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PROCESSING OF LEXICAL AND MORPHOLOGICAL CUES IN A STUDY ABROAD CONTEXT

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ABSTRACT

Acquiring a second language as an adult can be a difficult task, and much research has been conducted to explain the obstacles associated with adult second language acquisition (SLA). Some research has suggested biological (see Birdsong, 2006; DeKeyser & Larsen-Hall, 2005, for a summary), external (Lantolf, 2000; Long, 1996; Swain, 2000), and internal (VanPatten, 2004; Ellis, 2007) factors to account for these difficulties. The Associative-Cognitive theory (Ellis, 2007) suggests that there is no default mechanism determining what cues are processed, and that it is both linguistic characteristics (cue salience, reliability and redundancy) and language experience (early learned cues in the L1 and L2 affect the learning of later learned cues) that guide the processing of L2 cues. There is mounting evidence that native speakers of a morphologically poor language such as English learning a morphologically richer language such as Spanish or Italian as adults use lexical cues (adverbs) before morphological cues (verbs) when both cues provide information about temporal reference within a sentence (Bardovi-Harlig, 1992; Cadierno, Glass, Lee, & VanPatten, 1991; Lee, 1999, 2002; Jiang, 2004; Leeser, 2004; Musumeci, 1989; Rossomondo, 2003); Sagarra & Ellis, personal communication; VanPatten, 1996, 2004). Similarly, native speakers of a morphologically rich language learning another morphologically rich language show preference for morphological over lexical cues (Ellis & Sagarra, submitted; Jiang, Novokshanova, Masuda, & Wang, 2008; Liu, Bates, & Li, 1992). In addition to these linguistic and language experience factors, instructors' overuse of lexical items (Dracos, 2009) and underuse of certain morphological forms (Goodall, 2008) poses an additional obstacle for classroom learners' processing of redundant cues.

Previous research suggests that classroom learners with higher working memory capacity are better able to process redundant morphological cues, even at early stages of

acquisition (Leeser, 2007; Sagarra, 2007; Sagarra & Ellis, personal communication), than those with lower working memory capacity. Immersion experience and inhibitory control are two other factors that can help classroom learners focus on morphological cues, because naturalistic settings expose learners to great amounts of morphological cues and help them suppress their L1 (Linck, Kroll, & Sunderman, 2009). While there is no direct evidence about what role immersion experience and inhibitory control play in the L2 processing of such cues, studies indicate that in a study abroad setting, better working memory (Lafford, 2006; Tokowicz, Michael, & Kroll, 2004; Sunderman & Kroll, 2009) and inhibitory control (Linck, Hoshino, & Kroll, 2008; Linck, Kroll, & Sunderman, 2009) facilitate the L2 processing of linguistic features, suggesting that an immersion experience, working memory capacity, and inhibitory control can also assist in the L2 processing of morphological cues. The goal of this dissertation is to investigate the effects of these three factors on how Anglophone learners of Spanish process temporal adverbs and verbs to assign temporal reference. Heeding these studies, the predictions are that immersion experience, working memory capacity, and inhibitory control will help classroom learners to rely on morphological cues.

To test these predictions, English-Spanish adult classroom learners with (n = 36) and without (n = 24) an immersion experience completed 6 screening tasks (a language background questionnaire, a language contact profile (study abroad only), a test of Spanish proficiency, proficiency self-ratings, a verb recognition test, and tense recognition test), an eyetracking task, a working memory test, and an inhibitory control test. The eyetracking task followed a counterbalanced within-subjects design in which participants read 146 sentences in Spanish at their own pace (6 practice, 40 experimental, 100 fillers) and answered a comprehension question after each sentence. All experimental sentences contained a past tense adverb (lexical

cue), but half had past tense verbs (morphological cue) (half adverb-verb, half verb-adverb) and half had present tense verbs (half adverb-verb, half verb-adverb). The working memory test consisted of a modified version of Water's & Caplan's (1996b) reading span test and asked participants to read a set of sentences, judge their plausibility, and remember the last word of each sentence. Finally, inhibitory control was measured with the Simon test, which required participants to ignore the position of a target stimulus in order to respond only to its color.

The results for the screening tests revealed that the sample pool was homogeneous in terms of L2 proficiency and knowledge of the target verbs and tenses. The findings of the eyetracking task indicated that classroom learners without an immersion experience use lexical cues to resolve a tense conflict, whereas those with an immersion experience show a decreased reliance on lexical cues accompanied by an increased reliance on morphological cues. These data suggest that an immersion experience helps classroom learners acquire native-like processing patterns. This relates to the Associative-Cognitive theory by showing that both linguistic and language experience based factors affect SLA. The results of the reading span test revealed that working memory capacity modulates the processing of morphological cues in study abroad learners but not in non-study abroad learners. When in the study abroad setting, the learners with higher working memory capacity are able to focus on the morphological cues when lexical cues are absent. Finally, the results of the Simon test showed that inhibitory control was not a determinant factor in the processing of lexical or morphological cues for any of the groups. This may be attributed to the data being collected after the study abroad group learners had returned from their immersion experience. Taken as a whole, the findings of this dissertation suggest that immersion experience and the combination of immersion experience and working memory help adult classroom learners attend to morphological cues in the input.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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CHAPTER 1: Introduction

1.0 Introduction

Learning a second language (L2) as an adult can be a daunting task. Researchers have attributed adults' persistent difficulty acquiring L2 competence to many factors, including biological factors (e.g., see Birdsong, 2006; DeKeyser & Larsen-Hall, 2005; Hyltenstam & Abrahamsson, 2003, for a discussion), external factors (e.g., Krashen, 1994; Lantolf, 2000; Long, 1996; Swain, 2000) or internal ones (e.g., VanPatten, 2004; Clahsen & Felser, 2006; Ellis, 2006a). The Associative-Cognitive theory (Ellis, 2006a) posits that learned selective attention, the effect of earlier learned cues on later learned ones, determines attention to specific L2 cues in the short-term (blocking) and long-term (transfer), and eventually affects L2 ultimate attainment. According to this model, adults will have difficulty acquiring morphological cues when the L2 being learned is morphologically more complex than their L1 because they are accustomed to relying heavily on lexical cues when processing in the L1. There is mounting evidence that native speakers of English, a language with poor verbal morphology, prefer lexical cues (adverbs) to morphological cues (verbs) when assigning temporal reference in a morphologically rich language, such as Spanish or Italian (e.g., Bardovi-Harlig, 1992; Cadierno, Glass, Lee, & VanPatten, 1991; Lee, 1999, 2002; Lee, Cadierno, Glass, & VanPatten, 1997; Leeser, 2004; Musumeci, 1989; Rossomondo, 2003; Sagarra, 2007; VanPatten, 1996, 2004). In contrast, native speakers of Spanish use morphological cues instead of lexical cues to assign temporal reference (Sagarra & Ellis, personal communication; Sagarra, 2007).

Recent research suggests that the learners' preference for lexical cues is due to transfer (e.g., Jiang, Novokshanova, Masuda, & Wang, 2008; Ellis & Sagarra, submitted) rather than a default L2 processing strategy (e.g., VanPatten, 1996, 2004). Jiang et al. (2008) asked native

speakers of a language without verbal morphology (Japanese) and with rich verbal morphology (Russian) to read sentences with subject-verb agreement and plural morpheme disagreement in L2 English. They found that the Japanese-English learners showed no reading latencies in response to the subject-verb incongruencies, indicating that they were not sensitive to the errors, but that the Russian-English learners did show longer reading latencies, suggesting that they were sensitive to the errors. In a more recent study, Ellis & Sagarra (submitted) examined the short-term and long-term effects of language experience on the acquisition of temporal reference in a subset of Latin, and reported that native speakers of languages with some verbal morphology follow the cues in which they were trained in Latin (adverbs or verbs), but that native speakers of Chinese, which lacks verbal morphology, have difficulty producing inflectional cues even when exposed to such cues. These two studies provide support to the claim that early L1 experience with cues affects selective attention to L2 cues.

If overriding L1 cue preferences is difficult for adult learners, their exposure to an overuse of lexical cues in the classroom poses an additional obstacle to processing L2 morphological cues. It is well documented that one of the differences between classroom and naturalistic input consists of the overrepresentation of some linguistic features in the classroom and an underrepresentation of other linguistic features in the classroom (Santilli, 1996; Sanz, 1999; Schinke-Llano, 1986; VanPatten & Sanz, 1995). More recently, Goodall (2008) examined the use and availability of the Spanish progressive and reflexive verb forms in both naturalistic and classroom settings, and found that their use varies in different ways. In the case of the progressive form, its use in the classroom is overrepresented, while the reflexive is underrepresented in the classroom. Particularly relevant for this dissertation, Dracos (2009) compared the use of overt subject pronouns by native Spanish speaking instructors both inside

and outside the classroom setting, and found that they used more subject pronouns in the classroom context than when talking with other native Spanish speakers in an informal setting outside of the classroom. Considering that classroom learners are overexposed to lexical cues, and that studies including classroom learners who studied abroad did not discern between proficiency and immersion effects (Sagarra & Ellis, personal communication), it is important to tease apart these effects. That is, it must be considered whether classroom learners exposed to naturalistic input through an immersion experience can overcome the challenges of L1 transfer and previous exposure to the overuse of lexical cues in the classroom, and come to rely on morphological cues to assign temporal reference, as native speakers of Spanish do. To address this question, the eye-movement patterns of English-Spanish late bilinguals of equal proficiency with and without a study abroad experience are examined while processing sentences in Spanish containing lexical and morphological cues to determine how temporal reference is assigned.

Cognitive individual differences (working memory and inhibitory control) have been found to play a role in both L1 and L2 processing (L1 processing: Conway & Engle, 1994; Long & Prat, 2002; Engle, Cantor & Carullo, 1992; King & Just, 1991; Vos, Gunter, Schriefers, & Friederici, 2001; L2 processing: Bialystok, Martin, & Viswanathan, 2005; Harrington & Sawyer, 1992; Leeser, 2007; Mackey, Philp, Fujii, Egi, & Tatsumi, 2002; Miyake & Friedman, 1998; Payne & Whitney, 2002; Sagarra, 2007; Sagarra & Ellis, personal communication; Taguchi, 2008). An assumption of the Associative-Cognitive theory is that processing mechanisms are limited in capacity, and that when working memory capacity becomes full, either the incoming information is lost or cannot be processed. Furthermore, working memory capacity has been shown to constrain the L2 processing of redundant, non-salient, and low reliable cues in the

input (Sagarra, 2007), and it has been shown to affect L2 gains in a study abroad context (Sunderman & Kroll, 2009; Tokowicz, Michael, & Kroll, 2004). Concerning inhibitory control, Ellis argues that the ability to block or inhibit important information has implications on processing certain linguistic cues. Important for this research, an immersion experience has been found to affect inhibitory control in L2 learners and to weaken L1 influences (Levy, McVeigh, Marful, & Anderson, 2007; Linck, Kroll, & Sunderman, 2009). It is for the above reasons that these two individual differences are also taken into consideration in this work.

1.1 Background

This chapter provides a brief literature review on linguistic and experience-based factors that affect SLA (section 1.1.1), the effects of the L2 learning context on second language acquisition (SLA) (section 1.1.2), and the role of working memory and inhibitory control in SLA (section 1.1.3). Then follows a discussion of the motivation for the present investigation (section 1.2), along with the specific research questions and predictions. The significance of the study is presented in section 1.3. The chapter concludes with an overview of the dissertation (section 1.4) and the definitions of key terminology used throughout this work (section 1.5).

1.1.1 Linguistic and Experience-Based Factors Affecting SLA

Reliability, salience, and redundancy are linguistic factors that have been shown to affect SLA, as have experience based factors such as learned attention, blocking, and overshadowing. Reliability is the relationship between a cue and its ability to predict a certain outcome. Salience refers to a cue's specific strength, is subjective, and varies from person to person, and redundancy involves two (or more) cues that convey a similar meaning. Learned attention is a result of overshadowing and blocking, and can cause learners to avoid certain cues based on previous experiences. Overshadowing occurs when one cue is not viewed as a valuable

predictor of a certain outcome, and can lead to blocking, which is a long-term effect of overshadowing (Kruschke & Blair, 2000). This can be exacerbated by redundant, low salient, and low reliable items in the input. At early stages of acquisition for both L1 and L2 learners, the tendency is to focus on only one cue at a time and to choose cues based on their availability rather than their reliability (acquisition of artificial languages: Blackwell, 1995; MacWhinney & Bates, 1989; Matessa & Anderson, 2000; McDonald & MacWhinney, 1991; L1 acquisition: MacWhinney, Pléh, & Bates, 1985; L2 acquisition: VanPatten, 1996; 2004; Lee, 1999, 2002; Lee, Cadierno, Glass, & VanPatten, 1997). As most cues appear paired with other cues, learners need to determine which cues are most predictive for each circumstance. However, as language proficiency increases, so does the number of cues that will be attended to and processed, following selective attention preferences (Ellis, 2006c, d). Low salience and low reliability are two other factors that can constrain attention to these cues.

Verbal morphology that is accompanied by a temporal expression is redundant and low reliable because both the adverb and the morphology encode the same concept of time. For example, in the sentence 'Yesterday the boy played the piano', both the morphological ending -ed and the lexical item yesterday embrace the concept of pastness. Moreover, in some languages like English, frequent production of grammaticalized morphemes has resulted in a weakening of phonetic structures (Bybee, 2003; Jurafsky, Bell, Gregory, & Raymond, 2001; Zuraw, 2003; Slobin, 1974). Since some past tense verbal morphology is not orally salient (e.g., play and played are low salient in English), some verbal morphology can go unnoticed by L2 learners. Verbal morphology also has a low reliability when compared to temporal expressions because it tends to encode much more information than just pastness (e.g., person, mood, tense, and aspect), whereas temporal expressions only provide information about when an

action occurs. These characteristics decrease the chances that learners pay attention to the morphological cues of verbs.

In a laboratory study with a subset of Latin, Ellis (2007) investigated the short-term and long-term effects of early learned cues in adults from different L1 backgrounds. He found that the presence of highly salient and reliable cues, such as temporal adverbs, blocks or overshadows the processing of less salient and reliable cues, such as verbal tense morphology, regardless of their frequency. Studies examining learners in a real instructional setting, and not in a controlled training computerized environment, report similar findings. For example, in an eyetracking study, Sagarra & Ellis (personal communication) examined the cues monolingual Spanish speakers and beginning and intermediate level L2 Spanish learners use when processing redundant morphological and lexical items. They report that native Spanish speakers rely more on morphological than lexical cues, whereas the opposite applies to intermediate English-Spanish learners, and that beginning learners are not sensitive to the incongruency. Anglophone speakers' preference for temporal adverbs has also been reported in studies with adult learners of L2 Spanish, L2 Italian, and L2 French (offline: Bardovi-Harlig, 1992; Cadierno, Glass, Lee, & VanPatten, 1991; Lee, 1999; Lee et al., 1997; Musumeci, 1989; Rossomondo, 2003; VanPatten, 1996, 2002; online: Sagarra & Ellis, personal communication; Sagarra, 2007).

While the previous studies address the issue of how L2 learners from a morphologically poor first language process redundant morphological and lexical items in a morphologically rich second language, the studies presented next examine how native speakers of one language who are learning a morphologically similar L2 process morphological and lexical items, and can thus speak to transfer effects. Jiang (2004, 2007) asked Chinese speakers to read sentences word by word in L2 English that contained disagreement with the English plural morpheme 's', and found

that they were not sensitive to the disagreement. However, in a follow-up study with Russian-English and Japanese-English learners, Jiang et al. (2008) reported that the Japanese learners were not sensitive to the plural errors, but that the Russian speakers were. Taken together, the data of these studies suggest that L1 transfer affects cue preference. Similarly, Ellis (2007) and Ellis & Sagarra (submitted) investigated the short-term and long-term effects of early learned cues on instructional sequences. These studies also considered the L1 of the participants, and the results revealed that previous experience with L1 cues can block the use of later learned cues in the L2, and that these previous experiences can be long lasting.

Based on the recent evidence suggesting that both the L1 and L2 play a role (i.e., previous experience with an L1 and morphological congruency between L1 and L2), and that the classroom environment generally provides an overuse of lexical cues to L2 learners, it is important to examine whether a study abroad experience can alter the cues that L2 learners use when processing redundant morphological and lexical cues. Usage-based theories of language acquisition state that linguistic competence emerges from all of a learner's memories about all of the utterances that he/she has heard in his/her entire lifetime of using the language, and that repeated usage causes structures and forms to be learned. That is, exposure to the (L2) input affects how the language is learned and used, and the following section examines how exposure to naturalistic input in a study abroad setting affects L2 learning and development.

1.1.2 The Role of the L2 Learning Context

Most adults begin the task of learning the L2 in a classroom context, and only later decide whether or not to study abroad and immerse themselves in the L2 environment. A study abroad or immersion experience is defined as a period of time immersed in the L2 speech community, and research investigating the effects of study abroad on SLA has produced

conflicting results. For example, some studies indicate that learners who have studied abroad are faster at acquiring L2 pragmatics, sociolinguistic competence, cultural understanding, and fluency (Lafford, 1995, 2004; DeKeyser, 1986, 1991; Isabelli, 2001) than those who have not studied abroad. In contrast, study abroad learners perform equally-well or worse-than those who did not go abroad on their ability to accurately monitor and use certain grammatical forms (Lafford, 2006; Collentine, 2004; DeKeyser, 1986, 1990, 1991; Torres, 2003; cf. Isabelli & Nishida, 2005). However, these results were obtained using offline measures, and may not have been sensitive enough to capture the processing changes that occur while abroad.

Particularly relevant for the current research project, Lafford (2006) suggests a role for working memory in intermediate level learners' abilities to improve from a study abroad experience, and that lower span individuals may tend to focus on meaning over form, and thus "may neglect to work on acquiring redundant target language grammatical markers with less communicative value" (p. 17). Furthermore, she notes that those with any working memory capacity remaining will be able to process the input for both meaning and the redundant grammatical form, suggesting that only certain learners will benefit from an immersion experience, and that their ultimate success depends on their working memory capacity. Works by Sunderman & Kroll (2009) and Tokowicz, Michael, & Kroll (2004) have also found a relationship between higher working memory capacity individuals and gains from a study abroad experience. Regarding inhibitory control, Linck et al. (2009) found study abroad to affect inhibitory control in L2 learners and that an experience abroad could weaken L1 influences. Both working memory and inhibitory control are cognitive individual differences that have been related to the acquisition of L2 grammar in general, and are explained in more detail in the following section.

1.1.3 The Role of Cognitive Individual Differences (Working Memory and Inhibitory Control)

Working memory is the "temporary storage and manipulation of information that is assumed to be necessary for a wide range of complex cognitive activities" (Baddeley, 2003, p. 189) such as comprehension, learning, and reasoning (Baddeley & Hitch, 1974; Baddeley, 1986; Daneman & Carpenter, 1980; Miyake & Shah, 1999). Working memory has a limited capacity for processing that varies from person to person; however, performance is only affected when the resource demands of the task exceed the available supply (Just & Carpenter, 1992). Particularly important for the current dissertation is the finding that this limited capacity has been shown to play an important role in the L2 processing of redundant cues (Sagarra, 2007; Sagarra & Ellis, 2007), L2 reading comprehension (Abu-Rabia, 2003; Harrington & Sawyer, 1992; Geva & Ryan, 1993; Taguchi, 2008; Walter, 2004), L2 production (Payne & Whitney, 2002), L2 processing (Havik, Roberts, van Hout, Schreuder, & Haverkort, 2009; Leeser, 2007), L2 development (Ellis & Sinclair, 1996; Sagarra, 2008), L2 noticing (Mackey, Philp, Fujii, Egi, & Tatsumi, 2002), and L2 lexical access (Kroll, Michael, Tokowicz, & Dufour, 2002; Michael & Gollan, 2005) (but see Juffs, 2004, and Sagarra, 2000, for lack of correlation between working memory and L2 comprehension and L2 grammatical knowledge, respectively). The current study investigates whether working memory constrains learners' attention to lexical and/or morphological cues in the input. This is important because it may explain why some cues in the input are processed and others are not. Furthermore, a high working memory capacity may also allow for more cues to be added to the learners' repertoire sooner than it would be added to that of learners with a lower working memory capacity.

Because working memory capacity is limited, some elements of the input will be processed while others will be blocked. Inhibitory control has been defined as the mechanism

responsible for determining what will and will not enter into working memory (Rosen & Engle, 1998; Engle, Conway, Tuholski, & Shisler, 1995). Inhibitory control is the ability to maintain and process task pertinent information while suppressing extraneous information. Individual differences in inhibitory control in adult monolinguals have been proposed to explain variation in memory failures, working memory span, reading comprehension, problem solving, and general cognitive ability (Friedman & Miyake, 2004). Bialystok, Martin, & Viswanathan (2005) found that early bilinguals are better able to control their attention when misleading information is presented, even in the face of an incorrect but compelling alternative, and Michael & Gollan (2005) concluded that working memory and suppression (i.e., inhibition) are important factors in L2 processing. Ellis (2006d, 2007) suggests that the ability to inhibit or block linguistic input may play a role in what gets processed and the final level of L2 attainment, and Linck et al. (2009) found that the L1 is inhibited while L2 learners are abroad, and remains so even upon returning from an immersion experience. The variable of inhibitory control was included to examine its possible impact on the learners' ability in noticing redundant, low salient, and low reliable morphological cues paired with lexical cues upon returning from an experience abroad. The ability to inhibit the L1 or certain cues from processing may prove beneficial to the language learning process, and may ultimately make limitless the number of cues that L2 learners could add to their linguistic repertoire.

1.1.4 Summary

The literature discussed above suggests the following: (1) earlier learned cues can block the acquisition of later learned cues; (2) L2 learners from a morphologically poor L1 rely on lexical cues before morphological ones, unlike native speakers of a morphologically more complex language; (3) preference for lexical cues is intensified by the overuse of these cues in

the classroom, (4) an immersion experience has limited effects on improving grammatical accuracy in adult L2 learners; and (5) working memory capacity and inhibitory control facilitate the processing of L2 morphological cues in classroom learners with and without an immersion experience.

1.2 The Current Study

Heeding the extensive evidence suggesting that classroom learners prefer lexical over morphological cues (Jiang, 2004; Jiang et al., 2008; Lee, 1999, 2002; Leeser, 2004; Musumeci, 1989; Rossomondo, 2003; Sagarra & Ellis, personal communication; Sagarra, 2007), that L1 transfer causes them to prefer these cues (Jiang, 2004; Jiang 2007; Jiang et al., 2008; Ellis, 2007; Ellis & Sagarra, submitted), and that L2 learners receive an abundance of these cues in the classroom (Santilli, 1996; Goodall, 2008; Dracos, 2009), is it is important to determine whether L2 learners can rise above theses challenges and can change their processing behaviors to look like those of monolingual native speakers, if they are exposed to naturalistic input via an immersion setting. Past research has also shown cognitive individual differences to be factors that affect how redundant cues in the input are processed (Sagarra, 2007), as well as how L2 processing is affected in learners who have participated in an immersion experience (Linck et al., 2009; Levy et al., 2007; Sunderman & Kroll, 2009), and are included for investigation here as well. These three factors, two of which are fixed (i.e., working memory and inhibitory control), and one which is not (study abroad experience), are examined to determine which of these can assist learners in overcoming these problems.

The specific research questions addressed in this dissertation are as follows:

1. Do L1 English classroom learners learning L2 Spanish show a more native-like behavior and rely on morphological cues to assign temporal reference within a sentence after an immersion experience than those without an immersion experience, when both groups of learners are of the same proficiency level?

2. Does working memory play a role in determining what items in the input get processed? Do higher working memory capacity learners process these items differently from otherwise comparable low working memory capacity learners? Do learners with a higher working memory capacity benefit more from an immersion experience when compared with low working memory capacity counterparts?

3. Does inhibitory control play any role in what gets noticed in the input? Does the ability to better inhibit irrelevant or additional cues lead to a worse ability to process and incorporate them?

The predictions for these research questions are the following. First, L2 Spanish classroom learners with immersion experience will use morphological cues to resolve adverb-verb incongruencies (native-like behavior), whereas intermediate classroom learners without immersion experience will use lexical cues to resolve the incongruencies. This prediction follows from the research conducted in a laboratory setting with a miniature language (a subset of Latin) (Ellis, 2007) and classroom settings with native speakers of a language that lacks a morphological aspect learning a language that has the feature (English-Spanish learners processing Spanish verb tense morphology: Sagarra, 2007; Sagarra & Ellis, personal communication; Chinese-English and Japanese-English learners processing English subject-verb agreement: Jiang, 2007; Jiang et al., 2008). The second prediction is that working memory capacity will play a role in determining what gets processed: higher span learners will be better at processing redundant, low salient, and low reliable morphological cues than their lower working memory capacity counterparts, regardless of whether or not they have studied abroad. This is based on the findings that working memory plays a role in L2 morphological processing (Havik, Roberts, van Hout, Schreuder, & Haverkort, 2009; Leeser, 2007; Sagarra, 2007). The third prediction is that better inhibitors will be able to process multiple cues, and therefore will have no difficulty in acquiring both the lexical and morphological cue. However, this will only hold true for those learners who have had an immersion experience. This prediction is based on the

findings of Levy, McVeigh, Marful, & Anderson (2007) and Linck, Kroll, & Sunderman (2009) that the L1 is able to be suppressed during an immersion experience, and that these effects are durable.

To tackle these issues, Anglophone learners of Spanish with and without an immersion experience read sentences in a computer with adverb-verb incongruencies and answered a comprehension question after each sentence while their eye movements were recorded. All of the L2 learners in the study abroad group were immersed in the L2 environment for 16 weeks and answered a set of questions concerning their L1 and L2 usage while abroad (so as to determine the quantity and quality of the L2 input they received). In addition, they completed a reading span test in their L1 to measure their working memory capacity and another test to asses their inhibitory control. Finally, to ensure that the two groups were comparable in terms of L2 processing and proficiency, they completed a language background questionnaire and two measures of proficiency: one subjective (i.e., self-ratings) and three objective (i.e., proficiency test and verb and tense recognition tests). In addition, processing speed at N-1 (word immediately preceding the error) and accuracy on the filler comprehension questions for both groups were examined.

1.3 Significance of the Study

The results of this dissertation will add to the literature concerning L2 processing strategies for low reliable and redundant lexical and morphological cues in the input, and whether study abroad is an adequate intervention to alter these processing strategies. L2 cue processing is important to consider because the use of only one cue can delay processing. For example, it is more frequent in Spanish to hear *dos hamburguesas* 'two hamburgers' and *yo como* 'I eat' than *hamburguesas dos* and *como yo*. If only the lexical cue is used, processing is

interrupted because of the time it takes to regress to back to the lexical cue, when a perfectly acceptable cue is available in the morphology that would not require a regression or a delay to processing. If the findings reveal that an immersion experience can change L2 processing strategies, this would support the usage-based/experience-based models, suggesting that L1 transfer effects and exposure to the overuse of these cues in the classroom can be overcome by being in contact with more natural input in the L2 environment. The findings will also advance our understanding of the effects of a study abroad context on cue preference in adult L2 classroom learners. While some past research has suggested that an immersion experience does not necessarily lead to gains in grammatical accuracy, it may be that the tools and tests used to measure these gains were not sensitive enough to see the changes that occur in these particular learners. Furthermore, it may show that the quality of the L2 received while abroad may help the learners to change their processing behaviors and to overcome their reliance on adverbs and to thus more closely approximate the monolingual norms. That is, the input immersed learners receive while abroad is more natural (and contains more morphological cues and less lexical ones), and is what classroom learners lack. This research will also contribute to the literature on the Associative-Cognitive theory, and more specifically the role of early learned cues and blocking within this theory. As this model specifically theorizes about the role of inhibitory control, this dissertation will be a starting point to answer the question of whether differences in inhibitory control play a role in processing redundant, low salience, and low reliable morphological cues. Regarding working memory, this dissertation's findings will help to explain why certain items in the input are processed, while others go essentially unnoticed. Moreover, working memory capacity is important because it can partially explain why some learners who go abroad benefit immensely from the experience, while other learners seem to

obtain minimal gains. The findings of this research will also contribute to L2 instructional practices in that it may advocate study abroad for assisting L2 learners in altering their processing strategies. The issues that this dissertation investigates are important for SLA researchers and theorists, as well as to practitioners and pedagogues. The former benefit from understanding better the theories under investigation and their relevance, while the latter benefit from understanding the processes that L2 learners use, which allows them to develop materials that aid learners in overcoming their processing preferences.

1.4 Overview of the Dissertation

This chapter has served as an introduction to the dissertation, laying out the relevant theories, problems that still exist, its motivation and importance. It has also provided an overview of the current study and the specific research questions and hypothesis. The second chapter reviews the relevant literature on the Associative-Cognitive theory (Ellis, 2006a, b, d), with a specific emphasis on the role of linguistic and experience-based factors within the theory that speak to their effects on SLA. Furthermore, it reviews the role of the L2 learning context (classroom and immersion) in SLA, and relates the relevant literature on cognitive individual differences (working memory and inhibitory control) and their effect on L2 processing. Chapter three details the methods, subjects, materials, experimental design, procedures, scoring, and analysis of the data, while the fourth chapter presents the results of each experiment. Finally, the fifth chapter discusses the findings and methodological implications of this research, as well as its limitations and directions for future research.

1.5 Key Terminology

This study makes reference to a vast array of terms commonly used in psycholinguistics and second language acquisition.

Blocking: An effect of learned attention; the learning of a certain stimulus as associated with a particular outcome, and subsequent learning of a new stimulus associated with the same outcome as the previous stimulus, resulting in the newer stimulus' difficulty in being learned (or its being "blocked" from being learned).

Cue reliability/validity: The relationship between a cue and an outcome; the reliability of a cue to correctly predict a specific outcome.

Cue salience: A cues perceived strength, and can vary from person to person, as it is subjective.

Inhibitory control: The ability to suppress irrelevant information while processing task-relevant information.

Input: Comprehensible, meaning-bearing language that the learner hears or reads. It refers to ambient speech and apperceived/noticed input.

L1 experience: The information about and experiences with the first language with which the learners enters the task of learning the L2.

Learned attention: The shifting of a learner's attention to certain aspects of the linguistic input as a result of language experience.

Overshadowing: Causes blocking to occur; a case where two cues presented together jointly predict an outcome, yet the more salient cue becomes associated with the outcome, while the less salient cue entices little or no reaction on its own, thus being overshadowed by the more salient cue.

Second language acquisition: In the present study, this term will refer to both classroom and non-classroom learning of a second/foreign language. Thus, Krashen's distinction between acquisition (unconscious) and learning (conscious) is not taken into consideration and neither is the classical difference between L2 (learned in naturalistic settings) and foreign language (learned via formal instruction).

Working memory: "The temporary storage and manipulation of information that is assumed to be necessary for a wide range of complex cognitive activities" (Baddeley, 2003, p. 189).

Working memory capacity: "The maximum amount of activation available in WM to support either storage or processing" (Just & Carpenter, 1992, p. 123). Whenever such capacity becomes insufficient to support the level of activation necessary to perform a specific task, processing slows down and/or storage will decrease.

CHAPTER 2: Review of Literature

2.0 Introduction

This chapter will delve into the literature introduced in chapter one, and will begin with a description of the Associative-Cognitive theory (section 2.1), followed by a presentation of studies about L2 processing and production of lexical and morphological cues to assign temporal reference (section 2.2). Next, studies on the effects of the L2 learning context (i.e., classroom and study abroad) are discussed (section 2.3). Then, background on the cognitive individual differences of working memory and inhibitory control is presented (section 2.4). The chapter ends with a discussion of all the literature presented in the chapter, highlighting some of the shortcomings of past research and addressing what the current dissertation attempts to resolve (section 2.5).

2.1 The Associative-Cognitive Theory and Associative Learning

2.1.1 Overview

As mentioned in chapter 1, this dissertation adopts a usage-based approach to language acquisition that stems from the idea that languages are learned much like anything else, and that both associative and cognitive laws govern acquisition (e.g. Ellis' Associative-Cognitive, 2006a). Through experience, learners' perceptual systems are tuned, based on their probabilities to appear in the input, illustrating that constructions are learned by active engagement in communication. Usage-based theories of language acquisition claim that creative linguistic competence emerges from all of a learner's memories about all of the utterances that he/she has heard in his/her entire lifetime of using the language, and that repeated usage causes structures and forms to be learned. Unconscious processes weigh the odds when a sensation becomes associated with more than one reality, and the most probable

thing is what gets perceived. High frequency items are processed more readily than low frequency ones, lending support to the idea that associative learning comes from usage.

According to this theory, SLA is construction-based, rational, exemplar-driven, emergent, and dialectic. First, SLA is construction-based because the learner's perceptual system becomes tuned to expect certain constructions based on the probability of their appearance in the input. Furthermore, each time a new sequence in the input is detected, it activates the detector that then increases its resting level, and once the resting level reaches a certain threshold, the new resting level is increased, requiring less activation from the environment to raise the resting level the next time that sequence or feature occurs. The relationship between frequency of usage and activation threshold is curvilinear, and follows a power law of practice in which the effects of practice are greatest at the beginning stages of learning and eventually reach asymptote.

Second, SLA is rational in that the learners' mental models are optimally organized given their past experiences with the language. Based on the context in which language users find themselves, the unconscious language system is able to predict subsequent linguistic constructions which will be relevant for comprehension and production. Thus, both L1 and L2 learning are based on intuitive statistical learning that must consider probabilities of occurrences, and frequency, recency, and context of constructions must also be considered. Third, SLA is exemplar-driven because a form or construction that is frequent in the input can serve as a frame or schemata for other forms, and thus emerges a default case. Language users implicitly count linguistic features, and this accounts for them being able to understand and process unfamiliar linguistic items that appear in the input, irregardless of the fact that most

language use is formulaic. The theory of associative learning suggests that the more a cue is associated with an outcome, the more readily it is learned.

Fourth, SLA is emergent because the interaction between learners and problems, and every emergent level of language use, involves interaction with the levels below it that are known, and above it that are not. This means that the neural apparatus for L2 learners comes pre-tuned and committed to the L1, and these later experiences with the L2 are perceived through previous memories. Finally, SLA is seen as dialectic because the learners are involved in a conscious tension between their current interlanguage production and the feedback that they receive, be it linguistic, pragmatic, or metalinguistic. This explicit conscious processing creates a tension that allows for a type of socially scaffolded development that is free from L1 forces.

These components of the Associative Cognitive theory speak to both linguistic and experience based factors that affect SLA. Linguistic factors include reliability, salience, and redundancy, whereas experience based factors result from previous experiences with both the L1 and L2, may also involve reliability, salience, and redundancy, and are drawn from theories on associative learning. Experience based factors also consider the effects of learned attention, overshadowing, and blocking. The next two sections will examine more closely these factors, the components that comprise them, and how they can interact and affect SLA.

2.1.2 Linguistic Factors Affecting SLA

The Associative-Cognitive theory lists three linguistic factors that affect the acquisition of L2 cues: reliability (the power of a cue to predict a certain outcome), salience (how marked a cue is) and redundancy (the amount of similarity between two cues). Cue reliability and cue salience are subjective, and vary between individuals. When using cues in L2 learning, beginning language learners generally focus on only one cue at a time. Moreover, they tend to use the

most available and reliable cues to aid in comprehending the L2 input (MacWhinney et al, 1985; MacWhinney & Bates, 1989; Matessa & Anderson, 2000). This can be problematic for learners, especially when a less reliable but more available cue is chosen over a more reliable but less available one. However, as proficiency increases because of more experience with the L2, and one cue has been acquired, another cue can be added to their repertoire, and so the process continues and aids in reducing comprehension errors. The reliability of cues has implications for how learners use and rely on the other two linguistic factors. Low salience cues may remain unnoticed, especially when other, more obvious cues make due for everyday survival, therefore causing fossilization to occur.

The salience of a certain cue can have important implications for how an L2 is learned. In fast and informal speech, frequent morphemes become more phonologically fused with surrounding material because of lenition processes. Fluent language processors can perceive these changes and can process them because their language knowledge receives top-down support whereas learners lack this knowledge, thus causing difficulties. As Ellis (2006b) argues, associative learning can explain why certain factors, regardless of their frequency, recency, and context, are failed to be adopted and used by L2 learners. These reasons include cues being unreliable predictors of an outcome, of low importance or relevance for the overall comprehension of the message, or low salience.

The redundancy of a cue can also affect SLA, and to date, it has been the most investigated of these three linguistic factors. When a cue is redundant, another cue in the input contains similar information. In early stages of SLA, the learner may not have enough cognitive resources and knowledge of the L2 to use both cues, and therefore may only select one. These three linguistic factors of redundancy, reliably, and salience are all related to a certain degree,

and any combination of these cues can change their usefulness to L2 learners. The salience of a cue can cause it to remain unnoticed, especially if two cues in the input are redundant, and one of them is more salient than the other. Moreover, it is possible that a cue is both salient and redundant, which would cause that cue to be used over a more reliable but less salient cue. There are also other reasons why some cues may be selected over other ones, and include redundant cues being overshadowed and blocked by more salient or reliable cues or by previous experiences with previously selected cues, and/or ignored because of the way in which learners selectively attend to their processing of language due to a multitude of form-meaning contingencies. These options are discussed in the following section.

2.1.3 Experience-Based Factors Affecting SLA

Reliability, salience, and redundancy are not only linguistic factors that affect SLA, but are also related to experience based factors that can also affect L2 learning. The Associative-Cognitive theory (Ellis, 2006a) draws some of its ideas from the theory of associative learning, which suggests that past experiences reinforce one another. According to this theory, learners must acquire the relationship between a certain cue in the input and an outcome, where the cue is the only obvious causal feature present. Salience, reliability, redundancy, overshadowing, blocking, and learned attention also all have prominent roles, and can make the process of cue selection more difficult. Overshadowing is defined as one cue that is more salient than another cue, with the more salient one being associated with the outcome, while the less salient cue goes relatively unnoticed. Blocking, which is caused by overshadowing, causes learning difficulty of a new cue that predicts the same outcome because of a previous cue's association with that outcome, and is a learned inattention to certain items. However, this learned inattention can be longstanding in that once a cue has been blocked, subsequent learning of that cue is more

difficult (Kruschke & Blair, 2000). Learned attention results from overshadowing, blocking, and other effects of transfer and inhibition that cause a learner's attention to shift based on previous language experiences.

When only one readily identifiable cue is present in the input and it faithfully predicts an outcome, the task of learning the cue and its outcome is fairly easy. However, it is rarely the case that only one cue is present, and thus, learners are charged with the task of determining which of the multiple co-occurring cues truly predicts the outcome. Hence, the presence or absence and status (i.e., reliability, saliency, redundancy) of the cues determine which cues will be selected and associated with a specific outcome, all of which can be based on previous experiences. Previous experiences, including already having a complete linguistic system in place and starting with a blank slate, can affect the cues learners use when they begin to learn the L2. Research suggests that when L2 learners begin learning the L2, their L2 cue settings closely match the L1 settings, and eventually change to match those of the L2 (Ellis, 2006c; Bardovi-Harlig, 1992; Parodi, Schwartz, & Clahsen, 2004; Bordag & Pechmann, 2007). This previous experience with the L1 can either facilitate or hinder L2 processing, depending on the specific features of the language. Past research shows that facilitation occurs when the L1 and L2 are similar, and interference arises when the L2 structure is different from that of the L1, or the L2 structure is unique (i.e., absent in the L1) (Costa, Kovačić, Fedorenko, & Caramazza, 2003; Costa, Kovačić, Franck, & Caramazza, 2003; Ellis, 2005; Sato & Felser, 2006, 2008; Tokowicz & MacWhinney, 2005).

As noted above, the relationship between linguistic and experience based factors is not independent. Rather, the two interact and each plays off of the other. For example, a cue's salience is determined by L1 experience, transfer, blocking, and learned selective attention.

Additionally, when an item in the input is redundant, the learner may not deem it necessary to process one of the pieces of the redundant information because of past L1 experiences that block redundant cues.

