THE NATIVE AND NONNATIVE PROCESSING OF NUMBER AND GENDER

AGREEMENT IN SPANISH: AN ERP INVESTIGATION

By

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ABSTRACT

The present study utilizes EEG (Electroencephalography) to examine the processing of number and gender agreement in Spanish by native speakers and adult English-speaking learners. With respect to native processing, the study focuses on how different agreement features (number, gender) are retrieved for the purposes of agreement and on how structural distance (number of intervening phrases) impacts agreement resolution. With respect to nonnative processing, the study investigates the extent to which second language (L2) morphosyntactic processing is impacted by the properties of the learners' first language (L1), focusing on whether novel features (gender) and novel instantiations of a shared feature (number on adjectives) can be processed in a native-like manner. An additional question examined in the study is whether L2 morphosyntactic processing is impacted by structural distance.

Agreement was examined between nouns and adjectives within the same phrase (*edificio muy seguro* "building$_{\text{-MASC-SG}}$ very safe$_{\text{-MASC-SG}}$"), between nouns and adjectives across a verb phrase (VP) (*cuento es anónimo* "story$_{\text{-MASC-SG}}$ is anonymous$_{\text{-MASC-SG}}$"), and between demonstratives and nouns (*este apartamento* "this$_{\text{-MASC-SG}}$ apartment$_{\text{-MASC-SG}}$"), which is a syntactic context where both English and Spanish instantiate number agreement.

Both native speakers (n=24) and advanced English-speaking learners of Spanish (n=25) elicited a P600 for number and gender violations overall, which was not preceded by a Left Anterior Negativity. For native speakers, effects were equally robust for number and gender, suggesting that both features are processed similarly at the brain level. For learners, effects were more positive for number than gender, suggesting a quantitative advantage for the feature present in the L1. These results are in line with the Full Transfer/Full Access Hypothesis (Schwartz & Sprouse, 1996), which predicts that adult L2 learners can show

native-like processing for novel features. Furthermore, while both groups showed sensitivity to across-phrase violations, they were both affected by the distance manipulation, as suggested by the fact that within-phrase agreement yielded more positive waveforms than across-phrase agreement overall. These results suggest that L2 learners can establish syntactic dependencies outside of local domains (contra the Shallow Structure Hypothesis, Clahsen & Felser, 2006) and that both native and nonnative processing are modulated by structural distance similarly.

ACKNOWLEDGMENTS

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LIST of ABBREVIATIONS and ACRONYMS

1st: First Person
2nd: Second Person
3rd: Third Person
A: Adjective
AP: Adjective Phrase
c: class
COM: Common (gender)
CP: Complementizer Phrase
D: Determiner
DP: Determiner Phrase
EEG: Electroencephalography
ERP: Event-related Potential
FEM: Feminine
fMRI: Functional Magnetic Resonance Imaging
Gen: Gender
GenP: Gender Phrase
L1: First/Native Language
L2: Second Language
LAN: Left Anterior Negativity
MASC: Masculine
MEG: Magnetoencephalography
n: Little n
N: Noun
NEUT: Neuter
nP: Little n Phrase
NP: Noun Phrase
Num: Number
NumP: Number Phrase
Ø : Unmarked
PET: Positron Emission Tomography
PL: Plural
SG: Singular
SLA: Second Language Acquisition
t: trace
u: unvalued
UG: Universal Grammar
VP: Verb Phrase

CHAPTER 1:

INTRODUCTION

The present dissertation investigates the native and nonnative processing of number and gender agreement in Spanish. The purpose of the study is twofold. First, it seeks to better understand how native speakers establish agreement dependencies in the course of online processing, focusing on how different agreement features (number, gender) are retrieved for the purposes of agreement resolution, and on the extent to which structural distance (number of intervening syntactic phrases between the agreeing elements) impacts the establishment of agreement. Second, the study investigates whether morphosyntactic processing in adult second language (L2) learners at an advanced level of proficiency is qualitatively similar to native processing, focusing on the extent to which L2 processing is modulated by structural distance and by the properties of the learners' native language (L1).

Spanish, the language examined in the present study, is an excellent test case for addressing such questions, since each and every noun in the language triggers number and gender agreement on a wide range of elements, such as determiners, demonstratives, complementizers, and adjectives. An example of noun-adjective agreement is provided in (1a), where the adjective *ligera* "light" must agree in number and gender with the noun *caja* "box". Otherwise, the result is ungrammatical, as shown in (1b-c):

(1)
    a. caja   ligera
       box-FEM-SG light-FEM-SG
       "light box"

    b. caja   *ligeras
       box-FEM-SG light-FEM-PL

    c. caja   *ligero
       box-FEM-SG light-MASC-SG

With respect to native processing, examining agreement carries the potential to inform our understanding of how different linguistic features (number, gender) are represented in the speaker's mind and accessed during real-time language comprehension. For example, it has been proposed that number projects its own syntactic phrase, whereas gender in contrast is a lexical property of nouns (Ritter, 1991, 1993; Carstens, 2000). Based on this proposal, Faussart et al.'s (1999) lexical retrieval model argues that number and gender agreement are associated with different processing costs. Under Faussart et al.'s (1999) model, lexical information, such as gender, is assumed to be accessed earlier than syntactic information, such as number. Therefore, gender errors are predicted to generate greater processing costs than number violations, since the parser must return to the initial stage of lexical retrieval (identification) to check for gender, but to a later stage (recognition and integration) to check for number. Previous ERP studies on agreement have made different proposals with respect to whether number and gender are represented and processed similarly at the brain level (Barber & Carreiras, 2003, 2005; Nevins et al., 2007). The present study uses EEG, an electrophysiological method with excellent temporal resolution, to directly compare the online processing of number and gender agreement in order to bring neurolinguistic evidence to bear on the processing of different agreement features and how these features are used to resolve agreement dependencies in online language comprehension.

In addition to the recruitment of linguistic features, agreement involves forming dependencies between elements located at varying degrees of structural distance, which highlights the need for an investigation of how structural distance impacts the resolution of agreement dependencies in real time. An example is shown in (2), where the agreeing elements are located either within the same phrase (2a) or across different phrases (2b):

(2)
     a. una $_{NP}$[caja   muy <u>ligera</u>]
           a   box$_{-FEM-SG}$ very light$_{-FEM-SG}$
           "a very light box"

b. la caja   VP[es ligera]
   the box-FEM-SG is light-FEM-SG
   "the box is light"

The notion that dependency formation becomes increasingly difficult as the distance between the dependent elements increases is present in a number of models of sentence processing (Just & Carpenter, 1992; Gibson, 1998, 2000; Lewis et al., 2006). Although this question has been well-studied in some domains of dependency formation, such as wh-movement (e.g., Phillips et al., 2005), the impact of distance in the processing of agreement has only been examined in a few studies (e.g., Bock & Cutting, 1992; Deutsch, 1998; Pearlmutter, 2000; Kaan, 2002). Furthermore, most of these studies have examined distance in complex or ambiguous sentences and, therefore, the extent to which distance impacts syntactic processing in simple unambiguous configurations requires further inquiry (Bartek et al., 2011). In this dissertation, the focus will be on the unique contribution of structural distance to the online processing of agreement. This is an important open question, as most previous studies have confounded structural and linear distance (number of intervening words between the agreeing elements). The present study addresses this question by examining agreement realized within a phrase (_edificio muy seguro_ "building-MASC-SG very safe-MASC-SG") and agreement realized across a phrase (_cuento es anónimo_ "story-MASC-SG is anonymous-MASC-SG"). In the present design, linear distance is controlled for, allowing for a more systematic examination of the effects of hierarchical structure on agreement resolution.

