: -Buenos días, _____ . a. ¿Qué va? b. ¿Cómo es? c. ¿Quién es? d. ¿Qué tal?
9. ¡Qué ruido había con los gritos de los niños y el _____ de los perros! a. olor b. sueño c. hambre d. ladrar	**10**. Para saber la hora, don Juan miró el _____ . a. calendario b. bolsillo c. estante d. despertador

11. Yo, que comprendo poco de mecánica, sé que el auto no puede funcionar sin _____ . a. permiso b. comer c. aceite d. bocina	**12**. Nos dijo mamá que era hora de comer y por eso _____ . a. fuimos a nadar b. tomamos asiento c. comenzamos a fumar d. nos acostamos pronto
13. ¡Cuidado con ese cuchillo o vas a _____ el dedo! a. cortarte b. torcerte c. comerte d. quemarte	**14**. Tuvo tanto miedo de caerse que se negó a _____ con nosotros. a. almorzar b. charlar c. cantar d. patinar
15. Abrió la ventana y miró: en efecto, grandes lenguas de _____ salían llameando de las casas. a. zorros b. serpientes c. cuero d. fuego	**16**. Compró ejemplares de todos los diarios pero en vano. No halló _____ . a. los diez centavos b. el periódico perdido c. la noticia que deseaba d. los ejemplos
17. Por varias semanas acudieron colegas del difunto profesor a _____ el dolor de la viuda. a. aliviar b. dulcificar c. embromar d. estorbar	**18**. Sus amigos pudieron haberlo salvado pero lo dejaron _____ . a. ganar b. parecer c. perecer d. acabar
19. Al salir de la misa me sentía tan caritativo que no pude menos que _____ a un pobre mendigo que había allí sentando. a. pegarle b. darle una limosna c. echar una mirada d. maldecir	**20**. Al lado de la Plaza de Armas había dos limosneros pidiendo _____ . a. pedazos b. paz c. monedas d. escopetas
21. Siempre maltratado por los niños, el perro no podía acostumbrarse a _____ de sus nuevos amos. a. las caricias b. los engaños	**22**. ¿Dónde estará mi cartera? La dejé aquí mismo hace poco y parece que el necio de mi hermano ha vuelto a _____ . a. dejármela b. deshacérmela

c. las locuras d. los golpes	c. escondérmela d. acabármela
23. Permaneció un gran rato abstraído, los ojos clavados en el fogón y el pensamiento _____ . a. en el bolsillo b. en el fuego c. lleno de alboroto d. Dios sabe dónde	**24**. En vez de dirigir el tráfico estabas charlando, así que tú mismo _____ del choque. a. sabes la gravedad b. eres testigo c. tuviste la culpa d. conociste a las víctimas
25. Posee esta tierra un clima tan propio para la agricultura como para _____ . a. la construcción de trampas b. el fomento de motines c. el costo de vida d. la cría de reses	**26**. Aficionado leal de obras teatrales, Juan se entristeció al saber _____ del gran actor. a. del fallecimiento b. del éxito c. de la buena suerte d. de la alabanza
27. Se reunieron a menudo para efectuar un tratado pero no pudieron _____ . a. desavenirse b. echarlo a un lado c. rechazarlo d. llevarlo a cabo.	**28**. Se negaron a embarcarse porque tenían miedo de_____ . a. los peces b. los naufragios c. los faros d. las playas

APPENDIX C: Experimental Tokens

Item #1
Condition 1: El oficial piensa que los terroristas have injured the man.
Condition 2: El oficial piensa que los terroristas han injured the man.
Condition 3: The officer thinks that the terrorists have injured the man.
Condition 4: El oficial piensa que los terroristas han herido al hombre.

Item #2
Condition 1: La madre sabe que los chicos have gone to the park.
Condition 2: La madre sabe que los chicos han gone to the park.
Condition 3: The mother knows that the children have gone to the park.
Condition 4: La madre sabe que los chicos han ido al parque.

Item #3
Condition 1: El escultor cree que los organizadores have bought the clay.
Condition 2: El escultor cree que los organizadores han bought the clay.
Condition 3: The sculptor believes that the organizers have bought the clay.
Condition 4: El escultor cree que los organizadores han comprado la arcilla.