2.1.4 Summary

This section has reviewed the central tenets of the Associative-Cognitive theory and associative learning, with a specific focus on how usage-based models explain the processes involved in learning an L2. The evidence presented reveals that both linguistic and experience based factors affect how cues are learned and used by L2 learners. The next section presents empirical studies that specifically examine how learners process and produce redundant lexical and morphological cues when assigning temporal reference in the L2.

2.2 Studies on the Use of Lexical and Morphological Cues to Assign L2 Temporal Reference

Temporal reference is an ideal linguistic feature to investigate the role of overshadowing and blocking on adult SLA because it is often indicated by means of both morphological cues (verbs) and lexical cues (adverbs, prepositional phrases, serialization, and calendric reference). In this section, L2 studies on the use of lexical and morphological cues to assign temporal reference are described. While some of the studies belong to other theoretical frameworks, they are included in this section because their findings provide further support for the Associative-Cognitive theory's claim that early learned cues affect the learning of later learned cues. The studies are divided into laboratory learning studies (section 2.2.1) and classroom learning studies (section 2.2.2).

2.2.1 Laboratory Learning Studies

Laboratory learning studies refer to studies in which participants are trained in a miniature language or subset of a language, and the quantity and quality of the language to

which they are exposed is controlled by the researcher or through computer presentation. Ellis (2007) and Ellis & Sagarra (submitted) examined the short-term and long-term effects of learned selective attention in native speakers of different languages (English, Chinese, Korean, Russian) learning temporal reference in Latin. The goal of the first experiment was to explore short-term effects of language experience. In this experiment, the participants were divided into three groups. The adverb pre-training group was exposed to either a present or past Latin temporal adverb 36 times, whereas the verb pre-training group saw one Latin verb either in the present or past tense 36 times. Both groups had to match the words to their correct English translation and received feedback. A control group had no pre-training session. After the pre-training phase, participants completed three more testing tasks. For the first task, they read 36 sentences containing adverb-verb word order and verb-adverb, which also included a future adverb and future tense verb, along with past and present verbs and adverbs, and identified whether the action occurred in the past, present or future. The participants in all three groups received feedback for their responses. For the second task, they rated on a scale of 1 to 5 whether the sentences they saw were in the past (scale rating of 1), present (scale rating of 3), or future (scale rating of 5). For this task, they received no feedback. For the last task, they translated a sentence from English to Latin, and received no feedback on their responses. The results revealed that the adverb pre-training participants continued to rely on those cues and did not use the other cues, whereas the verb pre-training participants continued to use those cues and to ignore the others. However, the results for the control group reveal that they attended to both cues equally. The authors interpreted these data as evidence that early experience with adverbial cues causes L2 learners to use those cues and to block the morphological ones, and that early experience with verbal morphology blocks them from

learning and using the lexical cues. The second experiment explored the long-term effects of language experience by replicating the previous experiment save the pre-training phase with Chinese speakers only. The findings show that Chinese learners of Latin showed a bias for adverbial cues and blocking of morphological cues, suggesting that previous experiences with the L1 can have long lasting effects on SLA. The L2 learners' use of adverbs instead of morphology may block or delay their later use of morphology to express the same concept, thus being able to account for their "Basic Variety" of the L2 which lacks verbal morphology.

The findings of these two laboratory learning studies show that reliance on L2 cues is modulated by previous L1 experience. Because a one-shot training task in a controlled laboratory setting excludes many cues and factors that form part of real language learning, it is important to examine whether these results also apply to classroom learning settings. Furthermore, for many of their participants, the language being learned was a third language (L3), and it is unclear the role of the L2 on L3 processing.

2.2.2 Classroom Learning Studies

Most L2 studies on the use of lexical and morphological cues to assign temporal reference focus on native speakers of English, a language with poor verbal morphology, learning L2 Spanish, Italian or French, all morphologically rich languages, and only a few examine the effects of L1 experience by comparing native speakers of morphologically poor and rich L1s learning a morphologically rich L2. The studies also differ in input mode (oral or written), input type (sentences or passages), immersion experiences, and testing task (offline or online).

Numerous offline studies have examined how L2 learner's process oral input that contains both lexical and morphological cues. Musumeci (1989) studied the role of lexical and morphological information when assigning tense by L2 learners of French, Italian and Spanish.

The participants had the task of deciding whether the sentence they heard pertained to the present, past, or future, and the groups varied in terms of whether or not the phrase they heard contained a temporal adverb accompanied by the verbal morphology, a phrase without the lexical adverb but accompanied by a physical gesture to indicate time, phrases with adverbial cues and physical gestures accompanied by the verbal morphology, or sentences with the verbal morphology the only marker of time. The results revealed that the groups that received the lexical item performed significantly better at determining when the action occurred than the other groups, suggesting that learners prefer to process lexical cues before morphological ones, at least when processing and comprehending a message.

Similarly, Lee, Glass, Cadierno & VanPatten (1997) examined the grammatical and lexical cues used by L2 learners of different proficiency levels. The learners consisted of L1 English first, third, and fifth semester learners of Spanish, and they were required to listen to one of two versions of a passage, with the only difference between the two versions being the use of temporal adverbs. The verbs consisted of regular preterite verbs in the third person singular. After hearing the passage, the learners performed a free-recall task which was later scored for all of the correct past-temporal references. The results revealed language experience (i.e., level) was a significant factor that predicted performance, with the third and fifth semester Spanish learners outperforming the first semester ones. When adverbs were present in the passage the learners heard, the amount of past-temporal references was significantly higher in the recall task than when they were absent in the passage, suggesting that temporal adverbs are important for obtaining meaning for L2 learners at these levels.

The above researchers examined how these lexical and morphological cues are processed by learners only in the oral mode. However, past research has shown the task

modality to be important, with L2 learners performing better on written tasks than oral ones (Montrul, Foote, & Perpiñán, 2008; Wong, 2001). To address this issue, Leeser (2004) examined whether mode, topic familiarity, or pausing affect L2 comprehension of a previously unseen form, the Spanish future tense. Working with L2 learners of Spanish from a beginning level Spanish class, the groups varied in terms of the passages they received (familiarity or not with the topic) and the mode in which they received the material (oral or written). Furthermore, half of the group that heard the passage received three second pauses after each sentence. To assess comprehension, the participants performed a free-recall task and answered multiple-choice questions about the texts. While the results revealed that the learners comprehended more of the passages in the familiar topic group and in the unfamiliar topic with pauses group, the processing of future tense morphology was not facilitated. Future tense morphology processing was positively affected only in the written mode. These findings, taken with those of other researchers investigating the effects of task modality on SLA, reveal that L2 learners perform better in the written mode. More importantly for the discussion here, it appears that the processing of the future tense morphology was not necessary due to the presence of future discourse markers, again suggesting that L2 learners prefer to process lexical items before morphological ones when reading for meaning.

The previously reviewed studies cannot talk about the role of cue transfer in either the oral mode, whereas Liu, Bates, & Li (1992) can. They investigated the transfer of cues from the L1 and L2, and vice versa, with Chinese-English and English-Chinese bilinguals of varying proficiency levels in the oral mode. The participants heard sentences and were asked to determine which object carried out the action. These researchers found both forward and backward transfer that could be attributed to age of acquisition, with transfer of sentence

processing being found for both the early and late bilinguals. However, the childhood bilinguals showed differentiation strategies and appeared more like monolinguals in each language, whereas the infant and adolescent bilinguals showed backwards transfer using English strategies in both languages. More importantly, they argue that L2 performance is based on the competition between the two languages, with each cue having different strengths over the lifespan of learning the L2.

As noted above, Leeser (2004) examined whether the mode in which the input was received affected how L2 learners attended to morphological and lexical cues in the input. However, the studies that follow differ from that work as they review offline processing with written input that employed think-aloud protocols, free recall, comprehension questions, and cloze tasks. Bardovi-Harlig (1992) investigated the ways that beginning L2 learners express temporality, and how it changes as verbal morphology develops. The data obtained for analysis came from written narratives from journal entries or other class assignments from L2 learners who were immersed in the L2 environment and were taking beginner level English language classes. The narratives were examined for instances of temporal adverbs and past tense morphology, and an analysis of them revealed that as verbal morphology became more systematic and reliable, dependency on time adverbials decreased. These results suggest that proficiency level is important for using morphological and lexical cues, a conclusion that Lee et al. (1997) also make.

Using passages similar to those used in Lee et al. (1997), Lee (1999) used think-aloud protocols to determine if L2 learners make mention of the temporal adverbs. The participants were second and fourth semester learners of Spanish, and half of the participants read a passage that included temporal adverbs, while the other half read the passage without them. A

week later, they were asked to re-read the passage and perform the think-aloud task. All of the participants in the group that received the adverb passage made mention of the adverbs, although some did so sporadically whereas for others it was a common feature of their think-aloud verbalizations. However, in the group that did not receive the adverb passage, they either relied on their background knowledge to form a temporal timeframe or the verb forms. These results suggest that L2 learners can use the L2 morphology, but that they rely more on the temporal adverb to obtain meaning if it is present.

Lee (2002) investigated the incidental acquisition, or acquisition without explicit instruction, of Spanish future tense morphology while reading in the L2. The participants were enrolled in either a second semester Spanish course or a review course of first semester Spanish, and had no previous knowledge of the future tense and how it was formed. In order to examine the learners' reading comprehension and processing of future tense morphology, three passages were read by the participants with the groups varying in the amount of future tense verbs and number of temporal adverbs (at the beginning of each paragraph) appearing in each passage. The participants performed a written free-recall task and answered multiple choice questions to measure comprehension, and half of the learners performed a production task while the other half performed a recognition task of the target form. These tests occurred immediately after reading, two weeks later, and one month later. The results showed that the most important aspect affecting comprehension was the frequency with which the verb appeared. With regard to the adverb being a cue to meaning, the effects of the adverbs decreased with time. However, this limited effect may be because of their decreased frequency in these texts. This finding thus suggests that L2 learners with no knowledge of the target form can use verbal morphology as a cue to comprehending a written passage.

Rossomondo (2003), who also examined incidental acquisition of a form, explained Lee's (2002) findings differently, arguing that they were owed to a lack of temporal adverbs appearing in the passages. In order to test this, she examined the incidental acquisition of the future tense with first semester learners of Spanish. Two texts were created, with each containing 13 target items, but varying in whether or not a title for the text appeared and also whether or not each target item was accompanied by a temporal adverb. The participants, who had no previous knowledge of the target form, read the passage silently and also performed a think-aloud protocol. Using multiple-choice and cloze passage tasks to measure the effects of temporal adverbs on comprehension and input processing, the results revealed that temporal adverbs assist L2 learners in comprehending the passage and that they do not hinder the learners' input processing strategies when either reading silently or when performing the think-aloud protocol.

Like the above two studies, Han & Peverly (2007) also investigated the incidental acquisition of a form, and examined the approach true L2 beginners use when processing L2 input for the very first time: meaning-based or form-based, with the former referring to learners selectively relying on meaningful forms when processing input, and the latter to forms that are both meaningful and non-meaningful, regardless of redundancy. To examine this issue, 12 graduate students, all of whom were familiar with at least two other languages, but had no knowledge of Norwegian, were divided into two groups: sequential versus simultaneous. The sequential group read a passage twice, non-consecutively, and were given one task to complete after each reading, whereas the simultaneous group read the passage twice, consecutively, and were given two tasks to complete. The passage, written in Norwegian, was taken from a beginner level textbook of Norwegian as a second language. To measure input processing, the learners participated in a written free-recall protocol and a fill-in-the-blank activity to measure

comprehension and recognition of the forms, respectively. The results of these tasks revealed that the learners adopted a form-based approach, even when the task had oriented them to attend to meaning. As the input contained no extralinguistic cues to aid the learners in contextualizing the input, and the learners had no previous knowledge of the language, they were forced to rely on bottom-up processing and to use a form-based approach. These researchers also found that directing the participants' attention to either the form or meaning did not affect how they processed the input. These results suggest that the meaning-based default strategy for processing L2 input predicted by VanPatten (1996, 2002, 2004) may not hold true.

The above studies all used offline techniques to measure how L2 learners process or acquire morphological and lexical cues. However, offline techniques such as a think-aloud protocol or a fill in the blank task are very explicit, may not speak to implicit processing, and may also bias the results. Online techniques, however, capture processing as it unfolds, and can provide reaction times for the structures under investigation.

Sagarra (2007) used a self-paced moving window paradigm as an online measure to capture L2 processing in sentences that contained temporal adverbs and verbal morphology that were redundant. She specifically studied whether third semester L2 learners were able to process redundant verbal morphology. The participants were all native English speakers and were learning Spanish as an L2 in the university setting. The stimuli contained either a temporal adverb-verb tense congruent or incongruent condition, and each sentence was followed by a comprehension question to ensure that the participants were reading and understanding the sentences. The temporal adverb denoting the past always appeared in the first position of the sentence, and the verb was in the fourth position and alternated between the present and

simple past tense. The results revealed that the differences on the mean reading times on the verbs in either the present or simple past were not significant, suggesting that these L2 learners were not sensitive to the adverb-verb incongruency, and thus do not process redundant grammatical forms.

Jiang (2004), also using the moving window paradigm as an online technique, examined whether L1 Chinese advanced ESL learners and monolingual English speakers were sensitive to the plural morpheme and broken agreement as shown by reading times in the self-paced reading task and a written subject-verb agreement task. The participants read sentences which varied in terms of number agreement and disagreement, and in all cases the monolingual English speakers were sensitive to the disagreement. However, for the L2 English groups, the results revealed no significant difference for their reading times for either of the conditions, but that their performance on the written portion showed they had formal knowledge about these structures. The author suggests that these L2 learners were not sensitive to number disagreement, and that morphological knowledge is not automatically activated in reading comprehension.

Using the same moving window paradigm, Jiang (2007) examined whether L1 Chinese speakers of L2 English were sensitive to English sentences containing errors in plural –s and verb subcategorization as an attempt to probe the development of integrated knowledge. The participants in this experiment read sentences containing sentences with half containing plural nouns and the other half relating to verb subcategorization. They read the sentences for comprehension in a self-paced reading task as quickly as possible, and their results were compared with those of 26 native English speakers. The results for the native English speakers revealed sensitivity to all of the errors, whereas the L2 English learners were only sensitive to

errors involving verb subcategorization and not to those involving the plural –s. He again argues that these results suggest that the integration of L2 knowledge is selective, and that certain linguistic items are readily available in language processing whereas others are not.

Although Liu et al. (1991) discussed the role of cue transfer, their conclusions were based on results from an offline study. Jiang et al. (2008), however, used the online technique involving the moving window paradigm to examine transfer when processing both morphological and lexical cues. They tested the morphological congruency hypothesis by comparing L1 Russian and L1 Japanese advanced learners of English performance on recognizing errors in plural markers in a self-paced reading task. These language pairs were chosen because English and Russian are morphologically congruent in plural marking, such that the plural morpheme exists in both languages, and Japanese and English are morphologically incongruent, as the morpheme does not exist in Japanese but does in English. The results based on the reading times of the target regions revealed that Japanese ESL speakers showed no sensitivity to the plural errors, but that the Russian ESL learners did. They argue that these results suggest sensitivity to plural errors is L1-specific, and not a universal default, thus supporting the morphological congruency hypothesis. However, the past language learning experiences and proficiency level of these learners was not controlled for, and all of these learners were living immersed in the L2 environment. The combination of these factors may be affecting these results.

Likewise, Sato & Felser (2006, 2008) investigated whether L2 learners of English from different language backgrounds (Chinese, German, and Japanese) were sensitive to subject-verb number agreement and case errors in online L2 processing. Their knowledge of these structures was assessed via an online speeded grammaticality judgment task and also by an offline

sentence completion task. The performance of the 20 participants from each language on these tasks was compared with that of 28 monolingual English speakers. The L2 learners completed a general proficiency test, placing them within the intermediate to advanced range, and they also completed a vocabulary test to ensure their knowledge of the verbs and adverbs used in the experimental stimuli. All of the L2 participants had lived abroad, with a mean length of residence of 2.1 years for the Germans, 2.3 years for the Japanese, and 1 year for the Chinese learners. The experimental sentences in the speeded grammaticality judgment task were simple active sentences three words in length, with the target word being in the final position, and involved either case or agreement errors. The participants judged whether the sentences, which were presented word by word on the computer at a rate of 350ms per word, were grammatical or not by pressing either the yes or no button of a control box. The results from the offline condition revealed that all of the participants, native English speakers included, were successful in the sentence completion task. However, in the online condition, all of the L2 groups, but not the native English speakers, had more difficulty in detecting agreement errors than case violations, and were slower in detecting the agreement errors. These results argue that the role of L1 influence on L2 morphosyntactic processing is more limited and is not as strong as it was once thought to be.

While the above online techniques used online measures which can capture processing as it happens, a problem with this technique is that it does not allow for regressions to be made. That is, it is impossible to tell what cue the L2 learner uses when they encounter an incongruency between the lexical item and the morphological one. One of the benefits of using eyetracking, another online technique, is that it captures reading times and regressions,

allowing the researcher to know what cues learners rely on when processing lexical and morphological incongruencies.

Using eyetracking, Sagarra & Ellis (personal communication) examined how Anglophone learners of Spanish and Spanish monolinguals attend to lexical and morphological cues that assign temporal reference. English-Spanish beginning and intermediate learners and Spanish monolinguals read sentences on the computer that varied in the location of the temporal adverb that marked past tense (i.e., pre- or post-verbally) and the tense of the verb (i.e., present or simple past). Each sentence was followed by a comprehension question to ensure that the participants understood each sentence. Two weeks before doing the eyetracking task, the participants took two pre-tests to ensure they were familiar with the present and simple past tense, as well as with the verbs used in the experimental stimuli. The results revealed that the L2 learners used adverbs to resolve a tense conflict, as seen by longer reading times on the adverb in sentences with verb-adverb incongruencies and more regressions to the adverb in sentences with adv-verb incongruencies. Contrariwise, Spanish learners relied on verbal morphology to resolve a tense conflict, showing longer reading times in the verb in sentences with adverb-verb incongruencies and more regressions to the verb in sentences with verb-adverb incongruencies. Regarding monolingual English preferences, Sagarra (personal communication) reports that these speakers prefer to use the lexical cue over the morphological one to assign temporal reference. Particularly relevant for the present study, the comparison between beginner and intermediate learners suggested that reliance on the adverb decreased with proficiency level. However, problematic with the findings from the intermediate group is that some of the learners had studied abroad. Therefore, it is impossible to tease apart the effects of immersion on proficiency level in this group, and to determine whether it is

proficiency level, an immersion experience, or a combination of both that caused them to return to the adverb.

2.2.3 Summary

The above review of literature has shown that L2 learners from both laboratory and classroom settings prefer to process lexical cues over morphological ones when both cues are present; however, most of them did not consider or control for the effects of a study abroad experience, and how it may alter L2 processing behaviors. As the next sections will show, most foreign language learners in the United States begin to learn the L2 in a classroom, and only later decide whether or not to study abroad in the L2 environment. Therefore, it is important to consider the consequences that a study abroad experience may have on how L2 learners process redundant grammatical and lexical cues in the input.

2.3 The L2 Learning Context

Spanish is one of the most popular languages of study in colleges across the United States, and accounts for 52.2% of all language enrollments (Modern Language Association, 2007). As more and more students realize the importance of Spanish as a world language, and they begin to take Spanish as a foreign language classes in high school and college, it is important to consider the role of instruction and the L2 learning context. Most adult second language learners now begin the task of learning their second language in a formal classroom setting, and only later decide whether or not to immerse themselves in the L2 environment to continue learning the L2. Given this situation, it is important to consider how instruction and study abroad affect SLA. The role of instruction in L2 settings has often been advocated and seen as something beneficial, as has study abroad for helping learners to acquire even more of the language. While the former assumption has continually been challenged, it was not until the

mid 1990s that the latter was challenged. The subsequent sections will review the literature that examines both the role that both instruction (2.3.1) and immersion experience through study abroad (2.3.2) play on SLA.

2.3.1 The Role of Instruction in SLA

There are two levels of debate about the effectiveness of instruction in SLA: those researchers that argue that instruction has little or no effect (Long & Robinson, 1998; Schwartz & Sprouse, 1996; White, 1987, 1991), and those who argue that instruction is beneficial (Felix, 1981; Long, 1983a). Regardless of one's stance, Doughty (2003) notes that if instruction is provided, it should be pertinent to the language learners' needs.

Most L2 learners begin the process of learning an L2 in a more formal setting that involves pedagogical intervention and guidance (Housen & Pierrard, 2005). Classroom learners often receive "teacher talk", and while some have argued that foreigner and teacher talk are one and the same, teacher talk generally contains more modified input that is structured in such a way to facilitate language learning, and the interaction almost always consists of completing a task. The input that teachers provide to second language learners generally has been found to include a reduced rate of speaking (Chaudron, 1985, 1988), adjustments to vocabulary (Henzl, 1979; Kleifgen, 1985), and variation in syntactic complexity (Chaudron, 1985, 1988).

Moreover, Dracos (2009) examined the usage of overt subject pronouns by native Spanish speaking instructors in two contexts: the L2 classroom with non-native interlocutors and in an informal setting with another native Spanish speaker. The results revealed a significant increase in overt subject usage by these native speakers when in the L2 classroom, when compared with their overt subject usage in an informal conversation with another native

speaker. However, the implications that this increased and non-native-like frequency of overt subjects has on SLA remains uninvestigated.

Likewise, Goodall (2008) considered how the context affects the usage of certain forms. More specifically, he examined the usage of the progression and reflexive verbs in both naturalistic and classroom settings. Naturalistic data for these verb forms was examined via oral texts from the 20th century from the Corpus del Español, whereas classroom data for the forms was based on their frequency in three common Spanish language textbooks. The results from these analyses reveal the progressive form to be overused in the classroom, while the reflexive form is underrepresented in the classroom. These findings suggest that classroom input is altered and does not appear to have the same frequency or usage of more naturalistic input in more natural settings.

Taken together, the above research suggests that teachers are sensitive to learners' needs and proficiency levels, and tend to overuse some lexical items and forms and underuse other ones to facilitate SLA. These findings, coupled with having past experiences with an L1, make it even more difficult for Anglophone L2 learners of Spanish to change their processing behaviors and to focus on verbal morphology. However, it is also important to consider the effects of an immersion experience on SLA, and how it may change or accelerate L2 processing behaviors in L2 learners.

2.3.2 The Role of Immersion on SLA

Research comparing classroom learners with and without immersion experience is a relatively new area of investigation. While both types of learners attend formal classes which require them to use the L2 in a learning context, the latter differ in that they also use the L2 in more naturalistic and communicative contexts. That is, these learners participate in information

exchanges that frequently occur with native speakers and require different communicative strategies that may not have been taught in the classroom. Furthermore, and more obviously, study abroad learners are immersed in the community of the L2, and may live with host families. As Swain (1985) has stated, these situations allow for social interactions with native speakers and require the learners to produce the language and are crucial for developing complex morphosyntactic abilities. The studies reviewed in the following sections examine how the learning context affects the L2 development of oral abilities (2.3.2.1), vocabulary (2.3.2.2), sociolinguistic abilities (2.3.2.3), reading abilities (2.3.2.4), and grammatical abilities (2.3.2.5). As all of the participants in the studies presented below are classroom learners, for ease of exposition, the classroom learners with a study abroad experience may be referred to as study abroad learners or the study abroad group.

2.3.2.1 Study Abroad and Development of L2 Oral Abilities

Oral abilities refer to the ability to communicate in the language with accuracy and fluency, and are normally measured with the Oral Proficiency Interview (OPI). The OPI was developed by the American Council on the Teaching of Foreign Languages (ACTFL), and is a standardized procedure for measuring the overall L2 speaking abilities on a wide range of tasks in various contexts. Most of the studies described in this section rely on OPI ratings to assess the development of oral proficiency through a study abroad experience.

Freed (1995) asked whether students who studied abroad became more fluent in the use of the L2 than classroom learners. Of her 30 participants, half spent a semester abroad in France while the other half remained in domestic classes. To examine oral proficiency, the OPI was administered once at the beginning of the semester and again at the end. Six native speakers of French were asked to evaluate speech samples from the learners for global fluency

on a scale from one to seven. The results revealed significant differences between the two groups of learners for pre- and post-test speech samples, with study abroad learners being judged as more fluent in their speech than the classroom learners. Other studies have found similar results for the benefits of study abroad on global oral proficiency, although these results must be interpreted with caution, as there was no control group with which they could be compared (Guntermann, 1992a, 1992b).

Likewise, Segalowitz & Freed (2004) examined improvements in global oral proficiency and fluency, as measured by the OPI and smoothness and fluidity of language use, respectively. They compared 22 study abroad learners with 18 non-study abroad learners, all of whom had studied Spanish for at least two semesters. After a semester abroad, the study abroad group performed significantly better than the classroom group on the OPI, suggesting that a semester abroad is sufficient exposure to the L2 to improve oral proficiency. Furthermore, the study abroad group also significantly outperformed the classroom group on four of the seven fluency measures (i.e., turn, rate, filler-free, fluent-run). Of the learners who did improve, however, they only increased by one level of proficiency.

Similarly, Freed, Segalowitz, & Dewey (2004) investigated various measures of oral fluency in learners in study abroad, regular classrooms, and intensive domestic immersion programs. The participants performed an oral interview both at the beginning and end of the semester in which two minutes of the data were transcribed and analyzed for speech rate, hesitation-free speech runs, filler-free speech runs, fluent runs, repetition-free speech runs, grammatical-repair-free speech runs, total words spoken, and duration of speaking time. The results revealed significant differences among the groups and their improvement in oral fluency, with greatest gains for those learners in the intensive domestic immersion program. These

learners produced significantly more words, spoke them at a faster rate, produced longer turns of speech and had more fluent speech runs. They also showed fewer repetitions and pauses in their speech. These results suggest that higher fluency in learners is not caused by the context, but rather that it is what the L2 learners do in each context, the nature of their interactions, and how much time they actually spend using the L2 that promotes improved fluency in the L2.

Magnan & Back (2007) also investigated whether speaking ability improved during a study abroad experience in France, and examined whether the use of French and the living situation affected oral proficiency. The 24 participants spent a semester abroad either in Montpellier or Paris, and completed questionnaires about their expectations, can-do self-assessment scales, and the OPI before and after going abroad. Upon returning, they also completed the language contact profile. The results revealed the students had improved in their self-confidence to speak French upon returning from abroad, and the OPI showed that the students either maintained or improved their level of L2 French speaking abilities. The effect of the living situation proved to be insignificant, with positive changes in both contexts occurring. The results also revealed that those students who spoke French with other Americans while abroad improved less on the OPI, and that those students who had significant contact with the L2 through watching films and television, reading newspapers, and eavesdropping did not experience significant linguistic gains. Finally, those students with more L2 experience before going abroad improved more than those with less experience. These results suggest that the living situation and language contact in the L2 environment does not guarantee improved oral proficiency.

The above studies reveal mixed results for a study abroad experience on improving L2 oral abilities, based on scores from an OPI. The next group of studies also considers oral abilities,

but includes the role of phonological working memory as a factor that may affect L2 oral development in a study abroad setting. In a study that investigated the role of phonological memory in L2 speech production with 18 classroom learners and 25 study abroad learners, O'Brien, Segalowitz, Collentine, & Freed (2006) examined L2 productive vocabulary, grammatical abilities, and narrative abilities. The data were collected over the course of a semester, and participants had a minimum of two semesters of Spanish classes before the experiment began. Based on the results of the phonological memory test, participants were divided into high and low ability groups. Regarding productive vocabulary, those with better phonological memory used more words at both testing intervals than those with a worse phonological memory. Concerning the development of narrative abilities, only the participants with an overall low phonological memory significantly improved in this skill. Phonological memory was related to the gains in the correct usage of function words and for subordinate clause usage only for participants in the high ability group. Thus, it appears that the role of phonological memory depends on the specific item being tested, and not necessarily on the L2 learning context.

In a similar study, a study by O'Brien, Segalowitz, Freed, & Collentine (2007) examined the relationship between phonological memory and learning environment on L2 oral fluency gains as measured by the OPI and fluency and found different results. The 18 classroom learners without study abroad and 25 classroom learners with study abroad all had at least two semesters of Spanish classes before the time the experiment began. The results from the pre-test-post-test data indicated that phonological memory is a better predictor of fluency gains than is the learning context. Thus, regardless of the learning context, those with a better phonological memory were more likely to be more fluent in their speech than those with a more limited phonological memory.

Lord (2006) examined the ability of 19 third-year L2 Spanish learners to mimic L2 sounds, words, and phrases after a six week study abroad program in Mexico. In both a pre- and post-test, the participants were required to repeat sentences varying in length between 19 and 26 syllables in Spanish, which was expected to exceed the working memory capacity of the participants, and also included nonce words. The results revealed that over the six week period abroad, the participants' ability to reproduce nonce words and their vocoid segments did not improve; however, their ability to reproduce more syllables did increase. Although no control group was included in this experiment, the results are consistent with those of O'Brien et al. (2006, 2007), in that phonological memory may be important for L2 oral development.

Pronunciation is another feature within the realm of L2 oral proficiency, and its changes as a result of study abroad have been less investigated. It is generally measured by examining the articulation of certain phonemes that pertain to the L2 and how L2 learners produce them. Díaz-Campos (2004) investigated the development of pronunciation in classroom learners and study abroad learners as measured by a reading task. There were 20 participants in the classroom learners group, and in the classroom with study abroad group, there were 26 participants who went abroad for ten weeks. The reading task was chosen to elicit a more careful pronunciation, which would likely produce more native-like speech than would casual speech. The target sounds were word-initial stops, intervocalic fricatives, word-final laterals, and palatal nasals, as these tend to be areas of emphasis in popular Spanish pronunciation textbooks. The results revealed no significant differences in pronunciation between the classroom learner and study abroad groups on any of these measures, suggesting that study abroad is not necessarily a requisite for improving pronunciation. Two other studies, though, have revealed improvement in pronunciation with study abroad participants (Lord, 2000;

Simões, 1996). However, these studies involved very few participants, a very short time abroad, and only one of the experiments included a quasi-control group (Lord, 2000). Thus, the findings that suggest phonological improvement with study abroad groups are suggestive at best.

The next component of oral abilities involves communicative strategies, which refer to those strategies L2 learners use when communicating with another speaker in the L2, and can be operationalized as strategies used by the learners whenever there was a breakdown in communication caused by a lack of knowledge on the part of the learner, his or her performance in the L2, or due to problems resulting from interacting with another speaker. DeKeyser (1991) examined communicative strategies by classroom learners and study abroad learners of Spanish. The seven study abroad and five classroom learners performed a picture description task in which they described a picture to a native speaker who then had to draw the picture based on the descriptions given. They also participated in oral interviews which were meant to elicit data under semi-controlled situations. The data were collected with the classroom only and classroom plus study abroad learners three times during the quarter: at the beginning, middle, and end, and the data revealed no significant differences in the number and type of communicative strategies used by the study abroad group when compared with the classroom learners group.

Similarly, Lafford (1995) examined the communicative strategies that classroom only and classroom with study abroad experience learners use to enter, maintain and develop, and exit a conversation. The two groups of study abroad learners, one group of 13 in Mexico and another of 16 in Spain, were compared with one group of 13 students who made up the classroom only group. After a semester abroad, the study abroad learners were more adept in using communicative strategies for entering, maintaining, and exiting a conversation than their

classroom only learner counterparts. Furthermore, they were perceived as better conversationalists, based on pre- and post-test differences on the OPI.

Lafford (2004) continued to investigate the effect of the learning context on the use of communicative strategies. The 20 classroom only learners and 26 classroom learners with study abroad were administered an OPI pre- and post-test from which the data was derived. The data were analyzed for communicative strategies, and the results revealed improvement for both the classroom only and study abroad group over the course of the semester and a decrease in their reliance on communicative strategies. However, between the groups, the study abroad group used significantly fewer communicative strategies than the classroom learner group, suggesting that the learning environment may affect which communicative strategies get used.

The results from the experiments that investigate the effectiveness of study abroad on the development of L2 oral abilities are mixed. It appears that learners have better broad oral abilities and use communicative strategies more effectively after a study abroad experience, whereas the results concerning improvement on pronunciation are mixed. The next section examines the development of L2 vocabulary through a study abroad experience.

2.3.2.2 Study Abroad and Development of L2 Vocabulary

While it is widely thought that L2 vocabulary develops faster in an immersion setting than in a classroom setting, only two researchers have considered this variable. The development of vocabulary is generally defined as changes in the use of certain lexical items. Ryan & Lafford (1992) investigated the development of *ser* and *estar* in 16 L2 Spanish learners while spending a semester abroad. The study abroad learners were chosen in order to examine the role of the learning context in the development of the Spanish copula, since VanPatten's findings for an order of acquisition for Spanish copulas were based on data from classroom

learners who had not had any study abroad experiences. The results from this study did not corroborate VanPatten's, and the authors concluded that it may be the learners' exposure to natural input that causes them to acquire the Spanish copula in a different order from classroom learners.

In a similar study, Lafford & Ryan (1995) examined the acquisition of the lexical meaning of *por* and *para* by nine L2 Spanish learners who spent a semester abroad. The learners were given an OPI before leaving, halfway through the semester, and at the end of the semester in order to determine their proficiency level and also to determine how the uses of *por* and *para* vary at different proficiency levels. Their results revealed both canonical and non-canonical uses of these prepositions, and that canonical uses of both forms starts out high for learners of low proficiency, decreases at intermediate levels, and then increases again as proficiency increases. The authors explain this finding as a result of formulaic material first being memorized, thus producing few errors, and then a period of experimentation, followed by more normal uses of the prepositions and a decrease in errors.

The results from the studies presented in this section reveal that a study abroad experience can be beneficial for the development of L2 vocabulary. However, as the research investigating this variable is scant, caution must be used when interpreting these results. The next section introduces literature that has examined the development of sociolinguistic abilities through a study abroad experience.

2.3.2.3 Study Abroad and Development of Sociolinguistic Abilities

Regan (1995) investigated the acquisition of sociolinguistic competence and sociolinguistic speech norms, and more specifically the deletion of the first particle of the negative in French (i.e., *ne*). After a year abroad, the six advanced L2 French learners had

dramatically reduced the number of *ne* produced in their oral speech, matching the behavior of native speakers. However, closer inspection of the data revealed that they tended to overgeneralize the *ne* deletion.

In investigating another sociolinguistic variable, Marriott (1995) examined which aspects of politeness L2 Japanese learners acquire in a yearlong study abroad context and whether previous study of Japanese before the study abroad experience had any effect on its acquisition. Pre- and post-study abroad oral interviews were elicited and transcribed, and were judged by native Japanese speakers for acceptability of politeness patterns. The results revealed that previous study of Japanese did not have a significant impact on the learners' usage of politeness patterns, and that the learners became very competent in their use of polite formulaic expressions. However, these results must be interpreted with caution because of the small sample size (8 participants) and no control group to see how similar learners would have progressed in the classroom context.

Finally, Regan (1998) suggests that study abroad has important implications for the acquisition of sociolinguistic competence, and that contact with native speakers is an important factor, and that modified input is most beneficial to lower proficiency learners. Furthermore, she notes that issues related to dialect, acquisition of native speaker variation, fluency, and formulaic speech usage are affected by living abroad. She concludes on a more pessimistic note that even study abroad does not allow L2 learners to perform like native speakers.

The results from the experiments presented in this section reveal that sociolinguistic abilities can improve from a study abroad experience. However, the small number of participants in these studies suggests that the results must be interpreted with caution, and that further research is necessary before any firm conclusions can be made. Another area that is

under-investigated is the development of L2 reading abilities in a study abroad context, and the studies concerning this variable are presented in the next section.

2.3.2.4 Study Abroad and the Development of Reading Abilities

In a case study comparing 12 study abroad learners enrolled in an intensive Japanese language course with 12 non-immersed classroom learners enrolled in a similar style course, Huebner (1995) examined how the lack of similarity between the L1 (English) and L2 (Japanese) of the participants affected their proficiency and ability to obtain input in the L2. That is, since the beginning level study abroad learners were immersed in a new environment, they were functionally illiterate because of the differences between the writing scripts. The results revealed that the participants in the study abroad group more urgently needed to learn to read the Japanese writing system, and more importantly that study abroad may facilitate reading comprehension and literacy even at early stages of L2 acquisition.

Dewey (2004) questioned whether there were differences in the development of reading comprehension between study abroad and domestic-immersion learners (i.e., L2 learners participating in a program in which they live in the L1 environment but do not use the L1 and surround themselves by similar speakers who only wish to use the L2). Measures of reading were collected for the 15 participants before and after the 11 week study abroad program in Japan, and also for the 15 L2 learners of Japanese enrolled in the nine week domestic immersion program. Free-recall protocols, vocabulary knowledge tests and self-assessments were used to measure reading comprehension, and to measure reading processes, think-aloud protocols were used. Significant differences were only found for the self-assessment measure between the study abroad and domestic-immersion group, with the study abroad

group being more confident in their ratings than the other group. The domestic immersion group also monitored and reacted more than the study abroad group.

The results from these two studies are mixed, and suggest that it may not be the learning context itself that affects L2 reading abilities, but rather the necessity or motivation to understand the L2. However, more research is necessary in order to confirm or deny this hypothesis. Although the literature regarding reading comprehension is scant, one of the more studied areas within the study abroad literature involves the development of L2 grammatical abilities while abroad. The results from these studies are presented in the following section.

2.3.2.5 Study Abroad and the Development of Grammatical Abilities

Several studies have examined grammatical development across an array of tasks and forms in both study abroad and classroom participants, as well as with just study abroad participants. The studies presented in this section investigated morphological or syntactic development through a study abroad experience, oftentimes measured through an OPI, grammaticality judgment tests, or discrete point tests.

C.L. Isabelli (2000) measured the development of tense and aspect selection, subject-verb agreement, and adjectival agreement, and the data were elicited via an OPI and informal interviews. The OPI was conducted before going abroad, and also upon arriving back from the immersion experience. The informal interviews were conducted monthly with the learners while they were abroad, summing to a total of five, and each one lasted approximately 15 minutes. The results revealed that while all of the linguistic items measured did improve, the most gains were in tense selection, followed by gender-number and subject-verb agreement. The fewest gains for these learners were found for aspect selection. The results suggest that study abroad participants can improve linguistically in one semester abroad, but that motivation and

extended interaction in the target language play a more important role in this development. However, a major caveat of this research is the small number of participants and the lack of a classroom learners control group. Without a control group, the findings presented cannot be validated, as they may be confounded with a natural progression in L2 learning.

In order to examine development of the null subject parameter, C.A. Isabelli (2001) tested 31 L2 Spanish learners who studied abroad for nine months in Spain. The data, collected via grammaticality judgment tasks and oral interviews at the beginning and end of the nine month long study abroad period, revealed that study abroad participants do improve in the development of null subjects, free verb-subject inversion in declarative sentences, and violations of the *that*-trace filter when extracting *wh*-subjects from embedded clauses. These results were compared with the performance of 18 native Spanish speakers, and she concludes that the learners came close to resetting the null subject parameter for the development of null subjects and free verb-subject inversion, but failed to do so completely for violations of the *that*-trace filter.

In a similar study, C.A. Isabelli (2004), using 29 advanced learners participating in a one year study abroad experience, examined Spanish syntactic development and acquisition of three properties purported to be related to the null subject parameter (i.e., missing subject pronouns, verb subject inversion, and *that*-trace filter violations). The pre- and post-test data were collected from grammaticality judgment tasks and oral narratives, and the results revealed significant improvement on all properties, and with native-like performance on all but the *that*-trace filter violations. However, the results from this study also must be interpreted with caution because no classroom learners control group was used. Thus, it is uncertain whether these

findings are owed to the study abroad experience and exposure to the rich linguistic environment or are resultant from a natural development in their language abilities.