With respect to L2 processing, the present study examines the extent to which L2 morphosyntactic processing is impacted by structural distance and by L1 transfer. These are both core questions in current second language acquisition (SLA) research, since different theoretical models make different claims regarding the role of the L1 in L2 acquisition and regarding the types of representations that learners rely on during online processing. For

example, the Shallow Structure Hypothesis (Clahsen & Felser, 2006; Clahsen et al., 2010) argues that adult L2 learners do not rely on abstract syntactic representations in the course of online processing and, therefore, they can only successfully resolve agreement dependencies online if the agreeing elements are in a 'local' relationship, such as within the same phrase (as in (2a) above). Under this hypothesis, adult L2 learners are assumed to have a permanent impairment at the syntactic level and, therefore, they are not predicted to show sensitivity to hierarchical structural relations, regardless of proficiency and regardless of the properties of their L1.

In contrast, other theoretical models, such as the Failed Functional Features Hypothesis (Hawkins & Chan, 1997) or the Full Transfer/Full Access Hypothesis (Schwartz & Sprouse, 1996), propose that the properties of the learner's L1 do play an important role in adult L2 acquisition, although they make different claims as to whether or not the L1 is deterministic with respect to native-like attainment in the L2. Number and gender agreement present an excellent test case for the role of the L1 in L2 processing for several reasons. First, while both English and Spanish instantiate number agreement, for example, between demonstratives and nouns (3-4), only Spanish instantiates gender agreement. In addition, despite the fact that both languages instantiate the feature *number* at the abstract level, only Spanish marks number on adjectives, as shown in (5) and (6):

(3)
       a.   esta   caja
            this$_{SG}$ box$_{SG}$
            "this box"

       b.   estas   cajas
            this$_{PL}$ box$_{PL}$
            "these boxes"

(4)
       a.   this box
       b.   these boxes

(5)

    a.   caja   ligera
        box$_{\text{-FEM-SG}}$ light$_{\text{-FEM-SG}}$
        "light box"

    b.   cajas   ligeras
        box$_{\text{-FEM-PL}}$ light$_{\text{-FEM-PL}}$
        "light boxes"

(6)

    a.   light box
    b.   light boxes

These differences between English and Spanish, both at the abstract and morphological levels, allow us to systematically examine the role of L1 transfer on L2 morphosyntactic processing, and to adjudicate between models of second language acquisition which make different predictions for features that are unique to the L2. For example, the Failed Functional Features Hypothesis (e.g., Hawkins & Chan, 1997; Hawkins & Liszka, 2004) proposes that, in post-puberty second language acquisition, syntactic features that are not instantiated by the learners' L1 will not be acquired to native-like levels in the L2, regardless of proficiency. In a study focusing on number and gender agreement in L2 Spanish, Franceschina (2005) found that near-native speakers of Spanish whose L1 instantiates syntactic gender agreement were able to perform at native-like levels with gender agreement in L2 Spanish, whereas near-natives of Spanish whose L1 was English [–gender] were not (despite rather high accuracy rates). In addition, the English-speaking learners in the study performed at native-like levels with number agreement (present in the L1), which the proponents of the Failed Functional Features Hypothesis interpret as evidence that the inventory of syntactic features in the L1 is deterministic with respect to native-like attainment in the L2. A more recent version of this proposal, the Interpretability Hypothesis (Tsimpli & Dimitrakopoulou, 2007) posits that it is uninterpretable features that become inaccessible in late L2 acquisition unless they are instantiated in the learners' L1. As an example, number and gender in Spanish

are argued to be interpretable on the noun (*caja* 'box_FEM-SG') and uninterpretable on

agreement targets, such as demonstratives and adjectives (*esta caja ligera* 'this_FEM-SG

box_FEM-SG light_FEM-SG') (Carstens, 2000).

In contrast, the Full Transfer/Full Access Hypothesis (Schwartz & Sprouse, 1996) posits

that L2 acquisition is influenced but not constrained by the properties of the learners' L1. For

example, in a study focusing on number and gender agreement in L2 Spanish, White et al.

(2004) found that performance in gender agreement was better predicted by L2 proficiency

than L1 background. In White et al.'s (2004) study, advanced L2 learners of Spanish who

were native speakers of either French [+ gender] or English [–gender] performed at

native-like levels in a series of production and comprehension tasks targeting number and

gender agreement. White et al. (2004) interpret these results as support for Full Transfer/Full

Access (Schwartz & Sprouse, 1996). Although White et al.'s (2004) results are interesting, it

remains an open question whether high levels of accuracy on the production and

comprehension tasks that were used are indicative of native-like competence with gender

agreement, since such offline tasks may have masked underlying qualitative differences at the

level of processing (Mueller, 2005; Montrul et al., 2008). Importantly, it is not possible to tell

from an offline task whether L2 learners establish gender agreement by relying on

qualitatively similar mechanisms to native speakers, or whether they apply nonnative-like

strategies, such as 'matching' the endings of words. For example, in Spanish, most masculine

nouns end in *–o* (e.g., *año* "year") and most feminine nouns end in *–a* (e.g., *semana* "week").

Therefore, one strategy that L2 learners might apply would be to match *–o* with *–o* and *–a*

with *–a*. In fact, proponents of the Failed Functional Features Hypothesis and the

Interpretability Hypothesis claim that late L2 learners may actually be highly accurate on

tasks targeting features not instantiated in their L1, as was the case with the English-speaking

learners of Spanish in Franceschina's (2005) study, but they argue that such performance is

achieved through compensatory strategies. It is possible that L2 learners whose L1 does not

instantiate gender simply monitor the input and rely on a surface analysis of forms that tend

to co-occur (Hawkins, 2001). Using this type of mechanism, learners might treat gender

agreement violations as a 'mismatch' between two lexical items or between two word

endings.

The ERP methodology is particularly suitable for examining whether L2 morphosyntactic

processing is qualitatively similar to native processing. This is because different ERP

components have been found to be sensitive to different aspects of language processing in

native speakers and, therefore, they can inform us of the qualitative nature of L2 processing.

For example, lexical semantic anomalies such as *He spread the warm bread with <u>socks</u>*

typically elicit an ERP component known as the *N400* at the word that renders the sentence

anomalous (e.g., Kutas & Hillyard, 1980). Crucially, the N400 (a negative-going wave

between 200-600 ms post-stimulus onset that typically peaks at 400 ms) has been shown to

be sensitive to the strength of lexical associations and, therefore, if learners process

agreement violations as 'mismatches' between lexical items or markers that frequently

co-occur, as suggested by the proponents of the Failed Functional Features Hypothesis (e.g.,

Hawkins & Chan, 1997) and the Interpretability Hypothesis (Tsimpli & Dimitrakopoulou,

2007), this is the component that would be predicted for gender agreement mismatches. In

fact, in a study focusing on agreement in simple word pairs (7-8), Barber & Carreiras (2003,

2005) found an N400 for both number and gender violations (7b-c, 8b-c) in native speakers

of Spanish.