Item #4
Condition 1: El agente dice que los turistas have enjoyed the cruise.
Condition 2: El agente dice que los turistas han enjoyed the cruise.
Condition 3: The agent says that the tourists have enjoyed the cruise.
Condition 4: El agente dice que los turistas han disfrutado el crucero.

Item #5
Condition 1: El doctor admite que los actores have had the surgery.
Condition 2: El doctor admite que los actores han had the surgery.
Condition 3: The doctor admits that the actors have had the surgery.
Condition 4: El doctor admite que los actores han tenido la cirugía.

Item #6
Condition 1: El autor supone que los empleados have sold the book.
Condition 2: El autor supone que los empleados han sold the book.
Condition 3: The author supposes that the employees have sold the book.
Condition 4: El autor supone que los empleados han vendido el libro.

Item #7
Condition 1: El presidente piensa que los ministros have made the mistake.
Condition 2: El presidente piensa que los ministros han made the mistake.
Condition 3: The president thinks that the ministers have made the mistake.
Condition 4: El presidente piensa que los ministros han cometido el error.

Item #8

Condition 1: El dentista sabe que las recepcionistas have talked to the client.
Condition 2: El dentista sabe que las recepcionistas han talked to the client.
Condition 3: The dentist knows that the receptionists have talked to the client.
Condition 4: El dentista sabe que los recepcionistas han hablado al cliente.

Item #9
Condition 1: La audiencia cree que los canadienses have won the medal.
Condition 2: La audiencia cree que los canadienses han won the medal.
Condition 3: The audience believes that the Canadians have won the medal.
Condition 4: La audiencia cree que los canadienses han ganado la medalla.

Item #10
Condition 1: El juez dice que los acusados have committed the crime.
Condition 2: El juez dice que los acusados han committed the crime.
Condition 3: The judge says that the accused have commited the crime.
Condition 4: El juez dice que los acusados han cometido el crimen.

Item #11
Condition 1: El electricista admite que las secretarias have paid the bill.
Condition 2: El electricista admite que las secretarias han paid the bill.
Condition 3: The electrician admits that the secretaries have paid the bill.
Condition 4: El electricista admite que las secretarias han pagado la cuenta.

Item #12
Condition 1: El profesor supone que los estudiantes have passed the exam.
Condition 2: El profesor supone que los estudiantes han passed the exam.
Condition 3: The professor supposes that the students have passed the exam.
Condition 4: El professor supone que los estudiantes han pasado el examen.

Item #13
Condition 1: El arquitecto piensa que los pintores have painted the wall.
Condition 2: El arquitecto piensa que los pintores han painted the wall.
Condition 3: The architect thinks that the painters have painted the wall.
Condition 4: El arquitecto piensa que los pintores han pintado la pared.

Item #14
Condition 1: El director sabe que los productores have gotten the money.
Condition 2: El director sabe que los productores han gotten the money.
Condition 3: The director knows that the producers have gotten the money.
Condition 4: El director sabe que los productores han recibido el dinero.

Item #15
Condition 1: El sargento cree que los soldados have completed the mission.
Condition 2: El sargento cree que los soldados han completed the mission.
Condition 3: The sergeant believes that the soldiers have completed the mission.
Condition 4: El sargento cree que los soldados han terminado la misión.

Item #16
Condition 1: El piloto dice que los pasajeros have abandoned the plane.
Condition 2: El piloto dice que los pasajeros han abandoned the plane.
Condition 3: The pilot says that the passengers have abandoned the plane.
Condition 4: El piloto dice que los pasajeros han abandonado el aeroplano.

Item #17
Condition 1: El hospital admite que los pacientes have finished the treatment.
Condition 2: El hospital admite que los pacientes han finished the treatment.
Condition 3: The hospital admits that the patients have finished the treatment.
Condition 4: El hospital admite que los pacientes han terminado el tratamiento.

Item #18
Condition 1: El ingeniero supone que los hoteles have hired the workers.
Condition 2: El ingeniero supone que los hoteles han hired the workers.
Condition 3: The engineer supposes that the hotels have hired the workers.
Condition 4: El ingeniero supone que los hoteles han contratado a los trabajadores.

Item #19
Condition 1: La policía piensa que los adolescentes have stolen the car.
Condition 2: La policía piensa que los adolescentes han stolen the car.
Condition 3: The police think that the adolescents have stolen the car.
Condition 4: La policía piensa que los adolescentes han robado el coche.