C.A. Isabelli & Nishida (2005) examined the development of the Spanish subjunctive in three groups of learners: 16 classroom fifth semester Spanish learners, 16 classroom sixth semester Spanish learners, and 29 study abroad participants who spent a year abroad. The data were collected at the beginning, middle, and end via the OPI for the study abroad group, while they were collected cross-sectionally at the end of the fifth and sixth semesters of study for the two classroom groups. The results from this experiment revealed no differences between the two classroom groups in their oral production of the subjunctive, a slight improvement from the middle to the end of the time abroad for the study abroad group, and significant differences between the study abroad group and both classroom groups with regard to their oral production of the Spanish subjunctive (although their performance was still far from native-like). However, this finding may be owed to the learners more advanced level and more fully developed syntactic abilities. Alternatively, they may have more cognitive resources available to them to process low salient and redundant forms, suggesting that it is advanced learners who benefit more from a study abroad experience. However, this remains speculative because so little research has directly compared advanced learners with intermediate level learners in study abroad contexts.

Also interested in the development of Spanish morphology, Cheng & Mojica-Diaz (2006) investigated the effects of an intensive grammar instruction course and a two month study abroad program on improving the use of the Spanish subjunctive in oral discourse. The six participants were at the advanced level as measured by the ACTFL scale at the time of the pre-test, and on the post-test, only one of the participants was able to produce native-like discourse

in hypothetical situations. For the rest of the participants, no significant differences were found for their use of the Spanish subjunctive after the immersion experience. These results suggest that a study abroad experience is not sufficient in aiding even advanced learners to develop their discourse competence to a socially acceptable manner.

Also working with the subjunctive, C.A. Isabelli (2007) investigated whether features that were not acquired abroad would be more easily acquired after returning from a study abroad experience. The experiment measured grammatical development of the Spanish subjunctive in 24 advanced learners who had recently returned from a 4 to 18 month-long study abroad experience and compared them with 19 advanced learners who had never studied abroad. All of the participants received explicit instruction on mood selection in adverbial, nominal and adjectival clauses followed by activities that required a focus on form and meaning. The data from an OPI were collected one day after the period of instruction, and were examined for correct usage of the subjunctive. The results indicated that explicit instruction and negative evidence improved both groups of learners' production of the subjunctive, and that those with previous experience abroad improved even more than those without study abroad experiences. This suggests that continued instruction in the L2 after study abroad has benefits to the learners because of their advanced linguistic maturity and thus ability to understand and process complex syntax. However, these results must be interpreted with caution, as the experiment did not control for proficiency level for either group via pre- and post-tests, and the effects of instruction also were not considered.

Although not specifically interested in the development of the subjunctive in L2 learners with and without an immersion experience, Geeslin & Guijarro-Fuentes (2005) were interested in the development of one grammatical item, and whether knowledge of other languages and

the experience of spending time abroad affected language learners' copula choice in Spanish. The 26 learners were all from L1 languages that did not have a copula choice like the one in Spanish, and had varied in their time abroad from two weeks to three years. The data were elicited via a contextualized preference questionnaire in which participants were given a context and then had to choose a response, with each response varying in copula choice. Not surprisingly, the results from this experiment revealed no effect for L1 in copula choice, and suggest that learners from languages without a similar copula distinction would have similar preferences. Concerning study abroad, no significant benefits were found for time abroad and copula choice, suggesting that it is not an effect of learning context that aids in copula selection.

Howard (2001, 2005) was also interested in the development of only one grammatical form, and studied the effects of study abroad on L2 learners' development of the expression of past time in French by Irish university students. Each group consisted of six participants, and was based on their study abroad status. The first group comprised learners who were about to study abroad in France. The second consisted of learners who had just returned from their year-long study abroad experience, and the third group was made up of learners who, instead of going abroad like group two, remained in classes at the university. Thus, this last group was more advanced than the first group, and the author argues that the differences between groups two and three would allow for comparisons to be made with group one regarding the effectiveness of study abroad (group one and two) and further instruction without study abroad (group one and three). The results from this experiment revealed that study abroad increased usage and accuracy of the past time form-function relations, and that certain grammatical skills may benefit from a study abroad experience while others are less affected.

While the above studies were interested in only the development of one grammatical form, Collentine (2004), using data from transcribed oral interviews, took a more holistic approach and examined the effects of learning context on morphosyntactic (i.e., gender, number, person, tense, and mood) and lexical development in second language learners of Spanish. The data from the 20 learners comprising the classroom group and 26 from the study abroad group were examined for grammatical accuracy, and more specifically for accuracy in the production of gender, number, person, tense, and mood. Additionally, the following 17 measures of morphological, syntactic, and morphosyntactic structures were used to compare the groups' pre- and post-test performance and accuracy on: copula, preposition, object-pronoun, coordinate-conjunction, subordinate-conjunction, present-tense verb, past-tense verb, subjunctive, indicative, person (verbs and pronouns), plural adjective, plural pronoun, plural verb, feminine adjective, feminine pronoun, and coordinate and subordinate clause counts. Results from the experiment revealed that over the course of a semester, learners in the classroom context outperformed those in the study abroad context for their performance on grammatical accuracy, but that learners in the study abroad group improved their narrative abilities. Segalowitz, Freed, Collentine, Lafford, Lazar, and Díaz-Campos (2004) found similar results on the same 17 measures, again concluding that classroom learners perform better than their study abroad counterparts with regard to grammatical accuracy.

While the results of the experiments that are about to be presented have been mixed, the majority of them suggest that over the course of a semester or academic year, classroom learners outperform study abroad participants with regard to syntactic and lexical development (Lafford & Collentine, 2006; Freed, 2008). However, Isabelli & Nishida (2005) found that

advanced learners' use of the subjunctive improved significantly while abroad when compared to non-study abroad participants.

2.3.3 Summary

The overall benefits of study abroad appear to include improved fluency, lexical abilities, and sociolinguistic awareness, while one of the drawbacks of study abroad includes the lack of grammatical improvement. The results of these studies are shown in Table 1. Also obvious from the above review of literature is that study abroad learners tend to spend only a semester abroad, which is sufficient for some changes in the learners' linguistic system to develop and change. However, Lantolf (1999) has argued that if the learners' interlanguage system is to be adjusted to resemble that of native speakers, extended periods of time must be spent in the target culture, and Ife, Vives Boix, & Meara (2000) found some evidence for this with advanced learners who spent more time abroad than with intermediate level learners who spent a similar amount of time abroad. These authors suggest that daily exposure to the culture and language allowed the learners to restructure their cognitive associations and to make them appear more like native speakers. Most of the research has shown that a semester immersed in the L2 environment is sufficient exposure to the L2 for some changes to occur, save improvement in grammatical abilities, which may be attributed to other factors. However, another important factor to consider, and that is discussed in detail in the next section, is individual cognitive differences and their role in SLA and study abroad.

Table 1 *Overview of Past Study Abroad Research*

Study	Language	Classroom + Study Abroad (SA)	Classroom – Study Abroad (SA)	Duration	Instrument	Pre-experimental Level	Results
Fluency							
Guntermann (1992a)	Spanish	9	None	1 year; 8-10 weeks of instruction	OPI	Novice	Improved use of por/para and in overall proficiency
Guntermann (1992b)	Spanish	9	None	1 year;8-10 weeks of instruction	OPI	Novice	Improved use of copula ser/estar and in overall proficiency
Freed (1995)	French	15	15	1 semester	OPI	Few months to 9 years	Classroom + SA more fluent than Classroom - SA
Segalowitz & Freed (2004)	Spanish	22	18	16 weeks	OPI	3rd semester	Classroom + SA more fluent and proficient than Classroom - SA
Freed, Segalowitz, & Dewey (2004)	French	8	8 (Classroom – SA); 12 (Classroom + domestic immersion)	1 semester	OPI	2-4 years prior instruction	Classroom + Domestic Instruction more fluent than Classroom – SA and Classroom + SA
O'Brien, Segalowitz, Collentine, & Freed (2006)	Spanish	25	18	1 semester	OPI	Minimum 2 semesters	L2 context not significant for development of narrative abilities, productive vocabulary, correct usage of function words and for subordinate clause usage
Lord (2006)	Spanish	19	None	6 weeks	Mimicry test	3rd year	Classroom + SA able to reproduce more syllables

Study	Language	Classroom + Study Abroad (SA)	Classroom – Study Abroad (SA)	Duration	Instrument	Pre-experimental Level	Results
Magnan & Back (2007)	French	24	None	1 semester	OPI; self-assessment scale; language contact profile	4-6+ semesters prior instruction	Speaking proficiency was maintained or improved
O'Brien, Segalowitz, Freed, & Collentine (2007)	Spanish	25	18	1 semester	OPI	Minimum 2 semesters	Classroom + SA = Classroom – SA for fluency
Pronunciation							
Simões (1996)	Spanish	5	None	5 weeks	Pronunciation of syllable nuclei in sequence of words	Intermediate low and advanced	Classroom + SA improved pronunciation
Lord (2000)	Spanish	8; 4 with previous class on pronunciation; 4 without previous instruction	None	8 weeks	Production of voiced stops and their voiced fricative allophones	Intermediate level	Classroom + SA + previous pronunciation class > Classroom + SA – previous pronunciation class
Díaz-Campos (2004)	Spanish	26	20	10 weeks	Read-aloud text	Mixed	Classroom + SA = Classroom – SA for pronunciation
Communicative Strategies							
DeKeyser (1991)	Spanish	7	5	1 Quarter	Grammar test; interview; picture description; recall	Intermediate	Classroom + SA = Classroom – SA for communicative strategies

Study	Language	Classroom + Study Abroad (SA)	Classroom – Study Abroad (SA)	Duration	Instrument	Pre-experimental Level	Results
Lafford (1995)	Spanish	28	13	1 semester	OPI	N/A	Classroom + SA > Classroom – SA in using communicative strategies
Lafford (2004)	Spanish	26	20	1 semester	OPI	3rd semester	Classroom + SA < Classroom – SA in the amount of communicative strategies used
Vocabulary							
Ryan & Lafford (1992)	Spanish	16	None	1 semester	OPI	Novice	Order of acquisition of copula is different for Classroom + SA
Lafford & Ryan (1995)	Spanish	9	None	1 semester	OPI	Novice	Classroom + SA produce canonical and non-canonical uses of por/para
Sociolinguistic Abilities							
Regan (1995)	French	6	None	1 year	OPI	Advanced	Classroom + SA produced fewer *ne* in oral speech, but usage was overgeneralized
Marriott (1995)	Japanese	8	None	1 year	Oral interview	Mixed	Classroom + SA more competent in their use of polite formulaic expressions

Study	Language	Classroom + Study Abroad (SA)	Classroom – Study Abroad (SA)	Duration	Instrument	Pre-experimental Level	Results
Reading Abilities							
Huebner (1995)	Japanese	12	12	9 weeks	Japanese proficiency test; OPI, narrative retelling; interviews; observations; diary entries	Novice	Classroom + SA > Classroom – SA for facilitating reading comprehension
Dewey (2004)	Japanese	15	15	SA = 1 semester; Domestic immersion = 9 weeks	Free-recall protocol; vocabulary knowledge tests; self-assessments; think-aloud protocol	2-4 years prior instruction	Classroom + SA > Classroom – SA for self-ratings; Classroom + SA < Classroom – SA for monitoring and reaction to text content
Grammatical Abilities							
C.L. Isabelli (2000)	Spanish	5	None	5 months	OPI; informal interviews	Intermediate	Classroom + SA improved in fluency and grammatical abilities
C.A. Isabelli (2001)	Spanish	31	None	9 months	Grammaticality judgment tests; oral narratives	Intermediate	Partial resetting of the null subject parameter
Collentine (2004)	Spanish	26	20	16 weeks	OPI	3rd semester	Classroom - SA > Classroom + SA in grammatical accuracy
Segalowitz et al (2004)	Spanish	26	20	1 semester	OPI	At least 2 semesters	Classroom – SA > Classroom + SA in grammatical performance

Study	Language	Classroom + Study Abroad (SA)	Classroom – Study Abroad (SA)	Duration	Instrument	Pre-experimental Level	Results
C.A. Isabelli (2004)	Spanish	29	None	1 year	Grammaticality judgment task; oral narratives	Intermediate	Native-like performance on subject-verb inversion and development of null subjects
Geeslin & Guijarro-Fuentes (2005)	Spanish	26	None	2 weeks to 3 years	Contextualized preference questionnaire	Minimum 2 years prior instruction	Learning context does not aid in copula selection
C.A. Isabelli & Nishida (2005)	Spanish	29	32	9 months	OPI	3rd year	Classroom + SA > Classroom – SA in production of subjunctive
Howard (2001, 2005)	French	6	6	1 year	Sociolinguistic interviews	7-9 years	Classroom + SA > Classroom – SA for usage and accuracy of past time form-function relations
Cheng & Mojica-Diaz (2006)	Spanish	6	None	2 months	OPI	Advanced	Classroom + SA did not improve subjunctive usage
C.A. Isabelli (2007)	Spanish	24	19	4 to 18 months	OPI	Advanced	Explicit instruction on subjunctive usage benefiting more Classroom + SA than Classroom - SA

2.4 Cognitive Individual Differences

Before discussing any role that cognitive individual differences may play in the effectiveness of linguistic (i.e., grammatical) development in a study abroad context, or how they may affect how L2 cues are processed, a definition of working memory and inhibitory control is necessary. Working memory is the ability to maintain task-relevant information while performing complex, cognitive task, and inhibitory control is the ability to maintain and process task pertinent information while suppressing irrelevant information. What follows is an overview of working memory (section 2.4.1). Section 2.4.1.1 examines the different models of working memory, and section 2.4.1.2 presents the various tests used to measure working memory. Section 2.4.1.3 addresses the literature regarding working memory and its role in L1 processing; section 2.4.1.4 reviews its role in L2 processing, and section 2.4.1.5 discusses the predictions made about working memory capacity and its effects on SLA and for second language learners in different learning contexts, with the last subsection summarizing the literature. Section 2.4.2 reviews the extant literature on inhibitory control with section 2.4.2.1 examining the different models of inhibitory control. Section 2.4.2.2 presents the various tests used to measure inhibitory control, and while sections 2.4.2.3 and 2.4.2.4 address its role in L1 and L2 processing, respectively. Section 2.4.2.5 examines the predictions that have been made for inhibitory control's role in aiding L2 learners in different L2 contexts, while the last section summarizes the findings (2.4.2.6).

2.4.1 Working Memory

Working memory is a system used for temporarily storing and managing information that is necessary for carrying out complex cognitive tasks such as comprehension, learning and reasoning (Baddeley & Hitch, 1974; Baddeley, 1986; Daneman & Carpenter, 1980; Miyake &

Shah, 1999). Short-term memory and long-term memory both play passive roles, and the former stores information at a surface level of coding while the latter stores information at a deeper level of coding. In contrast, working memory plays an active role and is an on-line merger of information retrieved from the long-term memory with information from the immediate surroundings. Working memory has often been related to language because of its role in processing language, as incoming language must be comprehended by the listener in order for the listener to make some type of response to it. Moreover, since working memory is limited in capacity and varies from person to person, if task demands exceed a person's capacity, either incoming information cannot be processed or the information being held is lost.

2.4.1.1 Working Memory Models

Multiple theories have been proposed to explain working memory, and each will be briefly described below. The traditional model of working memory, the modal model (Atkinson & Shiffrin, 1968), contained three stages, with the first stage comprising a bank of sensory buffer stores that were able to accept and temporarily store information that came from varying modalities. These sensory buffer stores fed into the central feature of the model, the short term store. This short term store was responsible for encoding the incoming information in a number of ways as well as for retrieval. Under this model, learning depended on holding information in this temporary short term store for a specific amount of time until it got transferred to the long term store. This component also played an important role in selecting learning strategies and in aiding retrieval of information from long term memory. The third component, which received its information from the second, was the long term store, and was much larger in capacity. Problems with this model included the assumption of automatic transfer from the short term store to the long term one, which later proved difficult to support. Also problematic was the

research suggesting that the short term store was not important for information processing and the lack of impairment when testing recency.

Baddeley (1986) contested the predictions of the modal model and created a model of working memory that included a central executive, phonological loop, and visuospatial sketchpad. He later changed his model to include a fourth component, the episodic buffer (see Figure 1; Baddeley, 2000, 2003). Furthermore, the revised model differs from the earlier in that attention is focused on the processes of incorporating information, rather than on isolating the subsystems. The central executive is responsible for the attentional control of working memory, and binds information from multiple sources into a coherent episode. The phonological loop, which is the most developed component of the model, serves two purposes: to hold verbal and acoustic information using a temporary store and an articulatory (subvocal) rehearsal system. This subvocal rehearsal system allowed for the verbal and acoustic information to be refreshed, allowing the visual information to be registered within the store. Thus, the phonological or acoustic characteristics were retained, so long as subvocalization was performed. This feature plays an important part for SLA in that it can be a useful aid in vocabulary acquisition. That is, if the performance of the phonological loop is impaired, so too is foreign language learning (however, for native language learning, this appears not to be the case, for in paired associate learning in the L1, people typically rely on semantic coding (Baddeley, 2003)). Another subsystem of working memory, the visuospatial sketchpad, is responsible for "integrating spatial, visual and possibly kinesthetic information into a unified representation which may be temporarily stored and manipulated" (2003, p. 200). Regarding language comprehension, cognitive capacity and the ability to maintain and manipulate information that is visuospatial in nature are important factors. This subcomponent assumes a form of general rehearsal, or even

chunking. Some component to combine information from multiple subsystems into a form of temporary representation is needed, as evidenced in impaired patients with memory loss. The episodic buffer, which is controlled by the central executive via conscious awareness, is a limited capacity temporary storage system that integrates information from various sources. It plays an important role in sending and receiving information from the episodic long-term memory and to the phonological loop and visuospatial sketchpad. So that information between systems with different codes can be exchanged, the episodic buffer has a common, multi-dimensional code. It is limited because of the demands of allowing simultaneous exchanges of codes between the systems. The episodic buffer is separate from long-term memory, but is an important stage in long-term episodic learning.

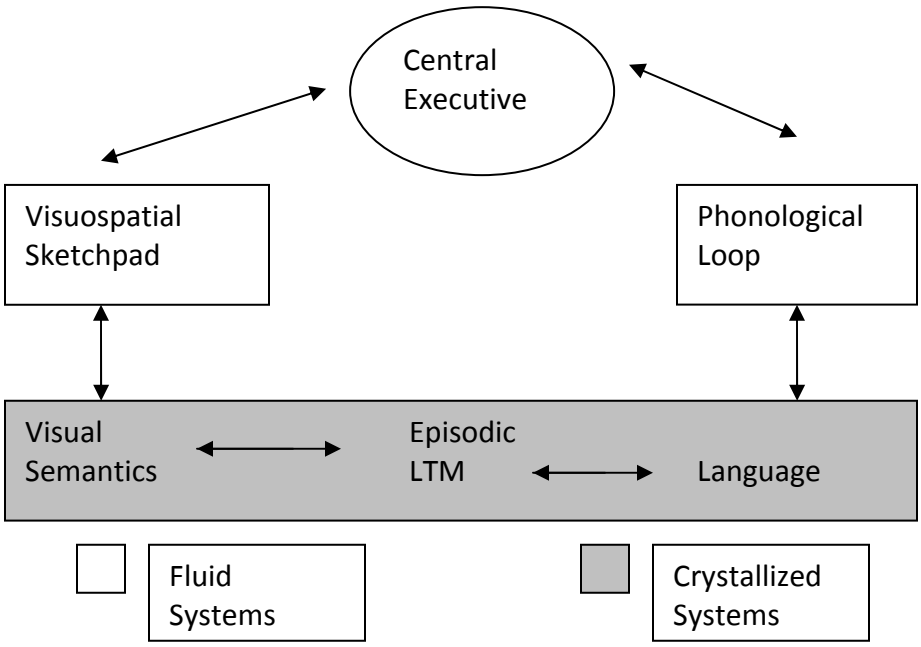

Figure 1. Baddeley's (2000) Model of Working Memory.

Alternatively, Just & Carpenter (1992) argue for a capacity theory of working memory, and state that individual differences in working memory have implications for language

comprehension among normal, college-aged adults. For these authors, working memory for language "refers to a set of processes and resources that perform language comprehension" (123), and differ from Baddeley in that the subsystems (i.e., articulatory loop and visuospatial sketchpad) are not included. Of importance to these researchers is what Baddeley terms the central executive, for it is concerned with language comprehension. The authors claim that the total amount of activation varies between people, based on the activation of both processing and storage. They propose that individuals vary in the amount of activation they have available for meeting the computational and storage demands for processing and comprehending a language. The authors assume a single capacity theory for language processing, in which various features of language comprehension processing (e.g., lexical access and syntactic analysis) are encompassed into one working memory. Since capacity is limited, performance is only affected when the resource demands of the task exceeds the available supply. However, this single capacity may only be a subset of some larger set of processing resources, thus noting that not all language processes (e.g., production) draw on a single resource.

Cantor & Engle (1993) promote the idea that individuals differ in the amount of activation available to receive information from long-term memory. They support a general capacity model which states that "differences in the amount of available LTM activation drive differences in WM capacity and produce the well-established correlation between WM span tasks and verbal abilities" (1110). That is, information from long-term memory reaches a certain threshold that then makes it accessible to cognitive processes or procedures (thus entering working memory) (see also Kane, Bleckley, Conway, & Engle, 2001). Their results revealed that low working memory capacity participants' recognition time increased as the fan size increased. They conclude that individual differences in working memory capacity are due to the total

capacity of long-term memory activation available to the individual, regardless of the task at hand.

Waters & Caplan (1996a) argue against Just & Carpenter's (1992) idea of a single capacity, citing results from neuropsychological data and claim that the capacity theory is unconvincing and makes contradictory predictions. They argue for a theory of separate language-processing resources, in which one resource pool in the working memory is used in obligatory, on-line processing while another is used in controlled, verbally mediated tasks. These latter theories speak explicitly about the role of working memory capacity, and many tests have been developed to measure this capacity.

2.4.1.2 Working Memory Tests

Before examining the types of working memory tests that can be used to measure working memory capacity, it is important to first discuss some issues surrounding these tests. There is much debate about the differences between linguistic and non-linguistic working memory, and whether they draw on the same or different resource pools. Just & Carpenter (1992) argue that a person's linguistic working memory only constrains the workings of language comprehension processes, whereas Waters & Caplan (1996) claim that there are multiple (at least two) linguistic working memory capacities, each one separate from the other. For example, they argue that there is a separate working memory for syntactic processing and comprehension processes. Concerning non-linguistic working memory, some argue that spatial, or non-verbal working memory is separate from linguistic, verbal working memory, and that it draws on a separate resource (Shah & Miyake, 1996). MacDonald & Christiansen (2002) take a connectionist approach and state that the distinction between language processing and working memory is an artificial one, and that any differences in working memory capacity can be

attributed to different amounts of exposure to the input and to biological differences that affect processing accuracy. Additionally, they argue that linguistic and non-linguistic working memory are similar, in that they draw on similar skills.

Another area of contention is whether working memory capacity is language dependent or independent. Osaka & Osaka (1992) argued that the efficiency of working memory capacity is language independent. They state that if an individual has sufficient comprehension in the second language, then he/she will have similar efficiency in processing the second language as he/she does in the first language. Their results revealed that working memory capacity related to language processing is stable; thus if the individual has a high working memory capacity in the first language, then he/she will be able to develop a high working memory capacity in the second language.

However, Berquist (1997) examined individual differences in working memory capacity and second language proficiency, and wondered if it was a matter of capacity or processing efficiency. He argues that since the biological capacity of working memory is fully formed in the first language, then any variation among working memory capacity in the second language must be due to efficiency of processing rather than to a fixed capacity. Finally, he claims that training can increase an individual's working memory efficiency in the second language, but not his/her capacity.

Regardless of the position one takes regarding the language (in)dependence of working memory capacity, ultimately researchers are interested in the working memory capacity of the participants. The scoring of these tests is yet another area of debate in the field. Some researchers only give one point for a correct response on both the recall and plausibility judgment, whereas others give one point for each response. However, this latter option is

contentious, as working memory by definition involves the ability to do both tasks simultaneously. Once each participant has a working memory score, some investigators label the participants who have taken these tests of working memory into high and low working memory capacity, while others perform a median split or quartile analysis of span scores, making the designation relative only to the participants in the experiment, and is done so that comparisons between the groups and their scores on some other measure can be compared. This allows researchers to determine whether or not working memory capacity played any role in the variable under investigation, and also to determine if these differences can be attributed to differences in working memory capacity. However, the designation of high and low is arbitrary, and Friedman & Miyake (2005) argue that more continuous measures, such as the total number of words recalled, are more reliable and have better correlations with other measurements under investigation, whereas designations into high and low span groups can lead to reduced predictive power (see also Sagarra, 2000, for a similar conclusion).

As seen above, there are multiple issues that surround these tests of working memory. Much contention remains as to whether working memory is language dependent or independent, if there are multiple pools of resources or just one for both linguistic and non-linguistic tests, and how to best score the tests to measure the effect of working memory capacity on the variable under investigation. What follows are some descriptions of both linguistic and non-linguistic tests.

One linguistic test to measure working memory was created by Daneman & Carpenter (1980). In the reading span test, the participants read aloud at their own pace (or hear) a set of sentences and were to memorize the last word of each sentence. Each sentence ended with a different word. The sentences were arranged into three sets of two, three, four, five and six

sentences. Each sentence was shown (or heard) one at a time, and when the participant had finished reading (hearing) the sentence, the next sentence was presented. At the end of each set, the participant was to recall each final word from every sentence in that set. Testing finished when the participant failed all three sets at a particular level. The level at which he/she correctly recalled two out of the three sets was taken as his/her reading span. That is, if a participant correctly recalled four words out of two sets of sentences, his/her reading span would be four.

A modified version of this task is that of Waters & Caplan (1996b), in which participants read sentences on a computer screen one at a time and are asked to decide whether or not a sentence is plausible by deciding "yes" or "no" (via designated keys on the computer). At the same time, however, they must also attempt to remember the last word of each sentence. After each set of sentences, they must recall each final word. However, they were not permitted to recall first the last word of the set last seen in the list of recall words. As in the Daneman & Carpenter (1980) test, the sentences were divided into sentences sizes two through six, and testing began with a set of two sentences, and continued through to a set of six sentences. The participants' reading span was calculated using the same criterion as for reading span in the Daneman and Carpenter test. Reaction times and errors on the plausibility portion were also recorded by the computer. The benefit of recording reading times and error rates is that this information can be used to determine whether or not there is a tradeoff between speed and accuracy in processing the sentence. A modification of this test is to not specify the level of difficulty of the next set (i.e., a set of two sentences may be followed by a set of five sentences, etc.).

The digit span test is also a linguistic test of working memory and requires participants to remember a sequence of digits from one to nine. In this task, they hear a sequence of digits and are then required to recall them in the exact order as presented. Testing begins at two digits, and is stopped when the participants fail to correctly recall the digits on three out of ten or less of the given set size.

The operation span test, which involves solving mathematical operations, is similar to the reading span test and is linguistic in nature. A participant is presented with math problems in sets ranging in size from two to six. After each mathematical operation, a word is presented that is to be memorized. Each set of mathematical operations must be solved as it is presented, and at the end of each set, all of the words must be recalled. The participant's working memory span is then determined by either counting the total number of words correctly recalled or by evaluating the largest set size at which performance was consistently successful (Turner & Engle, 1989; Michael & Gollan, 2005).

A non-linguistic test of working memory is the spatial span task, developed by Shah & Miyake (1996). It requires the simultaneous maintenance and processing of spatial information. In this task, a participant is presented with a set of letters, one at a time, with each one appearing in different orientations. The participant is charged with remembering the original orientation of the first letter while deciding if the subsequent letters are normal or mirror imaged by mentally rotating the image. At the end of the set, the participant provides the original orientation of each of the letters he/she saw. The participant's spatial span is found by summing the correct number of orientations accurately recalled. A modification of this task is the simple arrow span task, which requires the participants to recall the orientation of arrows

and does not require explicit processing. The following section will show how the tests reviewed above are used in both L1 and L2 research.

2.4.1.3 Working Memory and L1 Processing

Researchers, based on the above reviewed models of working memory, have attempted to determine how L1 comprehension is affected by working memory capacity. Daneman & Carpenter (1980) examined individual differences in working memory and reading comprehension. Their research looked to tax both the processing and storage functions of working memory with a reading span test. This test involved the usual demands of sentence comprehension, and required the participants to store and retrieve the final word of each sentence read in a set. Each sentence in the set, which was read orally, was presently rapidly so there was little time for overt rehearsal of the final word. For Daneman & Carpenter, this reading span test was taken as a measure of the participant's working memory capacity. To measure comprehension, a reading test was devised in which participants were questioned about a referent of a pronoun in a passage that they had just read, as well as some other fact from the passage. Finally, the participants were orally presented with a word span test, in which they were to recall all of the words after each set was completed. The researchers concluded that the reading span test was related to working memory capacity, and that working memory capacity is indeed limited. Moreover, the reading span test correlated with the other measures of reading comprehension. This illustrates that individual differences in reading can come from differences in working memory. Furthermore, the researchers suggest that good and bad readers may only differ on qualitative terms, and that poor readers may be using different and less-efficient processes than better readers, thus lessening the amount of information that can be held in working memory.

Also interested in L1 comprehension, Engle, Cantor & Carullo (1992) examined individual differences in working memory capacity and its effects on comprehension. To these authors, working memory consists "of those temporary or permanent knowledge units in long-term declarative memory that are currently active. Short-term memory is that information that is maintained at a surface level of coding" (990) and is still conscious. Thus, short-term memory is a subset of working memory, and working memory is a subset of long-term memory. Their goal was to investigate the relationship between storage, processing and comprehension in a task in which the speed and accuracy of processing could be measured independently of storage. The results from their research suggest that short term memory and working memory are separate structures and that individual differences in both are important to comprehension. The short term memory variable is important in comprehension because of the retention of surface-level codes. For an individual to build a mental model of a developing story, working memory is an important variable. With a greater working memory capacity, an individual is better able to comprehend a more difficult story, remember more minute details, and connect related ideas that are separated by context and time.

Like the above studies, King & Just (1991) were interested in how different working memory capacities influence syntactic processing and the ensuing comprehension. They examined, via word-by-word reading times, object relative and subject relative sentences. Furthermore, in each experiment, the participant's effective working memory was manipulated, either by imposing an extraneous memory load during processing, thus complicating comprehension, or by facilitating it with pragmatic information. They hypothesized that when the storage and processing requirements of comprehension exceed working memory capacity, performance on the subsequent tasks will deteriorate. Their results revealed that low working

memory capacity participants spent more time processing the critical portions of the object relative sentences yet still had difficulty in comprehension. Furthermore, participants with a high working memory capacity had difficulty comprehending object relative sentences when the demands made of their working memory capacity were increased. Regarding subject relative sentences, both high and low span readers performed similarly in reading times and comprehension. All readers, especially the low span readers, performed much better when pragmatic information was available to them when interpreting the object relative sentences. They concluded that individual differences in the supply and allocation of resources can account for differences between high and low working memory capacity participants in comprehending object relative sentences.

Vos, Gunter, Schriefers, & Friederici (2001) were also interested in comprehension and examined how working memory capacity and load affected online and offline processing of local syntactic ambiguity in German. Thirty-two native speakers of German participated in the experiment, and took Daneman & Carpenter's (1980) test of working memory in German; half were classified as high span, and the other half as low span. The experimental stimuli contained either a subject relative or object relative clause, and were ambiguous until a disambiguating auxiliary was reached. Working memory load was manipulated by extending the sentences beyond the disambiguating region. To ensure the participants understood the sentences, a true/false question was presented after every sentence. The researchers used ERPs to measure the processing of local syntactic ambiguity, and the participants began by memorizing either one or three words, were presented with the sentence word by word on a computer screen, and then answered the verification question. The results revealed that object-relative structures were harder to comprehend than subject-relative ones, and that high working memory capacity

participants were better at correctly answering the verification question, while low span participants were slower and less accurate in the verification task and word memorization task, especially when working memory load was increased. These results suggest that working memory capacity is related to syntactic processing.

To examine working memory constraints on lexical ambiguity, Miyake, Just, & Carpenter (1994) examined how participants with different working memory capacities maintained multiple representations of a lexical ambiguity during reading comprehension. They questioned whether those participants with a high working memory span were able to maintain multiple interpretations of a homograph in the absence of a previous disambiguating clue. For these authors, working memory is dynamic in nature and includes not only storage but also a computational component, neither of which is independent of the other. It is also the site for "executing various language processes and storing intermediate and/or final products of comprehension" (176). The two components of storage and computation compete with each other for a limited amount of cognitive resources. This has obvious implications for individual differences in language comprehension, in that if the storage component is not depleted, then enough resources are left over for comprehension. To study the effects of working memory constraints on resolving temporary lexical ambiguities, the researchers presented homographs in context-neutral positions with a disambiguating region multiple words after the homograph. They questioned how comprehenders would deal with multiple interpretations when the disambiguating information came much later after the ambiguous term, as representing and maintaining both meanings may consume more working memory resources. By using the moving windows paradigm, in which words are presented word-by-word, the task increases the demand on working memory capacity in two ways. First, the reader cannot go back to re-read

the previous parts of the sentence, and thus the information that is available is on that which is in the comprehenders' working memory. Second, by including comprehension questions at the end of each sentence, the comprehenders are forced to construct and maintain the mental representation of the text. Thus, high working memory capacity participants should be able to maintain both interpretations of the text as well as have them more fully elaborated at the time they reach the disambiguating region. Their research revealed that a reader's working memory capacity can constrain the degree to which multiple interpretations of a homograph can be held. That is, high working memory capacity participants were able to maintain both interpretations of the homograph and showed little effect of ambiguity when encountering the disambiguation, whereas the opposite was true for low working memory capacity participants. Overall, they conclude that working memory constrains ambiguity resolution.

2.4.1.4 Working Memory and L2 Processing

Working memory is an ideal variable for studying individual differences in SLA, for language analytic capacity, memory ability, and phonetic coding ability are often associated with working memory (Miyake & Friedman, 1998). It is also an important determinate for language proficiency in first language research, and as such may constrain second language learning (Hulstijn & Bossers, 1992). Since working memory plays a role in complex knowledge and skill acquisition, learners may be forced to rely on general learning mechanisms and principles to guide their SLA. Usage-based models argue that individual differences in working memory capacity stem from language experience (e.g., quantity and quality of input; frequency), and biological differences that affect processing accuracy (such as differences in the precision of phonological representation of oral/written input). To interpret differences found in working memory capacity in studies such as King & Just (1991), researchers working under this model

would argue that the differences found in syntactic processing emerge from variations in exposure to language, and that those high WMC participants have had more exposure to this type of language. The following studies examine the role of working memory in L2 (reading) comprehension and skill, noticing, processing, proficiency, and SLA in general.

Leeser (2007) examined how reading comprehension and processing of future tense morphology are affected by working memory capacity and topic familiarity. The 94 adult L2 learners of beginner level Spanish had no previous knowledge of the target form. For this experiment, they completed a grammar pre-test, answered questions about their familiarity with certain topics, and performed a computerized version of Waters & Caplan's (1996b) reading span test in English. They also read two reading passages that involved something that would happen in the future, with one group receiving two passages with topics familiar to them, and the other group receiving two passages with topics unfamiliar to them. Within the first two lines of the text, temporal expressions were provided to give some lexical cues to the participants about when the action would occur. After reading each passage, the participants performed a written recall protocol task in their L1 in order to determine what they understood, and they then completed a form recognition task in which they had to decide whether they had seen the word in the passage they read. They also performed a tense identification task that required them to translate a Spanish verb in the present, preterite, imperfect, conditional, or future into English. The results for the comprehension recalls revealed that only those learners with a higher working memory capacity benefited from receiving the familiar passage and that a higher working memory capacity also benefited learners that read unfamiliar topics on the form recognition task. These results suggest that working memory capacity plays a role in L2 learners'

comprehension and processing, and also some type of interaction between working memory and topic familiarity.

Taguchi (2008) was also interested in the relationship between working memory and L2 comprehension, and studied the ability of 35 L1 Japanese beginning learners of English to accurately and quickly comprehend conversational implicatures (i.e., implied meaning) in the L2. A pragmatic listening test was used to measure their ability to accurately and quickly comprehend implied intentions, two types of L2 listening tests were used to examine the impact of aural-specific variables on the comprehension of implied intentions, and two tests of cognitive abilities were also administered. The reading span test was administered in the L1 to measure the participants' working memory capacities, and a lexical access test was used to determine their speed in accessing semantic information. The results revealed accuracy and speed to not be related to each other, and that general listening ability was related to the correct comprehension of implicatures. Lexical access speed was found to be related to the speedy comprehension of implicatures, but not to accuracy of their comprehension. More importantly, working memory capacity did not strongly affect the accuracy or speed of the participants' comprehension of these implicatures, thus suggesting that working memory capacity does not play a role in L2 learners' ability to comprehend implied meaning.

Harrington & Sawyer (1992) was interested in working memory capacity and L2 reading skills as measured by performance on the reading and grammar portions of the TOEFL exam. The 34 advanced L2 English participants took a working memory test similar to Daneman & Carpenter's (1980), and the results of the working memory capacity were then correlated with the TOEFL scores. Their results showed that those participants with a larger working memory capacity scored higher on reading skill measures, as seen in the strong correlation between L2

reading span and TOEFL reading and grammar scores. The authors argue that L2 reading span test is an index of working memory capacity as defined as a trade-off between processing and storage. Geva & Ryan (1993) found similar results working with 10-12 year old English-Hebrew bilinguals. However, these bilinguals were simultaneous bilinguals who had learned to read the L2 at the same time they learned to read the L1, thus impeding any comparisons that could be made between L1 reading comprehension skills being transferred to L2 reading abilities.

Likewise, Abu-Rabia (2003) investigated the influence of working memory on reading and creative writing and whether the distance between a pronoun and its referent influenced retrieval of the pronoun from working memory. The 47 high school students in grades 10 and 11, whose L2 was English, took a test of written English which measured ten subtests including spelling, vocabulary, style, logical sentences, sentence combining, thematic maturity, contextual vocabulary, syntactic maturity, and contextual spelling and style. They also took the Daneman & Carpenter (1980) test of working memory in which they were required to read a passage and then answer questions about the text without referring back to it. The distance between the pronoun and its referent was manipulated in each of the two texts, and it varied from two sentences in the first passage to six in the second one. The results revealed a significant correlation between the test of written English and working memory. Concerning the distance between a pronoun and its referent, the results showed that distance did affect the participants' ability to correctly recall a referent accurately, suggesting that working memory did play a role in reading ability. Finally, the results also suggest that working memory and writing are positively correlated.

In similar vein, Walter (2004), working with two groups of L1 French learners of English that varied in terms of L2 proficiency, examined whether the transfer of L1 reading

comprehension skills to the L2 was related to working memory capacity in the L2. The 19 participants in the lower-intermediate group and the 22 in the upper-intermediate group performed three tasks in both languages: baseline comprehension assessment, pro-form resolution measure, and a verbal working memory measure. The first task required the participants to perform a summary completion in which they read a summary of a text and had to fill in the blank with the appropriate words, with the necessary words coming from level-appropriate books. For the second task, the participants read a story with instances of the pronoun and pro-verb co-reference printed in red, and were asked to tell what the word meant. Finally, a version of Waters & Caplan's (1996b) test of working memory was used to measure the verbal working memory capacity of the participants. The results revealed that both groups were skilled at reading comprehension in their L1, but were different in their ability to transfer this skill to L2 reading. There were also significant differences between the groups on their ability on the pro-form resolution measure. Finally, the results showed some correlation between L1 reading abilities transferring to L2 abilities and verbal working memory capacity. These results suggest that the ability to transfer L1 reading comprehension skills to the L2 is linked to the development of the L2 working memory.

Concerning noticing and working memory capacity, Mackey, Philp, Fujii, Egi, & Tatsumi (2002) found a relationship between working memory capacity and the noticing of interactional feedback. With regard to working memory, their study focused on verbal and phonological short-term memory, both of which have been linked to different aspects of language acquisition. Verbal working memory was defined as "the ability to recall verbal auditory input while simultaneously processing the input and was measured through a listening span test in L1 (Japanese) and L2 (English)" (187). Phonological short-term capacity was tested by the capability

to accurately recall novel verbal input, and a non-word recall test was used to test this ability. The authors also found that learners who reported noticing less tended to have lower working memory capacities, and that those who noticed more had higher working memory capacities. The developmental level of the learner seemed to play an important role in the relationship between noticing and working memory. Regarding working memory capacity and interlanguage development, learners with a high working memory capacity were more likely to benefit from interactional treatment in a face-to-face environment. These effects were found not immediately following the treatment, but rather after some time period. However, they must be interpreted with caution because of a small sample size.