(7)
        Determiner-Noun: Grammatical
    a. El   piano
        the-MASC-SG piano-MASC-SG
        "The piano"

Number Violation

b.   Los   *piano
the-MASC-PL   piano-MASC-SG

Gender Violation

c.   La   *piano
the-FEM-SG   piano-MASC-SG

(8)

Noun-Adjective: Grammatical

a.   Faro   alto
lighthouse-MASC-SG high-MASC-SG
"High lighthouse"

Number Violation

b.   Faro   *altos
lighthouse-MASC-SG high-MASC-PL

Gender Violation

c.   Faro   *alta
lighthouse-MASC-SG high-FEM-SG

(Adapted from Barber & Carreiras, 2005, p. 150)

Barber and Carreiras (2003, 2005) argue that, in the absence of a sentential context, agreement violations were processed at the lexical level by establishing associations between morphemes or word endings that tend to be associated (e.g., –o with –o, as in *faro alto*). When these associations fail due to a mismatch in word endings (e.g., –o with –a, as in *faro alta*), the result is an N400. Importantly, in sentential contexts, the same number and gender violations in Barber and Carreiras' (2005) study elicited a different component, the *P600*, a positive-going wave between 500-900 ms which has been argued to reflect a variety of morphosyntactic processes, including the repair of syntactic violations (e.g., Hagoort et al., 1993; Osterhout & Mobley, 1995; Gunter et al., 2000). Crucially, the P600 is consistently found for agreement violations in native speakers and, therefore, if adult L2 learners rely on native-like mechanisms to establish gender agreement, as suggested by the Full Transfer/Full Access hypothesis (e.g., Schwartz & Sprouse, 1996), this is the component that would be predicted for agreement violations. Along these lines, Osterhout et al. (2006, 2008)

interpreted different brain responses (e.g., N400 vs. P600) in novice learners as indexes of different processing mechanisms. The authors tested subject-verb agreement longitudinally in beginning English-speaking learners of French and found an N400 after only one month of instruction, which they take as evidence that the learners processed the violations as a mismatch between associated forms (see also McLaughlin et al., 2010). However, after four and eight months of instruction, the N400 for subject-verb agreement violations shifted into a P600 (similar to French native speakers), suggesting that, at higher levels of proficiency, learners processed the violations at the syntactic level (see also Morgan-Short et al., 2010).[1]

Compared to offline tasks, EEG allows for a more fine-grained investigation of the mechanisms underlying sentence processing in both native speakers and adult L2 learners. The present dissertation investigates the role of the native language on L2 processing by examining both number (present in the L1) and gender agreement (unique to the L2) in advanced English-speaking learners of Spanish. Moreover, the study examines whether morphological differences in how the L1 and the L2 realize a shared feature (number) impact processing, by examining number agreement in a context where both the L1 and the L2 instantiate number (demonstrative-noun) and a context where only the L2 realizes number agreement (noun-adjective). The role of structural distance in the L2 processing of agreement is examined by comparing agreement realized within the phrase and agreement realized across the phrase.

The present dissertation is structured as follows. In Chapter 2, an overview of the main theoretical proposals for the syntax of number and gender will be provided, alongside a brief description of the Spanish number and gender systems. In Chapter 3, a succinct description of EEG will be offered, alongside a review of the main ERP components reported in the sentence processing literature. In Chapter 4, a critical review of the most relevant ERP studies

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[1] Interestingly, patients with damage in frontal areas of the brain assumed to be engaged in syntactic processing show N400 effects for syntactic violations that typically elicit other components in normal controls (Kutas et al., 2006).

on the native processing of agreement will be provided, focusing on how different agreement features (number, gender) are recruited for the establishment of agreement, and on the role of structural distance/complexity in agreement processing. Chapter 5 provides a review of the most relevant literature on L2 processing, focusing on the role of the L1 on L2 processing and on the role of structural distance on the processing of syntactic dependencies. In Chapter 6, the present study and main research questions are introduced. Chapter 7 provides a detailed description of the methods used. Chapter 8 reports the results of the study. In Chapter 9, I discuss the main theoretical implications of the findings.

CHAPTER 2:

THE SYNTAX OF NUMBER AND GENDER

2.1. Number

As pointed out in Bernstein (2001b), there is little controversy in the literature regarding Ritter's (1991) proposal that number heads its own phrase somewhere below DP and above NP. In her analysis of two types of noun phrases (NP) in Modern Hebrew, construct states (9) and free genitives (10), Ritter provides evidence that the object noun (e.g., *house* in (9) and (10)) raises in both constructions, but lands in different sites.[2] In construct states (9a), Ritter posits that the object noun is raised to D, which explains why the noun and determiner cannot co-occur, as shown by the ungrammaticality of (9b). However, in free genitives (10a), the object noun head-moves to some position below DP and above NP, which Ritter calls Number Phrase (NumP) given that the material in that position (e.g., quantifiers) contributes to the specification of the DP for number.

(9) **Construct States**
    a. [beyt] ha-mora *t*

    house the-teacher
    "The teacher's house"

    b. *ha-beyt   ha-mora
       the-house the-teacher

(10) **Free Genitives**
    a. ha-[bayit] ʃel ha-mora *t*

    the-house of   the-teacher
    "The teacher's house"

(Adapted from Ritter, 1991, p. 40-42)

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[2] For a detailed explanation of DP-internal noun movement in Modern Hebrew, see Ritter (1991).

A similar analysis has been proposed for the syntax of number in Romance languages (Valois, 1991; Bernstein, 1991, 2001b). In most Romance languages, it is assumed that nouns raise from their underlying position (post-adjectival) to some intermediate position below DP (Cinque, 1994; Bernstein, 2001b). Following Ritter (1991), such position is assumed to be the head of Number Phrase. The diagram in (12) contains a tree representation of Number Phrase for the DP in (11).

(11)
Las   cajas   ligeras
the-PL boxes-PL light-PL
"The light boxes"

(12)
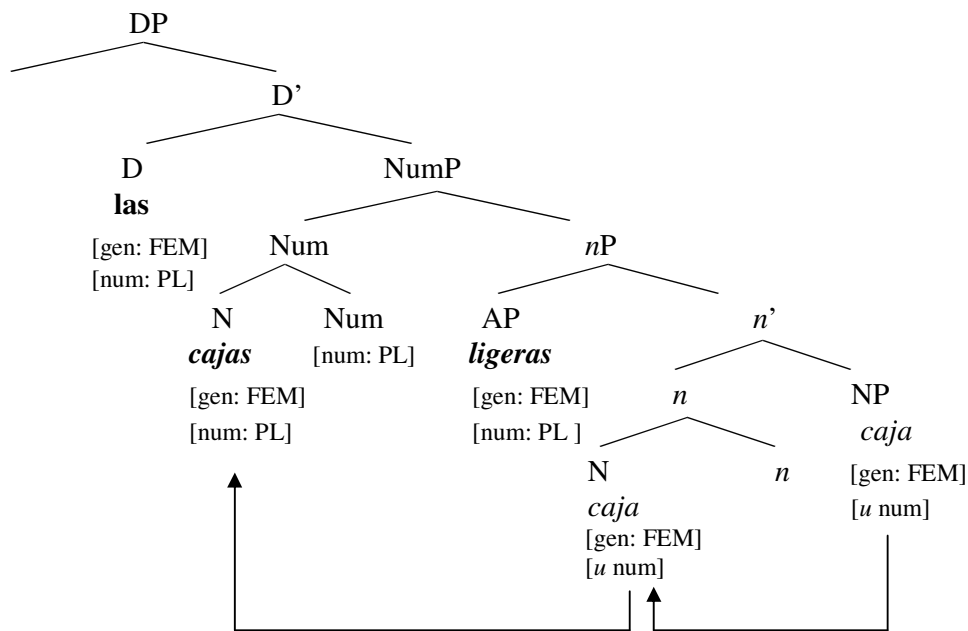
As can be seen in (12), the NP *caja* "box" originates with an unvalued number feature. It undergoes head movement to *n* first and then, to Num, where its number feature is valued as plural (*cajas* "boxes"). Once the number feature of the noun has been valued as plural, the uninterpretable number features of the elements which are in an agreement relationship with the noun (e.g., adjective, determiner) also become valued as plural, via agreement.