Item #20
Condition 1: El técnico sabe que los teléfonos have improved the connection.
Condition 2: El técnico sabe que los teléfonos han improved the connection.
Condition 3: The technician knows that the phones have improved the connection.
Condition 4: El técnico sabe que los teléfonos han mejorado la conexión.

Item #21
Condition 1: El asistente cree que las computadoras have completed the job.
Condition 2: El asistente cree que las computadoras han completed the job.
Condition 3: The assistant believes that the computers have completed the job.
Condition 4: El asistente cree que las computadoras han terminado el trabajo.

Item #22
Condition 1: El crítico dice que los documentales have discussed the issue.
Condition 2: El crítico dice que los documentales han discussed the issue.
Condition 3: The critic says that the documentaries have discussed the issue.
Condition 4: El crítico dice que los documentales han discutido el problema.

Item #23
Condition 1: El investigador admite que los químicos have designed the test.
Condition 2: El investigador admite que los químicos han designed the test.

Condition 3: The investigator admits that the chemists have designed the test.
Condition 4: El investigador admite que los químicos han diseñado la prueba.

Item #24
Condition 1: El filósofo supone que las ideas have changed the argument.
Condition 2: El filósofo supone que las ideas han changed the argument.
Condition 3: The philosopher supposes that the ideas have changed the argument.
Condition 4: El filósofo supone que las ideas han cambiado el argumento.

Item #25
Condition 1: El astrónomo piensa que los asteroides have influenced the weather.
Condition 2: El astrónomo piensa que los asteroides han influenced the weather
Condition 3: The astronomer thinks that the asteroids have influenced the weather.
Condition 4: El astrónomo piensa que los asteroides han influenciado el clima.

Item #26
Condition 1: El científico sabe que los experimentos have increased the budget.
Condition 2: El científico sabe que los experimentos han increased the budget.
Condition 3: The scientist knows that the experiments have increased the budget.
Condition 4: : El científico sabe que los experimentos han aumentado el presupuesto.

Item #27
Condition 1: El zoólogo cree que los animales have moved to the lake.
Condition 2: El zoólogo cree que los animales han moved to the lake.
Condition 3: The zoologist believes that the animals have moved to the lake.
Condition 4: El zoólogo cree que los animales han mudado al lago.

Item #28
Condition 1: El antropólogo dice que las civilizaciones have affected the future.
Condition 2: El antropólogo dice que las civilizaciones han affected the future.
Condition 3: The anthropologist says that the civilizations have affected the future.
Condition 4: : El antropólogo dice que las civilizaciones han afectado el futuro.

Item #29
Condition 1: La nación admite que los políticos have altered the system.
Condition 2: La nación admite que los políticos han altered the system.
Condition 3: The nation admits that the politicians have altered the system.
Condition 4: La nación admite que los políticos han alterado el sistema.

Item #30
Condition 1: El especialista supone que las medicinas have helped the infected.
Condition 2: El especialista supone que las medicinas han helped the infected.
Condition 3: The specialist supposes that the medicines have helped the infected.
Condition 4: El especialista supone que las medicinas han ayudado a los infectados.

Item #31

Condition 1: El gobierno piensa que los ciudadanos have supported the war.
Condition 2: El gobierno piensa que los ciudadanos han supported the war.
Condition 3: The government thinks that the citizens have supported the war.
Condition 4: El gobierno piensa que los ciudadanos han apoyado la guerra.

Item #32
Condition 1: La actriz sabe que los voluntarios have collected the money.
Condition 2: La actriz sabe que los voluntarios han collected the money.
Condition 3: The actress knows that the volunteers have collected the money.
Condition 4: La actriz sabe que los voluntarios han recogido el dinero.

Item #33
Condition 1: El sociólogo cree que las industrias have caused the problem.
Condition 2: El sociólogo cree que las industrias han caused the problem.
Condition 3: The sociologist believes that the industries have caused the problem.
Condition 4: El sociólogo cree que las industrias han causado el problema.

Item #34
Condition 1: El príncipe dice que los helicópteros have joined the battle.
Condition 2: El príncipe dice que los helicópteros han joined the battle
Condition 3: The prince says that the helicopters have joined the battle.
Condition 4: El príncipe dice que los helicópteros se han unido a la batalla.