Regarding L2 processing, Juffs (2004) examined four groups of L2 English speakers (30 L1 Chinese, 28 L1 Japanese, 46 L1 Spanish, and 21 native English speakers) to determine how individual differences in working memory capacity can explain individual variation in online performance. The sentences that the participants read included garden path sentences that caused processing difficulties and ambiguity, and it was this structure that was compared with working memory capacity. The results revealed only weak evidence for working memory's role in online processing, and that no differences were found between working memory capacity and average scores where the garden path sentences should be the most problematic and require the largest processing load. These results suggest that working memory capacity does not affect L2 comprehension.

Michael & Gollan (2005) were also interested in working memory and its effects on L2 processing. They studied the relationship between working memory capacity and bilingual performance on lexical retrieval and fluency by examining the role of inhibition, and they proposed that working memory may also be able to suppress irrelevant information while

maintaining task relevant information. They reviewed the two models of bilingual processing, Green's Inhibitory Control Model (1998), and Kroll and Stewart's Revised Hierarchical Model. Of importance is the relationship that suppression may have between working memory and bilingualism. Performance on working memory span tasks may be related to performance on bilingual tasks because both tasks require some type of suppression. There are two approaches to studying the relationship between working memory capacity and suppression. The first is to see whether or not working memory and suppression share resources. This is done by seeing whether or not the ability to suppress irrelevant information is disrupted by an increased working memory load. The second is to compare the ability to suppress irrelevant information between high and low working memory capacity individuals. They concluded that working memory and suppression are important factors in bilingual language processing.

Sagarra (2007) investigated the role of working memory capacity in the online processing of redundant grammatical forms in the L2. The 156 L1 English third-semester L2 Spanish learners read the experimental stimuli in Spanish at their own pace using the self-paced moving window paradigm. The stimuli contained regular transitive verbs that were controlled for length and frequency, and were placed in sentences with either temporal adverb-verb tense agreement or disagreement. The participants also completed a modified version of Waters & Caplan's (1996b) reading span test. The results from the moving window task revealed that the learners were not sensitive to adverb-verb tense incongruencies, suggesting that they could not process the redundant grammatical forms. Regarding the results for working memory capacity, the results showed that learners with a higher working memory capacity were better able to process both meaningful and redundant grammatical forms. These findings support a role for working memory capacity in L2 processing and comprehension.

Havik, Roberts, van Hout, Schreuder, & Haverkort (2009) also investigated the effects of working memory on online processing. They examined whether working memory would affect the online processing of temporarily ambiguous subject or object relative clauses in Dutch with L1 German advanced level learners of Dutch. The 24 learners were compared with a group of 24 native Dutch speakers. Using a word-by-word self-paced reading task, the participants read either short or long sentences and answered verification sentences based on the meaning of the sentence. The long sentences were six words longer than the short ones, and were meant to prolong the syntactic ambiguity of the sentence and thus complicate processing. However, before performing the online reading task, the L2 learners took a Dutch and German version of the Daneman & Carpenter (1980) reading span test, and the Dutch control group took the same test in the Dutch version only. The results of the self-paced task showed the native Dutch group preferred the subject-over-object preference when processing the temporarily ambiguous construction, with the L2 group showing the same preference. However, this latter finding was only true for those participants classified as having a higher working memory capacity, and only when they read the shorter sentences. Both the low working memory capacity native speakers and the L2 learners as a whole performed very similarly (i.e., poorly) on the long object-relative clauses, as this task was cognitively effortful for them. In a second experiment to address this finding, the researchers decreased the number of sentences that were followed by verification sentences from 100% to 25% of the time. The results revealed that processing was not affected by working memory capacity for the L2 learners. The results from both experiments suggest that when reading in the L2 for meaning, online processing in the L2 differs from L1 processing in that L2 learners are less able to use syntactic information for making online processing decisions, even when both languages are similar.

Payne & Whitney (2002) considered the relationship between working memory and oral proficiency development in the L2. They examined whether computer-mediated communication could aid in improving L2 oral proficiency by developing the same cognitive mechanisms that underlie spontaneous speech, and whether working memory capacity played any role in this development. Over the course of a semester, the experimental groups participated in two regular class periods and two online class periods per week. The online class periods consisted of chatting in chatrooms. The control group received regular instruction four days per week for the entire semester. Oral proficiency was measured at the beginning and end of the semester by an oral proficiency scale created by the researchers, and working memory capacity was measured via a non-word repetition task and an adapted version of Daneman & Carpenters (1980) reading span test. The results showed that L2 oral proficiency can be developed through L2 interaction in chatrooms, and that the learners in the experimental group scored higher than those in the control group. The results further revealed a strong correlation between phonological working memory capacity and oral proficiency development, and that the learners with a lower working memory capacity in the control group were disadvantaged when compared with those in the control group with a higher working memory capacity. However, the same cannot be said for those lower capacity participants in the experimental group, suggesting benefits for them in the chatroom environment.

Also interested in the relationship between working memory and L2 development, Sagarra (2008) examined the relationship between L2 development through computer-delivered oral recasts and working memory capacity. Eighty-two L1 English first-semester level L2 learners of Spanish were divided into two groups: recast group and control group. The participants in the recast group aurally received the correct construction if the answer they provided was incorrect,

whereas the control group received no feedback for an incorrect response. Working with noun-adjective agreement in Spanish, the participants filled in the blanks in sentences on the computer with an adjective that needed to be matched in gender and number with the noun it modified, and the participants in the recast group received feedback for an incorrect answer. They also completed written post-tests, an adapted version of Waters and Caplan's (1996b) test of working memory, and also performed oral information exchange tasks that required production of the target form. The results showed that recasts received orally and via computer positively affected grammatical development of the target form for both the immediate and delayed post-test. They also had positive effects on the participants' production of the target form on the face-to-face tasks. Regarding working memory, it proved to be a good predictor of the learners' ability to benefit from receiving recasts via computer, suggesting that development of L2 linguistic abilities is affected by working memory capacity.

Similar to the above works that examined the effects of working memory on one measure of L2 development, Ellis & Sinclair (1996) argue that working memory capacity, and the short-term phonological store, affects SLA in general. They examined working memory capacity and its role in the acquisition of vocabulary and syntax in an experiment with 87 L1 English speakers. The experiment consisted of a learning phase and a testing phase, with the former requiring the speakers to learn English translations of Welsh phrases. It was in this learning phase where the groups differed, with one group of learners being asked to repeat novel language utterances, while another group was prevented from articulating the phrases, and a third group serving as a control group and were not given instructions. The testing phrase involved a well-formedness test to elicit fast judgment of grammatical correctness, a rule test phase which tested explicit metalinguistic awareness of rule structures, and a speech production

test to examine the ability to produce phrases. The results of this experiment revealed a beneficial effect for articulatory rehearsal, with the group that repeated the novel language utterances outperforming the group that was required to suppress rehearsal in receptive skills, explicit metalinguistic knowledge, acquisition of the L2 words and phrases, pronunciation, and grammatical fluency and accuracy.

Likewise, Miyake & Friedman (1998) proposed working memory to be the fundamental component of language aptitude in adult second language learning. Their central tenet is on working memory for language and the constraints imposed upon it by limited resources. Moreover, "it is possible to specify what particular aspects or sub-processes of L2 learning and use depend on WM and exactly how they are constrained by capacity limitations" (348). As they note, a larger working memory capacity appears to facilitate second language learning. Furthermore, individual differences in first language working memory capacity are closely related to second language working memory capacity and to language comprehension. These authors review the "less is more" hypothesis, which states that having a larger working memory capacity is detrimental to the ultimate level of attainment, for it does not allow for only some elements within the input stream to be processed and maintained, as happens with a smaller working memory. Rather, a larger working memory capacity tends to make learners focus on each string of input as a whole, and they are thus prevented from performing a detailed internal analysis of the encoded elements. Miyake and Friedman ultimately discount the "less is more" hypothesis in favor of the "more (working memory) is better" perspective, at least for adult second language learners. They argue that the "less is more" hypothesis cannot easily be applied to the individual differences in working memory capacity because even an adult's low span working memory capacity is too large to allow for a careful internal analysis of the input.

To them, the “less is more” hypothesis is not compatible with the “more is better” framework, as the former compares the low working memory capacity of children to adults, whose working memory capacity is already higher for developmental reasons. Meanwhile, the “more is better” framework compares differences among adults’ capacities.

2.4.1.5 Working Memory and the L2 Learning Context

While the above studies suggest a possible role for working memory in some aspects of SLA, they do not consider how it affects L2 learners in different learning contexts. Although the classroom setting is important for second language learners, it has been noted that interaction between instructors and students tends to include simplified input at the sentence level (Chaudron, 1985, 1988; Henzl, 1979; Kleifgen, 1985; Hatch, 1983; Larsen-Freeman, 1985), and as such, does not overtax the learners working memory, thus allowing them to retain and process the linguistic information while simultaneously preparing a response. In these settings, there is sufficient time for controlled processing, thus allowing learners to hold and compare new input and output in their working memory with L2 norms. Thus, these items with may become automatized in the learners’ interlanguage system. However, non-simplified input, as well as input at the discourse level, requires more working memory capacity, and is this more problematic for second language learners at intermediate levels. Classroom learners with immersion experience generally are faced with discourse level input both inside and outside the classroom, and their conversation exchanges include host family members and friends, as well as other members of the target community with whom they may have daily interaction (e.g., waiters, store employees). Therefore, this increase in input may overtax the working memory capacity of beginning and intermediate learners, thus prohibiting them from encoding the

grammatical information in the message that would otherwise be compared with their current knowledge of the L2.

To date, little research has examined whether working memory capacity affects the amount of input that can be processed and comprehended in L2 learners in different learning contexts. However, Tokowicz, Michael, & Kroll (2004) did investigate the effects of working memory capacity on single word translation performance with two groups of learners who varied in their length of study abroad experience. They examined two types of errors the learners made: non-response errors and meaning errors. The former refer to errors that occur when the participants said they did not know the answer or did not provide one, while the latter refers to incorrect responses in their translations. Twenty participants who had eight months or fewer of study abroad experience were compared with 17 participants who had 15 or more months of study abroad experience. Within each group, they were divided into either high or low working memory capacity, based on their performance on an operation-word task. The results revealed that the participants in the more study abroad group with higher working memory capacity make as many meaning errors as they did non-response ones when translating into their non-dominant language. Furthermore, they found that study abroad forces learners to attempt to make meaning related responses instead of not answering, and conclude that learners with a higher working memory capacity are better able to take advantage of certain communicative strategies, thus leading to increased communicative success in a study abroad context.

In a more extensive study, Sunderman & Kroll (2009) examined the role of working memory capacity in lexical comprehension and production of learners with and without a study abroad experience, and if a certain level of cognitive abilities is necessary if L2 learners are to

benefit from a study abroad experience. The 34 classroom learners had no experiences studying abroad, whereas the 14 study abroad learners had spent anywhere between two and ten months immersed in the L2 context. All of the participants performed the Waters & Caplan (1996b) test of working memory, and the comprehension task consisted of a translation recognition task, whereas the production task consisted of a picture naming task. The results for the comprehension task revealed that regardless of the learning context, those participants with a higher working memory capacity performed better than those with a lower working memory capacity. Concerning the results from the production task, those with a higher working memory capacity and who have had an immersion experience performed better. They conclude that those learners with a lower working memory capacity do not benefit as much from a study abroad context.

However, working memory capacity is predicted to affect the relative success or failure of second language learners' grammatical development in study abroad contexts. Lafford (2006) and Lafford & Collentine (2006) have proposed a role for working memory capacity in SLA in general, and they hypothesize that as some processes become automatized, more space becomes available for controlled processing. This therefore allows input, including low salient and highly redundant forms, to become intake and to be incorporated into the learners' interlanguage system. They also argue that intermediate learners with lower working memory capacities may also lack sufficient grammatical knowledge, prohibiting processing of both grammatical form and content, thus benefiting less from a study abroad experience, as they will only focus on comprehending the message. Alternatively, more advanced learners that have better grammatical knowledge and cognitive abilities will not become frustrated while abroad because they have enough space in working memory to process both low salient and highly

redundant forms, all the while being able to comprehend the message. Therefore, as Lafford (2006) notes, the study abroad setting is not ideal for controlled processing which requires time for planning and self-monitoring L2 production. Moreover, contextual pressures to keep the conversation flowing hinder learners' working memory functions, breaking the controlled to automatic cognitive processing, therefore "facilitating the automatization of incorrect L2 forms in SA learners" (11). These hypotheses suggest that more advanced learners and those with larger working memory capacities may benefit more from study abroad experiences because many grammatical forms have already been automatized, and as such the learners will have enough resources to process highly redundant cues and incorporate them into their interlanguage and improve their L2 grammar abilities. Conversely, learners with low working memory capacities or those who are not as advanced in the L2 will not benefit as much from the immersion experience because of their undeveloped linguistic system and lack of automatized processing.

Alternatively, Sunderman & Kroll (2009) argue that in an immersion context, there are two possible explanations for how the L1 is inhibited: the inhibition may be natural and not require any internal resources to actively suppress it, or that it must be actively inhibited and working memory capacity plays a more central part. If the latter is true, then high working memory capacity L2 learners can benefit more from an immersion experience because they can attend to multiple factors simultaneously (i.e., suppress the L1 and attend to the L2), whereas low working memory capacity learners cannot handle the cross-linguistic competition and either revert back to using the L1 or suffer other costs to their language processing.

2.4.1.6 Summary

The results from the experiments presented in this section suggest working memory plays a role in both L1 and L2 processing and comprehension. Much research has shown it to have some effect on how certain items in a second language are learned, and more recently, its role in a study abroad setting has been pondered. The next section will examine inhibitory control, a cognitive individual difference that is thought to be closely related to working memory.

2.4.2 Inhibitory Control

2.4.2.1 Inhibitory Control Models

Although there is currently only scant research and hypotheses suggesting that working memory capacity affects L2 processing in different learning contexts, there is some literature suggesting that inhibitory control is affected by the L2 learning context (Linck, Hoshino, & Kroll, 2008; Linck, Kroll, Sunderman, 2009; Levy, McVeigh, Marful, & Anderson, 2007). However, before examining this literature, we will examine some models and features of inhibitory control, a concept thought to be closely related to working memory. As noted above, inhibitory control is the ability to allow target items to enter the linguistic system and be processed while preventing the processing of non-target items (Linck et al., 2008). This inhibitory ability is one factor thought to be responsible for the limited capacity of working memory (Rosen & Engle, 1998; Engle et al., 1995), and individual differences in inhibitory control in normal adults has been proposed as underlying variation in memory failures, working memory span and reading comprehension, problem solving, and general cognitive ability (Friedman & Miyake, 2004).

Hasher & Zacks (1988) present a model for efficient operation of working memory and the inhibitory mechanisms within it. These inhibitory mechanisms serve to limit entrance into

working memory any information that is not along the “goal path” of comprehension (212). A breakdown in the efficiency of inhibitory mechanisms “will lead to cross talk among simultaneously active messages, preventing organized responses” (213). Thus, comprehension and memory are restricted. Under this model, when non-goal information enters working memory, it results in the prolonged maintenance of information in working memory, and also causes difficulty in switching attention from one category of events to another. This also has effects for retrieval, as information that cannot be encoded cannot be rehearsed for later recall.

Green (1998) proposed an inhibition control model that contains multiple levels of control. Under this model, a conceptualizer builds conceptual representations of the message to be conveyed (i.e., goal) based on information from the long-term memory. The supervisory attentional system (SAS) and other components of the language system (i.e., lexico-semantic system and a set of language task schemas) mediate language processing. Language task schemas include translation schemas or word production schemas, and these compete to control output from the lexico-semantic system. Activation levels are important in this model, as an item must remain active until the goal is achieved, another schema inhibits it, or the goal was changed. For example, when one has to name a picture in one language, the SAS activates the word production schema which sends further activation to the lexical level where lemmas contain language tags. As the lemmas in each language are activated, the task schema is responsible for raising the activation level of one of the lemmas in one language while it inhibits the raising of the activation level in the other. This requires a conscious effort on the part of the speaker, and all of this occurs as long as the individual maintains the task as the goal; otherwise, task-irrelevant behavior may arise.

Bunting, Conway & Heitz (2004) suggested that differences in working memory capacity are better explained by a model in which working memory capacity is referred to as the ability to resist interference rather than a limited amount of activation. In their experiments, they found that individual differences in working memory capacity were related to performance in the fan paradigm when there were multiple sources of response competition, but even more so, when there was interference across learning sets. This difference was not found when interference from competing sets was removed. They stated that individual differences in working memory capacity are owed to "(1) the ability to control the activation of relevant information, and (2) the ability to block activation of distracting information" (620). This ability was found in their experiments with high working memory capacity individuals outperforming and being better able to suppress irrelevant information than those low working memory capacity individuals.

2.4.2.2 Inhibitory Control Tests

Just as there are numerous tests to measure working memory, there are also many tests of inhibitory control. Furthermore, there are issues surrounding the use of these tests, and what they measure. As noted above, it remains debatable whether working memory and suppression share resources, and the amount of overlap between the two. What follows are some of the types of tests used to measure inhibitory control.

To assess inhibitory control, oftentimes a Stroop task is performed. Since word reading is an automatic process, it is not easily inhibited, and adept readers process the meaning of a word, even when instructed not to do so (Long & Prat, 2002). This task is an ideal measure for investigating the relationship between working memory capacity and inhibitory control, since the "capacity of controlled attention is limited and is the primary source of individual

differences in working-memory capacity" (Long & Prat, 2002, 295). In the Stroop task, individuals are asked to identify the color of a stimulus in congruent, neutral, and incongruent trials. For example, in the congruent trials, the word "red" is presented in the color red .In neutral trials, the letters "XXX" appear in the color red, and in incongruent trials, the word "red" is presented in the color blue. Response times for incongruent trials are generally larger than those for congruent and neutral trials, and this is known as the "Stroop Effect". This effect has been found for both verbal and manual key press responses.

Negative priming is another way to measure inhibitory control. One example of negative priming can be included in the Stroop task. In this task, the conflict trials are arranged in pairs. Some pairs are related so that the irrelevant word on the prime trial is the to-be-named word on the target trial (negative priming trials). That is, the to-be-named color was the to-be ignored word on the previous trial. For example, if the previous trial showed the word "red" in the color blue, the subsequent trial would show the word "green" in the color red.

The antisaccade task can also measure inhibitory control and does not require a verbal response. It is a visual orienting task in which a cue flashes on one side of a screen, and the participant must try to suppress the reflexive saccade toward it and instead look at the opposite side of the screen to identify the target (Friedman & Miyake, 2004).

Another way to measure inhibitory control is to use the fan paradigm. In this task, participants first learn many "facts" about various people in various locations. The number of sentences that share concepts is manipulated experimentally. By varying the number of concepts about the people and locations, it is assumed that "the size of the propositional networks developed in LTM will also vary" (Cantor & Engle, 1993). In subsequent speeded recognition tasks, participants verify the truth of some statements. Some were previously

learned target facts whereas others were not, and were meant to mislead them. It is thought that the more facts that are associated with a person or location, the longer it will take to verify just one fact about a person or location.

The cocktail party phenomenon is yet another measure of inhibitory control. In this dichotic listening task, participants hear a relevant message in the right ear, and are to ignore an irrelevant message in the left ear. They are instructed to shadow (repeat) the relevant message as soon as it is presented and to ignore the irrelevant message. The participant's name is inserted in the irrelevant message, and is later asked via questionnaire about the irrelevant message. Participants that detected something unusual in the irrelevant message generally stated that they heard their own name (Conway, Cowan, & Bunting, 2001). The following sections show how researchers have used these tests to examine the role of inhibitory control in L1 and L2 processing.

2.4.2.3 Inhibitory Control and L1 Processing

Conway & Engle (1994) studied how individual differences in working memory affected performance on retrieval tasks. They found that high and low working memory span participants differed in their ability to retrieve information from their working memory. In these retrieval tasks, low span participants were unable to inhibit activation of the irrelevant information. Therefore, this weaker information was able to come into an active state, and the differences in retrieval were owed to differences in the ability to inhibit irrelevant information. These authors assume, however, that inhibition is resource demanding and that participants differ in the attentional resources they have available to them, and that participants with a high working memory capacity have greater attentional resources, and thus a greater capacity for inhibiting task-irrelevant information.

Also interested in the relationship between working memory and inhibitory control, Conway et al. (2001) examined individual differences in working memory capacity via the cocktail party phenomenon to measure inhibitory control. They proposed two theories, each with a different outcome. The first idea was that those participants with a high working memory capacity would detect their names in an experiment using the cocktail party phenomenon because they would be better able to monitor the irrelevant message with no damage to the shadowing performance. The second was that low working memory capacity individuals would more likely detect their names because they would be poor at maintaining attention on the relevant message when irrelevant information is presented. Their results revealed the latter to be true. That is, the participants with a low working memory capacity detected their names more often in the irrelevant message than did those with a high working memory capacity. This suggests that low working memory capacity individuals have difficulty in inhibiting irrelevant information.

Long & Prat (2002) examined differences in working memory and the ability to suppress irrelevant information by using the Stroop task. They examined whether high working memory capacity participants performed better on the Stroop task than those participants with a low working memory capacity. They also studied whether or not high working memory capacity individuals would develop a reading suppression strategy when performing the task. Their results revealed that low working memory capacity participants showed more Stroop interference regardless of the number of conflict trials, whereas those with a high working memory capacity only showed this effect when a low proportion of conflict trials was present. With higher numbers of conflict trials, high working memory span individuals were able to

minimize the Stroop interference. They concluded that individual differences in working memory are related to differences in the ability to suppress task-irrelevant information.

Related to the interaction between working memory and inhibitory control, Wagner & Gunter (2004) explored whether the inhibitory processes in working memory could be determined by the trade-off between contextual and mental lexicon information. Their data suggest no general difference in inhibition between high and low working memory capacity participants when no context information was available, so long as lexicon information was available to calculate the relevance of the two meanings of the lexical ambiguity. However, a trade-off was found between the lexicon and content. They argued that individual differences in lexical ambiguity resolution can be determined by "factors that specify the relevance of certain WM content" (297) and not just by general differences in inhibitory processes. Furthermore, they assert that this lexicon-context trade-off differs in its default setting for high and low working memory capacity participants, where high span participants prefer to use a higher portion of lexical information than do low span participants when calculating the importance of information in their working memory. They concluded that during reading, high and low span participants make a trade-off between lexicon and context, both factors that drive the inhibition of unrelated information in working memory.

Considering the role of working memory in the management of interference, Radvansky & Copeland (2006) studied the degree to which working memory capacity provides a "partial index of how well someone deals with sources of interference" (33). They examined the role of working memory capacity on long-term memory retrieval and learning, and found some support for the idea that working memory capacity is related to the ability to integrate information, although only in retrieval of information and not of its learning. When information is integrated,

there are fewer sources of interference that can be experienced during later memory retrieval. However, their results did not reveal support for the idea that working memory capacity involves a "coordination of retrieval inhibition" (44). They suggest that inhibition operating in working memory may be different from inhibition operating in long-term memory retrieval. That is, any inhibition that is operating in the working memory controls the contents of the current flow of information, and suppresses any irrelevant information that enters working memory. In comparison, any irrelevant information that enters during long-term memory is inhibited by a different mechanism, which guides those parts of prior knowledge that are relevant.

Finally, Gunter, Wagner, & Friederici (2003) used event-related potentials (ERPs) to investigate two mechanisms which can underlie working memory that are employed during language processing, for each makes a different prediction. When activation is the underlying mechanism, it is thought that high working memory capacity individuals will activate both meanings of a homonym equally well in their working memory, while low working memory capacity individuals will only activate one meaning (King & Just, 1991; Just & Carpenter, 1992). When inhibition is the underlying mechanism, the opposite is predicted. That is, high working memory capacity individuals are better able to suppress irrelevant information better than those with a low working memory capacity. If it is the case that inhibition is the underlying mechanism of working memory, then it is expected that upon encountering a homonym, a high working memory capacity individual will suppress the subordinate meaning, and will only have active the principle one, whereas a lower working memory capacity individual will maintain both meanings present. In their experiment, participants were presented with sentences which started off with an ambiguous noun, and were later cued to a particular meaning three words after the ambiguous noun. The cueing was followed by a verb in which half of the cases were

disambiguated from the meaning of the homonym to the expected meaning, thus being in line with the disambiguation cue. In the other half, the verb disambiguated to the other meaning which required the participants to switch meaning. Their results revealed that high working memory participants were able to suppress the irrelevant meaning quickly and efficiently. Low working memory span individuals, however, were only able to suppress a dominant meaning if they were provided with enough time. High working memory span participants principally had the dominant meaning in their working memory at the cueing position, whereas the low working memory participants had both meanings equally active in their working memory. Thus, they argue that it is inhibition that underlies working memory.

2.4.2.4 Inhibitory Control and L2 Processing

Thus far, it appears that inhibitory control plays a role in L1 processing and is related to working memory capacity. However, just as working memory is thought to play a role in L1 and L2 processing, it is also important to consider the role inhibitory control plays in SLA. Bialystok, Martin, & Viswanathan (2005) examined age effects on inhibition. They propose that the concept of control is a function of attention, and is thus dependent on inhibition. As working memory capacity declines with age, older adults have less control over its contents and therefore less executive control in general, when compared to younger adults. Their experiments with monolingual and bilingual older adults and children show an advantage for the bilinguals in their performance on the Simon task in both congruent and non-congruent trials. They explain that “the attentional processes required to manage a mixed set of items is under the same executive control as that needed to inhibit the misleading cue in the incongruent trials” (117). That is, bilinguals are better able to control their attention when misleading information is presented, even in the face of an incorrect, but compelling, alternative.

2.4.2.5 Inhibitory Control and the L2 Learning Context

Much of the research on inhibitory control has been conducted with monolinguals (Conway & Engle, 1994; Conway et al., 2001; Long & Prat, 2002; Gunter et al., 2003; Wagner & Gunter, 2004; Radvansky & Copeland, 2006), advanced bilinguals (Bialystok et al., 2005; Michael & Gollan, 2005), and the elderly (e.g., Hasher & Zacks, 1988; Connelly, Hasher, & Zacks., 1991; Hamm & Hasher, 1992). However, one possibility is that inhibitory control also plays a role in second language acquisition and how beginning and intermediate learners process or do not process certain cues in different learning contexts. Ellis (2007) proposes that the ability to inhibit or block linguistic input may play a role in what gets processed and the final level of L2 attainment. If L2 learners in an immersion setting block or inhibit their L1, then they may have more cognitive resources available to them to devote to L2 cue acquisition and to focus on different cues. As such, this ability can affect both classroom learners and classroom learners with immersion experience differently, possibly causing better inhibitors to allow more cues to enter their linguistic system. Moreover, it is possible that better inhibitors in the classroom perform differently or inhibit different information from the better inhibitors in the immersion setting, and it is therefore important to consider the L2 learning context and its effects on inhibitory control.

Interested in this possibility, Levy, McVeigh, Marful, and Anderson (2007) argue for an adaptive role of inhibitory control in speeding up SLA. Their first experiment asked 32 L1 English L2 Spanish participants to repeatedly name words either zero, one, five, or ten times, in English or Spanish, and they then measured the participants' ability to access the English labels for the objects using rhyming independent probes (e.g., snake, break). The second experiment was similar to the first, but examined whether inhibition was specific to phonology and not to

semantic representations, and used phonologically or semantically related test cues. The results revealed that the more often the L2 word was repeated, the more difficult it was to produce the word in the L1. The level of proficiency in the L2 also played an important role, and the results showed that the largest phonological inhibition of English words was found in participants who were the least fluent in producing the L2 vocabulary tested. This suggests that L1 attrition is most likely to occur when the learners have difficulty producing the L2, similar to what may happen in an immersion context. The second experiment found that the inhibition effect can be isolated solely to phonology, and not to semantic relatedness. These authors conclude that L1 attrition cannot be owed to a lack of use of the L1 during an immersion experience, but rather to a paradoxical dynamic: that words more frequently used in the L2 are more likely to be forgotten in the L1.

In a more developed study, Linck, Hoshino, and Kroll (2008) examined the effects of the L2 learning context on the development of inhibitory control. The participants were 23 classroom learners without an immersion experience with 20 pre-immersion classroom learners, 28 classroom learners who were currently in their third month of residence in Spain on a semester-long study abroad program, and 50 post-immersion classroom learners, and they all performed multiple cognitive and linguistic tests, including the Simon task. The immersed learners were matched with classroom learners without an immersion experience on a variety of measures, including L1 and L2 self-ratings and WMC. The results from the Simon task revealed that classroom learners were significantly better at inhibitory control than the immersed L2 learners, suggesting that the L2 learning context is an important variable in the development of inhibitory control. They argue that while L2 learners in the immersion context

receive external cues about what to inhibit, classroom learners only receive cues on what to inhibit from within, as external cues are unavailable to them.

Also interested in the role of inhibitory control in a study abroad setting, Linck, Kroll, and Sunderman (2009) examined two groups of L1 English L2 Spanish learners of intermediate level who varied in their study abroad experiences. The study abroad group consisted of 25 learners living in Spain, and the classroom only group consisted of 20 participants. All of the participants performed a translation recognition and verbal fluency task, as well as a Simon and reading span task, with these tasks taking place during the third month of immersion for the study abroad group. The results from the immersion group revealed that access to the L1 was weakened during an immersion experience, and that the L1 was less accessible for the comprehension and production tasks. Fourteen of the immersed learners were tested six months upon returning from their study abroad experience to examine if these effects were long-lasting, and the results revealed that for the translation recognition and verbal fluency tasks, the effects were durable; however, for the latter task, the L1 abilities did improve to match those abilities of the classroom only group. The authors conclude that L2 learners inhibit their L1 while immersed in the L2 context, and that L2 learning affects L1 processing.

2.4.2.6 Summary

The literature reviewed in this section reveals that there appears to be a relationship between working memory and inhibitory control, and that the latter may be responsible for the limited capacity of the former. Research has shown that inhibitory control plays a role in both L1 and L2 processing and can affect accessibility to the L1 while immersed in an L2 environment. It has been proposed that both working memory and inhibitory control may inhibit or block

certain cues from being processed in the L2, and it is for these reasons that they have been included as variables to be investigated in this work.

2.5 The Present Study

The studies presented in this chapter indicate that native speakers of a morphologically poor language who are learning a morphologically rich one attend to lexical cues before morphological ones when both encode the same meaning in a sentence. In addition to the role of L1 experience, two other factors emphasize this preference for lexical cues: L2 experience (instructors overuse lexical cues in the classroom) and the linguistic characteristics of this type of morphological cues (they are low reliable, low salient, and redundant). L1 experience and the linguistic characteristics of L2 cues are fixed factors in the sense that there will always be both people learning an L2 morphologically richer than their L1 and the co-occurrence of lexical and morphological cues within a sentence to assign the same meaning. However, the overrepresentation of lexical cues in the classroom can be changed by immersing learners in a naturalistic learning environment rich in morphological cues. If this is added to the fact that the number of students complementing classroom learning with study abroad settings has skyrocketed in the last decade, and that studies examining the role of proficiency have failed to separate proficiency from immersion experience, a study on the effects of studying abroad on the learners´ ability to change their cue preferences (from relying on lexical cues to relying on morphological cues) is both timely and overdue.

This dissertation aims to cover this lacuna by examining whether classroom learners with immersion experience will show a more native-like preference for processing morphological cues in the input when the morphology is redundant with a lexical item than classroom learners without an immersion experience of the same proficiency level. The

prediction is that classroom L2 learners without an immersion experience will prefer to process the lexical adverb whereas those learners with an immersion experience will prefer to process the verbal morphology.

The role of working memory in processing redundant lexical and verbal morphology has also been investigated, and it has been found that learners with a better working memory capacity are better able to process both cues simultaneously. In addition to its role in processing multiple cues, it has also been found to play a role in L2 development in a study abroad environment, with higher working memory capacity individuals benefiting more from such an experience. Inhibitory control is another factor that is thought to affect how L2 cues are added to a learner's linguistic repertoire, and past research has shown inhibitory control to be affected by the learning context. As learners become immersed in the L2 environment, access to the L1 becomes inhibited, and may therefore allow L2 morphological cues to enter their linguistic system.

This work addresses these two issues by examining whether working memory and inhibitory control, two factors that cannot be changed, play a role in determining what cues are selected for processing temporal reference. More specifically, it investigates whether higher working memory capacity learners process these items differently from otherwise comparable low working memory capacity learners, and if learners with a higher working memory capacity benefit more from an immersion experience when compared with low working memory capacity counterparts. The prediction is that higher span learners, regardless of their L2 learning context, will outperform their lower-span counterparts. Additionally, this experiment studies the role of inhibitory control on what gets noticed in the input and if the ability to better inhibit irrelevant or additional cues leads to a worse ability to process and incorporate them. The

prediction is that a better inhibitory control will assist the classroom learners with an immersion experience in noticing the morphological incongruency, as access to the L1 will be limited.

In order to address these questions, two groups of classroom learners of Spanish that only vary in terms of their immersion experiences will be compared with Sagarra & Ellis' (personal communication) and Sagarra's (2007) findings that monolingual Spanish speakers prefer to process morphological cues over lexical ones. The use of two groups is important because it allows for comparisons to be made between the groups who only vary in terms of a study abroad experience. A pretest-posttest design (same group before and after studying abroad) was not adopted due to logistical reasons (the eye-tracker equipment could not be moved at the time of the data collection, and many of the participants left the university upon returning from their study abroad experience). However, a classroom control group was included in this work. The lack of a classroom control group would prohibit attributing any gains in L2 development to the study abroad experience, as the gains could be owed to a natural progression in the L2 learning process that L2 classroom learners without an immersion experience may also have shown. In order to match the participants for proficiency level, the two L2 Spanish groups performed a proficiency test and grammar and vocabulary test as objective measures of L2 proficiency. Processing speed for N-1 was also considered. The participants also gave subjective measures of L2 proficiency by providing self-ratings of their L2 abilities in the four skills. Each group also performed an eyetracking task in which they read sentences that varied in terms of adverb-verb tense congruency. The use of eyetracking was motivated by several factors. First, it is an online technique that provides insight into which cognitive processes may be in use at a given moment in time. Offline tasks, in comparison, do not allow the investigator to know with great detail what or how the learner processes the

input. Moreover, many offline tasks that attempt to mimic online processing, such as think-aloud protocols or grammaticality judgment tasks, are unnatural, intrusive, and may not be a true reflection of the learner's knowledge. Second, by continuously recording eye-movements during reading, researchers are able to identify the locations and durations of eye fixations. Eyetracking is a better measure of this than the moving window technique, as it allows for a more natural style of reading and for regressions. By examining regressions, researchers are able to determine what cues a learner uses to resolve adverb-verb incongruencies.

This chapter has served to provide the appropriate conceptual framework for the current experiment by reviewing and critiquing the pertinent literature. Additionally, it has motivated the need to carry out such an experiment. In the chapter that follows, the specific methodologies and procedures used to answer the research questions of this work are discussed.

CHAPTER 3: Methodology

3.0 Introduction

The purpose of this chapter is to describe the methods and procedures used in the present study. Section 3.1 presents an overview and the experimental design of the study, and section 3.2 examines the target structure. Section 3.3 and 3.4 delineate the characteristics of the subject pool and the materials used, respectively. The next section 3.5 describes the data collection procedure, and section 3.6 covers the data scoring. Finally, section 3.7 discusses the statistical analyses employed for each context.

3.1 Overview and Experimental Design

To examine the effect of immersion and cognitive individual differences in the L2 processing of lexical and morphological cues, 60 classroom learners (24 without an immersion experience, and 36 with an immersion experience) of the same proficiency level completed 6 tasks in one session that lasted two hours (see Table 2 below).

Table 2 *Experimental Design*

Language background questionnaire	Language contact profile (study abroad group only)	Reading span test in L1 (working memory)	Simon test (inhibitory control)	L2 proficiency test	Eyetracking task	Verb and tense recognition tests
(10 minutes)	(10 minutes)	(30 minutes)	(10 minutes)	(20 minutes)	(30 minutes)	(15 minutes)

Participants in the study abroad group completed six L2 processing and proficiency tests. The language background questionnaire determined their language learning experience, and was administered to ensure homogeneity among the participants and served as a screening

test to determine eligible participants. The language contact profile included questions to ensure that the immersion experience of the study abroad group was comparable among the students in this group. The proficiency test was an objective measure that examined participants' linguistic knowledge via a discrete point grammar task and was used to test homogeneity between and among the groups and learners, respectively. Additionally, the participants provided a subjective measure of their L2 proficiency via self-ratings of their L2 abilities on the four skills. The remaining screening tests, the verb and tense tests, evaluated both the meaning of the verbs and the present and past forms of regular verbs. The verb and tense tests were used to guarantee that any longer reading times on incongruent adverb-verb pairings could be attributed to the participant recognizing the error and not to a lack of familiarity with the targeted tense, forms, and/or verbs. It was important that these tests be provided after the eyetracking task so as not to draw their attention to verb conjugations, which might have affected their performance on the eyetracking task. The RT on N-1 was also used as an objective measure of L2 proficiency, as was accuracy on the filler comprehension questions. The non study abroad group performed the same tests, save the language contact profile. The eyetracking task measured processing time on lexical and morphological cues and required participants to read sentences with adverb-verb and verb-adverb tense congruencies/incongruencies and answer a yes-no comprehension question after each sentence. Finally, cognitive individual differences in working memory and inhibitory control were measured by means of a reading span and a Simon test, respectively. The reading span test as a measure of working memory was given because it is thought that working memory plays an important role in maintaining task-relevant information while performing complex processing tasks. The working memory test was given in the participants' L1 because working memory is

thought to be language independent (Osaka & Osaka, 1992; Osaka, Osaka, & Groner, 1993). The reading span test required participants to read sets of sentences, decide whether each sentence was plausible within a limited amount of time, and recall the final word of each sentence within a set. Inhibitory control is believed to affect reading comprehension and to be important for allowing input access to working memory, and its role in the Associative-Cognitive theory has been predicted to be an important factor but has not been empirically tested. In the Simon test, participants had to match the color box that appeared on the computer screen with the correct colored button on the keyboard as quickly as possible. However, the location of the box on the screen varied with the location of the button, causing either congruent or incongruent conditions between the button and box location.

The current research project follows a mixed design with three independent variables (two within-subjects: adverb position (pre or post verbal) and verb correctness (correct or incorrect) and one between-subjects: group) and two covariates (working memory, inhibitory control).

3.2 Spanish Temporal Adverbs and Verbal Morphology

The target structure consisted of regular transitive verbs in Spanish in the present and simple past tenses presented with the temporal adverb *ayer* 'yesterday'. The present tense for third person singular in Spanish is formed by adding –e to the root of verbs whose infinitives end in –er or –ir, such as *comer* 'to eat' and *vivir* 'to live'. Thus, these verbs conjugate as *come* 'he/she eats' and *vive* 'he/she lives'. For verbs whose infinitives end in –ar, -a is added to the root of the verb, and thus the verb *hablar* 'to talk' conjugates as *habla* 'he/she talks'. The simple past tense for the third person singular is formed by adding –ió to the stems of regular –er/-ir verbs or –ó for regular –ar verbs. For example, the simple past of the verb *comer* 'to eat' is

comió ‘he/she ate’ for the third person singular; the verb *vivir* ‘to live’ becomes *vivió* ‘he/she lived’; and the verb *hablar* ‘to talk’ becomes *habló* ‘he/she talked’ in the third person singular (Butt & Benjamin, 1995). Only regular verbs in both the present tense and simple past tense, and not verbs in which the root changes between them, were included in the experimental sentences. Although the frequency of the target verbs was considered, following Alameda & Cuetos’ (1995) dictionary of frequencies, Anderson (2007) notes that that classroom input tends to follow the organization of the textbook used very closely. To account for this lack of variability in the classroom, and for the variability that does occur in a more naturalistic setting, all of the verbs included varied in their frequency, but were verbs that would heard in the L2 classroom (see Appendix A for verb frequencies). Perceptual span, or the region from which a reader can obtain useful information during single eye fixations, can vary between and within participants, and there is an asymmetry between the number of characters available to the left (three to seven characters) and right (up to 15 characters) (Den-Buurman, Roersema, & Garrisons, 1981; Foucart, 2008; McConkie & Rayner, 1975; McConkie & Rayner, 1976; Pollatsek, Rayner, & Balota, 1986; Underwood & McConkie, 1985). For this reason, every verb was a minimum of five characters in length to reduce the likelihood of it being skipped when reading or to be perceived when reading the word immediately before or after it.