Since the present study will focus on agreement on adjectives and demonstratives, a succinct description of the syntactic position of adjectives and demonstratives is provided in the next few lines. In Romance, adjectives are assumed to be generated prenominally in specifier positions below D and above NP (Bernstein, 1991; Cinque, 1994), consistent with the diagram in (12). As for demonstratives, Bernstein (2001a) argues that they originate prenominally below D and above N and that they raise to D, which explains why they encode definiteness and why they are in complementary distribution with determiners.[3]

2.2. Gender

The theoretical proposals for the syntax of gender are not as unified as those for number (Bernstein, 2001b). Based on the observation that knowledge of a noun involves knowledge of its (generally invariable) gender, Ritter (1991, 1993) posits that gender is part of the noun's lexical entry and not a functional head. This approach to gender as a lexical property of the noun is also adopted by Carstens (2000). This proposal is shown in the diagram in (12) above, where the noun caja "box" originates valued as feminine, and values the gender feature of its agreeing elements (determiner, adjective) via agreement.[4] Crucially for the purposes of the present study, both Ritter and Carstens posit that gender is a lexical feature, placing number and gender at different levels of representation (syntactic vs. lexical). In contrast, Picallo (1991) posits that gender, similar to number, projects its own phrase (Gender Phrase), below NumP and above NP. Under Picallo's (1991) proposal, nouns first raise to

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[3] Other proposals have been made about the status of both adjectives and demonstratives (Giusti, 1993; Roca, 1996). However, since the present study is not aimed at testing these different proposals about the syntactic position of either adjectives or demonstratives, I will not review them here.
[4] Ritter (1993) argues that there is parametric variation across languages regarding the locus of gender. For a Romance language like Spanish, she argues that gender is a feature of Num, which explains why gender switching is not a productive word formation strategy in Spanish—if gender is in Num, it is not linked to the noun stem and, therefore, gender switching to derive new nouns is not available—and why plural morphemes in Romance are specified for gender. In contrast, for a language like Modern Hebrew, where gender switching is a very productive word formation strategy and where plural morphemes are not specified for gender (e.g., some feminine nouns take masculine plural morphemes and vice versa), Ritter (1993) proposes that gender is located under N. For the purposes of the present study, I will leave these differences aside.

GenP to receive gender and then, to NumP to receive number. The diagram in (13) includes

an approximate tree representation of Picallo's (1991) proposal.

(13)

DP

D'

D
las
[gen: FEM]
[num: PL]

NumP

Num

GenP

N
cajas
[gen: FEM]
[num: PL]

Num
[num: PL]

Gen

*n*P

N
caja
[gen: FEM]
[*u* num]

Gen
[gen: FEM]

AP
ligeras
[gen: FEM]
[num: PL]

n'

n

NP
caj-
[*u* gen]
[*u* num]

N
caj-
[*u* gen]
[*u* num]

n
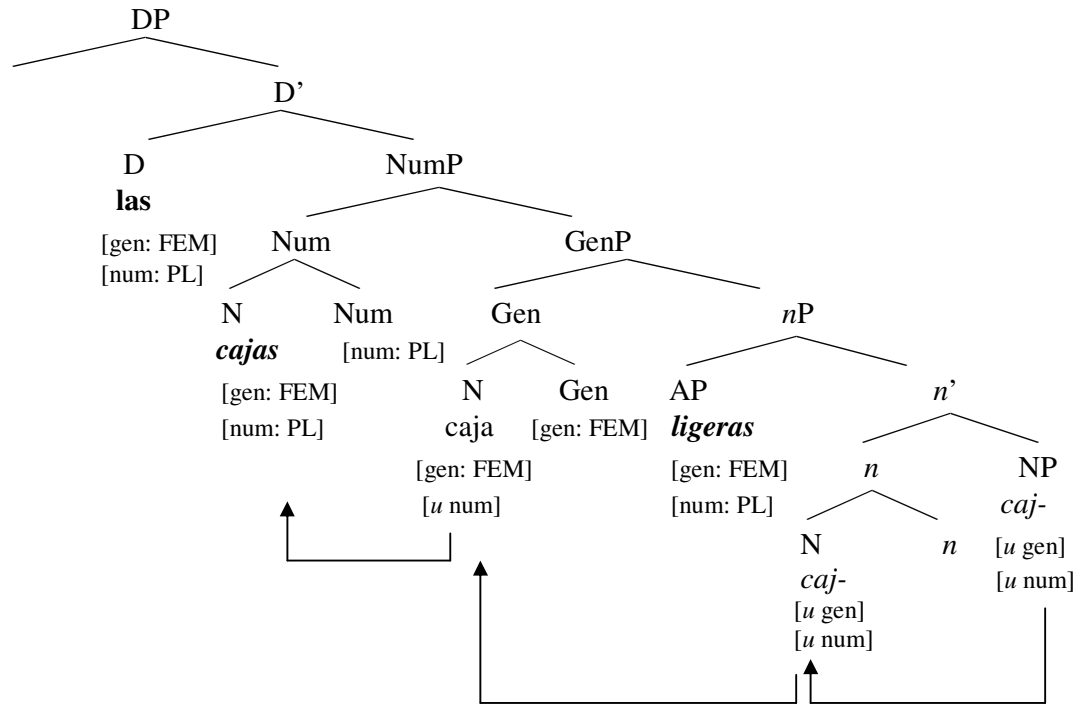
As can be seen in (13), the gender feature of the noun *caj-* "box" originates as an

unvalued feature. After raising to *n*, the noun head-moves to Gen, where its gender feature is

valued as feminine. Then, the noun head-moves to Num, where its number feature is valued

as plural. More recently, Picallo (2008) has proposed that gender is the exponent of CLASS,

a functional feature related to the categorization of entities which projects its own phrase (*c*)

right under NumP and right above N. Picallo (2008) argues that, in Romance languages,

CLASS is valued by the inherent gender of the noun through agreement, whereas in other

languages, CLASS is realized in the form of noun classes or classifiers. Under this approach,

gender is assumed to be valued but uninterpretable in N, and interpretable but unvalued in

CLASS.

2.3. Number and Gender in Spanish

2.3.1. Spanish Number Morphology

Spanish makes a two-way distinction between singular, which is morphologically unmarked, and plural, which is formed in three different ways depending upon the phonetic properties of the root (Saporta, 1965). If the root ends in an unstressed vowel, the plural is formed by suffixing the allomorph [-*s*] to the root, as shown in (14a-b). If the root ends in a stressed vowel or in a consonant other than [-*s*], as in (15a) and (15c) respectively, the plural is formed by suffixing the allomorph [-*es*] to the root, as shown in (15b) and (15d). Finally, if the root ends in [-*s*] and has more than two syllables, as in (16a), plural is unmarked.