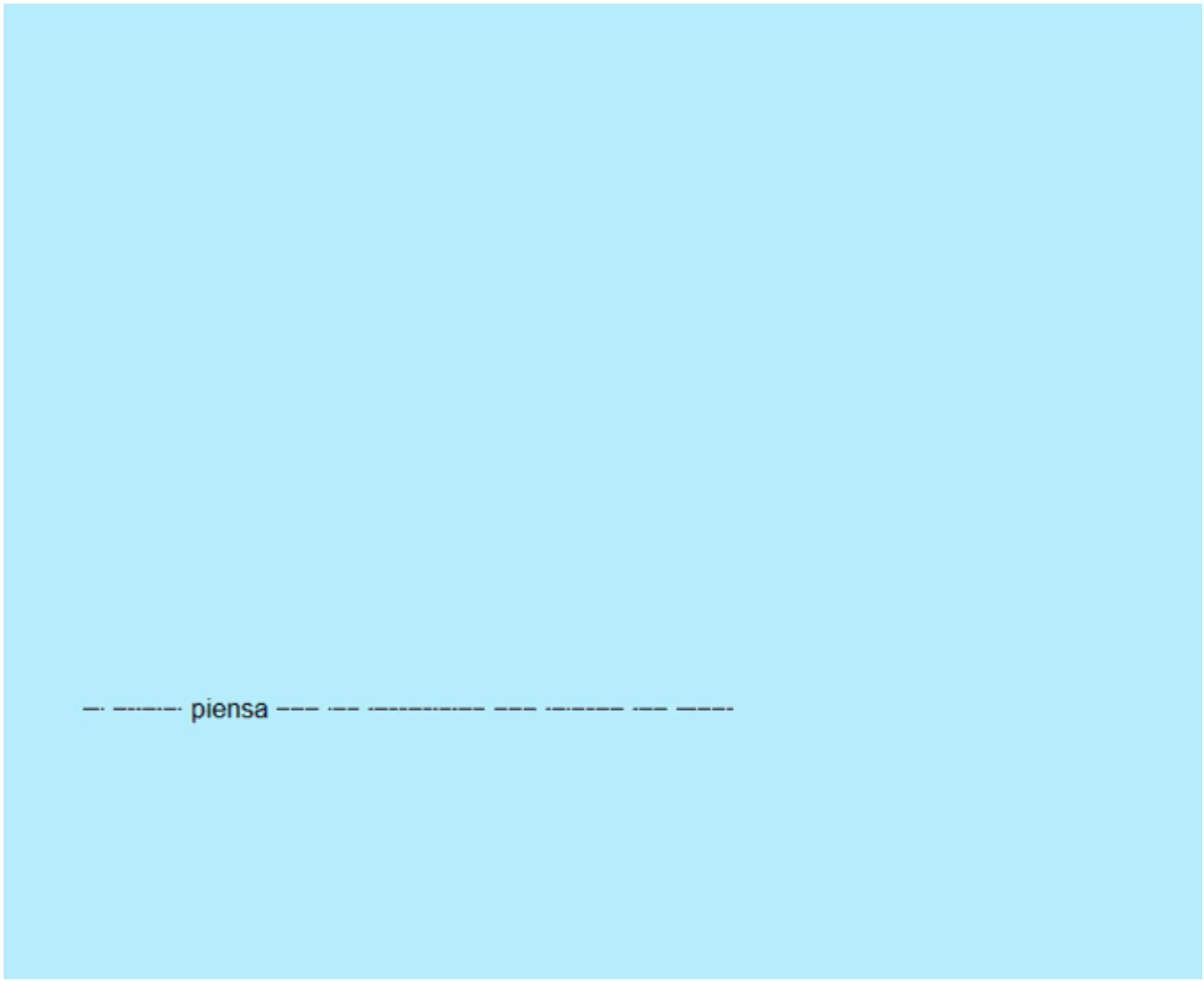
Item #35
Condition 1: El senador admite que los ataques have defined the agenda.
Condition 2: El senador admite que los ataques han defined the agenda.
Condition 3: The senator admits that the attacks have defined the agenda.
Condition 4: El senador admite que los ataques han definido la agenda.