The decision to use present and simple past tenses was motivated by several factors. First, data from a control group of monolingual Spanish speakers reading similar sentences with adverb-verb tense incongruencies has already been collected (Sagarra & Ellis, personal communication), and the results suggest that L1 Spanish speakers prefer to process morphological cues over lexical ones. Second, both tenses are frequent in classroom and immersion settings and are covered in the first semester of study of Spanish. Third, the

morphological change for regular verbs between the present and simple past tense does not change the number of syllables in the verb and only changes the last morpheme(s) of the word. While the written accent on simple past regular third person singular verbs makes them more salient, this is not a problem for the present experiment as the written accent will appear with and match the correct temporal adverb. In other words, it is the correct form and should not cause longer reading times.

As for temporal adverbs in Spanish, they can either precede or follow the verb without any pragmatic or semantic difference. This is important because altering the position of the adverb (before or after the verb) is in line with the research of Sagarra & Ellis (personal communication), and allows us to rule out the possibility that learners regress to the adverb in the adverb-verb condition simply because they rely on whatever cue they encounter first in the sentence. Following Sagarra & Ellis, the temporal adverb was *ayer* 'yesterday,' given its frequency in classroom and naturalistic contexts. Additionally, it was used because other temporal adverbs such as *el año pasado* 'last year' provides a double clue, in that *pasado* 'last' inherently denotes pastness.

3.3 Participants

The sample pool consisted of 60 intermediate learners: 36 classroom learners with immersion experience and 24 without immersion experience. To be included in the study, participants had to be between 18 and 40 years of age (working memory and processing speeds decrease after the age of 40: Park, Welsh, Marschuetz, Gutchess, Mikels, Polk, Noll, & Taylor, 2003), be university students, and complete all tasks. In addition, they had to be native speakers of English who began learning Spanish after puberty to ensure that their L1 syntax had already been formed (e.g., Crain & Lillo-Martin, 1999; Guasti, 2002; Hawkins & Franceschina, 2004).

Furthermore, the L2 learners could not have knowledge of another foreign language or have had previous exposure to one for more than three months either in the foreign country or classroom, as some researchers have shown even three months to be sufficient time for language improvement (e.g., pronunciation; ability to mimic longer strings of the L2; pragmatics) (Lafford, 2006). They must also have received a 90% or better on the verb and tense recognition tests to control for knowledge of the target structure and lexicon, must have scored between 40%-60% on the Spanish proficiency test to ensure L2 homogeneity between the two L2 groups. Although this range of scores appears quite low, the test measures very advanced grammatical structures, therefore making those scores within this range acceptable. The participants also must have been accurate above chance on the comprehension questions of the eyetracking and the plausibility judgments of the working memory test to ensure that they understood the sentences. Participants were seventh or eighth semester Spanish students at a large public university on the east coast of the United States who have had similar L2 learning experiences at the university, based on the findings from the language background questionnaire. In addition to these characteristics, the immersion group lived 16 weeks with a monolingual host family in a monolingual community (Madrid, Spain). In summary, the two groups of participants were comparable in terms of motivation, type of instruction, proficiency level in terms of performance on a discrete-point proficiency exam, and age of acquisition. Finally, students received a combination of extra credit and $15 for their participation in the study.

3.4 Materials

As mentioned earlier, participants completed three types of tests: either four or five screening tests (language background questionnaire, language contact profile (study abroad

group only), L2 proficiency test, and tense and verb recognition tests), one eyetracking task, and two tests of cognitive individual differences (reading span and Simon test).

3.4.1 Screening Tests

The language background questionnaire evaluated the participants L2 learning experiences and was administered in the participants' L1 to ensure they fully understood each question. The questionnaire determined what their L1 was, any other languages they knew, their past L2 learning experiences, their use of the L2 outside of the classroom (a percentage between 0 and 100%), the age at which they began learning the L2 and in what context, the number of years they have been learning the L2, and their motivation to learn the L2. They were also asked to list their major. In addition to the language background questionnaire, the study abroad group answered questions from Freed, Dewey, Segalowitz, & Halter's (2004) language contact profile. This questionnaire included detailed questions about their experience abroad, including the number of days each week they did certain activities and the number of hours each day they spent doing these activities. The questions also focused on their living situation: whether any of the other members in the household spoke English, the amount of time spent reading, writing, speaking, and listening to Spanish both inside and outside the classroom, and the amount of time spent using English in similar contexts while abroad. The language background questionnaire and the language contact profile are illustrated in Appendices B and C, respectively.

The second screening test consists of a Spanish proficiency test taken from the grammar portion of the Diploma de Español como Lengua Extranjera (DELE), which examines broad, general knowledge of the L2. For this task, the participants read a passage written in Spanish and chose from three options the correct answer for 20 items (see Appendix D). In addition to

the L2 proficiency test that examined knowledge of the L2 grammar, the participants also gave a self-rating of their L2 proficiency. In this task, the participants provided a self-rating on their ability to read, write, aurally comprehend, and speak the target language on a scale ranging from 1 (minimum ability) to 5 (native-like proficiency). It is important to examine both the participants' self-rating of proficiency and their proficiency based on the proficiency tests because research suggests that self-ratings correlate with L2 abilities and proficiency (Blanche & Merino, 1989; Oscarson, 1997; cf. Brantmeier, 2006), and having both tests allows for both subjective and objective proficiency measures. Moreover, the participants RTs on N-1 is examined to determine L2 processing speed, and their accuracy on the filler comprehension questions is also considered as an objective measure of their L2 proficiency.

The third screening test, the verb recognition test, required the learners to match Spanish verbs in the infinitive with their English translation equivalents (e.g. *hablar* → 'to talk') (see Appendix E). The verbs corresponded to those employed in the experimental sentences. Finally, for the tense recognition test, participants matched conjugated Spanish verbs with their English translation equivalents (e.g., *hablé* → 'I talked') (See Appendix F). The present and simple past tense Spanish verbs were conjugated for the first person singular, second person singular, and third person singular and plural.

3.4.2 Eyetracking Task

Eyetracking measures the location and time that the eye fixates at a certain point on a computer screen. Eyetracking, and not some other on-line measure such as event-related potentials (ERPs) or self-paced reading tasks, was used because eye-movements are a natural reaction in normal silent reading, and thus tracking these movements via eyetracking is a logical progression. Furthermore, previous research investigating morphological and lexical cue

preferences have used written stimuli, and as Sagarra and Ellis (personal communication) have found their results based on the stimuli in this modality, the same mode must be used in order to make a valid comparison. Additionally, as noted above, past research has shown L2 writing abilities to improve from a study abroad experience (Huebner, 1995; C.A. Isabelli, 2000, 2001, 2004). Rayner, Sereno, Morris, Schmauder, & Clifton (1989) note that reading rates and comprehension levels obtained in the presence of eyetracking are the same as those obtained during natural, silent reading. Yet another benefit of eyetracking is that it provides richer details about the data and may also allow for subtle differences to be captured (Mitchell, 2004). Furthermore, it provides information about the nature of a problem at a specific point in the sentence and not simply that there was a problem (as indicated by an increased reading time). Diagnosis of a problem area is revealed by different, but commonly recorded, measures, such as first-pass gaze duration or reading time, cumulative (e.g., total) reading time, and percentage of regressions, which are crucial to determine what cues learners use to resolve adverb-verb tense incongruencies.

The eyetracking data for this experiment were collected in a laboratory setting on the main campus of the Pennsylvania State University using an EyeLink 1000 machine designed by SR Research. The EyeLink 1000 used required the participant to rest his/her chin on a chin rest approximately 55 centimeters from the camera, and 75 centimeters from the monitor, while a remote camera mounted on the table followed his/her right eye. The sampling rate for the remote camera was 1 kHz, with a gaze tracking range of 32 degrees horizontal and 25 degrees vertical and a 0.01 degree for the root mean square (RMS) spatial resolution. The machine was calibrated and validated for each participant before the trial sentences and after each break. See Appendix G for an image of the actual equipment and lab.

For the eyetracking task, participants read two-line sentences in Spanish on a computer screen presented one by one and answered a yes-no comprehension question after each sentence. Each participant randomly received one of four sets of 146 sentences: 6 practice trials, 40 experimental sentences (10 per condition), and 100 fillers (see Appendix H for the experimental sentences). All sentences were controlled for length (9 to 15 words) and the vocabulary and grammar were adequate for the participants' L2 proficiency level. In order to avoid experimental sentences from appearing next to each other within a set, they were randomized using a Latin square design, which is an experimental design that allows the researcher to control for variation in two directions. Each set contained 10 blocks of 4 experimental and 10 filler sentences each.

The experimental sentences followed an ADV-NP-V-NP-PP-PP or NP-V-NP-ADV-PP-PP structure and sentences broke onto the next line after the first preposition preceding the NP. All sentences were controlled for length (9 to 15 words) and the vocabulary and grammar was adequate for the participants' L2 proficiency level. Adverbs and verbs did not appear at the end of sentences to avoid wrap-up effects (Just & Carpenter, 1980). Half of the experimental sentences contained adverb-verb tense agreement, and the other half had adverb-verb tense disagreement, as shown in (1) and (3) and (2) and (4) below, respectively. The complex NP as the subject of the sentence was included so that the participants' perceptual span would not interfere with the results. Perceptual span is the angular span (vertical and horizontal), within which the human eye has sharp enough vision to read text. While reading, readers will fail to recognize a word unless they are fixating within three to four character spaces to the left of the word and up to fifteen character spaces to the right of a word (Den-Buurman, Roersema, & Garrisons, 1981; Foucart, 2008; McConkie & Rayner, 1975; McConkie & Rayner, 1976; Pollatsek,

Rayner, & Balota, 1986; Rayner, 1975; Underwood & McConkie, 1985). Also, the location of the temporal adverb varied, and was either the first word of the sentence as in (1) and (2), or was placed before the first prepositional phrase as in sentences (3) and (4). The adverb was placed in the very first position of the sentence to replicate previous studies.

(1) *Ayer el profesor de economía cocinó el arroz en la cocina para su mujer.*
'Yesterday the professor of economics cooked rice in the kitchen for his wife.'

(2) **Ayer el profesor de economía cocina el arroz en la cocina para su mujer.*
*'Yesterday the professor of economics cooks the rice in the kitchen for his wife.'

(3) *El profesor de economía cocinó el arroz ayer en la cocina para su mujer.*
'The professor of economics cooked the rice yesterday in the kitchen for his wife.'

(4) **El profesor de economía cocina el arroz ayer en la cocina para su mujer.*
*'The professor of economics cooks the rice yesterday in the kitchen for his wife.'

Regardless of the condition, the comprehension question that followed was based on the content of the previously read sentence, and not its grammaticality, so as not to draw the participant's attention to the incongruency. As such, a comprehension question for above sentences would be *¿Era un profesor de economía?* 'Was he a professor of economics?'. Half of the comprehension questions required a yes response, and the other half required a no response. This was also true for the practice sentences.

The filler sentences for the participants were similar in length and difficulty to the experimental ones, and half of them were based on subject-verb agreement, while the other

half were based on gender agreement. The sentences based on subject-verb agreement were similar to the sentences seen in (5) and (6), and the filler sentences for gender agreement were similar to those seen in (7) and (8), below. The comprehension questions for these filler sentences were similar in style to those for the experimental ones, always with a focus on content of each sentence. Similar to the experimental sentences for the experiment, half required a yes response while the other half required a no response.

(5) *El profesor explica que las abogadas caminan/*camina por la playa con sus hijos.*

'The professor explains that the lawyers walk/*walks on the beach with their children.'

(6) *El profesor explica que la abogada camina/*caminan por la playa con sus hijos*.

'The professor explains that the lawyer walks/*walk on the beach with her children.'

(7) *El bebé pide el plátano amarillo/*amarilla/*amarillos de la mesa de la cocina.*

'The baby asks for the yellow banana on the kitchen table.'

(8) El bebé pide los plátanos amarillos/*amarillas/*amarillo de la mesa de la cocina.

"The baby asks for the yellow bananas on the kitchen table.'

3.4.3 Working Memory Test

To measure working memory, participants completed a modified version of the Waters & Caplan (1996b) reading span test in English. The test was divided into 3 practice sets, and then 20 experimental sets, each containing two to six sentences. Sentences were presented in sets of 2, 3, 4, 5 or 6 sentences, but were randomized so that the subjects did not know the subsequent set size. For this test, participants read silently 80 sentences on a computer screen one at a time,

decided whether each sentence was implausible (e.g., *It was the story that told the librarian*) or plausible (e.g., *It was the dentist that extracted the cavity*) by pressing a yes or a no button, and recalled the last word of each sentence. Half of the sentences for both the practice and experimental sentences in this test were plausible, while the other half were implausible. At the end of each set of sentences, the participants were prompted to recall the last word of each sentence within that set, and were to write it in a booklet provided. They were given an unlimited amount of time to write their answers. The sentences used appear in Appendix I.

3.4.4 Inhibitory Control Test

To measure inhibitory control, participants performed the Simon test, which "is a simple means of assessing the degree to which individuals can override a habitual response and replace it with a more intentional choice" (Bialystok et al., 2005). In this task, the participants were asked to ignore the position of a target stimulus in order to respond to its color. The position of the stimulus in some of the trials conflicted with the response key that was required for the correct solution. The test consisted of 24 practice trials and three experimental blocks of 42 trials, for a total of 150 trials (126 experimental trials). The trials were presented in random order, and both reading times and accuracy were recorded. If the participant made an error, the word ERROR appeared in the center of the screen, as one way to encourage accuracy in the test.

3.5 Procedure

Participants completed all tasks in a laboratory in one session that lasted approximately two hours. First, participants filled out the informed consent form and completed the paper-and-pencil language background questionnaire in 10 minutes. The study abroad group also answered the language contact questionnaire, which took approximately 10 additional minutes. After completing the questionnaire(s), participants took the reading span test and inhibitory

control tests; both tests were presented on a computer via E-Prime software (Schneider, Eschmann & Zuccolotto, 2002). After the tests of cognitive individual differences, they performed the eyetracking task. The finished the experiment by performing the verb and tense recognition tests. This procedure order in which all of the English materials were seen during the first part of the experiment was done primarily so that upon beginning the DELE, they could begin to transition from reading and thinking in English to Spanish, and would therefore be ready to read the experimental sentences in Spanish. This follows from the research by Levy et al. (2007) that showed that L2 usage can inhibit certain L1 features.

The working memory test took 30 minutes to complete. For each trial, participants saw a fixation point in the middle of the screen for 500 ms, read a two-line sentence in English, and indicated whether the sentence made sense or not using a yes or no button. The handedness of the participants was controlled for, with right handed people placing their right index finger on the yes button, and their left index finger on the no button. The converse was true for left handed participants. The participants had to read each sentence, remember the last word of the sentences, and provide a plausibility judgment for each sentence between 300ms and 5000ms, and the process continued until they say the word RECALL. When they finished reading the sentence and made the plausibility judgment, and they were within the window of acceptable reading times, they would strike the spacebar to progress to the next sentence. When the word RECALL appeared, they wrote the last word of each sentence from that set in the booklet provided. Once finished, they placed their hands back on the keyboard and pressed the spacebar button to start another set of sentences of unknown difficulty level (i.e., a set of two sentences may be followed by a set of five sentences, etc.). The researcher observed the

participant while performing the three practice sets to ensure he/she understood how to proceed with the test. An illustration of this task is provided below in Figure 2.

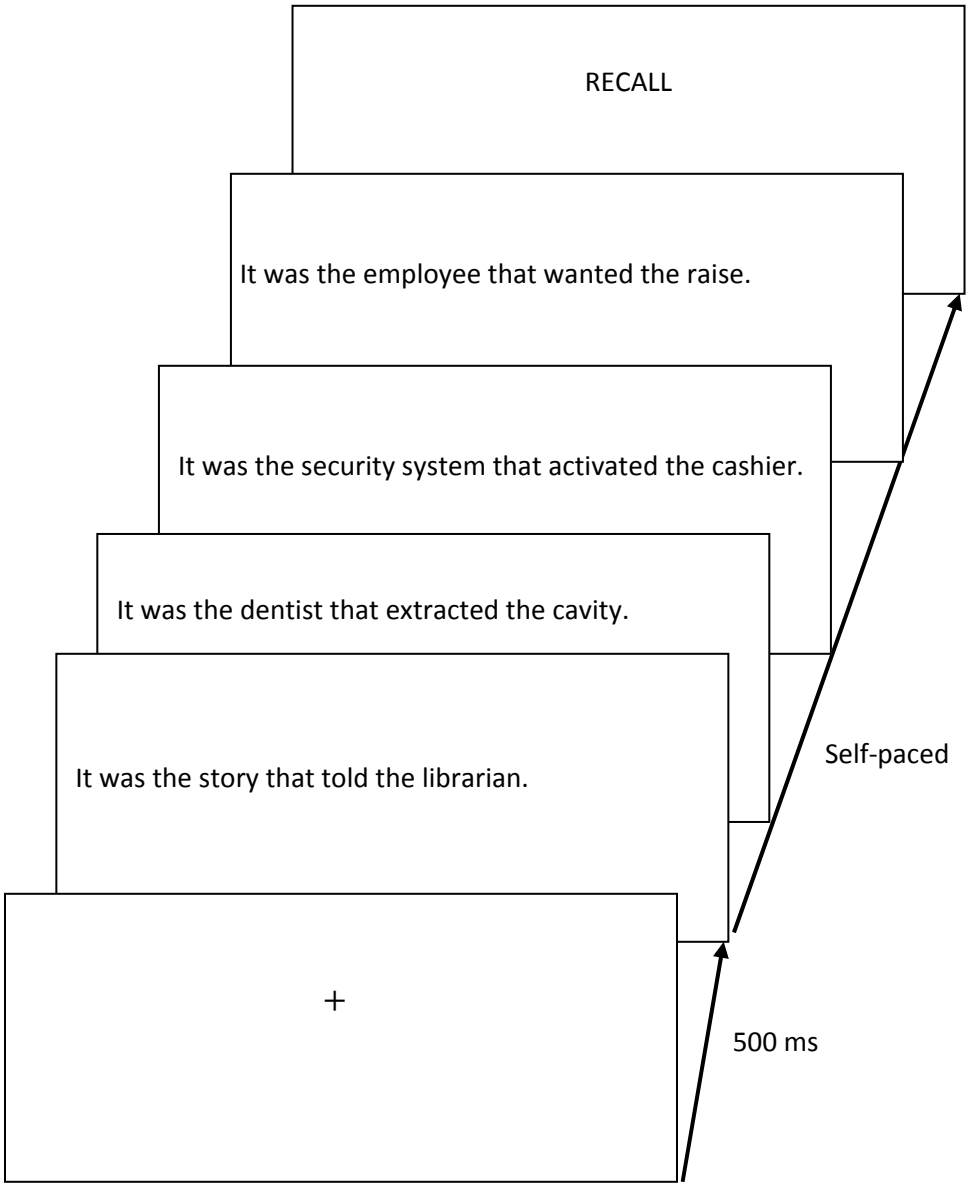

Figure 2. Sample Screen of Working Memory Test.

After finishing the working memory test, participants completed a 10-minute test of inhibitory control. In this test, the participants remained seated in front of a computer and were

provided with instructions both orally as well as written on the computer screen. The participant saw either a blue square or a red square on either the extreme left or extreme right of a computer screen. His/her fingers were placed either on a blue key or a red key, and they had to press the corresponding colored button to the matching colored square that appeared on the screen. However, not all trials were congruent. That is, the red key may have been on the right side of the keyboard, but the red square may have appeared on the left side of the monitor (above the location of their left hand, which would have been covering the blue key), and vice versa. The participant did not know where the colored square would appear. Reaction time responses for these tests were recorded via key strokes on the computer. During the practice trials, the researcher observed the participant to make sure he/she understood how to do the test. This test is illustrated below in Figure 3.

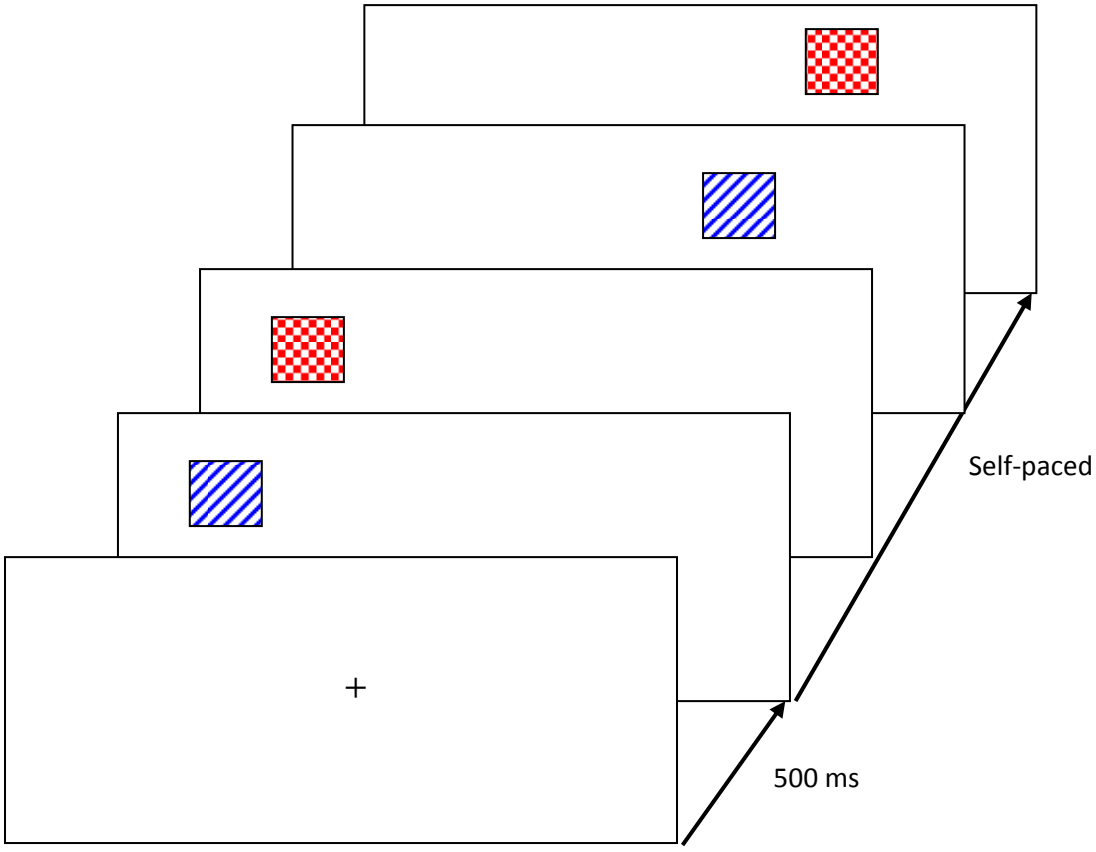

Figure 3. Sample Screen of Simon Test.

Upon completing the test of inhibitory control, participants performed the L2 proficiency test which consisted of the grammar portion of the DELE for the classroom learners with and without immersion. The participants were instructed that they would be taking a test of Spanish grammar, and to select the answer they believed best fit the question. The test took 20 minutes to complete.

After the DELE proficiency test, all of the participants performed the eyetracking task. For this task, they were seated at a different table and were briefly explained the task that they would be performing: reading sentences on a computer screen while a desk mounted camera followed their eye movements. For this task, they placed their chin on a chin rest that was

adjusted for their body size, so that when seated properly, their eyes were parallel with the top one-quarter of the computer monitor from which they would read the sentences. Next, the researcher adjusted the camera that would follow the participant's eye movements, and then began the calibration and validation stage of the experiment in which the participants had to follow a dot on the computer screen first for the calibration stage, and once again for the validation stage. Upon finishing this step, the participants were ready to begin and took hold of a hand-held controller which would be used to answer the yes/no comprehension questions. They focused on the dot approximately 2 inches below the upper left corner of the computer monitor, and when the camera captured the eye, the researcher would strike the spacebar on the keyboard of a different computer so that the sentence would appear. When finished reading the sentence, the participants would look at a grey box in the bottom right corner of the screen approximately 25 square centimeters in size, which would then bring up a comprehension question. Upon answering the comprehension question, the process was repeated until the next break. After taking each of the two breaks from reading the sentences, calibration and validation was performed, and the experiment continued. Figure 4 illustrates a sample of two trials.

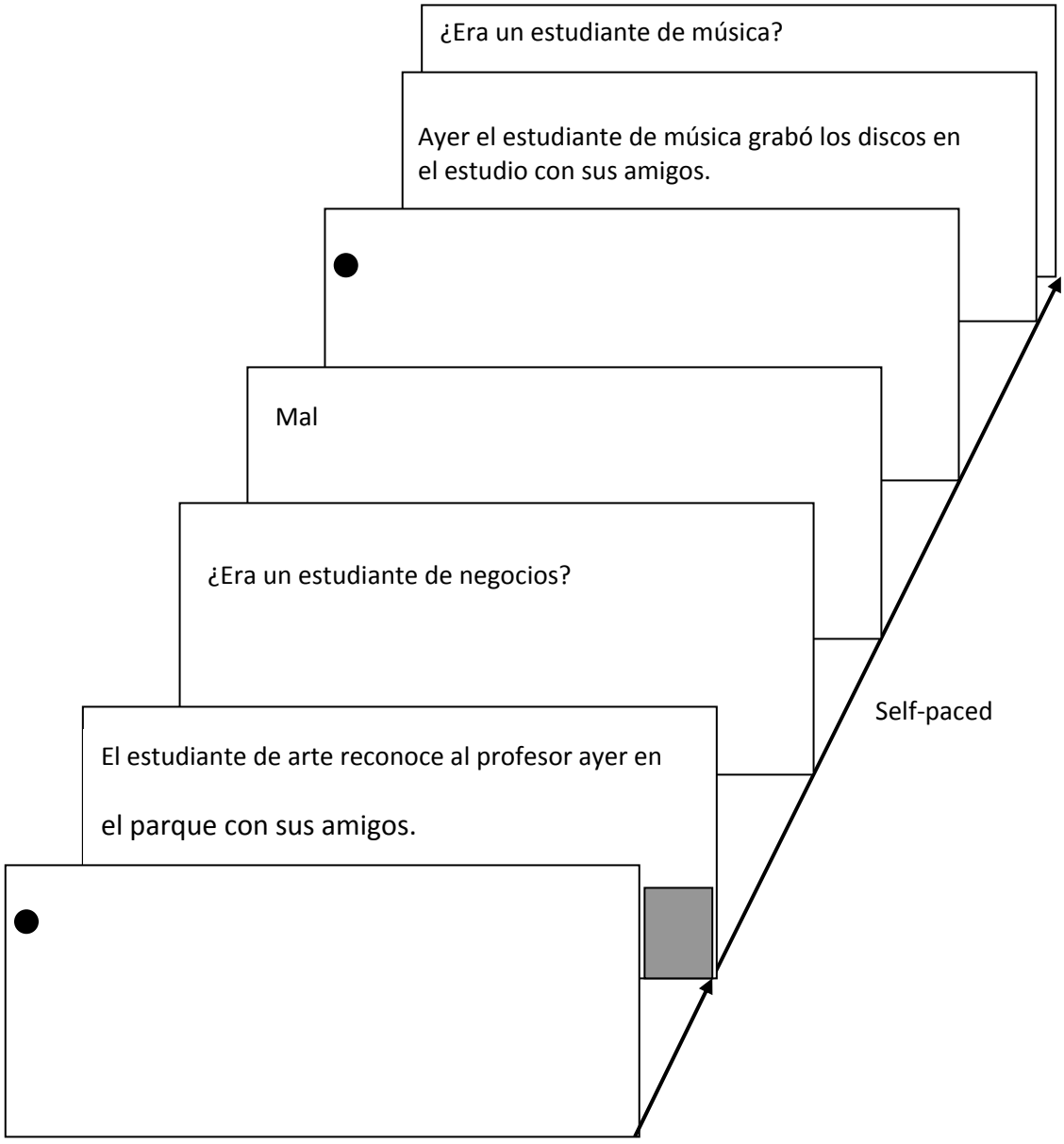

Figure 4. Sample of Eyetracking Task with Two Trials.

At the end of the eyetracking task, the final ten minutes required the participants to complete two more paper-and-pencil tests: the verb vocabulary and tense recognition tests. For each of these tests, the participants were seated at a desk and chose the option they believed to be the best fit for each question.

3.6 Data Scoring

The screening tests were used as a method to eliminate participants so that the participants within and between groups would be as homogeneous as possible. The language background questionnaire was used as a screening measure to eliminate any participants that did not fit the requirements for the experiment. The data from the language contact profile was used to examine the amount of exposure to the L1 and L2 the classroom learners with immersion experience had while abroad. For the language proficiency exam, the participants received one point for each correct answer, and zero points for each incorrect answer, and must have scored between 40 and 60% on the exam (eight to twelve correct out of 20). For both the verb recognition and tense recognition tasks, one point was awarded for each correct response, and zero for each incorrect response. Participants must have received a 90% or better on the test to be included in the experiment.

For the eyetracking task, the reading times for the critical regions were only taken from those sentences in which the comprehension question was correctly answered. Furthermore, only sentences which had corresponding comprehension questions that were answered correctly were included for statistical analysis, to decrease the probability of increased reading times being owed to a lack of comprehension. Then, for each critical region, the mean reading times were calculated from the individual reading times for each condition, and this number was used for the statistical analysis. Reading times less than 120 ms were excluded from analysis, as is standard in current psycholinguistic procedures (Rayner & Pollatsek, 1989). Mean reading times were calculated for the adverb and verb, as well as the word immediately preceding and following the adverb (adverb-1, adverb+1, respectively) and verb (verb-1, verb+1, respectively). The mean reading times considered were the gaze duration and total time. Gaze duration

includes the first pass reading time (i.e., the amount of time spent on a word or region when first landing on it) and is the total amount of time fixated on the critical word before moving on to the next word. Total time is the sum of the first gaze duration and any other gaze durations or regressions into the region before finishing reading the sentence. The mean reading times for adverb-1 and adverb+1 included the first gaze duration, whereas the reading times for the adverb contained both the first gaze duration and total time. Gaze durations were also obtained for the verb-1, verb+1, and verb regions, and total time on the on the verb was also included. The critical regions included the item preceding the critical region to ensure there were no differences between the conditions prior to encountering the error. The region following each of the verbs and adverbs was included because of evidence suggesting delayed processing when reading due to concurrent comprehension processes still being carried out, and especially when there is an incongruence or error (L1: Blanchard, 1987; L2: Dekydtspotter, Schwartz, & Sprouse, 2006).

Multiple factors determined the ultimate working memory capacity for the participant in the working memory test. First, the participant had to accurately recall the “recall” word as well as answer correctly the sentence’s plausibility. Second, the plausibility judgments had to be made faster than 5000 ms but no slower than 300 ms, so that neither the complexity of the task was jeopardized nor there was insufficient time for processing. The participants had to be accurate above chance on their responses because it is well documented that under time pressure, the dominant hand is faster and would tend to press the yes button more often, and it is for this reason that handedness was controlled for. Working memory capacity was calculated as the total number of correctly recalled final words from the sentences in which correct plausibility judgments were made.

For the inhibitory control test, one point was awarded for each response in which the participant correctly matched the color to the key (successful inhibition), and zero points for each unsuccessful attempt. Any trial in which the reading time was greater than 1500ms was excluded from analysis, as were trials immediately following an incorrect response. The mean reading time was then calculated separately for the congruent and incongruent trials, and the inhibitory control score (i.e., Simon effect) was determined by the difference between the means, or reading time (incongruent) minus reading time (congruent). This was used as a between-subjects variable to asses its effect on the participants' ability to notice the incongruence.

3.7. Analyses Procedures

The initial results to be presented in the next chapter will be analyzed via a repeated measures fully factorial analysis of covariance (ANCOVA) with a 2 (position: pre/post verbal adverb) x 2 (correctness: correct/incorrect verb morphology) x 2 (group: +/- study abroad) factorial design with working memory capacity and inhibitory control scores (Simon effect) entered as covariates for each variable under investigation (adverb and verb gaze duration, adverb and verb total reading time, and gaze duration for the word immediately following the verb and adverb). A fully factorial ANCOVA includes all interaction terms between the covariates, within participants factors, and between participants factors. In a combined analysis, differences in variability between groups can sometimes mask significant differences that are present in a single group. Moreover, results from repeated measures ANCOVAs do change main effects of the repeated measure when compared to assessing the main effect via a simple repeated measures analysis of variance (ANOVA). Main effects of repeated measures factors are independent of the between participant covariate of working memory and inhibitory control;

therefore, pure repeated measures effects are reported from an ANOVA that excludes the covariates when the original model proved to lack the power to explain any main and interaction effects. For this reason, the degrees of freedom (df) may differ for pure repeated measures effects and between participant effects or interactions.

Per the backward stepwise approach for choosing a model, a model begins with a particular set of variables and deletes terms one at a time until the simplest model that fits the data is formed (Jobson, Olkin, & Fienberg, 1991; Kutner, Nachtsheim, & Neter, 2004). This method for choosing a model is similar to that of a step down approach, which can be used to assign high priority to certain covariates and low priority to others that initially showed lower causality (Raykov & Marcoulides, 2008). For the case with these data, the largest model will begin with inhibitory control and working memory capacity entered as covariates, and will consider how well the model fits the data by examining the main and interaction effects. Depending on the degree to which each covariate explains the variability in the variables, it will either be kept or removed. If the covariate can explain a considerable amount of the variability (i.e., interaction between the covariate and variable(s) is significant), then it will be kept in the model as it will make the model stronger. However, if the covariate explains little of the variability (i.e., the interaction between the covariate and the variable(s) is non significant), then it is removed from the model for it makes the model weaker. The process will continue until the strongest model is formed. As more covariates are removed from the model, the fewer degrees of freedom are removed from the error. The results of this full factorial model, as well as those for the resultant, final model for each critical region, are presented in the following chapter.

Chapter 4: Results

4.0 Introduction

This chapter presents the results of the experiment conducted to investigate whether study abroad experience helps classroom learners acquiring Spanish to rely more on morphological cues, like native Spanish speakers do, and whether individual differences in working memory capacity and inhibitory control modulate their ability to do so. To address these questions, L2 classroom learners with and without an immersion experience performed an eyetracking task consisting of reading sentences with lexical and morphological cues encoding temporal reference, a working memory test (reading span test) and an inhibitory control test (Simon test). To control for variables other than those under investigation, participants also completed six screening and proficiency tests: a language background questionnaire, a language contact profile (study abroad group only), an L2 proficiency test, self-ratings, a verb recognition test, and a tense recognition test. The chapter is divided into three sections.

The first section (4.1) presents the descriptive statistics for the screening tests (4.1.1), the eyetracking task (4.1.2), and the working memory and inhibitory control tests (4.1.3), and a summary of the descriptive statistics (4.1.4). Subsection 4.1.1 presents the means for the language background questionnaire and language contact profile, the L2 proficiency level test (DELE), the verb recognition test, and the verb tense recognition test. Subsection 4.1.2 presents the grand means for the gaze durations at the word immediately preceding the adverb and verb (N-1 henceforth), the adverb and verb (N), and the word immediately following the adverb and verb (N+1). N-1 is used to ensure no differences in first gaze reading times before encountering the error, while N+1 is used to capture delayed processing effects. N-1 and N+1 are examined in terms of one RT measure (i.e., gaze duration), and N is examined in terms of two RT measures

(i.e., gaze duration and total time). Gaze duration includes the first pass reading time (i.e., the amount of time spent on a word or region when first landing on it) and is the total amount of time fixated on the critical word before moving on to the next word. Total time is the sum of the first gaze duration and any other gaze durations or regressions into the region before finishing reading the. Total time is important because it considers gaze durations for regressions into the critical region. Moreover, as past research has shown, L2 learners may show delayed processing, and will not notice the error until they have already moved on, and will then return to the problem area.

The second section (4.2) provides the results from the inferential statistics for the screening tests (4.2.1), as well as the eyetracking task and the working memory and inhibitory control tests (4.2.2). The first subsection (4.2.1) consists of *t*-tests for independent samples to determine whether the two groups of participants are comparable in terms of L2 proficiency level and L2 experience, based on their responses from the screening tests. The second subsection (4.2.2.1) presents the results from a series of repeated measures ANOVAs on N-1, and subsection 4.2.2.2 presents the results from a series of 3-way repeated measures ANCOVAs with a 2 (Position) x 2 (Correctness) x 2 (Group) factorial design with working memory and inhibitory control as covariates for the gaze duration at N, as well as the results of a repeated measures ANOVA. Subsection 4.2.2.3 presents the results for the gaze duration at N+1 from a series of 3-way repeated measures ANCOVAS with a 2 (Position) x 2 (Correctness) x 2 (Group) factorial design with working memory and inhibitory control as covariates, and a subsequent repeated measures ANOVA. 4.2.2.4 presents the results of a 3-way repeated measures ANCOVA with a 2 (Position) x 2 (Correctness) x 2 (Group) factorial design with Working Memory and Inhibitory Control entered as covariates for the total time at N, and the results of repeated

measures ANOVAs. As mentioned in Chapter 3 (section 3.7), the inferential statistics follow a backward stepwise approach that starts with a particular set of variables and progressively deletes them until the simplest model that fits the data is created (Jobson, Olkin, & Fienberg, 1991; Kutner, Nachtsheim, & Neter, 2004). In the case of the data presented here, this will lead to the above mentioned repeated measures ANOVA. Finally, the chapter closes with a summary of the results (section 4.3).

4.1 Descriptive Statistics

This section is divided into three subsections: descriptive statistics of the screening tests (4.1.1), descriptive statistics of the eyetracking task (4.1.2), and descriptive statistics of the working memory and inhibitory control tests (4.1.3). These subsections will provide information about the mean (*M*), standard deviation (*SD),* skewness and kurtosis, and range of scores. Standard deviation is a measure of variability in the data set. Skewness is a measure of asymmetry of a distribution, and kurtosis is a measure of how peaked or flat the data are relative to normal distribution. It is important that these be between -2 and +2 to ensure that the data are normally distributed. Normal distribution is a necessary requisite to run parametric statistical analyses such as *t*-tests, ANOVAS, and ANCOVAs. The range of scores involves the minimum and maximum scores per data set, and is important to consider because it can help to determine outliers and to explain irregular kurtosis and skewness.

4.1.1 Descriptive Statistics of the Screening Tests

As mentioned earlier, participants completed 5 screening tests: a language background questionnaire, language contact profile (study abroad only), DELE proficiency test, verb recognition test, and tense recognition test. The language background questionnaire indicates that study and non-study abroad participants are comparable in terms of years learning Spanish

(+abroad: *M* = 6.94, *SD* = .23; -abroad: *M* = 6.96, SD = .90) and daily use of Spanish at the time of data collection (+abroad after returning from Spain: *M* = 7.6% of the time, *SD* = 7.41; -abroad: *M* = 7.91% of the time, SD = 6.41). The larger standard deviation for the non-study abroad group for the total number of years learning Spanish can be attributed to some participants learning the L2 for more time than the majority, as the range for this group was between five and eight years. As mentioned earlier, in addition to the language background questionnaire, the study abroad group completed a language contact profile to ensure their immersion experience was similar. This questionnaire shows that, while in Spain, study abroad learners used Spanish an average of 6.63 days per week (*SD* = .87) and 2.7 hours per day (*SD* = 1.27), and that they used English an average of 6.72 days per week (*SD* = 1.0) and 3.40 hours per day (*SD* = 1.37).