(14)
    a. caja
        box-ø
        "box"

    b. cajas
        box-PL
        "boxes"

(15)
    a. tabú
        taboo-ø
        "taboo"

    b. tabúes
        taboo-PL
        "taboos"

    c. peón
        pawn-ø
        "pawn"

    d. peones
        pawn-PL
        "pawns"

(16)
    a. tesis
        thesis-ø
        "thesis"

b. dos tesis
   two theses
   "two theses"

As will be discussed in Chapter 7 (Methodology), the only elements that exhibit plural morphology in the present study are nouns, adjectives, and determiners. Therefore, I will leave aside questions pertaining to the realization of number in other categories (e.g., complementizers, verbs, or pronouns). All nouns and adjectives in the current study end in unstressed vowels and, therefore, select for the [-*s*] plural allomorph (as in 14). As for the demonstratives, their plural forms are provided below both for the masculine (17b) and for the feminine demonstratives (18b):

(17)
   a. este
      this-MASC-SG
      "this"

   b. estos
      this-MASC-PL
      "these"

(18)
   a. esta
      this-FEM-SG
      "this"

   b. estas
      this-FEM-PL
      "these"

2.3.2. Spanish Gender System

In Spanish, nouns are assigned to one of two genders, masculine or feminine. For inanimate nouns, which are the focus of the present study, lexical gender is assigned arbitrarily, as shown in (19), where two synonymous nouns show different lexical genders.[5] By contrast, for nouns referring to human beings, lexical gender and biological sex largely

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[5] Examples are from Harris (1991, # 11a).

overlap, as shown by the examples in (20), although there are exceptions (e.g., *persona* "person" is invariably feminine regardless of the sex of its referent).

(19)
       a. domicilio
           home-MASC
           "home"

       b. residencia
           residence-FEM
           "residence"

(20)
       a. tío
           uncle-MASC
           "uncle"

       b. tía
           aunt-FEM
           "aunt"

Spanish instantiates gender on most of the elements where Corbett (1991) notes that languages realize gender, namely, determiners, demonstratives, nouns, pronouns, adjectives, a few numerals, and complementizers.[6] It is important to note that neither of the two genders in the Spanish system is associated with a unique word marker. Harris (1991) shows that both genders can exhibit every one of the seven word markers in the language, meaning that gender cannot be predicted on the basis of the noun's word ending. Therefore, despite the superficial association between the masculine and feminine genders and the markers –*o* and –*a*, respectively, Harris (1991) argues that these suffixes are not gender morphemes, but word markers. Further evidence for Harris' (1991) proposal comes from the fact that some Spanish adverbs, which do not carry inherent gender, bear those same markers (e.g., *dentr-o* "inside", *fuer-a* "outside").[7] Although Harris' (1991) proposal should be kept in mind, the author himself points out that when a masculine noun or adjective exhibits a vowel marker, that

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[6] Corbett (1991) also mentions that gender agreement can be marked on adverbs and verbs, although this is not the case for Spanish.
[7] Examples are from Harris (1991, # 7a-b).

marker is usually –*o*. Likewise, when a feminine noun or adjective exhibits a vowel marker, it is usually –*a*. As will be discussed in Chapter 7 (Methodology), only masculine nouns ending in –*o* and feminine nouns ending in –*a* will be tested in the present study, since previous studies have proposed that the availability of clear cues in the agreeing elements impacts agreement processing (Molinaro et al., 2011a; Molinaro et al., 2011b).

CHAPTER 3:

EEG AND ERPs

EEG is an electrophysiological method that records the electrical activity generated by large populations of neurons, at the scalp. It provides very high temporal resolution, at the level of milliseconds, and therefore, it is an excellent tool to investigate the temporal dynamics of language processing as it unfolds over time. In contrast, EEG presents considerable limitations when it comes to reliably locating the neural generators of the electric signal captured at the scalp. This is because electricity is highly sensitive to its conductor and the path it will follow will depend upon the conductivity of the brain tissues surrounding its source.[8]

Event-related brain potentials (ERPs) are small voltage changes measured at the scalp that are time-locked to the onset of a particular stimulus. As previously mentioned, one of the clearest advantages of ERPs is that different components have been found to be sensitive to different aspects of language processing (e.g., lexical vs. morphosyntactic processing) and, therefore, they can inform us of the qualitative nature of native and nonnative language processing. In addition, ERPs are multidimensional, that is, they can be characterized based on a number of factors, such as their latency, amplitude, and topographical distribution.[9] The latency of an ERP component refers to the time window during which the waveforms for the conditions being compared diverge from one another. The amplitude of an ERP component is the intensity of the voltage change recorded at the scalp, which is assumed to be directly proportional to the amount of resources allocated to the processing of a particular stimulus. Importantly, ERP amplitude is also considered to be an index of sensitivity to the properties

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[8] In order to compensate for EEG's limited spatial resolution, highly sophisticated source modeling techniques can be used (Federmeier et al., 2002), although their reliability is debated (Friederici, 2004). Alternatively, EEG can be used alongside other brain imaging methods which provide excellent spatial resolution (e.g., fMRI or PET).

[9] For a more comprehensive and explanatory list of factors (peak-to-peak latency, onset latency, et cetera), see Handy (2004).

under investigation. Finally, the topography of an ERP refers to the location of the scalp electrode or electrode region where the voltage change is captured. It is, however, not a strong indicator of the neural generators of the electric signal (e.g., Friederici, 2004).[10]

Owing to their multidimensional nature, ERPs can reveal subtle quantitative differences between experimental conditions (e.g., in terms of amplitude or latency differences), or even the involvement of different neural generators, since components with different topographies can be safely assumed to involve, at least, partially non-overlapping neural sources. Importantly, this allows for a very fine-grained examination of the properties of interest (Federmeier et al., 2002).

3.1. Main Event-Related Potentials Reported for Sentence Processing

3.1.1. Lexical and Semantic Processing: The N400

Within lexical and semantic processing, the best known component to date is the N400, a negative-going wave between 200-600 ms that typically peaks approximately 400 ms post stimulus onset in central and parietal electrodes, sometimes with a right hemisphere bias (Kutas & Hillyard, 1980; Kutas et al., 2006; Lau et al., 2008). It is important to keep in mind that all content words in a sentence elicit an "N400 component". However, the amplitude of the N400 component is modulated by the ease with which the eliciting word is integrated into the previous semantic context, an effect which is referred to as the "N400 context effect" (e.g., Kutas et al., 2006) or simply the "N400 effect" (e.g., Lau et al., 2008). For example, lexical semantic violations like (21b) typically elicit an N400 effect at the word which renders the sentence semantically anomalous (e.g., *socks*), relative to a more felicitous counterpart (e.g., *butter*, as in (21a)).

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[10] For example, the abovementioned N400 is said to have a central-parietal distribution, as its maximum peak is typically captured by central and parietal electrodes (Kutas & Hillyard, 1980). However, evidence from studies on split-brain patients and studies using brain imaging methods with high spatial resolution (e.g., MEG) suggests that the neural generators of the N400 are located in left temporal areas (Kutas et al., 2006).

(21)
    a.   He spread the warm bread with <u>butter</u>.
    b.   He spread the warm bread with *<u>socks</u>.

(Adapted from Kutas & Hillyard, 1980, p. 203)

In addition, evidence has been provided that the N400 component is modulated by semantic predictability, such that unexpected but semantically plausible words show larger N400s than more predictable words. For example, using sentences like (22a) and (22b), Kutas & Hillyard (1984) found a larger N400 for less expected words (e.g., *coffee*) than for more predictable words (e.g., *tea*), despite the fact that both continuations are semantically licit.

(22)
    a.   He liked lemon and sugar in his <u>tea</u>.
    b.   He liked lemon and sugar in his <u>coffee</u>.

(Adapted from Kutas & Hillyard, 1984, p. 163)

Along the same lines, it has been shown that the amplitude of the N400 component tends to decrease over the course of a given sentence, which has been interpreted as evidence that, as semantic context is built up, incoming words become increasingly predictable and easier to integrate, causing a reduction in N400 amplitude (Van Petten & Kutas, 1990). Importantly, as shown by Kutas and Hillyard (1980), the amplitude of the N400 component is unaffected by lower-level factors, such as unexpected letter sizes, suggesting that this component is modulated by a specific type of predictability, semantic and pragmatic predictability.