Item #36
Condition 1: El artista supone que los mexicanos have sponsored the exhibition.
Condition 2: El artista supone que los mexicanos han sponsored the exhibition.
Condition 3: The artist supposes that the Mexicans have sponsored the exhibition.
Condition 4: El artista supone que los mexicanos han patrocinado la exhibición.

APPENDIX D: Linger Screenshot

This screenshot shows an example of a sentence that a participant might encounter. Linger utilizes a non-cumulative moving window display, where each character is replaced by a dash (excluding spaces) and each word appears one at a time with the press of a spacebar.

Here, the full sentence is, "*El oficial piensa que los terroristas han* injured the man."



APPENDIX E: Vocabulary Quiz

Name _____

Instructions: Each of the following sentences contains an underlined word ___ indicating that a word or phrase is of interest. From the four choices, select the one which is the best translation for the meaning of the underlined word.

1. El autor supone que los empleados han vendido el libro. a. employers b. workers c. author d. employees	**2**. La audiencia cree que los canadienses han ganado la medalla. a. Canadians b. canisters c. camaraderie d. confidence
3. El juez dice que los acusados han cometido el crimen . a. judge b. juice c. player d. jester	**4**. El sargento cree que los soldados han terminado la misión. a. cheese b. surge c. army d. sergeant
5. El piloto dice que los pasajeros han abandonado el aeroplano. a. stewardesses b. passions c. passengers d. travelers	**6**. El ingeniero supone que los hoteles están alimentando los trabajadores. a. engineer b. ingenious c. innovator d. ingenuine
7. El crítico dice que los documentales han discutido el problema. a. documentaries b. documents c. documentator d. documented	**8**. El filósofo supone que las ideas han cambiado el problema . a. poses b. assume c. puts d. suppose
9. El gobierno piensa que los ciudadanos están apoyando la guerra. a. government b. cities c. civilization d. citizens	**10**. El sociólogo cree que las industrias han causado el problema. a. socialist b. sociology c. psychologist d. sociologist

11. El príncipe dice que los helicópteros se han unido la batalla. a. prince b. principal c. participant d. prisoner	**12**. La madre sabe que los chicos han ido al parque a. supposes b. suggests c. puts d. knows
13. El senador admite que los ataques están definiendo la agenda. a. attackers b. swords c. articles d. attacks	**14.** El agente dice que los turistas están disfrutando el crucero. a. dialogues b. dices c. complains d. says

15. El doctor admite que los actores están teniendo la cirugía. a. admits b. acts c. describes d. suggests	**16**. El escultor cree que los organizadores están comprando la arcilla. a. thinks b. poses c. supplies d. believes

APPENDIX F: Recruitment E-mail

Dear Professor,

I am conducting a study on the Spanish and English languages and am currently searching for potential participants. My thesis mentor is Dr. Tania Leal in the World Languages and Literatures Department. This study is focused on Spanish-English code-switching. People who participate in the study will be asked to read short conversations in Spanish and English, then answer brief questions about them. The experiment only takes about an hour, and participants will be awarded extra credit for their time from participating professors. Both Dr. Leal and I encourage you to offer extra credit in your classroom to support student research, especially language research in this case.

Who can participate? All students who are at least 18 years old are eligible.

If students choose to participate, what will they be asked to do? They will complete two easy tasks. The first task requires participants to read Spanish and English sentences that are broken up into pieces and then answer questions about them. The second task requires participants to take a Vocabulary Quiz to ensure that participants are familiar with the vocabulary employed in the study. There will also be a short language background questionnaire about the languages they know and when they learned them prior to participation in the study. The whole experiment will take around an hour, and it will take place in EJCH 209 (Computer Lab) on the University of Nevada, Reno campus.

Participation in the experiment is entirely voluntary, and, although I will not collect any sensitive information and participation will be confidential. The results of the study will not be disseminated to you. You will only get a list of who to give extra credit to.

Students do not have to participate in the study to get the extra credit. They can instead opt to do an alternative assignment related to your course content that takes about the same amount of time, like writing a short essay. Further, they may withdraw from the study at any time.

If your students are interested in participating, please have them contact me by email at raghavianand@nevada.unr.edu. If you know students who are not enrolled in your course, but who might qualify or may be interested, please pass this message along to them and/or have them contact me.

I appreciate your help and time. This project is important for understanding Spanish-English code-switching, specific to this university.

Thank you,
Raghavi Anand

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