The goal of the third screening test was to measure L2 proficiency level. The means for the DELE proficiency test are similar for both groups, suggesting that both groups were homogeneous in terms of Spanish proficiency (see Table 3 below). In addition, the values for skewness (how symmetric the means are distributed) and kurtosis (the degree of peakedness in a distribution of means: flat versus sharp peak curve) within the normal range of -2 and +2 show that the means are normally distributed in terms of symmetry and peakedness in a bell-shape curve, and that parametric statistical analyses can be conducted to find out whether the mean differences are significant. As for the verb and verb tense recognition tests, the means reveal that all of the participants performed better than the 90% cut-off required of them to be included in the experiment, revealing that they know the meaning of the target verbs and the verb tenses used in the experiment. In addition, out of a score of 5, the participants' L2 self-ratings were similar: reading abilities (study abroad = 3.58 (*SD* = .65); non study abroad = 3.37 (*SD* = .49) listening abilities (study abroad = 3.33 (*SD* = .53); non study abroad = 3.35 (*SD* = .72)),

writing abilities (study abroad = 3.63 (*SD* = .54); non study abroad = 3.33 (*SD* = .70)), and speaking abilities (study abroad = 3.33 (*SD* = .53); non study abroad = 3.04 (*SD* = .55)). The skewness and kurtosis for these measures were all within the acceptable range. Regarding the participants' accuracy on the filler comprehension questions, the performance between the two groups appears similar: study abroad = 86.63 (*SD* = 5.22); non study abroad = 87.63 (*SD* = 5.47). The data are normally distributed.

The fourth screening test was administered to ensure the L2 learners were familiar with the verbs used in the target items. Table 3 shows the means for both groups on the verb recognition test, and the means are identical, suggesting that the learners were familiar with the verbs. The vales for skewness and kurtosis were not within acceptable ranges, with both groups displaying negative skewness and positive kurtosis. The data have a longer tail to the left, and are leptokurtic and have a sharper peak around the mean. The large skewness and kurtosis associated with the tense and verb recognition tests and number of years learning Spanish can be attributed to the heavy tails, a single peak, lack of symmetry, and smaller sample size.

The final screening test was measured to measure the learners' knowledge of the present and past tense in Spanish, so that longer reading times could be attributed to the manipulated conditions, and not to a lack of knowledge of the verb tenses. The means for both groups are almost identical, as are the standard deviations (see Table 3 below). The minimum and maximum scores are identical. However, the data are not normally distributed, based on the values of the negative skew and large kurtosis. Like the data for the verb recognition test, the data have a longer tail to the left, and are leptokurtic with a sharp peak. Again, this can be attributed to the heavy tails, a single peak, and the small sample size.

Table 3 *Descriptive Statistics for the L2 Proficiency Test, Self-Ratings, and the Verb and Tense Recognition Tests*

Variable	*N*	*M*	*SD*	*Skewness*	*Kurtosis*	*Minimum*	*Maximum*
L2 Proficiency Test (DELE) (*k*=20)							
+abroad	36	10.1	1.7	.56	-.68	8	14
-abroad	24	10.2	1.8	.45	-.76	8	14
Self-Rating (Reading)							
+abroad	36	3.58	.65	.69	-.48	3	5
-abroad	24	3.37	.49	.551	-1.86	3	4
Self-Rating (Listening)							
+abroad	36	3.33	.53	1.32	.88	3	5
-abroad	24	3.35	.72	-.22	-.076	2	5
Self-Rating (Writing)							
+abroad	36	3.63	.54	-.02	-.88	3	5
-abroad	24	3.33	.70	.244	.234	2	5
Self-Rating (Speaking)							
+abroad	36	3.33	.53	1.32	.88	3	5
-abroad	24	3.04	.55	.037	.825	2	4
Filler Comprehension Question Accuracy							
+abroad	36	86.63	5.22	-.96	.89	71	94
-abroad	24	87.63	5.47	-1.12	1.07	73	95
Verb Recognition Test (*k*=36)							
+abroad	36	35.9	.33	-6.0	36.0	34	36
-abroad	24	35.9	.41	-4.9	24.0	34	36
Tense Recognition Test (*k*=32)							
+abroad	36	31.9	.46	-4.1	15.3	30	32
-abroad	24	31.8	.56	-3.2	9.12	30	32

Note. 36 participants in the study abroad group, and 24 participants in the non study abroad group.

4.1.2 Descriptive Statistics of the Eyetracking Task

As mentioned earlier, the data presented in this section are organized as follows: the mean gaze durations for N-1 for the adverb and verb are presented first, followed by the mean gaze durations for N for the adverb and verb, which are followed by the mean gaze durations for N+1 for the adverb and verb. The descriptive statistics for Condition 1 (ayer… cantó), Condition 2

(*ayer… canta), Condition 3 (cantó… ayer), and Condition 4 (*canta… ayer) are provided in the tables below. For every condition presented, the data are based on the results from all of the 36 classroom learners with a study abroad experiment and all of the 24 classroom learners without a study abroad experience.

4.1.2.1 Gaze Duration at N-1

N-1 is used to ensure no differences in first gaze reading times before encountering the error, and total time was not considered because it would include second gaze durations from having seen the error and reverting back to one of the cues, making total time an unreliable measure of processing for this word. There are only two RTs for N-1 for the adverb because in C1 (ayer…cantó) and C2 (*ayer…canta), the adverb is the first word in the sentence. Table 4 below shows that the means (i.e., grand means; mean of all means) and standard deviations for the RTs (in milliseconds, [ms]) on N-1 for both groups are similar, and that the data are normally distributed, as seen by the skewness and kurtosis values. The minimum and maximum RTs between both groups are similar. These means appear to suggest that before the learner encounters the incongruency, the processing speed of the participants is similar within and between the groups and conditions.

Table 4 *Descriptive Statistics for the Word Immediately Preceding the Adverb*

Variable	*M*	*SD*	*Skewness*	*Kurtosis*	*Minimum*	*Maximum*
Gaze						
C3:cantó…ayer						
+abroad	387.88	90.52	.169	-.189	192.67	571.43
-abroad	380.42	92.79	.328	.753	218.56	621.20
C4: canta…ayer						
+abroad	401.74	112.22	.756	.766	219.89	735.75
-abroad	369.68	96.75	.815	.286	227.0	612.75

Note. 36 participants in the study abroad group, and 24 participants in the non study abroad group.

The descriptive statistics for N-1 for the verb are presented below in Table 5. The means for the four conditions for both groups appear similar, as are the standard deviations within groups. The data are normally distributed, as shown by the skewness and kurtosis numbers being within the acceptable range.

Table 5 *Descriptive Statistics for the Word Immediately Preceding the Verb*

Variable	*M*	*SD*	*Skewness*	*Kurtosis*	*Minimum*	*Maximum*
Gaze						
C1:ayer…cantó						
+abroad	372.34	100.26	.968	1.057	233.63	640.88
-abroad	350.50	80.17	-.079	-.589	188.22	503.10
C2: ayer…canta						
+abroad	381.23	117.70	.825	.346	211.0	709.0
-abroad	344.98	88.77	.094	-.736	169.67	488.0
C3: cantó…ayer						
+abroad	374.54	112.67	1.07	1.42	223.19	712.15
-abroad	342.07	92.36	.81	1.25	199.67	600.16
C4: canta…ayer						
+abroad	379.53	114.43	.64	-.26	198.35	657.19
-abroad	343.44	86.33	.048	-.739	169.67	486.53

Note. 36 participants in the study abroad group, and 24 participants in the non study abroad group.

In summary, the mean gaze durations on the adverb at N-1 are very similar and the data are normally distributed. The same can be said for the gaze durations on the verb at N-1. This finding suggests that before reaching the adverb-verb incongruency, the learners were equal and were reading similarly across the conditions. However, only these means must be subjected to further analyses to determine the truth to this statement.

4.1.2.2 Gaze Duration at N

The descriptive statistics for the gaze duration for the adverb are provided in Table 6. The means for C1 (ayer…cantó) and C2 (*ayer…canta) are similar, as are the means on C3

(cantó…ayer) and C4 (*canta…ayer). However, the difference between the mean RTs on C1 (ayer…cantó) and C3 (cantó…ayer) and C2 (*ayer…canta) and C4 (*canta…ayer) is almost 100ms. The RT for the former two conditions is almost 100ms longer. This may not prove to be of much importance, as the RTs between C3 (cantó…ayer) and C4 (*canta…ayer) are similar. If it were the case that only C3 were 100ms longer than the other three conditions, this would be problematic in that differences would be seen on first gaze, and later comparisons would be problematic; however, this is not the case with the data, which simply show that the gaze duration on C3 (cantó…ayer) and C4 (*canta…ayer) is longer than it is when the adverb is preverbal. Moreover, the data are normally distributed, save the kurtosis for the non study abroad group on the adverb first gaze duration reading time in C1 (6.279), suggesting a sharp peak around the mean, and a leptokurtic distribution. However, this can be attributed to the smaller sample size.

Table 6 *Descriptive Statistics for the Adverb*

Variable	*M*	*SD*	*Skewness*	*Kurtosis*	*Minimum*	*Maximum*
Gaze						
C1: ayer…cantó						
+abroad	218.9	40.29	1.08	1.19	163.5	331.67
-abroad	230.95	49.63	2.00	6.279*	170.0	407.5
C2: ayer…canta						
+abroad	210.58	28.96	.39	.472	162.83	293.22
-abroad	224.51	32.71	.008	.229	149.13	288.3
C3: cantó…ayer						
+abroad	311.98	63.88	.44	-.993	207.83	435.5
-abroad	299.03	81.74	.068	-1.128	185.29	445.67
C4: canta…ayer						
+abroad	312.24	61.52	.32	-.140	207.25	463.2
-abroad	311.47	85.3	.935	1.349	181.8	550.0

Note. 36 participants in the study abroad group, and 24 participants in the non study abroad group.

Table 7 presents the descriptive statistics for the gaze duration on the verb. The means for the gaze duration are similar across all groups, suggesting that on first gaze duration, the learners are not sensitive to the error. The data are normally distributed based on the skewness and kurtosis values. Additionally, the minimum and maximum RTs are similar.

Table 7 *Descriptive Statistics for the Verb*

Variable	*M*	*SD*	*Skewness*	*Kurtosis*	*Minimum*	*Maximum*
Gaze						
C1:ayer…cantó						
+abroad	401.67	77.07	1.021	2.031	262.78	646.5
-abroad	397.73	105.55	-.298	-1.011	205.1	576.56
C2: ayer…canta						
+abroad	394.11	93.39	.637	-.239	237.4	622.5
-abroad	382.53	121.76	1.115	1.322	222.14	704.22
C3: cantó…ayer						
+abroad	405.26	74.42	.494	1.10	267.14	623.89
-abroad	394.64	101.75	.294	-1.122	250.57	578.0
C4: canta…ayer						
+abroad	398.12	96.84	.892	.19	251.3	658.0
-abroad	381.76	97.24	.618	-.069	236.6	601.75

Note. 36 participants in the study abroad group, and 24 participants in the non study abroad group.

In summary, the gaze durations on the adverb and verb are similar for both groups. The data are normally distributed, save the kurtosis for the non study abroad group in C1 (ayer…cantó). Based on these means, it appears that the learners are not sensitive to the incongruency upon first encountering the error. However, only further statistical analyses will determine if this is true.

4.1.2.3 Gaze Duration at N+1

Table 8 shows the mean RTs for the word immediately following the adverb. The gaze duration on N+1 is considered because of delayed processing effects. For L2 learners, they may

not recognize an error until they have already moved on. Capturing differences in N+1 justifies the use of the total time on N. Total time is not considered because it would include the re-reading that would occur after the learner has seen the error and the difference would be exaggerated. The mean gaze durations for N+1 on C1 (ayer…cantó) and C2 (*ayer…canta) are similar, as it to be expected, for the learner has yet to encounter an error on this variable. Also note that the mean RT for C3 (cantó…ayer) is similar to that of C1 (ayer…cantó) and C2 (*ayer…canta). Again, this is attributed to a lack of error in this condition. However, note the difference in mean RTs between C3 (cantó…ayer) and C4 (*canta…ayer): both groups of learners spend almost 50ms more on the C4 condition. This is evidence of delayed processing, or of sensitivity to an error after having already left the region that contained the error, therefore justifying the use of the total RT on the N condition, and not just the gaze duration. The data for N+1 are normally distributed, and the minimum and maximum scores between the two groups are similar.

Table 8 *Descriptive Statistics for the Word Immediately Following the Adverb*

Variable	*M*	*SD*	*Skewness*	*Kurtosis*	*Minimum*	*Maximum*
Gaze						
C1: ayer…cantó						
+abroad	239.08	56.47	.96	.217	157.13	387.57
-abroad	232.22	43.46	.666	-.450	173.25	328.33
C2: ayer…canta						
+abroad	235.81	46.48	.802	.480	169.0	369.50
-abroad	237.19	52.37	.973	.374	165.75	362.0
C3: cantó…ayer						
+abroad	237.33	49.96	.04	-1.147	144.33	324.0
-abroad	236.86	46.22	-.126	-.448	144.0	332.0
C4: canta…ayer						
+abroad	283.6	54.41	.011	-.299	172.67	397.0
-abroad	280.54	44.07	.090	-.013	200.5	375.0

Note. 36 participants in the study abroad group, and 24 participants in the non study abroad group.

Table 9 presents the descriptive statistics for the word immediately following the verb. These results are a mirror image of those for N+1 for the adverb. That is, the evidence of delayed processing occurs in C2 (*ayer…canta) when compared with the RT for C1 (ayer…cantó), and the difference between the two is approximately 40ms. No major differences between the means are found for C3 (cantó…ayer) and C4 (*canta…ayer), and for C1 (ayer…cantó) with C3 (cantó…ayer) or C4 (*canta…ayer). This is because for C3 (cantó…ayer) and C4 (*canta…ayer), there is no error immediately following the verb, and for C1 (ayer…cantó), the sentence is correct. The data are normally distributed, as the kurtosis and skewness are within acceptable ranges. Minimum and maximum RTs are similar, save the almost 100ms longer RT for a participant in the study abroad group in C3 (cantó ayer).

Table 9 *Descriptive Statistics for the Word Immediately Following the Verb*

Variable	*M*	*SD*	*Skewness*	*Kurtosis*	*Minimum*	*Maximum*
Gaze						
C1: ayer…cantó						
+abroad	239.95	48.57	.213	-.868	160.0	334.0
-abroad	244.90	33.10	-.133	.376	166.0	314.33
C2: ayer…canta						
+abroad	281.02	70.57	.421	-.767	165.0	433.0
-abroad	286.82	62.72	.134	-1.019	188.0	404.0
C3: cantó…ayer						
+abroad	245.98	66.42	1.177	1.269	163.33	445.0
-abroad	237.44	45.12	.614	.429	167.25	352.0
C4: canta…ayer						
+abroad	236.15	47.13	.130	-.852	160.5	328.67
-abroad	250.15	39.16	.539	.391	180.0	336.5

Note. 36 participants in the study abroad group, and 24 participants in the non study abroad group.

In summary, the results for the total time on both the verb and adverb suggest evidence of delayed processing when the error follows either the adverb or verb, depending on the

condition. This finding justifies the use of the total time on N. Moreover, the skewness and kurtosis are within acceptable ranges, and indicate that the data are normally distributed.

4.1.2.4 Total Time at N

Table 10 shows the descriptive statistics for the adverb. Concerning the adverb total times, both groups display a larger RT for C2 (*ayer…canta) and C4 (*canta…ayer) when compared with those for C1 (ayer…cantó) and C3 (canta…ayer). The mean difference between C1 (ayer…cantó) and C2 (*ayer…canta) is approximately 65ms, with a larger mean difference showing between C3 (cantó…ayer) and C4 (*canta…ayer) (nearly 100ms). The data are normally distributed, save the moderate kurtosis for the study abroad group in C4 (3.167), denoted by an asterisk (*) in the table, which can be attributed to the smaller sample size. Further statistical analyses will determine if these differences are significant. These numerical differences are illustrated graphically in Figure 5.

Table 10 *Descriptive Statistics for the Adverb*

Variable	*M*	*SD*	*Skewness*	*Kurtosis*	*Minimum*	*Maximum*
Total Time						
C1: ayer…cantó						
+abroad	473.38	94.31	-.180	.626	205.0	665.71
-abroad	468.59	46.94	.499	-.114	390.3	580.83
C2: ayer…canta						
+abroad	535.86	86.99	1.009	.573	416.71	757.44
-abroad	559.17	68.48	-.372	.591	394.08	706.5
C3: cantó…ayer						
+abroad	518.27	141.89	-.135	.511	224.0	885.17
-abroad	508.89	189.08	-.240	-.919	187.0	841.87
C4: canta…ayer						
+abroad	614.29	108.35	-.485	3.167*	258.0	892.0
-abroad	614.7	145.02	-1.087	2.055	181.8	850.0

Note. 36 participants in the study abroad group, and 24 participants in the non study abroad group.

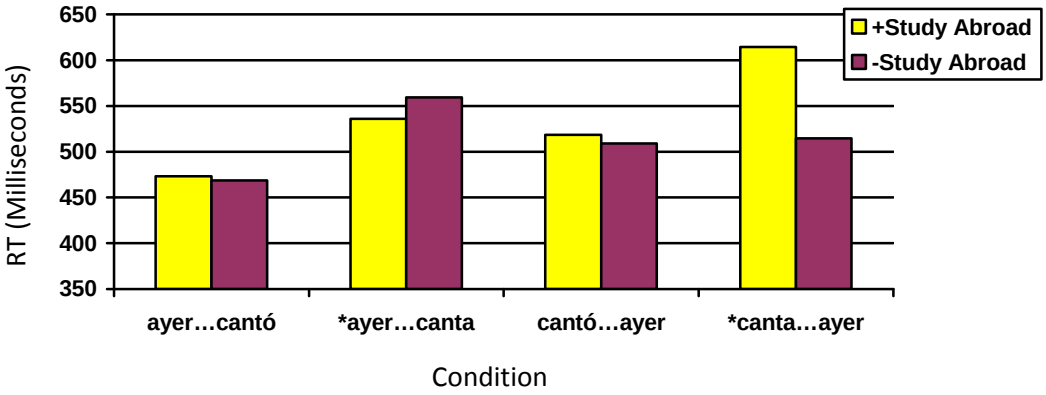

Figure 5. Total Time for the Adverb.

Table 11 shows the descriptive statistics for total time on the verb. The mean RTs for the total time on the verb show some variation between the groups, depending on the condition and its correctness. For C1 (ayer…cantó), the mean total RTs are similar for both groups, as would be expected since the condition is correct. However, for C2 (*ayer…canta), the study abroad group spends almost 100ms more on the verb than the non study abroad group. A similar difference is found between the groups in C4 (*canta…ayer), with the study abroad learners spending over 80ms more on the verb than their non study abroad counterparts. Noteworthy are the higher minimum RTs for the study abroad group for C2 (*ayer…canta) and C4 (*canta…ayer), and the similar maximum RTs for C2 (*ayer…canta) between the groups, and dissimilar RTs between them for C4 (*canta…ayer). Only further statistical analysis will reveal if these differences are significant. A graphical representation of these differences is provided in Figure 6.

Table 11 *Descriptive Statistics for the Verb*

Variable	*M*	*SD*	*Skewness*	*Kurtosis*	*Minimum*	*Maximum*
Total Time						
C1: ayer…cantó						
+abroad	725.14	124.05	-.206	.021	405.5	976.64
-abroad	713.34	180.91	-.184	-.724	382.11	1013.76
C2: ayer…canta						
+abroad	802.68	127.43	.355	-1.184	618.0	1032.0
-abroad	707.91	167.29	.318	-.043	383.8	1044.32
C3: cantó…ayer						
+abroad	736.13	118.4	.218	.178	510.79	1008.2
-abroad	698.54	145.88	.466	-1.078	503.4	940.9
C4: canta…ayer						
+abroad	803.56	118.33	.043	-.532	575.72	1055.84
-abroad	716.01	116.61	-.191	-.353	470.58	914.63

Note. 36 participants in the study abroad group, and 24 participants in the non study abroad group.

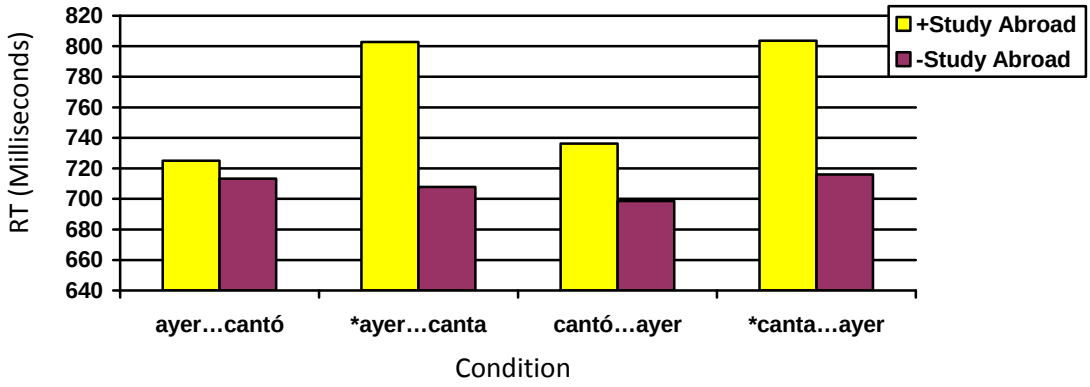

Figure 6. Total Time for the Verb.

In summary, the mean RTs for the total time on the verb and adverb present interesting differences within and between the groups. For the study abroad group, they have longer RTs on the verb in the incongruent conditions, whereas the RTs for the non study abroad group on

the verb appear similar. For the RTs on the adverb, the groups' RTs are similar. Whether these differences on the verb RTs are significant can only be told through further statistical analyses.

4.1.3 Descriptive Statistics of the Working Memory and Inhibitory Control Tests

Recall that the descriptive statistics for the tests of working memory and inhibitory control are formed from the participants' scores on the reading span test and Simon test, respectively. Table 12 provides the descriptive statistics for these two tests for both groups. The mean working memory capacity for the two groups is similar, while the mean Simon test score for each group vary (study abroad = 39.42; non study abroad = 33.39). Skewness and kurtosis are within acceptable ranges, suggesting that the data are normally distributed. Minimum scores are similar between the groups, although the maximum score for the inhibitory control test for a participant in the study abroad group is higher than the maximum score for the non study abroad group.

Table 12 *Descriptive Statistics for the Reading Span and the Simon Tests*

Variable	*M*	*SD*	*Skewness*	*Kurtosis*	*Minimum*	*Maximum*
Working Memory (Reading Span Test)						
+abroad	46.69	10.58	.26	.24	24	74
-abroad	44.79	13.84	.004	-1.25	22	66
Inhibitory Control (Simon Test)						
+abroad	39.42	24.32	.352	.479	-6.8	99.64
-abroad	33.39	19.85	-.39	.512	-18.63	63.91

Note. 36 participants in the study abroad group, and 24 participants in the non study abroad group. Highest possible score for working memory is 80.

4.1.4 Summary of Descriptive Statistics

The results from the descriptive statistics for N-1 reveal no apparent differences between the mean RTs for both groups for neither the adverb nor verb. For the gaze duration for the adverb and verb, no obvious differences in the RTs were found between the groups. However, for the total RT on the adverb, the mean RTs were larger on than incongruent condition in comparison to the congruent condition, suggesting that when these learners encounter the error, they return back to this cue. However, for the total RT on the verb, only the study abroad group had higher reading times on the verb in the incongruent condition, perhaps suggesting that they are using the verb as a cue as well. Concerning the working memory scores, the means between the groups appears to be similar, while the differences in scores for the test of inhibitory control are larger. These descriptive statistics must be subjected to further testing, as only the results of the inferential statistics will reveal which, if any, of these differences are significant.

4.2 Inferential Statistics

Inferential statistical analyses are divided into three sections. Section 4.2.1 presents the results of independent samples *t*-tests on the screening tests of L2 proficiency level (DELE test), self-ratings, comprehension question accuracy on the filler sentences, verb recognition and tense recognition to ensure that no differences exist between the two groups. Section 4.2.2 presents the results from 6 ANCOVAs, with working memory and inhibitory control scores entered as covariates: one for the gaze duration on the adverb, one for the gaze duration on the verb, one for the gaze duration on N+1 for the adverb, one for the gaze duration on N+1 for the verb, and one for the total time on the adverb, and one for the total time on the verb. Recall that the backward stepwise approach begins with a full model and removes covariates until the

best model is found to account for the data. Then, based on the results from this approach, the results from the model that best suits the data are presented.

4.2.1 Inferential Statistics of the Screening Tests

To determine whether the two groups of participants are comparable in terms of L2 proficiency level, a *t*-test for independent samples was conducted on the means obtained on the DELE proficiency test. The results reveal no significant differences between the groups, t (58) = -.152, p = .880 (Levene's test: F(.145), p = .705). These findings indicate that the study and non-study abroad participants had the same level of proficiency in Spanish at the time of data collection. The results of a *t*-test for independent samples reveal significant differences between the groups for the speaking self-rating, t (58) = 2.047, p = .045 (Levene's test: F(2.53), p = .117). However, no significant differences are found between the groups for their listening self-rating, t (39.459) = -.727, p = .472 (Levene's test: F(4.50), p = .038), writing self-rating, t (58) = 1.898, p = .063 (Levene's test: F(1.36), p = .248), or reading self-rating, t (58) = 1.334, p = .187 (Levene's test: F(3.845), p = .055). These findings suggest that the learners were similar, save their oral abilities. The results from the accuracy on the filler comprehension questions reveal no significant differences between the groups on their performance, t (58) = -.705, p = .483 (Levene's test: F(.004), p = .950), suggesting that the two groups are similar in their accuracy on correctly answering the comprehension questions.

The results from the verb recognition test reveal no significant differences between the groups, t (58) = .289, p = .774 (Levene's test: F(.334), p = .566), indicating that the two groups of learners performed similarly on this test and were familiar with the verbs. Finally, The results from the tense recognition test reveal no significant differences between the study abroad and

non study abroad groups, *t* (58) = .416, *p* = .679 (Levene's test: *F*(.691), *p* = .409), suggesting that the two groups of learners were familiar with the Spanish past and present tense.

4.2.2 Inferential Statistics of the Eyetracking Task

4.2.2.1 Gaze Duration at N-1

A repeated measures ANOVA with a 2 (Correctness) x 2 (Group) factorial design was carried out on the RTs for the word immediately preceding the adverb to ensure that up to the point before encountering the error, the learners were reading the sentences similarly. As the adverb is sentence initial in C1 (ayer…cantó) and C2 (*ayer…canta), no comparisons for N-1 in these conditions can be made. The results reveal no significant main effects within subjects for Correctness, *F*(1, 58) = .012, *p* = .912 (partial η^2 = 0.0%), or for Group between subjects, *F*(1, 58) = .803, *p* = .374 (partial η^2 = 1.4%). No interaction effects are found, *F*(1, 58) = .770, *p* = .384 (partial η^2 = 1.3%). The partial eta squared (η^2) is included in these statistics and indicates the relative degree to which the variance that is found in the test is associated with each of the main effects. That is, it is the proportion of variability in the dependent measure that is attributable to a factor, and for these data, the partial η^2 is very low, suggesting that very little of the variability is due to the independent variable. These results suggest that up to the point before encountering the incongruency, there were no significant differences in mean reading times on the word immediately preceding the adverb.

One repeated measures ANOVA with a 2 (Correctness) x 2 (Position) x 2 (Group) factorial design was carried out on the RTs for the word immediately preceding the verb in C1 (ayer…cantó), C2, (*ayer…canta), C3 (cantó…ayer), and C4 (*canta…ayer). The results reveal no significant main effects within subjects for Position, *F*(1, 58) = .347, *p* = .558 (partial η^2 = 0.6%), Correctness, *F*(1, 58) = .025, *p* = .875 (partial η^2 = 0.0%), or between subjects for Group, *F*(1, 58)

= 2.17, p = .146 (partial η^2 = 3.6%). Additionally, no significant interaction effects are found for Position x Group, F(1, 58) = .423, p = .518 (partial η^2 = 0.7%), Correctness x Group, F(1, 58) = .086, p = .770 (partial η^2 = 0.1%), Position x Correctness, F(1, 58) = .035, p = .852 (partial η^2 = 0.1%), or Position x Correctness x Group, F(1, 58) = .460, p = .500 (partial η^2 = 0.8%). The η^2 for these variables is low, again suggesting that very little of the variance can be predicted from the independent variable. These results are evidence that prior to reaching the incongruency, the mean reading times on the word immediately before the verb were not significantly different from each other, suggesting that before reaching the critical region that contains the morphological and lexical incongruency, everything else was the same.

4.2.2.2 Gaze Duration at N

Two repeated-measures ANCOVAs with a 2 (Position) x 2 (Correctness) x 2 (Group) factorial design with Working Memory and Inhibitory Control as covariates were conducted: one for gaze duration at the adverb and one for gaze duration at the verb. The ANCOVA for gaze duration at the adverb reveals no significant main effects for any of the variables: Position, F (1, 56) = 3.043, p = .087 (partial η^2= 5.2%), Correctness, F (1, 56) = .708, p = .404 (partial η^2= 1.2%), Group, F (1, 56) = .054, p = .817 (partial η^2= .1%), Working Memory, F (1, 56) = 1.159, p = .286 (partial η^2 = 2%), and Inhibitory Control, F (1, 56) = .035, p = .852 (partial η^2 = .1%). Also, there are no interaction effects for Position x Working Memory, F (1, 56) = .096, p = .758 (partial η^2 = .2%), Position x Inhibitory Control, F (1, 56) = .544, p = .464 (partial η^2 = 1%), Position x Group, F (1, 56) = 1.025, p = .316 (partial η^2 = 1.8%), Correctness x Working Memory, F (1, 56) = 2.153, p = .148 (partial η^2 = 3.7%), Correctness x Inhibitory Control, F (1, 56) = 1.374, p = .246 (partial η^2 = 2.4%), Correctness x Group, F (1, 56) = .474, p = .494 (partial η^2 = .8%), Position x Correctness, F (1, 56) = .258, p = .109 (partial η^2 = 4.5%), Position x Correctness x Working Memory, F (1, 56) =

1.113, p = .296 (partial η^2 = 1.9%), Position x Correctness x Inhibitory Control, F (1, 56) = 1.236, p = .271 (partial η^2 = 2.2%), or Position x Correctness x Group, F (1, 56) = .064, p = .801 (partial η^2 = .1%). Recall that the partial η^2 is a measure of the proportion of the variability in the dependent measure that is owed to an independent variable. These results, together with the lack of main effects or interaction effects involving Working Memory and Inhibitory Control, indicate that these two variables do not explain a significant amount of variance in Position, Correctness, or Group, and that the model needs to be adjusted by excluding the covariates and running a 2x2x2 repeated measures ANOVA.

Based on the results of a 2 (Position) x 2 (Correctness) x 2 (Group) repeated measures ANOVA for the adverb gaze duration, a significant main effect is found for Position, F (1, 58) = 105.95, p = .000 (partial η^2 = 64.6%). No significant main effects are found for Correctness, F (1, 58) = .011, p = .915 (partial η^2 = 0.0%) or Group, F (1, 58) = 0.88, p = .768 (partial η^2 = .2%). No interaction effects are found, F (2.374, 63.013) = .962, p = .397 (partial η^2 = 1.6%). Multiple contrast comparisons for the study abroad group reveal longer RTs on C2 (ayer... canta) than C4 (canta…ayer) (p = .000), and longer RTs on C1 (ayer…cantó) than C3 (cantó…ayer) (p = .000), but there are no significant differences between C3 (cantó…ayer) and C4 (canta…ayer) (p = .978). Similar results are found for the non study abroad group, with longer RTs on C2 (ayer…canta) than C4 (canta…ayer) (p = .000), and longer RTs on C1 (ayer…cantó) than C3 (cantó…ayer) (p = .002), but there are no significant differences between C3 (cantó…ayer) and C4 (canta…ayer) (p = .346). These results suggest that on first gaze duration for the adverb, neither group is sensitive to the adverb-verb incongruency.

The above results reveal a repeated measures ANOVA to best describe the variability for these data on adverb gaze duration. However, it is also important to consider the results the

results for the 2 (Position) x 2 (Correctness) x 2 (Group) ANCOVA with Working Memory and Inhibitory Control as covariates for verb gaze duration. The results reveal no significant main effects within subjects for Position, F (1, 56) = .869, p = .355 (partial η^2 = 1.5%) or Correctness, F (1, 56) = 3.497, p = .067 (partial η^2 = 5.9%), or between subjects for Group, F (1, 56) = .116, p = .753 (partial η^2 = .2%), Working Memory, F (1, 56) = .679, p = .413 (partial η^2 = 1.2%), or Inhibitory Control, F (1, 56) = .574, p = .452 (partial η^2 = .1%). Also, there are no interaction effects for Position x Working Memory, F (1, 56) = .423, p = .518 (partial η^2 = .7%), Position x Inhibitory Control, F (1, 56) = .824, p = .368 (partial η^2 = 1.5%), Position x Group, F (1, 56) = .285, p = .596 (partial η^2 = .5%), Correctness x Working Memory, F (1, 56) = 1.962, p = .167 (partial η^2 = 3.4%), Correctness x Inhibitory Control, F (1, 56) = 1.219, p = .274 (partial η^2 = 2.1%), Correctness x Group, F (1, 56) = .005, p = .944 (partial η^2 = 0.0%), Position x Correctness, F (1, 56) = 3.335, p = .073 (partial η^2 = 5.6%), Position x Correctness x Working Memory, F (1, 56) = 2.796, p = .10 (partial η^2 = 4.8%), Position x Correctness x Inhibitory Control, F (1, 56) = .909, p = .345 (partial η^2 = 1.6%), or Position x Correctness x Group, F (1, 56) = .037, p = .848 (partial η^2 = .1%). The η^2 for all of these tests is low, suggesting that very little of the variance in the dependent variables is due to the influence of the independent variable. The lack of main or interaction effects with Working Memory and Inhibitory Control indicate that they cannot explain the significant amount of variation in Position, Correctness, or Group, and that the model should remove them as covariates and a 2 x 2 x 2 ANOVA should be run.

Therefore, a 2 (Position) x 2 (Correctness) x 2 (Group) repeated measures ANOVA for the gaze duration on the verb is run, and reveals no significant main effects within subjects for Position, F (1, 58) = .014, p = .906 (partial η^2 = 0.0%), Correctness, F (1, 58) = 1.144, p = .289 (partial η^2 = 1.9%), or between subjects for Group, F (1, 58) = .270, p = .605 (partial η^2 = .5%).

Multiple contrast comparisons reveal no significant differences for C2 (*ayer…canta) and C4 (*canta…ayer) (p = .964), C3 (cantó…ayer) and C4 (*canta…ayer) (p = .492), C1 (ayer…cantó) and C3 (cantó…ayer) (p = .859), and C1 (ayer…cantó) and C2 (*ayer…canta) (p = .409) for the non study abroad group. Similar results are obtained for the study abroad group, with no significant differences for C2 (*ayer…canta) and C4 (*canta…ayer) (p = .772), C3 (cantó…ayer) and C4 (*canta…ayer) (p = .635), C1 (ayer…cantó) and C3 (cantó…ayer) (p = .752), and C1 (ayer…cantó) and C2 (*ayer…canta) (p = .642). These results indicate that on the first gaze duration on the verb, the learners are not sensitive to the incongruency between the adverb and verb.

4.2.2.3 Gaze Duration at N+1

The results for the ANCOVA with a 2 (Position) x 2 (Correctness) x 2 (Group) factorial design with Working Memory and Inhibitory Control as covariates on adverb+1 gaze duration reveal no significant main effects within subjects for Position, F (1, 56) = .457, p = .502 (partial η^2 = .8%) or Correctness, F (1, 56) = .052, p = .821 (partial η^2 = .1%), or between subjects for Group, F (1, 56) = .102, p = .751 (partial η^2 = .2%), Working Memory, F (1, 56) = .418, p = .794 (partial η^2 = .7%), or Inhibitory Control, F (1, 56) = .069, p = .751 (partial η^2 = .1%). An interaction effect is found for Position x Correctness, F (1, 56) = 4.171, p = .046 (partial η^2 = 6.9%). However, there are no interaction effects for Position x Working Memory, F (1, 56) = .2.441, p = .124 (partial η^2 = 4.2%), Position x Inhibitory Control, F (1, 56) = .110, p = .741 (partial η^2 = .2%), Position x Group, F (1, 56) = .058, p = .811 (partial η^2 = .1%), Correctness x Working Memory, F (1, 56) = .782, p = .380 (partial η^2 = 1.4%), Correctness x Inhibitory Control, F (1, 56) = .370, p = .545 (partial η^2 = .7%), Correctness x Group, F (1, 56) = .036, p = .851 (partial η^2 = .1%), Position x Correctness x Working Memory, F (1, 56) = 2.880, p = .095 (partial η^2 = 4.9%), Position x Correctness x Inhibitory Control, F (1, 56) = .738, p = .394 (partial η^2 = 1.3%), or Position x Correctness x Group,

F (1, 56) = .253, p = .617 (partial η^2 = .4%). Based on the η^2 for these data, very little of the variability can be owed to the independent variable. These results suggest that including two covariates, Working Memory and Inhibitory Control, does not explain the amount of variability in the three variables Position, Correctness, or Group. As these covariates do not significantly interact with the adverb gaze duration, they are removed from the model. The best model for the gaze duration for adverb+1 is a repeated measures ANOVA.

The results of a 2 (Position) x 2 (Correctness) x 2 (Group) repeated measures ANOVA for the gaze duration on adverb+1 reveal significant main effects within subjects for Position, F (1, 58) = 12.393, p = .001 (partial η^2 = 17.6%), Correctness, F (1, 58) = 11.418, p = .001 (partial η^2 = .164%), and no main effects between subjects for Group, F (1, 58) = .098, p = .755 (partial η^2 = .2%). No interaction effects are found, F (3, 174) = .079, p = .971 (partial η^2 = .1%). The results of multiple contrast comparisons for the study abroad group reveal longer RTs on C4 (*canta…ayer) than both C2 (*ayer…canta) (p = .000) and C3 (cantó…ayer) (p = .000), and no significant differences between C1 (ayer…cantó) and C3 (cantó…ayer) (p = .799). These results suggest evidence of delayed processing in C3 (cantó…ayer) and C4 (*canta…ayer). The results for these comparisons for the non study abroad group are similar to those of the study abroad group and reveal longer RTs on C4 (*canta…ayer) than both C2 (*ayer…canta) (p = .004) and C3 (cantó…ayer) (p = .000), and no significant differences between C1 (ayer…cantó) and C3 (cantó…ayer) (p = .680) and C1 (ayer…cantó) and C2 (*ayer…canta) (p = .705). Again, these results show evidence of delayed processing, or that when the error follows the adverb, as it does in (cantó…ayer) and C4 (*canta…ayer), the learner notices the error after leaving it. Moreover, they are evidence that in favor of examining the total reading time on the verb.

Finally, the results of the ANCOVA with a 2 (Position) x 2 (Correctness) x 2 (Group) factorial design with Working Memory and Inhibitory Control as covariates for gaze duration on V+1 reveal a significant main effect for Position, F (1, 56) = 5.540, p = .022 (partial η^2 = 9%). However, no other significant main effects are found within subjects for Correctness, F (1, 56) = .071, p = .791 (partial η^2 = .4%), or between subjects for Group, F (1, 56) = .053, p = .818 (partial η^2 = .1%), Working Memory, F (1, 56) = .507, p = .479 (partial η^2 = .9%), or Inhibitory Control, F (1, 56) = 2.248, p = .139 (partial η^2 = 3.9%). Also, there are no interaction effects for Position x Working Memory, F (1, 56) = 1.387, p = .244 (partial η^2 = 2.4%), Position x Inhibitory Control, F (1, 56) = 2.881, p = .095 (partial η^2 = 4.9%), Position x Group, F (1, 56) = .018, p = .894 (partial η^2 = 0.0%), Correctness x Working Memory, F (1, 56) = .251, p = .618 (partial η^2 = .4%), Correctness x Inhibitory Control, F (1, 56) = 1.677, p = .201 (partial η^2 = 2.9%), Correctness x Group, F (1, 56) = 1.006, p = .320 (partial η^2 = 1.8%), Position x Correctness, F (1, 56) = .221, p = .640 (partial η^2 = .4%), Position x Correctness x Working Memory, F (1, 56) = .290, p = .593 (partial η^2 = .5%), Position x Correctness x Inhibitory Control, F (1, 56) = .317, p = .576 (partial η^2 = .6%), or Position x Correctness x Group, F (1, 56) = .789, p = .378 (partial η^2 = 1.4%). As there are no main or interaction effects with either Working Memory or Inhibitory Control, they are removed from the model, per the backward stepwise approach. Therefore, the statistical analysis that best suits the data for gaze duration on V+1 is a repeated measures ANOVA.