The N400 component has also been found to be sensitive to lexical factors, such as word frequency (Van Petten & Kutas, 1990; Van Petten, 1993; Allen et al., 2003) and repetition (Rugg, 1995; Besson et al., 1992). More specifically, high-frequency words and repeated words tend to elicit smaller N400s than low-frequency words and unrepeated words, respectively, which has been interpreted as evidence that the N400 is impacted by the ease of lexical access. As previously mentioned, the N400 is also modulated by the strength of

lexical associations. For example, words which are semantically related to a previously presented prime (e.g., *dog-cat*) show a significant reduction in N400 amplitude compared to targets which are unrelated to the prime (e.g., *car-pen*) (Holcomb & Neville, 1990). Along the same lines, studies investigating the effects of phonological rhyming on visual lexical processing have shown that targets which rhyme with a previously presented prime (e.g., *flower-hour*) show a reduction in N400 amplitude compared to phonologically unrelated prime-target pairs (e.g., *toe-male*) (e.g., Coch et al., 2008). It is worth noting that, in some of these studies (McPherson et al., 1998; Coch et al., 2008), participants are specifically instructed to perform a "matching strategy". That is, participants are instructed to press one button if the target rhymes with the prime (e.g., *flower-hour*), and to press another button if it does not (e.g., *toe-male*). Notice that this is similar to the matching strategy that English-speaking learners of Spanish are predicted to apply for Spanish gender agreement under the Failed Functional Features Hypothesis (Hawkins & Chan, 1997) and the Interpretability Hypothesis (Tsimpli & Dimitrakopoulou, 2007). The fact that non-matching targets (e.g., *toe-male*) yield a greater N400 than matching ones (e.g., *flower-hour*) (e.g., McPherson et al., 1998; Coch et al., 2008) is consistent with the prediction that, if adult L2 learners process gender agreement by forming associations between word endings that tend to co-occur (e.g., *caja ligera* "box-FEM light-FEM"), an N400 should be found for cases where word endings do not match due to a gender violation (e.g., **caja ligero* "box-FEM light-MASC"). Recall also that this is consistent with the results of a previous study by Barber and Carreiras (2003, 2005) examining number and gender agreement in word pairs. In their study, both number violations (**faro altos* "lighthouse-MASC-SG high-MASC-PL") and gender violations (**faro alta* "lighthouse-MASC-SG high-FEM-SG") yielded equally robust N400s. Barber and Carreiras (2003, 2005) interpret these results as evidence that, when agreement violations are

treated as a mismatch between word endings or agreement markers (due to the lack of a syntactic context), violations yield an N400.

Crucially for the purposes of the present study, N400 effects are not usually found in native speakers for morphosyntactic violations, such as agreement violations in sentential contexts. However, N400 effects have previously been reported in adult L2 learners for violations that typically elicit another component (the P600) in native speakers, which has been interpreted as evidence that learners may process certain syntactic dependencies at the lexical level, especially at lower levels of proficiency (Osterhout et al., 2006; McLaughlin et al., 2010; Morgan-Short et al., 2010).

3.1.2. Morphosyntactic Processing: The P600

The ERP component that is most consistently reported for morphological and syntactic violations in native speakers is the P600, also referred to as Syntactic Positive Shift (SPS). The P600 is a positive-going wave that typically emerges approximately 500 ms post stimulus onset, peaks at roughly 600 ms, and is evident until approximately 900 ms (Osterhout & Holcomb, 1992; Hagoort et al., 1993; Friederici, 2002), although earlier and later latencies have been reported in the literature (e.g., Demestre et al., 1999; Martín-Loeches et al., 2006; see Kutas et al., 2006 for a review). The P600 exhibits a broad scalp distribution and usually reaches its maximum in centro-parietal electrodes, although a frontal P600 has been reported in the literature and linked to syntactic complexity (Friederici et al., 2002; Kaan & Swaab, 2003; but see Kaan, 2000).

There are two main accounts regarding the functional significance of the P600. Under one proposal, the P600 is assumed to reflect late controlled processes associated with a variety of morphosyntactic operations. For example, evidence has been provided that the P600 is sensitive to syntactic integration difficulty (Kaan et al., 2000; Phillips et al., 2005; Gouvea et

al., 2010), as it is found for grammatical and preferred structures which require the integration of a filler at its gap position (23b), relative to structures where no such integration is necessary (23a). Importantly, the fact that the eliciting sentences (e.g., 23b) are perfectly grammatical and unambiguous provides evidence that the P600 is not a simple response to the detection of a violation.

(23)
    a. Emily wondered whether the performer in the concert had imitated a pop star for the audience's amusement.

    b. Emily wondered <u>who</u> the performer in the concert had imitated <u>t</u> for the audience's amusement.

<div align="right">(Adapted from Kaan et al., 2000, p. 164)</div>

Evidence has also been provided that the P600 reflects the processing costs associated with syntactic reanalysis (Osterhout & Holcomb, 1992; Gouvea et al., 2010), as it has been found for garden path sentences where the parser is temporarily misled into the incorrect (but grammatical) phrase structure, relative to unambiguous sentences. For example, in (24b), the parser temporarily analyzes the DP *the nurse with the white dress* as the object of the verb *met*. Then, when the parser encounters the verb *showed*, it must abandon its initial analysis and rebuild the phrase structure of the sentence to accommodate the new input.

(24)
    a. The patient met the doctor while the nurse with the white dress *showed* the chart during the meeting.

    b. The patient met the doctor and the nurse with the white dress **showed* the chart during the meeting.

<div align="right">(Adapted from Gouvea et al., 2010, p. 157)</div>

Finally, the P600 has also been argued to reflect syntactic and morphosyntactic repair (Hagoort et al., 1993; Osterhout & Mobley, 1995; Gunter et al., 2000; Barber & Carreiras,

2005), as it is very consistently found for outright syntactic and morphosyntactic violations, including agreement violations like (25b, relative to 25a):

(25)
    a. The elected <u>officials</u> <u>hope</u> to succeed.
    b. The elected <u>officials</u> *<u>hopes</u> to succeed.

(Adapted from Osterhout & Mobley, 1995, p. 742)

Under another proposal, the P600 is considered to be a manifestation of the P3b, an ERP component with similar topography to the P600 that is sensitive to the probability and saliency of the stimuli of interest (Coulson et al., 1998; Hahne & Friederici, 1999). For example, Coulson et al. (1998) manipulated both the frequency and saliency of morphosyntactic violations in English (case, agreement) and found a larger P600 for more salient (case) and more improbable violations, which they interpret as evidence that the P600 is not independent from the P3b component (but see Osterhout & Hagoort, 1999).[11]

Some have argued that the P600 can be divided into two distinct phases, which exhibit different scalp distributions and are sensitive to different properties (Hagoort & Brown, 2000; Barber & Carreiras, 2005; Molinaro et al., 2008b). The logic behind this proposal is that the early and late portions of the P600 are not equally affected by different experimental manipulations, suggesting that they might reflect different subprocesses. The early portion of the P600 (between 500-700 ms), which is generally broadly distributed, has been argued to index syntactic integration. In turn, the late portion (700-900 ms), which is mainly posteriorly distributed, has been argued to be associated with syntactic reanalysis or repair (Hagoort & Brown, 2000).

It has also been suggested that the P600 is sensitive to task effects (Molinaro et al., 2011a). For example, the P600 shows greater amplitude in tasks where participants are

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[11] In contrast, Frisch et al. (2003) and Wassenaar et al. (2004) provide evidence that the P3b can be preserved in aphasic subjects who fail to show a P600 for morphosyntactic violations, suggesting that the two components are, to some extent, independent from one another.

explicitly asked to check the grammaticality or acceptability of the sentences than in more implicit tasks where participants passively read for meaning (e.g., Osterhout & Mobley, 1995; but see Hagoort et al., 1993). One example is Osterhout and Mobley (1995), who examined the processing of number and gender agreement in English reflexives under different task conditions (grammaticality judgment vs. passive reading), and found a P600 for agreement violations only when the participants were explicitly asked to focus on grammaticality. Although Osterhout & Mobley's (1995) results are interesting, a number of studies where no explicit task is used (e.g., Hagoort et al., 1993; Münte et al., 1997; Hagoort & Brown, 2000; Wicha et al., 2004) still report P600 effects for morphosyntactic violations, which indicates that the P600 emerges even in the absence of an explicit task.

Importantly for the purposes of the present study, the majority of ERP studies investigating the native processing of syntactic agreement report the P600 for agreement violations regardless of the task associated with the experiment (e.g., Dutch: Hagoort et al., 1993; Hagoort & Brown, 1999, 2000; Kaan et al., 2000; Vos et al., 2001; Kaan, 2002; Kaan & Swaab, 2003; Hagoort, 2003; English: Osterhout & Holcomb, 1992; Coulson et al., 1998; Molinaro et al., 2008a; French: Frenck-Mestre et al., 2008; German: Münte et al., 1997; Gunter et al., 2000; Schmitt et al., 2002; Rossi et al., 2005; Hammer et al., 2008; Hebrew: Deutsch & Bentin, 2001; Hindi: Nevins et al., 2007; Italian: De Vincenzi et al., 2003; Molinaro et al., 2008b; Spanish: Demestre et al., 1999; Hinojosa et al., 2003; Wicha et al., 2004; Barber & Carreiras, 2005; Martín-Loeches et al., 2006; O'Rourke & Van Petten, 2011). This suggests that the P600 is a robust indicator of syntactic agreement processing across a number of languages.

3.1.3. Morphosyntactic Processing: The Left Anterior Negativity

The P600 is sometimes preceded by a Left Anterior Negativity (LAN), a negative-going wave between 300 and 500 ms post stimulus onset that typically exhibits a left anterior distribution, although other distributions have also been reported (e.g., Kutas & Hillyard, 1983; Coulson et al., 1998; Demestre et al., 1999; Kaan, 2002; Silva-Pereyra & Carreiras, 2007). Two main proposals have been put forward regarding the functional significance of the LAN. Under the first one, the LAN is assumed to reflect automatic morphosyntactic processing (Friederici, 2002), as it has been found for a number of morphosyntactic anomalies, including morphosyntactic agreement violations like (26b, relative to 26a) (Kutas & Hillyard, 1983; Osterhout & Mobley, 1995; Coulson et al., 1998; Gunter et al., 2000; Rossi et al., 2005; Barber & Carreiras, 2005; O'Rourke & Van Petten, 2011; De Vincenzi et al., 2003), incorrect case-marking (e.g., Coulson et al., 1998, but see Frenzel et al., 2011), and tense violations (e.g., Morris & Holcomb, 2005).

(26)   **Grammatical**
        a. Sie   bereist <u>das</u>   <u>Land</u>   auf einem Kraftigen Camel
           she travels the$_{-NEUT}$ land$_{-NEUT}$ on a   strong   camel
           "She travels the land on a strong camel"

        Gender Violation
        b. Sie   bereist <u>den</u>   *<u>Land</u>   auf einem Kraftigen Camel
           she travels the$_{-MASC}$ land$_{-NEUT}$ on a   strong   camel

                                  (Adapted from Gunter et al., 2000, p. 559)

Under the second account, the LAN is assumed to reflect the working memory costs associated with processing, as it is sensitive to working memory load (Vos et al., 2001) and has been found for syntactic computations that require keeping a displaced element in working memory to perform integration, such as filler-gap dependencies (Kluender & Kutas, 1993; Fiebach et al., 2002) or object relative clauses (King & Kutas, 1995). This

non-morphosyntactic LAN is often more sustained and typically exhibits a bilateral distribution (see Kutas et al., 2006 and Molinaro et al., 2011a for a review).

Crucially, a significant number of studies have not reported the LAN for agreement violations in native speakers (Dutch: Hagoort et al., 1993; Hagoort & Brown, 1999; Kaan & Swaab, 2003; Kolk et al., 2003; English: Osterhout & Mobley, 1995; French: Frenck-Mestre et al., 2008; German: Münte et al., 1997; Hammer et al., 2008; Hindi: Nevins et al., 2007; Spanish: Wicha et al., 2004; Martín-Loeches et al., 2006), which reveals the need for a more fine-grained account of the functional significance of this component and a better description of the conditions under which it is elicited. This is especially relevant for the purposes of the present study, since the presence of the LAN for morphosyntactic computations has been considered by some as a hallmark of native-like processing in adult L2 learners (e.g., Clahsen & Felser, 2006; Steinhauer et al., 2009). However, given the variability in LAN elicitation for morphosyntactic violations among native speakers, it remains an open question whether the LAN can be considered a fair metric to evaluate the qualitative nature of L2 processing (e.g., McLaughlin et al., 2010).

A recent review by Molinaro et al. (2011a) proposes that one of the factors that may determine the presence of the LAN for agreement violations (at least, in native speakers) is the overtness of morphophonological cues in the agreeing elements. This proposal is based upon the results of a previous investigation by Molinaro et al. (2011b), who examined the processing of Italian subject-verb agreement in sentences like (27) and (28). Molinaro et al. (2011b) observed that subject-verb agreement violations consisting of a plural subject DP and a singular verb elicited a LAN only when the subject DP was overtly marked for plural (27b, relative to 27a), but not when the subject consisted of two conjoined singular DPs (28b, relative to 28a):

(27)

       Grammatical
    a. <u>I</u>   <u>fratelli</u> <u>giunsero</u> a casa…
       the$_{-PL}$ sibling$_{-PL}$ arrived$_{-PL}$ to home...
       "The siblings arrived home..."

       Subject-Verb Number Violation
    b. <u>I</u>   <u>fratelli</u> *<u>giunse</u>   a casa…
       the$_{-PL}$ sibling$_{-PL}$ arrived$_{-SG}$ to home...

(28)

       Grammatical
    a. Il   fratello e la   sorella <u>giunsero</u> a casa…
       the$_{-SG}$ brother$_{-SG}$ and the$_{-SG}$ sister$_{-SG}$ arrived$_{-PL}$ to home...
       "The brother and the sister arrived home..."

       Subject-Verb Number Violation
    b. Il   fratello e la   sorella *<u>giunse</u>   a casa…
       the$_{-SG}$ brother$_{-SG}$ and the$_{-SG}$ sister$_{-SG}$ arrived$_{-SG}$ to home...

(Adapted from Molinaro et al., 2011b, p. 5)

Another factor that, according to Molinaro et al. (2011a), may impact the presence of the LAN for agreement violations is the referencing site of the EEG recording (e.g., left mastoid vs. averaged linked mastoids). Molinaro et al. (2011a) argue that choosing the left mastoid as a reference can cause the LAN to be reduced or subtracted out, due to the left lateralization of this component. According to the authors, this may explain why most studies on the native processing of agreement where the recording was referenced to the left mastoid have failed to report the LAN for agreement violations.