The results of a 2 (Position) x 2 (Correctness) x 2 (Group) repeated measures ANOVA for the gaze duration on the verb+1 condition reveal significant within subjects main effects for Position, F (1, 58) = 9.151, p = .004 (partial η^2 = 13.6%) and Correctness, F (1, 58) = 8.575, p = .005 (partial η^2 = 12.9%), and no main effects for Group, F (1, 57) = .248, p = .621 (partial η^2 = .4%). No significant interaction effects are found, F (2.52, 146.155) = .469, p = .671 (partial η^2 =

.5%). Multiple contrast comparisons reveal longer RTs on C2 (*ayer…canta) than both C4 (*canta…ayer) (p = .002) and C1 (ayer…cantó) (p = .008), and no differences in RTs for C3 (cantó…ayer) and C4 (*canta…ayer) (p = .367) and C1 (ayer…cantó) and C3 (cantó…ayer) (p = .711) for the study abroad group. These results are evidence of delayed processing, and that the learners in this group did not notice the error until after they had read it and moved on to the next word. Similar results are obtained for the non study abroad group, with longer RTs on C2 (*ayer…canta) than both C4 (*canta…ayer) (p = .027) and C1 (ayer…cantó) (p = .009), and no differences for C3 (cantó…ayer) and C4 (*canta…ayer) (p = .320) and C1 (ayer…cantó) and C3 (cantó…ayer) (p = .452). Again, these results justify using the total time on the verb, as L2 learners do not always notice an error upon first seeing it.

4.2.2.4 Total Time at N

The results for the 2 (Position) x 2 (Correctness) x 2 (Group) repeated measures ANCOVA for adverb total time with Working Memory and Inhibitory Control as covariates reveal a significant main effect for Working Memory, F (1, 56) = 4.955, p = .030 (partial η^2 = 8.1%). However, no significant main effects within subjects for Position, F (1, 56) = .643, p = .426 (partial η^2 = 1.1%) or Correctness, F (1, 56) = 2.820, p = .099 (partial η^2 = 4.8%), or between subjects for Group, F (1, 56) = .001, p = .970 (partial η^2 = 0.0 %), or Inhibitory Control, F (1, 56) = .382, p = .539 (partial η^2 = .7%) are found. There are no interaction effects for Position x Working Memory, F (1, 56) = .024, p = .877 (partial η^2 = 0.0%), Position x Inhibitory Control, F (1, 56) = .294, p = .590 (partial η^2 = .5%), Position x Group, F (1, 56) = .174, p = .678 (partial η^2 = .3%), Correctness x Working Memory, F (1, 56) = .024, p = .858 (partial η^2 = 0.0%), Correctness x Inhibitory Control, F (1, 56) = .222, p = .635 (partial η^2 = .4%), Correctness x Group, F (1, 56) = .314, p = .578 (partial η^2 = .6%), Position x Correctness, F (1, 56) = .442, p = .509 (partial η^2 = .8%),

Position x Correctness x Working Memory, F (1, 56) = .130, p = .720 (partial η^2 = .2%), Position x Correctness x Inhibitory Control, F (1, 56) = 4.018, p = .05 (partial η^2 = 6.7%), or Position x Correctness x Group, F (1, 56) = .356, p = .553 (partial η^2 = .6%). These results suggest that including Inhibitory Control as a covariate does not explain the variability of the other variables, as there are no significant main or interaction effects for Inhibitory Control on the adverb total time. However, since Working Memory is found to have a main effect between subjects, another ANCOVA with Working Memory as the sole covariate is necessary to determine if Working Memory has any interaction effects that are masked by including Inhibitory Control, and the results are presented next.

Therefore, a 2 (Position) x 2 (Correctness) x 2 (Group) repeated measures ANCOVA with only Working Memory entered as a covariate for adverb total time is run. It reveals a significant main effect for Working Memory, F (1, 57) = 5.326, p = .025 (partial η^2 = 8.5%). However, no other significant main effects within subjects for Position, F (1, 57) = 1.247, p = .237 (partial η^2 = 2.4%) or Correctness, F (1, 57) = 2.743, p = .103 (partial η^2 = 4.6%), or between subjects for Group, F (1, 57) = .003, p = .958 (partial η^2 = 0.0%) are found. Also, there are no interaction effects for Position x Working Memory, F (1, 57) = .044, p = .835 (partial η^2 = .1%), Position x Group, F (1, 57) = .255, p = .616 (partial η^2 = .4%), Correctness x Working Memory, F (1, 57) = .012, p = .913 (partial η^2 = 0.0%), Correctness x Group, F (1, 57) = .410, p = .524 (partial η^2 = .7%), Position x Correctness, F (1, 57) = .084, p = .773 (partial η^2 = .1%), Position x Correctness x Working Memory, F (1, 57) = .292, p = .591 (partial η^2 = .5%), or Position x Correctness x Group, F (1, 57) = .090, p = .765 (partial η^2 = .2%). While it appears that keeping Working Memory as a covariate in the model has significant explanatory power for the model, it is removed because

no interaction effects for working memory are found, making the best model to examine adverb total time a repeated measures ANOVA.

The results for the 2 (Position) x 2 (Correctness) x 2 (Group) repeated measures ANOVA for the adverb total time condition reveal significant main effects within subjects for Position, F (1, 58) = 15.486, p = .000 (partial η^2 = 21.1%) and Correctness, F (1, 58) = 37.815, p = .000 (partial η^2 = 39.5%), and no significant main effects between subjects for Group, F (1, 58) = .015, p = .901 (partial η^2 = 0.0%). No interaction effects are found, F (2.78, 161.221) = .274, p = .829 (partial η^2 =.5%). Multiple contrast comparisons for the non study abroad group reveal longer RTs on C4 (*canta…ayer) than C3 (cantó…ayer) (p = .005,) and longer RTs on C2 (*ayer…canta) than C1 (ayer…cantó) (p = .000), and no differences between C1 (ayer…cantó) and C3 (cantó…ayer) (p = .280) and C2 (*ayer…canta) and C4 (*canta…ayer) (p = .060). These results suggest that the non study abroad learners are sensitive to the error, and that they return to the adverb when there is an incongruency between the verb and adverb. The results for the study abroad group reveal longer RTs on C2 (*ayer…canta) than C1 (ayer…cantó) (p = .011), longer RTs on C4 (*canta…ayer) than both C3 (*ayer…canta) (p = .003) and C2 (*ayer…canta) (p = .001), and no differences between C1 (ayer…cantó) and C3 (cantó…ayer) (p = .068). These results suggest that the study abroad learners are sensitive to the incongruency, and the latter results suggest that the position of the adverb for the study abroad group is important.

However, the results obtained for the total time on the adverb are of little use if they cannot later be compared with the results for the total time on the verb. Therefore, a 2 (Position) x 2 (Correctness) x 2 (Group) repeated measures ANCOVA with Working Memory and Inhibitory Control entered as covariates for the total reading time on the verb is run. The results reveal no main effects within subjects for Position, F (1, 56) = 1.161, p = .286 (partial η^2 = 2%) or

Correctness, F (1, 56) = 1.016, p = .318 (partial η^2 = 1.8%), or between subjects for Group, F (1, 56) = 3.412, p = .07 (partial η^2 = 5.7%), Working Memory, F (1, 56) = .212, p = .647 (partial η^2 = .4%), or Inhibitory Control, F (1, 56) = .522, p = .473 (partial η^2 = .9%). A significant interaction effect is found for Correctness x Working Memory, F (1, 56) = 4.078, p = .048 (partial η^2 = 6.8%) and Correctness x Group, F (1, 56) = 6.059, p = .017 (partial η^2 = 9.8%). However, no other significant interaction effects are found for Position x Working memory, F (1, 56) = .405, p = .527 (partial η^2 = .7%), Position x Inhibitory Control, F (1, 56) = 1.771, p = .189 (partial η^2 = 3.1%), Position x Group, F (1, 56) = .351, p = .556 (partial η^2 = .6%), Correctness x Inhibitory Control, F (1, 56) = .005, p = .944 (partial η^2 = 0.0%), Position x Correctness, F (1, 56) = .363, p = .549 (partial η^2 = .6%), Position x Correctness x Working Memory, F (1, 56) = .672, p = .416 (partial η^2 = 1.2%), Position x Correctness x Inhibitory Control, F (1, 56) = .182, p = .671 (partial η^2 = .3%), or Position x Correctness x Group, F (1, 56) = .437, p = .511 (partial η^2 = .8%). These results suggest that including Inhibitory Control cannot explain the variability between the factors under investigation, and it is therefore removed from further analysis. However, the next analysis includes Working Memory as the only covariate, and the results of that model are discussed next.

The results of a 2 (Position) x 2 (Correctness) x 2 (Group) repeated measures ANCOVA with Working Memory as the only covariate for the total time on the verb reveal no main effects within subjects for Position, F (1, 57) = .268, p = .607 (partial η^2 = .5%) or Correctness, F (1, 57) = 1.403, p = .241 (partial η^2 = 2.4%), or between subjects for Group, F (1, 57) = 3.926, p = .052 (partial η^2 = 6.4%), or Working Memory, F (1, 57) = .156, p = .695 (partial η^2 = .3%). A significant interaction effect is found for Correctness x Working Memory, F (1, 57) = 4.217, p = .045 (partial η^2 = 6.9%) and Correctness x Group, F (1, 57) = 6.247, p = .015 (partial η^2 = 9.9%). However, no

other significant interaction effects are found for Position x Working Memory, F (1, 57) = .258, p = .613 (partial η^2 = .5%), Position x Group, F (1, 57) = .161, p = .690 (partial η^2 = .3%), Position x Correctness, F (1, 57) = .827, p = .367 (partial η^2 = 1.4%), Position x Correctness x Working Memory, F (1, 57) = .758, p = .387 (partial η^2 = 1.3%), or Position x Correctness x Group, F (1, 57) = .372, p = .544 (partial η^2 = .6%). Note the almost 10% partial η^2 for the interaction between Correctness x Group, suggesting that they can account for almost 10% of the variability. Multiple contrast comparisons for the study abroad group reveal an interaction effect with Working Memory, and longer RTs on C2 (*ayer…canta) than C1 (ayer…cantó) (p = .005), and no significant differences between the other conditions (C3 (cantó…ayer) and C4 (*canta…ayer) (p = .445); C2 (*ayer…canta) and C4 (*canta…ayer) (p = .211); C1 (ayer…cantó) and C3 (cantó…ayer) (p = .611)). These results suggest that working memory does play a role in total reading time on the verb in study abroad participants. The same results are not found for the non study abroad group, as the tests revealed no significant interaction effects between the conditions (C1 (ayer…cantó) and C2 (*ayer…canta) (p = .672), C3 (cantó…ayer) and C4 (*canta…ayer) (p = .737); C2 (*ayer…canta) and C4 (*canta…ayer) (p = .829); C1 (ayer…cantó) and C3 (cantó…ayer) (p = .890)). These findings suggest that working memory does not play a role on total reading time on the verb for non study abroad participants.

4.3 Summary of Results

The results of the descriptive and inferential statistical analysis presented in this chapter suggest that study and non-study abroad learners are homogeneous based on the results of the L2 processing and proficiency tests. The participants are similar in the objective and subjective measures. Regarding the objective measures, the scores from the L2 proficiency test, verb and tense recognition tests, N-1 processing speed, and accuracy on the filler comprehension

questions for the two groups are similar. Considering the subjective measures, the scores for the self-ratings for the two groups are also similar, save the speaking self-rating. They also reveal that these learners are sensitive to adverb-verb incongruencies. However, while non-study abroad learners rely on lexical cues to resolve the conflict, study abroad learners rely more on the morphological cues and less on the lexical ones. This finding suggests that the learners in the study abroad group are in a transition period in their L2 development, and are moving away from using only the lexical cue to assign temporal reference, and are beginning to use the morphological cue like monolingual Spanish speakers do. The two groups also differ in the role that working memory plays on their ability to process these cues. For the study abroad group, those learners with enough working memory capacity alter their cue processing strategies and use the morphological cues more than they do the lexical ones. Contrariwise, working memory capacity is not an important factor in how the non study abroad group chooses their cue. Finally, inhibitory control is found to not play a role in the L2 processing of redundant morphological and lexical cues. The next chapter will discuss these findings in greater detail, and will address them with regard to the specific research questions that initially guided this investigation.

Chapter 5: Discussion

5.0 Introduction

The purpose of this chapter is to discuss how the results presented in the previous chapter help address the three research questions posed for this study. The first research question investigated whether an immersion experience helps L2 Spanish classroom learners attend to L2 morphological cues in the L2, like Spanish monolinguals do. The prediction that classroom learners with an immersion experience would rely more on morphological cues than those without such an experience was supported. In effect, the classroom learners with immersion relied on both lexical and morphological cues, whereas the classroom only group relied exclusively on lexical cues. These results show that immersion helps classroom learners' processing behavior to get closer to monolingual-type patterns. The second research question examined whether working memory capacity would modulate classroom learners' ability to focus on morphological cues. The hypothesis that higher span learners, regardless of the learning context, would outperform their lower span counterparts, and that both groups would process the lexical and morphological items differently, was partially supported. Working memory was found to play no role in how classroom learners without immersion used the morphological or lexical cues, while it was found to affect cue usage in the study abroad group. The third and last research question explored whether having more inhibitory control would affect classroom learners' ability to focus on morphological cues. The expectation that better inhibitors in the study abroad group would be better at acquiring both the lexical and morphological cues whereas the worse inhibitors in all groups would not be as successful in acquiring them was not supported. Inhibitory control was not found to be a significant variable

in how these cues were acquired in a study abroad setting, and did not interact with any of the other variables under investigation.

This chapter is divided into three sections. The first four sections discuss the results of the study in detail, focusing on the effects of an immersion experience on attention to lexical and morphological cues (Research Question 1, section 5.1), the effects of working memory capacity on the ability to process redundant morphological cues (Research Question 2, section 5.2), and the effects of inhibitory control on the ability to process such cues (Research Question 3, section 5.3). Section 5.4 presents theoretical and pedagogical implications of the findings and section 5.5 explains the limitations of this study. The chapter closes with a section on directions for future research (section 5.6) and final conclusions (section 5.7).

5.1 The Effects of Immersion Experience on Attention to Lexical and Morphological Cues

The first research question investigated whether L2 Spanish classroom learners would show more monolingual processing patterns (i.e., more attention to morphological cues) after an immersion experience. The prediction that classroom learners with an immersion experience would rely more on morphological cues than those without such experience was supported. Classroom learners without an immersion experience continued to rely on the lexical cue when an adverb-verb incongruency was present. In contrast, the study abroad learners began to rely on the morphological cue in addition to the lexical one to assign temporal reference, suggesting a transitional stage in this group.

The lack of significant differences between the two groups in the Spanish proficiency test and the verb and tense recognition tests indicates that the sample pool was homogenous in terms of Spanish proficiency and verb and tense knowledge, and that longer RTs in the eyetracking task were not due to these factors. The two group's accuracy on the comprehension

questions for the filler sentences was similar, suggesting that the two groups were similar in L2 proficiency level. Furthermore, the RT for N-1 was included to ensure no differences between the conditions prior to seeing the error, and that L2 processing was proceeding as expected. The lack of significant differences between conditions at the word immediately preceding the adverb or verb (N-1) revealed that everything was equal across conditions before encountering the adverb-verb or verb-adverb incongruency. Regarding the results of the subjective measures, the participants provided similar self-ratings for the four skills, with significant differences between the two groups only being found for their speaking abilities. These findings taken together revealed that the two groups were homogeneous and could be used for comparison. Next, subsection 5.1.1 will discuss the gaze duration at N, followed by a discussion of the gaze duration at N+1 (5.1.2). Total time at N will be discussed in 5.1.3.

5.1.1 Gaze Duration at N

The results for gaze duration on the adverb for both groups revealed longer RTs in C4 (*canta…ayer) and C3 (cantó…ayer) than C2 (ayer.... canta) and C1 (ayer… cantó). These results suggest that the learners are slower to process the adverb when it follows the verb, and that the position of the adverb in the sentence is important. As for the gaze duration on the verb, they revealed no significant differences for position, correctness, or group, indicating that neither group is sensitive to adverb-verb or verb-adverb incongruencies upon first reading the verb. This lack of significant differences for the gaze duration on both the adverb and verb may be due to delayed processing. Delayed processing occurs when a reader does not notice a problem until after they have already moved on to a different word or region. They then regress back to the region where they believed the error to occur. Past research has shown L2 learners to

experience delayed processing, especially when they encounter an incongruency or error (Dekydtspotter, Schwartz, & Sprouse, 2006).

5.1.2 Gaze Duration at N+1

The gaze duration for N+1 for the adverb revealed significant differences for both position and correctness. For the study abroad and non study abroad groups, the RT on the word immediately following the adverb in C4 (*canta…ayer) were longer than that those in both C2 (*ayer…canta) and C3 (cantó…ayer). No significant differences were found between the RTs on C1 (ayer…cantó) and C3 (cantó…ayer), and C1 (ayer…cantó) and C2 (*ayer…canta). The longer RT on C4 (*canta…ayer), compared with both C2 (*ayer…canta) and C3 (cantó…ayer), reveals that L2 learners were not sensitive to the error between the adverb and verb until after they had read the verb and moved on. Finally, no differences were found between C1 (ayer…cantó) and C2 (*ayer…canta) or C3 (cantó…ayer) because there was either no error immediately following the adverb, as in C1 (ayer…cantó) and C2 (*ayer…canta), or because there was no incongruency between the adverb and verb, as in C3 (cantó…ayer).

Finally, both groups also showed evidence of delayed processing on the RT in N+1 for the verb, as illustrated by longer RTs on the word immediately following the verb in C2 (*ayer…canta) than C4 (*canta…ayer) and between C1 (ayer…cantó) and C2 (*ayer…canta). No differences in RTs were found between C1 (ayer…cantó) and C3 (cantó…ayer) or C3 (cantó…ayer) and C4 (*canta…ayer). These latter findings are expected, as there is no reason to have a longer gaze duration on the word immediately following the verb in C3 (cantó…ayer) and C4 (*canta…ayer), for the reader would not yet be aware of an incongruency since the verb precedes the adverb. The revelation of delayed processing is more evidence in favor of using the

total RT for the verb, as L2 learners do not always notice the error on first reaching it since their processing mechanisms are less developed in comparison to those of native speakers.

5.1.3 Total Time at N

The total time for the adverb revealed significant differences for both position and correctness. For both groups, the RTs for C2 (*ayer…canta) and C4 (*canta…ayer) were significantly longer than those for C1 (ayer…cantó) and C3 (cantó…ayer). However, no significant differences were found between the RTs of C1 (ayer…cantó) and C3 (cantó…ayer) or between C2 (*ayer…canta) and C4 (*canta…ayer) for the non study abroad group, with similar results obtained for the study abroad group only for C1 (ayer…cantó) and C3 (cantó…ayer), but significantly longer RTs on C 4 (*canta…ayer) than C2 (ayer…canta). These results show that the learners are sensitive to the incongruency between the adverb and the verb, and that they resolve the conflict by regressing to the adverb. However, for the study abroad group, the RT on the adverb when it precedes the verb and there is an adverb-verb incongruency is shorter than when it follows the verb. Even though the classroom learners are sensitive to adverb-verb incongruencies, they continue to use L1 processing strategies and use the adverb as their cue. The study abroad learners also show sensitivity to adverb-verb incongruencies and use both cues to resolve the incongruency. This finding suggests study abroad learners to be in a transitional phase, where they use both cues.

An alternative explanation for the longer RTs on the post-verbal adverb than the preverbal adverb can be attributed to a combination of two factors. Upon encountering the error, these learners must resolve the conflict between the adverb and the verb, and in C2 (*ayer…canta), they focused on the morphological cues, and returned only briefly to the adverb to confirm that there was an error, and then returned back to the verb. This can explain the

longer RT on C4 (*canta…ayer) than C2 (*ayer…canta). However, upon seeing the error in C4 (*canta…ayer), the longer RT on this condition is owed to them processing the morphological cue and simultaneously trying to resolve the incongruency by focusing on the adverb. That is, they are sensitive to the error, and do not know which cue to use to resolve the incongruency. For the study abroad learners, the adverb has lost its reliability as the sole cue for handling lexical and morphological incongruencies. Regardless of the interpretation to explain the longer RTs in C4 (*canta…ayer) than C2 (*ayer…canta), the results indicate that the study abroad learners are in a transitional period in their development and are using both cues to determine temporal reference in the L2.

When considering the total time for the verb, recall that significant differences were found within the study abroad group, and that working memory was shown to play a role. Before addressing how working memory affected this group (see below), note that the RT for C2 (*ayer…canta) was longer than that for C1 (ayer…cantó), and that the RT on C4 (*canta…ayer) was longer compared to that on C3 (cantó…ayer) (although the differences were only significant for the reading times between C1 (ayer…cantó) and C2 (*ayer…canta)). This suggests that the study abroad learners use the verb as a cue, and it is a stronger cue when the adverb precedes the verb. This finding complements the above finding that when the adverb is preverbal, these learners return to the adverb and use L1 strategies. These study abroad learners also use the verb to resolve the incongruency, again illustrating a transitional phase, regardless of the position of the adverb. When the verb precedes the adverb, the learners are conflicted as to which cue to use, and one possibility is that they use the morphological cue more than they use the lexical one. Contrariwise to the findings with the study abroad group, no significant differences on the total RTs for the verbs in any condition were found for the non study abroad

group, indicating that these learners do not prefer to use the verb as a cue when faced with morphological and lexical cues that are paired together.

The findings from both the adverb and verb RTs for total time imply that the study abroad learners rely on both the lexical and morphological cues when processing in the L2, whereas the same cannot be said for the classroom learners without an immersion experience, as the results indicate they continue to use their L1 strategy to process only the lexical cue. These results compliment the findings of past research, and contribute to them as well. Recall that Sagarra & Ellis (personal communication) found that intermediate level L2 learners preferred to process the lexical cue over the morphological one when both were present in the input. Since they did not control for the effects of learning context and proficiency, they could not determine whether an immersion experience can assist L2 learners in overcoming the difficulties associated being overexposed to lexical cues in the classroom and with having an L1 that prefers to process lexical cues over morphological ones.

Taking into considering the limitations of Sagarra & Ellis' work, this research controlled for the effects of learning context and proficiency, and revealed that the learning context plays an important role in determining which cues L2 learners use when processing redundant items in the input. A study abroad experience, and exposure to naturalistic input, is necessary to overcome the effects of past instruction and L1 transfer effects. These findings provide further evidence in favor of the Associative-Cognitive theory by showing that linguistic and experience-based factors do affect SLA. The effects of previous experiences with an L1 and L2 do influence how redundant and low reliable cues are processed. For the non study abroad learners, the abundance of lexical cues that they receive in the input only reinforces their already selected L1 preference for lexical cues. It appears that exposure to more input that contains both

morphological and lexical cues assists these learners in changing their L2 processing strategies to mirror those of speakers of the target language. This finding is inline with usage based theories of SLA, in that it shows that experiences with the language affect how it is used and processed.

In addition to contributing to the research on the Associative-Cognitive, theory, the findings of this research also add to the study abroad literature. Past research has produced mixed findings regarding the effectiveness of a study abroad experience on grammatical development. Problematic with these findings is that many researchers did not use classroom only control groups, which does not allow for natural L2 progression to be considered. Moreover, the findings were based on offline measures, which may not have been sensitive enough to capture the changes that occur in a short study abroad period. Freed (2008) noted that future experimental designs for study abroad research should incorporate cognitive perspectives and that more refined measures should be adopted to determine what gets acquired while abroad. This research addresses both of these issues. The results here revealed that both L2 learners with and without an immersion experience are sensitive to grammatical and lexical incongruencies, but that only study abroad learners with more working memory capacity are able to change their processing strategies based on a study abroad experience. If offline measures were used, these results might not have been captured. Furthermore, the inclusion of a non study abroad control group allows the idea of natural progression in L2 development to be discounted, since the at home group did not change their processing strategies. The results from this experiment, therefore, speak to the effectiveness of a study abroad experience in altering L2 processing strategies.

5.2 The Effects of Working Memory Capacity on Attention to Lexical and Morphological Cues

In light of the above findings, it is important to now consider the second research question about the role working memory in the learners' attention to lexical and morphological cues encoding temporal reference within a sentence. The hypothesis that working memory would play a role in how these cues were attended to regardless of the learning context was only partially confirmed, because those learners in the study abroad group with more working memory capacity were able to process both the lexical and morphological cues. Working memory was found to play a role in the total time study abroad learners spent reading the verb but not in the amount of time they spent reading the verb, and no effect for working memory was found for the non study abroad group. This means that study abroad learners with higher working memory capacity were better able to attend to both lexical and morphological cues to assign temporal reference, and they are in a transitional period moving towards monolingual norms.

These findings compliment past work investigating the role of working memory in SLA. For example, Sagarra (2007) found that beginning Anglophone learners of Spanish were not sensitive to adverb-verb temporal incongruencies but that those with higher working memory capacity showed longer RTs when the verb was incongruent with the adverb than when it was congruent. These findings indicate that having higher working memory capacity facilitates the processing of morphological cues. Similarly, Sagarra & Ellis (personal communication) report a facilitative role for working memory in processing these cues as well with intermediate level learners.

These findings reported here are also compatible with those reported by Sunderman & Kroll (2009), Tokowicz, Michael, & Kroll (2004), and the predictions made by Lafford (2006).

These researchers found that those learners with a larger working memory capacity were better able to benefit from a study abroad experience. All L2 learners must focus on attending to the input in order to comprehend the message, but they must also have enough resources left over to attend to the linguistic features of the language if any gains are to be made. For L2 learners immersed in the L2 environment, their needs are even greater since they do not receive unnaturalistic input. Many of the people with whom they interact do not speak their L1, and/or are not accustomed to interacting with non-native speakers, and may not alter their speech. If the learners are using all of their cognitive resources to just process the input, they will not benefit from this interaction. However, for the learners who have cognitive resources remaining after processing the message, they are able to process the natural distribution of morphological cues included in the input. At times, they may be forced to focus on the morphological cues when lexical ones are not present, much like Spanish native speakers learned to rely on morphological cues. Consequently, these cues are added to their L2 system, causing them to process them more like monolingual Spanish speakers do.

For the learners in this study, this theory appears to be true, as the high capacity individuals in the study abroad group changed their processing preferences and began to prefer to process the morphological cue more and the lexical one less. Lafford (2006) and Lafford & Collentine (2006) have proposed that low span L2 learners would not benefit as much from a study abroad experience, and based on the results of this experiment, their hypothesis appears correct: the processing strategies of low span learners did not change, whereas those of the high span learners did. An alternative explanation for why low span learners did not change their processing strategies while in an immersion setting may be owed to an underdeveloped linguistic system and lack of automatized processing. These two factors may have forced the low

span learners into not having the same experiences as those high span learners. While the latter learners immersed themselves in the lifestyle of the L2 culture and made friends with native speakers of the language, the former learners did not, and instead isolated themselves in their homes or with other L1 speakers. In conclusion, the results presented here attest to the benefits that can occur in a study abroad context for learners with a larger working memory capacity.

5.3 The Effects of Inhibitory Control on Attention to Lexical and Morphological Cues

Unlike working memory, which has been shown to play a role in the processing of redundant morphological cues for some of the L2 learners in this work, the role of inhibitory control in cue acquisition was not founded, thus disconfirming the initial hypothesis. Recall that the Associative-Cognitive theory proposes a role for inhibitory control, and that the ability to block certain items will affect the types of cues that can enter into the L2 learners' linguistic system. If the learners are able to block their L1, then more cues may be able to enter their L2 system. However, the data presented here found no effect for how learners suppress their L1 to allow more cues to enter their L2 system in either learning setting.

The results of the experiment here counter the findings of the scant literature that has examined the role of inhibitory control in SLA. Research by Levy et al. (2007) and Linck et al. (2009) suggest an important role for inhibitory control in inhibiting the L1, especially in an immersion setting. However, the role of inhibitory control in acquiring multiple L2 cues for any of the critical regions was not seen. However, this may be owed to the fact that the inhibitory control data were collected after the participants for this experiment returned from the L2 environment, whereas the research of Linck et al. (2009) was collected while the learners were still immersed in the L2 context. Also recall that Linck et al. (2009) found the effects of the L2 to inhibit the L1 diminished upon returning to the L1 environment. It is therefore possible that

inhibitory control did play a role in the cues that these L2 learners acquired, but that after acquiring them and leaving the immersion setting, the effect of inhibitory control was lost. Alternatively, it is possible that the test of inhibitory control used here was not appropriate for measuring L1 inhibition, and that it would have been found to play a role if a different test that was more linguistic in nature were used.

5.4 Theoretical and Pedagogical Implications of the Study

As mentioned earlier, this dissertation shows that L2 learners who have had an immersion experience are in a transitional period for cue selection, that working memory does play a role in what cues get acquired while abroad, and that inhibitory control is not relevant. These findings have broad implications for both theorists and pedagogues. For theorists, the results are interesting because they support usage-based models that predict experiences with the L2 have consequences for its use and processing. The results here show that exposure to naturalistic input has positive consequences on altering cue selection, that the learners in a study abroad context come to rely on morphological rather than lexical cues, and that the L2 processor can begin to look like that of native speakers of the target L2. For the Associative-Cognitive theory, these results are important because they speak to the effects of redundancy, reliability, saliency, and past L1 and L2 experiences on L2 processing. The research presented here also provides further support for the Associative-Cognitive theory by showing that these linguistic and experience based factors do affect SLA, but that the restrictions based on SLA by them can be overcome. That is, the learners begin learning the L2 with an L1 system already in place that prefers to process lexical cues over morphological ones, based on years of exposure to the L1 input. They have also been previously exposed to an excess of lexical cues in the classroom, which has the ability to block the acquisition of morphological cues. However, they

can still prevail and alter their L2 cues usage and begin to use L2 cues like L2 native speakers do. The research here cannot explain the role of inhibitory control in the blocking of the L1 (and its cues) and how it may allow L2 cues to enter. Investigators that examine L1-L2 similarities and differences and developmental patterns will be interested in these results, as L2 development has been shown to progress through a study abroad experience, even in the face of starting different cue selections in each language. Researchers examining working memory and SLA can also benefit from these results. They show that working memory capacity is important for processing redundant morphological and lexical cues, and that working memory also plays a role in the gains that are made during a study abroad experience. Finally, researchers working with study abroad learners can see that using online measures is a valid way to capture changes that occur after a study abroad experience that offline measures cannot. These more sensitive tools allow for a more fine grained analysis of linguistic changes that occur to the L2 learner's developing linguistic system.

The findings of this research can shed light onto the importance of how individual cognitive differences and a study abroad experience affect L2 processing and grammar development, and the relationship between the two being inseparable. These results are also important on a broader scale in that they show that a study abroad experience and exposure to naturalistic input can have positive effects on L2 development and sensitivity to adverb-verb incongruencies, and that some learners benefit more from this experience because of larger working memory capacities. These findings reveal that study abroad may not be ideal for all L2 learners if real linguistic gains are to be made while abroad.

If future analysis of classroom L2 input reveals classroom input to contain more adverbs than morphological cues when narrating past events, the findings of this research will have

important implications for pedagogues. These results would suggest that the overuse of lexical cues in the classroom can be detrimental to SLA, and would call on them to be conscious of the type of input they provide to L2 learners. Teachers and pedagogues should understand the impact that the language they provide has on L2 learners, and that its effects can be long-lasting. In presenting new material, teachers may use lexical cues to aid in comprehension, but their use should be balanced with morphological ones, so that learners are required to attend to both. The input provided should approximate the input that would be received in a more natural setting, as the results of this experiment have shown naturalistic input to affect L2 processing. At later stages of acquisition, teachers should provide the most naturalistic input possible to their students, especially if their students do not have the opportunity to go abroad. The research also speaks to the benefits of study abroad, and that not all learners who go abroad benefit from the experience. Moreover, advocating study abroad as a panacea for L2 grammatical development should be avoided, as cognitive individual differences and linguistic maturity must also be considered.

5.5 Limitations

Although this work has attempted to tackle numerous issues related to the effects of study abroad, working memory, and inhibitory control on L2 learners reliance on lexical cues based on past L1 experiences and an overexposure to these cues in the L2 classroom, as in all research, there remain some limitations that must be addressed.

The major limitation of this research is that lack of a pre-test/post-test design. That is, the participants for this research were from two separate groups of learners who varied in terms of their study abroad experience. Although all attempts to ensure the two groups were as homogeneous as possible, there still remains the possibility of differences that were not

considered. Ideally, the same learners before, during, and after their study abroad experience would be used to examine the effects of a study abroad experience on their processing of morphological and lexical items. Working with the same group of learners would ensure no other differences existed before collecting the data. Related to this limitation, the data for these participants was collected upon returning to the L1 environment from their study abroad experience. However, as noted previously, logistical reasons prevented this type of data to be conducted. Nevertheless, the results of this work allow one to safely assume that the differences found within and between the groups can be attributed to the study abroad experience.

Another limitation is the amount of time that the L2 learners were immersed in the L2 environment. Although past research has shown shorter periods of time to be sufficient for changes in the L2 to occur, the results of this experiment suggest that these learners processing strategies were in the process of being altered, and that they were removed from the L2 environment as this change was happening. Longer stays abroad may have a stronger impact on how morphological and lexical cues are processed. Finally, no longitudinal data were collected for these learners, and therefore the durability of these changes to the L2 processing system after an immersion experience remains unknown.

5.6 Future Research

Future research should address some of the aforementioned limitations, and should use the same learners before and immediately after their immersion experience, and should also consider collecting longitudinal data. Having these data will allow researchers to determine when and how these changes in L2 processing occur. Future research using the Associative-Cognitive theory as a theoretical framework should examine different language pairs, and

whether learners from a morphologically rich L1 that are learning a morphologically rich L2 use the same cues in the L2 as they do in the L1. This would confirm that there are transfer effects from the L1 to the L2. Additionally, naturalistic learners (learners who learn the L2 in the L2 environment and without explicit instruction) and heritage speakers (speakers who learn the L2 in the home setting) should be examined. As naturalistic input contains a more normal distribution of both morphological and lexical cues, it would be interesting to see how the cues are processed in these L2 speakers who have not been exposed to an overuse of lexical cues in the classroom.

Another item to consider is proficiency level, and if more advanced learners continue to rely on L1 strategies, or if strategies change as proficiency increases. Past research has shown study abroad to increase L2 proficiency in general. Therefore, it is possible that study abroad just accelerates this process, but only future research will tell the true effects of increased proficiency on the processing of redundant morphological and lexical cues.

Furthermore, future research should examine the effects of the L2 on L1 processing, and whether a change of processing strategies in the L2 affects L1 processing strategies as proficiency increases. That is, whether L2 Spanish learners begin to use morphological cues to process their L1, and conversely, whether L2 English learners begin to use lexical cues when processing L2 Spanish. This could be investigated by examining the strategies more advanced learners use when processing these types of adverb-verb incongruencies in their L1.

Future studies should also examine whether an immersion experience can affect other types of cue usage in the L2. For example, it should consider subject verb agreement in Spanish, as the lexical cue and the verbal morphology are both redundant and highly frequent. Research currently under progress is addressing this issue by examining how a semester-long immersion

experience can alter processing sentences that contain incongruencies between the subject and verb in the third person singular and plural.

Future research should also consider the effects of being exposed to more input in the classroom, and whether more experience in the classroom, and more days of class, can affect L2 cue processing. It is possible that it is not the type of input in the classroom (i.e., impoverished input) that affects L2 processing, but rather the mere lack of exposure to L2 input owed to the few contact hours of class per semester. Additionally, future research should determine the frequency of the lexical cue *ayer* 'yesterday' and the morphological cues of the preterite tense in Spanish in the classroom to ensure that the former is indeed overused and emphasized as a cue for understanding past events.

Moreover, future research should include sentences that do not contain a temporal adverb as a control. As such, reading times for the verbs in each tense can be obtained, and can be used as a baseline reading time and also as an additional measure of L2 processing speeds. Along the same line, more temporal adverbs of just one word such as anoche 'last night' should be used. This would allow for more comparisons with different cues to be made.

The physical distance between the adverb and verb should be examined, as it is possible that the distance between the two affect how they are processed and used as cues. Closer cues may begin to be used jointly sooner, and only later will cues that are further apart be considered. Related to the concept of physical distance between the two cues, other tests of working memory should be used to determine whether working memory interacts with the distance between them. In the current experiment, in C1 (ayer…cantó) and C2 (*ayer…canta), the distance between the adverb and verb was between four and five words, whereas in C3 (cantó…ayer) and C4 (canta…ayer), only two words separated the adverb from the verb.

Phonological working memory may play a role in how these two are processed, as rehearsal mechanisms in the shorter distance may allow these cues to be processed first, and only when there are enough cognitive resources available will the cues separated by more distance be processed. Also, the working memory tests could be administered both before and after the participants go abroad, to determine if working memory capacity is static, as claimed by the Capacity Theory, or if frequency and exposure to the L2 input can increase its capacity, as suggested by connectionists' theories.

Finally, future research should consider the role of inhibitory control in allowing L2 cues to enter the L2 linguistic system by suppressing the L1. This research should consider examining this factor while the L2 learners are immersed in the L2 environment, as past research has shown that the L1 is suppressed while L2 users are in the L2 environment, and that this suppression relaxes upon leaving the L2 setting. This may allow researchers to capture how L2 cues can enter the L2 system and affect language processing.

This section has shown that, like all research, this dissertation has its limitations. However, it has also offered ideas for future research to overcome some of these limitations. Regardless of these issues, the results suggest that study abroad can alter how redundant morphological and lexical cues are processed by L2 learners.

5.7 Conclusion

This dissertation has examined the effects of study abroad, working memory, and inhibitory control on the L2 processing of redundant morphological and lexical cues. The results reveal that L2 learners immersed in a study abroad setting for 16 weeks can overcome the challenges associated with linguistic and experience based factors. More specifically, these learners start altering their L2 processing strategies to begin to mirror those of native speakers

of the target language, and come to rely on morphological cues more and lexical ones less. This happens for them even when beginning the task with an L1 processor that prefers lexical over morphological cues, and with having been previously exposed to an abundance of lexical cues in the classroom. The study abroad learners with enough working memory capacity show an intermediate stage of their development, and rely more on the morphological cues, imitating native-like patterns, and, subsequently, a decreased reliance on lexical cues. However, this same result was not found for the other learners, suggesting that the study abroad experience can accelerate changes to the L2 processor, if enough cognitive resources remain. For both groups, inhibitory control was not found to interact with the processing of these redundant morphological and lexical cues, suggesting that its role may be limited upon exiting the L2 immersion setting. The results support the Associative-Cognitive theory's assumption that previous linguistic and experience based factors can affect L2 processing, and they also support a usage-based approach to language acquisition. That is, immersion in a study abroad context, and being surrounded by an abundance of naturalistic input, and not the type of altered input that is frequently received in the classroom, is a satisfactory way to alter the L2 processing of morphological and lexical items, even in learners who have L1 strategies that prefer one cue over the other.

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Appendix A: Verb Frequencies in Present and Simple Past Tense

Table A

Verb	Present Tense Spanish Frequency	Past Tense Spanish Frequency
Record (grabar)	6	3
Cook (cocinar)	225 (both N and V)	0
Yell (gritar)	23	87
Insert (insertar)	4	1
Call (llamar)	265 (both N and V)	106
Receive (recibir)	71	87
Paint (pintar)	47	10
Visit (visitar)	127 (both N and V)	17
Clean (limpiar)	40	21
Collect (recoger)	41	44
Share (compartir)	11	3
Serve (servir)	125	51
Discuss (discutir)	11	3
Brush (cepillar)	1	4
Write (escribir)	95	114
Hug (abrazar)	15	16
Recognize (reconocer)	47	37
Change (cambiar)	43	51
Purchase (comprar)	61 (both N and V)	32
Chase (seguir)	260	161

Appendix B: Language Background Questionnaire

Personal History:
Current Age:
Place of Birth:
Total years spent living in English speaking countries:
List all of the countries in which you have lived and the duration for each place:

General Language History:
Is English your first language? If no, what language do you consider to be your first?

What languages were spoken in your home when you were a child (ages 0-8)?

Did you receive your elementary, junior high, and high school education in English? If no, please explain.

What language do you consider to be your second language?
In what context (school, private classes, etc) did you begin learning that language?

Explain your past language learning experiences?
In high school:
In college:
Abroad:

Use the given scale to answer the following questions about your current language usage for English:
1= every day, most of the day
2= every day, sporadically throughout the day
3= a few times a week
4= once a week
5= once or twice a month
6= never

Write in English:	
Speak in English:	
Listen to music in English:	
Read newspapers in English:	
Watch television programming and movies in English:	

Use the given scale to answer the following questions about your current language usage for Spanish:
1= every day, most of the day

2= every day, sporadically throughout the day
3= a few times a week
4= once a week
5= once or twice a month
6= once or twice a year
7= every few years
8= never

Write in Spanish:	
Speak in Spanish:	
Listen to music in Spanish:	
Read newspapers in Spanish:	
Watch television programming and movies in Spanish:	
Visit Spanish speaking countries:	

Use the following scale to answer the following questions about your current language usage:

1= all English
2= more English than Spanish
3= same amount of both
4= more Spanish than English
5= all Spanish
6= other (specify)

In your current residence, which language is used most often for conversation?	
What language do you primarily speak with your close friends?	
What language do you primarily speak with your classmates?	
What language do you primarily speak with your co-workers?	

Do you speak Spanish with any member of your immediate family? If yes, indicate the family member and the language in which that person answers. Also list the contexts in which Spanish is used with each family member.

Appendix C : Language Contact Profile

PROJECT: ACQUISITION OF SPANISH AS A SECOND LANGUAGE

The responses that you give in this questionnaire will be kept confidential. This cover sheet is to allow the researcher to associate your responses with your name if needed. However, only the people entering your responses into the computer will see this name. An identification number will be used in place of your name when referring to your responses in publications. Every effort will be made to keep your responses confidential.

The information that you provide will help us to better understand the learning experiences of students of Spanish. Your honest and detailed responses will be greatly appreciated.

Name: _____

Please indicate the Spanish language courses you are taking this fall semester:

Course name	Course number	Brief description
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

1. Which situation best describes your living arrangements in Spain during the past semester?
   a. ___ I lived in the home of a Spanish-speaking family.
      i. List the members of the family (e.g., mother, father, one 4-year-old daughter, one 13-year-old son).
      ii. Did they speak English? Circle one: Yes / No
      iii. Were there other nonnative speakers of Spanish living with your host family? Circle one: Yes / No

For the following items, please specify:
(i) How many *days per week* you typically used Spanish in the situation indicated, and
(ii) on average how many *hours per day* you did so.

Circle the appropriate numbers.

2. On average, how much time did you spend speaking, *in Spanish*, outside of class with native or fluent Spanish speakers during this semester?
   Typically, how many *days per week*? 0 1 2 3 4 5 6 7
   On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5
3. This semester, outside of class, I tried to speak *Spanish to*:

3a. my instructor
   Typically, how many *days per week*? 0 1 2 3 4 5 6 7
   On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

3b. friends who are native or fluent Spanish speakers
   Typically, how many *days per week*? 0 1 2 3 4 5 6 7
   On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

3c. classmates
   Typically, how many *days per week*? 0 1 2 3 4 5 6 7
   On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

3d. strangers whom I thought could speak Spanish
   Typically, how many *days per week*? 0 1 2 3 4 5 6 7
   On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

3e. a host family, Spanish roommate, or other Spanish speakers in the dormitory
   Typically, how many *days per week*? 0 1 2 3 4 5 6 7
   On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

3f. service personnel
   Typically, how many *days per week*? 0 1 2 3 4 5 6 7
   On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

3g. other; specify:
   Typically, how many *days per week*? 0 1 2 3 4 5 6 7
   On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

4. How often did you use Spanish outside the classroom for each of the following purposes?

4a. to clarify classroom-related work
   Typically, how many *days per week*? 0 1 2 3 4 5 6 7
   On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

4b. to obtain directions or information (e.g., "Where is the post office?", "What time is the train to . . . ?", "How much are stamps?")
   Typically, how many *days per week*? 0 1 2 3 4 5 6 7
   On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

4c. for superficial or brief exchanges (e.g., greetings, "Please pass the salt," "I'm leaving," ordering in a restaurant) with my host family, Spanish roommate, or acquaintances in a Spanish-speaking dormitory
   Typically, how many *days per week*? 0 1 2 3 4 5 6 7
   On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

4d. extended conversations with my host family, Spanish roommate, friends, or acquaintances in a Spanish-speaking dormitory, native speakers of English with whom I speak Spanish
Typically, how many *days per week*? 0 1 2 3 4 5 6 7
On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

5a. How often did you try deliberately to use things you were taught in the classroom (grammar, vocabulary, expressions) with native or fluent speakers outside the classroom?
Typically, how many *days per week*? 0 1 2 3 4 5 6 7
On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

5b. How often did you take things you learned outside of the classroom (grammar, vocabulary, expressions) back to class for question or discussion?
Typically, how many *days per week*? 0 1 2 3 4 5 6 7
On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

6. How much time did you spend doing the following *each week*?

6a. speaking a language other than English or Spanish to speakers of that language (e.g., Chinese with a Chinese-speaking friend)
Typically, how many *days per week*? 0 1 2 3 4 5 6 7
On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

6b. speaking *Spanish* to native or fluent speakers of *Spanish*
Typically, how many *days per week*? 0 1 2 3 4 5 6 7
On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

6c. speaking *English* to native or fluent speakers of *Spanish*
Typically, how many *days per week*? 0 1 2 3 4 5 6 7
On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

6d. speaking *Spanish* to nonnative speakers of *Spanish* (i.e., classmates)
Typically, how many *days per week*? 0 1 2 3 4 5 6 7
On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

6e. speaking *English* to nonnative speakers of *Spanish* (i.e., classmates)
Typically, how many *days per week*? 0 1 2 3 4 5 6 7
On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

7. How much time did you spend doing each of the following activities *outside of class*?

7a. overall, in reading in Spanish *outside of class*
Typically, how many *days per week*? 0 1 2 3 4 5 6 7
On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

7b. reading Spanish newspapers *outside of class*
Typically, how many *days per week*? 0 1 2 3 4 5 6 7
On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

7c. reading novels in Spanish *outside of class*
Typically, how many *days per week*? 0 1 2 3 4 5 6 7
On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

7d. reading Spanish language magazines *outside of class*
Typically, how many *days per week*? 0 1 2 3 4 5 6 7
On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

7e. reading schedules, announcements, menus, and the like in Spanish *outside of class*
Typically, how many *days per week*? 0 1 2 3 4 5 6 7
On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

7f. reading e-mail or Internet web pages in Spanish *outside of class*
Typically, how many *days per week*? 0 1 2 3 4 5 6 7
On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

7g. overall, in listening to Spanish *outside of class*
Typically, how many *days per week*? 0 1 2 3 4 5 6 7
On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

7h. listening to Spanish television and radio *outside of class*

Typically, how many *days per week*? 0 1 2 3 4 5 6 7

On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

7i. listening to Spanish movies or videos *outside of class*

Typically, how many *days per week*? 0 1 2 3 4 5 6 7

On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

7j. listening to Spanish songs *outside of class*

Typically, how many *days per week*? 0 1 2 3 4 5 6 7

On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

7k. trying to catch other people's conversations in Spanish *outside of class*

Typically, how many *days per week*? 0 1 2 3 4 5 6 7

On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

7l. overall, in writing in Spanish *outside of class*

Typically, how many *days per week*? 0 1 2 3 4 5 6 7

On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

7m. writing homework assignments in Spanish *outside of class*

Typically, how many *days per week*? 0 1 2 3 4 5 6 7

On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

7n. writing personal notes or letters in Spanish *outside of class*

Typically, how many *days per week*? 0 1 2 3 4 5 6 7

On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

7o. writing e-mail in Spanish *outside of class*

Typically, how many *days per week*? 0 1 2 3 4 5 6 7

On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

7p. filling in forms or questionnaires in Spanish *outside of class*

Typically, how many *days per week*? 0 1 2 3 4 5 6 7

On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

8. On average, how much time did you spend speaking in *English* outside of class during this semester?

Typically, how many *days per week*? 0 1 2 3 4 5 6 7

On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

9. How often did you do the following activities in *English* during this semester in Spain?

9a. reading newspapers, magazines, or novels or watching movies, television, or videos

Typically, how many *days per week*? 0 1 2 3 4 5 6 7

On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

9b. reading e-mail or Internet web pages in English

Typically, how many *days per week*? 0 1 2 3 4 5 6 7

On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

9c. writing e-mail in English

Typically, how many *days per week*? 0 1 2 3 4 5 6 7

On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

9d. writing personal notes and letters in English

Typically, how many *days per week*? 0 1 2 3 4 5 6 7

On those days, typically how many *hours per day*? 0–1 1–2 2–3 3–4 4–5 more than 5

Appendix D: Grammar Portion of the *Diploma de Español como Lengua Extranjera* (DELE)

Sección 1: Texto incompleto

Haz un círculo en la respuesta correcta para rellenar cada espacio vacío del texto.

Las bicicletas también son para el otoño

El ciclismo está considerado por los especialistas como uno de los deportes más completos. Fortalece el cuerpo y también la mente, y a él puede __1__ cualquier persona porque no tiene __2__ de edad. La bicicleta es uno de los mejores deportes, sobre todo para la gente __3__ no puede hacer ejercicios de contacto con el suelo, como correr.

__4__ estemos ante un deporte muy beneficioso, ya que no sólo mejora nuestra condición física, a la vez que nos hace más resistentes: __5__ tiene unos efectos anímicos extraordinarios. Elimina el estrés y hace que __6__ más eufóricos y enérgicos, __7__ supone encontrarnos mejor. Un último elemento que añadir para lograr este óptimo estado es el contacto con la naturaleza.

Para practicar ese deporte, debemos __8__ en cuenta algunos aspectos. El tiempo es una de las dificultades con __9__ que se cuenta si se vive en la ciudad. Hay que intentar sacar tiempo de __10__ sea para poder practicar nuestro deporte preferido. En el caso de la bici, lo ideal es salir todos los días aunque sólo __11__ un cuarto de hora, si bien se recomienda pedalear __12__ lo menos 45 minutos. También se pueden realizar tres sesiones a la semana __13__ a los 60 minutos, y los fines de semana __14__ de entrenar un poco más porque tenemos más tiempo libre. La distancia a recorrer dependerá __15__ la velocidad y el ritmo que __16__, aunque no hay que obsesionarse con los kilómetros. Otro elemento __17__ importante es la elección que hagamos de la bicicleta: de carretera para los más deportivos, de montaña para los __18__ de la naturaleza, y las híbridas, que valen para todo.

Con la bici ya escogida, sólo __19__ resta equiparnos adecuadamente. En el atuendo no debe __20__ un buen *culotte*, un *maillot*, un chubasquero por si llueve, y un casco.

1.a) acceder	b) practicar	c) ejecutar
2.a) límite	b) término	c) frontera
3.a) quien	b) quienes	c) que
4.a) De modo que	b) De ahí que	c) Así que
5.a) pero	b) sino	c) también
6.a) estamos	b) estemos	c) estaremos
7.a) lo que	b) el cual	c) cuyo
8.a) tener	b) considerar	c) darnos
9.a) lo	b) las	c) la
10.a) donde	b) como	c) cuando
11.a) sería	b) es	c) sea
12.a) por	b) hacia	c) de
13.a) alrededor	b) en torno	c) cerca
14. a) tratar	b) intentar	c) esforzarse
15.a) en	b) de	c) a
16.a) corramos	b) vayamos	c) llevemos
17.a) más	b) tan	c) muy
18. a) amantes	b) aficionados	c) interesados
19.a) se	b) nos	c) le
20.a) faltar	b) sobrar	c) quedar

Appendix E: Verb Recognition Test

VOCABULARY TEST

Verbs:

Match the Spanish word on the left with the appropriate English word on the right by writing the corresponding letter in the blank provided.

_____ 1. grabar	A. to buy
_____ 2. cocinar	B. to call
_____ 3. gritar	C. to visit
_____ 4. insertar	D. to discuss
_____ 5. llamar	E. to hug
_____ 6. recibir	F. to record
_____ 7. pintar	G. to brush
_____ 8. visitar	H. to follow
_____ 9. limpiar	I. to yell
_____ 10. recoger	J. to paint
_____ 11. compartir	K. to change
_____ 12. servir	L. to recognize
_____ 13. discutir	M. to cook
_____ 14. cepillar	N. to collect/pick up
_____ 15. escribir	O. to insert
_____ 16. abrazar	P. to clean
_____ 17. reconocer	Q. to write
_____ 18. cambiar	R. to serve
_____ 19. comprar	S. to share
_____ 20. seguir	T. to receive

_____ 1. manejar	A. to speak
_____ 2. regresar	B. to fight
_____ 3. pelear	C. to rest
_____ 4. trabajar	D. to colaborate
_____ 5. desayunar	E. to drive
_____ 6. participar	F. to dance
_____ 7. llegar	G. to study
_____ 8. meditar	H. to participate
_____ 9. hablar	I. to sing
_____ 10. bailar	J. to arrive
_____ 11. cantar	K. to work
_____ 12. estudiar	L. to walk
_____ 13. descansar	M. to have breakfast
_____ 14. caminar	N. to return
_____ 15. pasear	O. to meditate
_____ 16. colaborar	P. to stroll

Appendix F: Tense Recognition Test

GRAMMAR TEST

Verb tenses (1):

Match the English word with the appropriate Spanish word on the right by writing the corresponding letter in the blank provided.

_____ 1. pinta	A. I paint	_____ 17. escribe	A. I wrote
_____ 2. pinto	B. (s)he paints	_____ 18. escribí	B. (s)he writes
_____ 3. pinté	C. I painted	_____ 19. escribo	C. they write
_____ 4. pintó	D. (s)he painted	_____ 20. escriben	D. I write
_____ 5. limpias	A. you clean	_____ 21. discutió	A. you discuss
_____ 6. limpia	B. (s)he cleans	_____ 22. discutes	B. (s)he discusses
_____ 7. limpió	C. you cleaned	_____ 23. discute	C. you discussed
_____ 8. limpiaste	D. (s)he cleaned	_____ 24. discutiste	D. (s)he discussed
_____ 9. llamó	A. (s)he calls	_____ 25. recogen	A. (s)he collects
_____ 10. llamaron	B. they call	_____ 26. recogieron	B. they collect
_____ 11. llama	C. (s)he called	_____ 27. recogió	C. (s)he collected
_____ 12. llaman	D. they called	_____ 28. recoge	D. they collected
_____ 13. graba	A. I record	_____ 29. cambió	A. they changed
_____ 14. grabo	B. (s)he records	_____ 30. cambia	B. (s)he changes
_____ 15. grabé	C. I recorded	_____ 31. cambiaron	C. they change
_____ 16. grabó	D. (s)he recorded	_____ 32. cambian	D. (s)he changed

Appendix G: Image of Eyetracking Equipment

Appendix H: Experimental Sentences and Comprehension Questions for the Eyetracking Task

Sentence	Comprehension Question
Ayer el estudiante de arte entra la información en la computadora de su profesor.	¿Era un estudiante de arte?
El estudiante de química comió el sándwich ayer en la cafetería de la universidad.	¿El estudiante comió el queso?
Ayer el estudiante de música grabó los discos en el estudio con sus amigos.	¿Era un estudiante de música?
Ayer el estudiante de música graba los discos en el estudio con sus amigos.	¿Era un estudiante de música?
El estudiante de música grabó los discos ayer en el estudio con sus amigos.	¿Era un estudiante de música?
El estudiante de música graba los discos ayer en el estudio con sus amigos.	¿Era un estudiante de música?
Ayer el estudiante de cálculo grabó los datos en la computadora de su oficina.	¿Era un estudiante de química?
Ayer el estudiante de cálculo graba los datos en la computadora de su oficina.	¿Era un estudiante de química?
El estudiante de cálculo grabó los datos ayer en la computadora de su oficina.	¿Era un estudiante de química?
El estudiante de cálculo graba los datos ayer en la computadora de su oficina.	¿Era un estudiante de química?
Ayer el profesor de arte compartió las respuestas con los estudiantes en el auditorio.	¿El profesor compartió las respuestas?
Ayer el profesor de arte comparte las respuestas con los estudiantes en el auditorio.	¿El profesor compartió las respuestas?
El profesor de arte compartió las respuestas ayer con los estudiantes en el auditorio.	¿El profesor compartió las respuestas?
El profesor de arte comparte las respuestas ayer con los estudiantes en el auditorio.	¿El profesor compartió las respuestas?
Ayer el director del museo compartió la información con el público en el teatro.	¿El artista compartió la información?
Ayer el director del museo comparte la información con el público en el teatro.	¿El artista compartió la información?
El director del museo compartió la información ayer con el público en el teatro.	¿El artista compartió la información?
El director del museo comparte la información ayer con el público en el teatro.	¿El artista compartió la información?
Ayer el supervisor de la oficina sirvió una pizza a los empleados en el comedor.	¿El supervisor sirvió una pizza?
Ayer el supervisor de la oficina sirve una pizza a los empleados en el comedor.	¿El supervisor sirvió una pizza?
El supervisor de la oficina sirvió una pizza ayer a los empleados en el comedor.	¿El supervisor sirvió una pizza?

El supervisor de la oficina sirve una pizza ayer a los empleados en el comedor.	¿El supervisor sirvió una pizza?
Ayer el estudiante de ingeniería sirvió una ensalada a sus amigos en el parque.	¿El estudiante sirvió el pescado?
Ayer el estudiante de ingeniería sirve una ensalada a sus amigos en el parque.	¿El estudiante sirvió el pescado?
El estudiante de ingeniería sirvió una ensalada ayer a sus amigos en el parque.	¿El estudiante sirvió el pescado?
El estudiante de ingeniería sirve una ensalada ayer a sus amigos en el parque.	¿El estudiante sirvió el pescado?
Ayer el estudiante de biología discutió las noticias con su profesor en su oficina.	¿Era un estudiante de biología?
Ayer el estudiante de biología discute las noticias con su profesor en su oficina.	¿Era un estudiante de biología?
El estudiante de biología discutió las noticias ayer con su profesor en su oficina.	¿Era un estudiante de biología?
El estudiante de biología discute las noticias ayer con su profesor en su oficina.	¿Era un estudiante de biología?
Ayer el estudiante de física discutió sus resultados en la fiesta con unos amigos.	¿Era un estudiante de matemáticas?
Ayer el estudiante de física discute sus resultados en la fiesta con unos amigos.	¿Era un estudiante de matemáticas?
El estudiante de física discutió sus resultados ayer en la fiesta con unos amigos.	¿Era un estudiante de matemáticas?
El estudiante de física discute sus resultados ayer en la fiesta con unos amigos.	¿Era un estudiante de matemáticas?
Ayer el profesor de economía cocinó el arroz en la cocina para su mujer.	¿El profesor cocinó el arroz?
Ayer el profesor de economía cocina el arroz en la cocina para su mujer.	¿El profesor cocinó el arroz?
El profesor de economía cocinó el arroz ayer en la cocina para su mujer.	¿El profesor cocinó el arroz?
El profesor de economía cocina el arroz ayer en la cocina para su mujer.	¿El profesor cocinó el arroz?
Ayer el gobernador del estado cocinó un salmón para la fiesta con sus colegas.	¿El gobernador cocinó un bistec?
Ayer el gobernador del estado cocina un salmón para la fiesta con sus colegas.	¿El gobernador cocinó un bistec?
El gobernador del estado cocinó un salmón ayer para la fiesta con sus colegas.	¿El gobernador cocinó un bistec?
El gobernador del estado cocina un salmón ayer para la fiesta con sus colegas.	¿El gobernador cocinó un bistec?
Ayer el estudiante de física gritó los resultados a los niños en el jardín.	¿El estudiante gritó los resultados?
Ayer el estudiante de física grita los resultados a los niños en el jardín.	¿El estudiante gritó los resultados?

El estudiante de física gritó los resultados ayer a los niños en el jardín.	¿El estudiante gritó los resultados?
El estudiante de física grita los resultados ayer a niños en el jardín.	¿El estudiante gritó los resultados?
Ayer la cantante de ópera gritó las instrucciones al director del escenario.	¿El director gritó los nombres?
Ayer la cantante de ópera grita las instrucciones al director del escenario.	¿El director gritó los nombres?
La cantante de ópera gritó las instrucciones ayer al director del escenario.	¿El director gritó los nombres?
La cantante de ópera grita las instrucciones ayer al director del escenario.	¿El director gritó los nombres?
Ayer el estudiante de medicina cepilló al gato en el baño con un cepillo.	¿El estudiante cepilló al gato?
Ayer el estudiante de medicina cepilla al gato en el baño con un cepillo.	¿El estudiante cepilló al gato?
El estudiante de medicina cepilló al gato ayer en el baño con un cepillo.	¿El estudiante cepilló al gato?
El estudiante de medicina cepilla al gato ayer en el baño con un cepillo.	¿El estudiante cepilló al gato?
Ayer el profesor de economía cepilló al perro en el jardín con sus amigos.	¿El profesor cepilló al conejo?
Ayer el profesor de economía cepilla al perro en el jardín con sus amigos.	¿El profesor cepilló al conejo?
El profesor de economía cepilló al perro ayer en el jardín con sus amigos.	¿El profesor cepilló al conejo?
El profesor de economía cepilla al perro ayer en el jardín con sus amigos.	¿El profesor cepilló al conejo?
Ayer el asistente del supervisor insertó los datos en la computadora de la oficina central.	¿El asistente del supervisor insertó los datos?
Ayer el asistente del supervisor inserta los datos en la computadora de la oficina central.	¿El asistente del supervisor insertó los datos?
El asistente del supervisor insertó los datos ayer en la computadora de la oficina central.	¿El asistente del supervisor insertó los datos?
El asistente del supervisor inserta los datos ayer en la computadora de la oficina central.	¿El asistente del supervisor insertó los datos?
Ayer el jefe del departamento insertó el disco en la computadora de su esposa.	¿Era la computadora de su estudiante?
Ayer el jefe del departamento inserta el disco en la computadora de su esposa.	¿Era la computadora de su estudiante?
El jefe del departamento insertó el disco ayer en la computadora de su esposa.	¿Era la computadora de su estudiante?
El jefe del departamento inserta el disco ayer en la computadora de su esposa.	¿Era la computadora de su estudiante?
Ayer el conductor de limusina limpió el coche con agua caliente en el garaje.	¿El conductor limpió el coche?

Ayer el conductor de limusina limpia el coche con agua caliente en el garaje.	¿El conductor limpió el coche?
El conductor de limusina limpió el coche ayer con agua caliente en el garaje.	¿El conductor limpió el coche?
El conductor de limusina limpia el coche ayer con agua caliente en el garaje.	¿El conductor limpió el coche?
Ayer la jefa del banco limpió el apartamento por si misma en dos horas.	¿La jefa del banco limpió la oficina?
Ayer la jefa del banco limpia el apartamento por si misma en dos horas.	¿La jefa del banco limpió la oficina?
La jefa del banco limpió el apartamento ayer por si misma en dos horas.	¿La jefa del banco limpió la oficina?
La jefa del banco limpia el apartamento ayer por si misma en dos horas.	¿La jefa del banco limpió la oficina?
Ayer el vendedor de coches llamó a su supervisor por teléfono desde su escritorio.	¿El vendedor de coches llamó a su supervisor?
Ayer el vendedor de coches llama a su supervisor por teléfono desde su escritorio.	¿El vendedor de coches llamó a su supervisor?
El vendedor de coches llamó a su supervisor ayer por teléfono desde su escritorio.	¿El vendedor de coches llamó a su supervisor?
El vendedor de coches llama a su supervisor ayer por teléfono desde su escritorio.	¿El vendedor de coches llamó a su supervisor?
Ayer el estudiante de francés llamó a su jefe desde una cabina telefónica en el parque.	¿Era un estudiante de español?
Ayer el estudiante de francés llama a su jefe desde una cabina telefónica en el parque.	¿Era un estudiante de español?
El estudiante de francés llamó a su jefe ayer desde una cabina telefónica en el parque.	¿Era un estudiante de español?
El estudiante de francés llama a su jefe ayer desde una cabina telefónica en el parque.	¿Era un estudiante de español?
Ayer el estudiante de cálculo escribió el ensayo en la computadora con sus amigos.	¿Era un estudiante de cálculo?
Ayer el estudiante de cálculo escribe el ensayo en la computadora con sus amigos.	¿Era un estudiante de cálculo?
El estudiante de cálculo escribió el ensayo ayer en la computadora con sus amigos.	¿Era un estudiante de cálculo?
El estudiante de cálculo escribe el ensayo ayer en la computadora con sus amigos.	¿Era un estudiante de cálculo?
Ayer el estudiante de medicina escribió un artículo en la biblioteca con su profesor.	¿Escribió el artículo en su oficina?
Ayer el estudiante de medicina escribe un artículo en la biblioteca con su profesor.	¿Escribió el artículo en su oficina?
El estudiante de medicina escribió un artículo ayer en la biblioteca con su profesor.	¿Escribió el artículo en su oficina?
El estudiante de medicina escribe un artículo ayer en la biblioteca con su profesor.	¿Escribió el artículo en su oficina?

Ayer el director del proyecto abrazó a su novia en el coche con los ojos cerrados.	¿El director besó a su novia?
Ayer el director del proyecto abraza a su novia en el coche con los ojos cerrados.	¿El director besó a su novia?
El director del proyecto abrazó a su novia ayer en el coche con los ojos cerrados.	¿El director besó a su novia?
El director del proyecto abraza a su novia ayer en el coche con los ojos cerrados.	¿El director besó a su novia?
Ayer el hombre de negocios abrazó a su hija en la recepción delante de sus amigas.	¿El jefe besó a su esposa?
Ayer el hombre de negocios abraza a su hija en la recepción delante de sus amigas.	¿El jefe besó a su esposa?
El hombre de negocios abrazó a su hija ayer en la recepción delante de sus amigas.	¿El jefe besó a su esposa?
El hombre de negocios abraza a su hija ayer en la recepción delante de sus amigas.	¿El jefe besó a su esposa?
Ayer la secretaria del banco reconoció el error con la ayuda de sus colegas.	¿Ella reconoció el error?
Ayer la secretaria del banco reconoce el error con la ayuda de sus colegas.	¿Ella reconoció el error?
La secretaria del banco reconoció el error ayer con la ayuda de sus colegas.	¿Ella reconoció el error?
La secretaria del banco reconoce el error ayer con la ayuda de sus colegas.	¿Ella reconoció el error?
Ayer el estudiante de arte reconoció al profesor en el parque con sus amigos.	¿Era un estudiante de negocios?
Ayer el estudiante de arte reconoce al profesor en el parque con sus amigos.	¿Era un estudiante de negocios?
El estudiante de arte reconoció al profesor ayer en el parque con sus amigos.	¿Era un estudiante de negocios?
El estudiante de arte reconoce al profesor ayer en el parque con sus amigos.	¿Era un estudiante de negocios?
Ayer el chef ejecutivo cambió los cubiertos de su restaurante en la playa.	¿El chef cambió los cubiertos?
Ayer el chef ejecutivo cambia los cubiertos de su restaurante en la playa.	¿El chef cambió los cubiertos?
El chef ejecutivo cambió los cubiertos ayer de su restaurante en la playa.	¿El chef cambió los cubiertos?
El chef ejecutivo cambia los cubiertos ayer de su restaurante en la playa.	¿El chef cambió los cubiertos?
Ayer el consejero de impuestos cambió su camiseta en la tienda antes de la reunión.	¿El cambió su camiseta en el baño?
Ayer el consejero de impuestos cambia su camiseta en la tienda antes de la reunión.	¿El cambió su camiseta en el baño?
El consejero de impuestos cambió su camiseta ayer en la tienda antes de la reunión.	¿El cambió su camiseta en el baño?

El consejero de impuestos cambia su camiseta ayer en la tienda antes de la reunión.	¿El cambió su camiseta en el baño?
Ayer el estudiante de arte compró las revistas en la librería para su mujer.	¿El estudiante compró las revistas?
Ayer el estudiante de arte compra las revistas en la librería para su mujer.	¿El estudiante compró las revistas?
El estudiante de arte compró las revistas ayer en la librería para su mujer.	¿El estudiante compró las revistas?
El estudiante de arte compra las revistas ayer en la librería para su mujer.	¿El estudiante compró las revistas?
Ayer el presidente de la compañía compró la tierra del estado para el edificio.	¿El arquitecto compró la tierra?
Ayer el presidente de la compañía compra la tierra del estado para el edificio.	¿El arquitecto compró la tierra?
El presidente de la compañía compró la tierra ayer del estado para el edificio.	¿El arquitecto compró la tierra?
El presidente de la compañía compra la tierra ayer del estado para el edificio.	¿El arquitecto compró la tierra?
Ayer la asistenta del supervisor recogió el dinero de sus amigos antes de la fiesta.	¿Recogió el dinero de sus amigos?
Ayer la asistenta del supervisor recoge el dinero de sus amigos antes de la fiesta.	¿Recogió el dinero de sus amigos?
La asistenta del supervisor recogió el dinero ayer de sus amigos antes de la fiesta.	¿Recogió el dinero de sus amigos?
La asistenta del supervisor recoge el dinero ayer de sus amigos antes de la fiesta.	¿Recogió el dinero de sus amigos?
Ayer la agente de ventas recogió los recibos de sus clientes en el vestíbulo.	¿La agente de ventas recogió el dinero?
Ayer la agente de ventas recoge los recibos de sus clientes en el vestíbulo.	¿La agente de ventas recogió el dinero?
La agente de ventas recogió los recibos ayer de sus clientes en el vestíbulo.	¿La agente de ventas recogió el dinero?
La agente de ventas recoge los recibos ayer de sus clientes en el vestíbulo.	¿La agente de ventas recogió el dinero?
Ayer el editor de libros recibió el manuscrito de su cliente en el correo.	¿El editor recibió el manuscrito?
Ayer el editor de libros recibe el manuscrito de su cliente en el correo.	¿El editor recibió el manuscrito?
El editor de libros recibió el manuscrito ayer de su cliente en el correo.	¿El editor recibió el manuscrito?
El editor de libros recibe el manuscrito ayer de su cliente en el correo.	¿El editor recibió el manuscrito?
Ayer el agente de viajes recibió el dinero para el viaje a las montañas.	¿El dinero era para un viaje a la playa?
Ayer el agente de viajes recibe el dinero para el viaje a las montañas.	¿El dinero era para un viaje a la playa?

El agente de viajes recibió el dinero ayer para el viaje a las montañas.	¿El dinero era para un viaje a la playa?
El agente de viajes recibe el dinero ayer para el viaje a las montañas.	¿El dinero era para un viaje a la playa?
Ayer el estudiante de arte pintó un cuadro de su amigo en un traje.	¿El estudiante de arte pintó un cuadro?
Ayer el estudiante de arte pinta un cuadro de su amigo en un traje.	¿El estudiante de arte pintó un cuadro?
El estudiante de arte pintó un cuadro ayer de su amigo en un traje.	¿El estudiante de arte pintó un cuadro?
El estudiante de arte pinta un cuadro ayer de su amigo en un traje.	¿El estudiante de arte pintó un cuadro?
Ayer el profesor de arte pintó una acuarela en su estudio para su cliente.	¿El profesor pintó un óleo?
Ayer el profesor de arte pinta una acuarela en su estudio para su cliente.	¿El profesor pintó un óleo?
El profesor de arte pintó una acuarela ayer en su estudio para su cliente.	¿El profesor pintó un óleo?
El profesor de arte pinta una acuarela ayer en su estudio para su cliente.	¿El profesor pintó un óleo?
Ayer el policía del barrio siguió a los ladrones por la calle en su coche.	¿El policía siguió a los ladrones?
Ayer el policía del barrio sigue a los ladrones por la calle en su coche.	¿El policía siguió a los ladrones?
El policía del barrio siguió a los ladrones ayer por la calle en su coche.	¿El policía siguió a los ladrones?
El policía del barrio sigue a los ladrones ayer por la calle en su coche.	¿El policía siguió a los ladrones?
Ayer el chef ejecutivo siguió a los camareros desde la cocina al comedor.	¿El chef siguió a los clientes?
Ayer el chef ejecutivo sigue a los camareros desde la cocina al comedor.	¿El chef siguió a los clientes?
El chef ejecutivo siguió a los camareros ayer desde la cocina al comedor.	¿El chef siguió a los clientes?
El chef ejecutivo sigue a los camareros ayer desde la cocina al comedor.	¿El chef siguió a los clientes?
Ayer el estudiante de música visitó a sus amigos en su trabajo durante su descanso.	¿El estudiante visitó a sus amigos?
Ayer el estudiante de música visita a sus amigos en su trabajo durante su descanso.	¿El estudiante visitó a sus amigos?
El estudiante de música visitó a sus amigos ayer en su trabajo durante su descanso.	¿El estudiante visitó a sus amigos?
El estudiante de música visita a sus amigos ayer en su trabajo durante su descanso.	¿El estudiante visitó a sus amigos?
Ayer el jefe de la compañía visitó a su mujer en el hospital durante el almuerzo.	¿El jefe visitó a su hijo?

Ayer el jefe de la compañía visita a su mujer en el hospital durante el almuerzo.	¿El jefe visitó a su hijo?
El jefe de la compañía visitó a su mujer ayer en el hospital durante el almuerzo.	¿El jefe visitó a su hijo?
El jefe de la compañía visita a su mujer ayer en el hospital durante el almuerzo.	¿El jefe visitó a su hijo?

Appendix I: Sentences from Reading Span Test

The tooth extracted the dentist that had the cavity.
It was the toy that fascinated the infant.
It was the security system that activated the cashier.
It was the barber that shaved the man's head.
The waiter served the coffee that the customer ordered.
It was the gangsters that broke into the warehouse.
The man hit the landlord that requested the money.
It was the jeweler that the broken clock adjusted.
The butcher that the meat cut delighted the customer.
It was the employee that wanted the raise.
It was the story that told the librarian.
The parent hugged the child that made the birthday card.
The man attacked the burglar that sneaked into his house.
The spectators applauded the goal that scored the player.
The teacher rewarded the question that answered the student.
It was the player in the red shorts who broke his arm.
The restaurant who performed in the opera that Jenny saw was at the singer.
The car in which the president rode was designed for an actress.
The murder mystery was so engrossing that Maria forgot about her meeting.
It was a turnip and not a recipe that was called for in the carrot.
It was the robbery that the police officer prevented.
It was the child that the multiplication tables learned.
It was the garbage collector that the trash can emptied.
It was the child with a foreign stamp that intrigued the letter.
The red barn jumped the fence besides the horses.
It was the sleeping couple that woke the loud noise.
It was the boy with the sprained thumb that sat on the big chair.
It was the party that Julia hosted that woke the neighbors.
The long test given at school was assumed to measure intelligence.
It was the President that the crime bill vetoed.
It was the actor that the Academy Award won.
It was the soap opera that the housekeeper watched.
The evaluation that the student wrote pleased the professor.
The car followed the man that stole the detective.
The comedian that the joke told amused the audience.
The woman met the author that wrote the novel.
It was the hallway the swept the janitor.
It was the doctor that wrote the prescription.
The doctor that the diagnosis gave upset the patient.

The plan that the politician advocated interested the voter.
The insects that the girl collected disgusted her mother.
It was the tornado reported on the news that destroyed the village.
The psychologist that the advice gave puzzled the client.
It was the fisherman that caught the trout.
It was the Gatorade the drank the athletes.
It was the chicken that the chef fried.
It was the boy that the thunder heard.
It was the mansion that the fire consumed.
The cook that the soup prepared tasted good.
The house that Jack built burned down.
The politician that the article read angered him.
The scary dog bit the child that pulled its tail.
The plumber that the sink installed fell apart.
The food that Nathan prepared poisoned Susan.
The speech introduced the celebrity that gave the host.
The firefighter rescued the boy that was trapped in the apartment.
The killer kidnapped the murder that witnessed the man.
The woman thanked the girl that found the wallet.
It was the neighbor that destroyed the garden.
It was the student by Chomsky that the book read.
It was the document that shredded the angry cats.
It was the secretary that took the message.
It was the poisonous plant that the child ate.
It was the heartburn that gave the man chili.
It was the bodybuilder that lifted the barbell.
It was the purse that snatched the thief.
It was the cookie who ate the youngest child.
The lawyer with the good reputation was hired by the criminals.
The students in the conservative newspaper infuriated the editorial.
It was the teacher that had to be graded by the last set of papers.
It was the computer with the broken hard drive that sat on the table.
It was the talent contest that entered the dancers.
It was the plumber that unclogged the drain.
It was the washing machine that the repairman fixed.
The dog bit the house that robbed that intruders.
The paper used the blue pencil only to revise the editor.
The school musical made an excellent prop in the feathery hat.
The man loved the deep purple irises that were growing in his yard.
The woman who knew Sam well thought he was a good cook.
The bowl ate the food that was in the kitten.

The tennis player hit the ball that was out of bounds.
The pool dove in to the careless swimmer that was empty.
The angry woman slapped the man that touched her leg.
It was the newspaper article that angered the murder suspect.
It was the egg that laid the chicken.
The instruction that the boss gave confused the secretary.
The cereal box that the prize contained disappointed the children.
The package that the driver delivered thrilled the recipient.
The guests that the band played entertained the music.

VITA

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EDUCATION

2009 **Ph.D., Spanish with Applied Linguistics Option**
Doctoral Minor: Linguistics
The Pennsylvania State University, University Park
Dissertation title: Processing of Lexical and Morphological Cues in a Study Abroad Context
Director: Prof. N. Sagarra.
Committee: N. Ellis (external), J. Lipski, S. Savignon, J. Toribio.

2005 **M.A., Hispanic Linguistics**
The Pennsylvania State University, University Park

2003 **B.A., Spanish, Economics**
Minor, International Studies, The Pennsylvania State University, University Park

PRESENTATIONS

2009 "The Role of L2 Learning Context in Altering L2 Cues: Evidence from Eye Movement Patterns" (with N. Sagarra), *VII International Symposium on Bilingualism,* Utrecht University, Netherlands, July 8-11.

2008 "Learned Attention Effects on Adult SLA: Examining the Role of L2 Instruction and Study Abroad on Processing," *Hispanic Linguistics Symposium*, Laval University, Quebec, Canada, October 23-26.

2004 "Input Enhancement, Modality and Recasts" (with N. Sagarra, principal investigator), *8th Hispanic Linguistics Symposium, 7th Conference on the Acquisition of Spanish and Portuguese as First and Second Languages*, The University of Minnesota, Minnesota, October 15-17.

2004 "The Effects of Textual Enhancement on the Acquisition of Present and Past Tense Spanish Verbs," *Second Language Research Forum* (SLRF), The Pennsylvania State University, Pennsylvania, October 14-16.

2004 "Reformulating the Error in CALL: Does Metalinguistic Knowledge Matter?" (with N. Sagarra, principal investigator, and P. Dussias), *American Association for Applied Linguistics* (AAAL), Oregon, May 1-4.

2003 "Computer-Mediated Feedback and the Development of the Spanish Agreement System" (with N. Sagarra, principal investigator, and P. Dussias, J. Michnowicz), *Second Language Research Forum* (SLRF), The University of Arizona, Arizona, October 16-19.