CHAPTER 4:

AGREEMENT PROCESSING IN NATIVE SPEAKERS

4.1. The Native Processing of Agreement in Spanish

As discussed in Chapter 3, a review of the previous literature on the native processing of syntactic agreement reveals that agreement violations in sentential contexts are consistently associated with a P600 and, sometimes, with a Left Anterior Negativity (LAN). In nonsentential contexts (e.g., word pairs), however, agreement violations have been found to elicit N400 effects (Barber & Carreiras, 2003, 2005).

For Spanish, the previous literature provides a similar picture, with some studies showing a biphasic ERP pattern (LAN-P600) for agreement violations in sentential contexts (Demestre et al., 1999; Barber & Carreiras, 2005; O'Rourke & Van Petten, 2011; Mancini et al., 2011) and others showing only a P600 (Wicha et al., 2004; Martín-Loeches et al., 2006; Silva-Pereyra & Carreiras, 2007). For example, Demestre et al. (1999) examined the processing of gender agreement in sentences like (29), where the adjective (*rico* "rich-MASC") either agreed or disagreed with the subject of a controlled infinitival clause, and found an early P600 (peaking at roughly 450 ms) preceded by an early and broadly distributed negativity (100-250 ms) for gender violations (29b), relative to grammatical sentences (29a).

(29)

Grammatical
a. <u>Pedro</u>   quiere ser   <u>rico</u>   en un futuro próximo.
Pedro-MASC wants to-be rich-MASC in a near future
"Pedro wants to be rich in the near future."

Gender Violation
b. <u>María</u>   quiere ser   *<u>rico</u>   en un futuro próximo.
María-FEM wants to-be   rich-MASC in a near future

(Adapted from Demestre et al., 1999, p. 300)

Wicha et al. (2004) examined determiner-noun gender agreement in short stories biasing readers towards one specific word whose semantic fit and agreement properties were manipulated. For example, the context in (30) makes readers anticipate the word *corona* "crown". The semantic fit of the anticipated word (*corona*) and its agreement relationship with the preceding determiner were then manipulated (30b and 30c, respectively), in order to investigate the interaction between semantic and syntactic processing.

(30)

Grammatical, Congruous
a. El príncipe sabía que cuando su padre muriera podría   al fin   ponerse
the prince   knew that when   his father died   he-could finally wear

la   corona.
the$_{FEM}$ crown$_{FEM}$

"The prince knew that when his father died he would finally be able to wear the crown."

Grammatical, Incongruous
b. El príncipe sabía que cuando su padre muriera podría   al fin   ponerse
the prince   knew that when   his father died   he-could finally wear

la   maleta.
the$_{FEM}$ suitcase$_{FEM}$

Gender Violation, Congruous
c. El príncipe sabía que cuando su padre muriera podría   al fin   ponerse
the prince   knew that when   his father died   he-could finally wear

el   *corona.
the$_{MASC}$ crown$_{FEM}$

Gender Violation, Incongruous
d. El príncipe sabía que cuando su padre muriera podría   al fin   ponerse
the prince   knew that when   his father died   he-could finally wear

el   *maleta.
the$_{MASC}$ suitcase$_{FEM}$

(Adapted from Wicha et al., 2004, p. 1286)

Gender agreement violations alone (30c) and collapsed over semantic congruity (30c, 30d) yielded a posteriorly distributed P600, but no LAN.[12] Interestingly, gender violations (30c, 30d) also yielded a positive-going wave between 500 and 700 ms at the determiner preceding the critical word (e.g., *ponerse el corona/maleta*), when there was still no outright syntactic violation, suggesting that the parser makes predictions, not only about incoming words, but also about some of their formal properties, including syntactic gender.

Martín-Loeches et al. (2006) examined number and gender agreement between adjacent nouns and adjectives in Spanish sentences like (31), and found a late P600 for agreement violations overall (31b and 31c, relative to 31a).[13] Similar to Wicha et al.'s (2004) study, the P600 was not preceded by a LAN.

(31)

Grammatical
a. El <u>sentimiento</u>   <u>profundo</u>   emociona.
   the feeling$_{MASC-SG}$ deep$_{MASC-SG}$ moves
   "The deep feeling moves"

Number Violation
b. El <u>sentimiento</u>   *<u>profundos</u>   emociona.
   the feeling$_{MASC-SG}$ deep$_{MASC-PL}$ moves

Gender Violation
c. El <u>sentimiento</u>   *<u>profunda</u>   emociona.
   the feeling$_{MASC-SG}$ deep$_{FEM-SG}$ moves

(Adapted from Martín Loeches et al., 2006, p. 182)

Finally, both Barber and Carreiras (2005) and O'Rourke and Van Petten (2011) examined the processing of Spanish agreement in contexts that manipulated agreement type (number, gender) and the distance between the agreeing elements. In these two studies, agreement violations were generally associated with both a LAN and a P600, similar to Demestre et al.

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[12] While gender violations alone (30c) did not elicit a LAN, they increased the amplitude of the N400. Since both the LAN and the N400 typically emerge in the 300-500 ms time window and only differ in topography, Wicha et al. (2004) argue that the N400 for gender violations in their study may be the same component as the LAN reported in previous ERP studies on gender agreement (Gunter et al., 2000).

[13] Number and gender violations were not examined separately in Martín-Loeches et al.'s (2006) study.

(1999). However, both studies also show that the ERP correlates of agreement violations are modulated by differences in agreement type (number vs. gender) and by the distance between the agreeing elements.[14] I will turn to both of these questions in the next sections.

4.2. The Electrophysiological Processing of Number and Gender

Despite the considerable number of behavioral studies comparing the processing of different agreement categories (e.g., Lukatela et al., 1987; Colé & Segui, 1994; De Vincenzi, 1999; Domínguez et al., 1999; Faussart et al., 1999; Antón-Méndez et al., 2002; Carminati, 2005), few studies have taken advantage of the excellent temporal resolution provided by EEG to contrast the online processing of number and gender (Barber & Carreiras, 2005; Nevins et al., 2007; O'Rourke & Van Petten, 2011).[15] The evidence from these studies suggests that, at least at the brain level, number and gender are associated with similar ERP components, although some differences between the two features have been reported. For example, Barber and Carreiras (2005) compared the processing of Spanish number and gender agreement both in initial (32) and middle position (33), and found a similar ERP pattern for both violation types: a LAN and a P600.

(32)
        Initial Position: Grammatical
  a. <u>El</u>   <u>piano</u>   estaba viejo y   desafinado.
     the-MASC-SG piano-MASC-SG was   old   and off-key
     "The piano was old and off-key."

        Number Violation
  b. <u>Los</u>   *<u>piano</u>   estaba viejo y   desafinado.
     the-MASC-PL piano-MASC-SG was   old and off-key

        Gender Violation
  c. <u>La</u>   *<u>piano</u>   estaba viejo y   desafinado.
     the-FEM-SG piano-MASC-SG was   old and off-key

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[14] Silva-Pereyra & Carreiras (2007) and Mancini et al. (2011) both compared the processing of number and person agreement in Spanish sentences. However, since the present study is not concerned with differences in the processing of these two features (number, person), I will not review those studies here.
[15] Osterhout & Mobley (1995), Hagoort (2003), and Martín-Loeches et al. (2006) examined number and gender agreement violations in English, Dutch and Spanish, respectively, but did not directly compare the two features.

(33)

Middle Position: Grammatical

a. El <u>faro</u>   es <u>alto</u>   y   luminoso.
   the lighthouse-MASC-SG is high-MASC-SG and bright
   "The lighthouse is high and bright."

Number Violation

b. El <u>faro</u>   es *<u>altos</u>   y   luminoso.
   the lighthouse-MASC-SG is   high-MASC-PL and bright

Gender Violation

c. El <u>faro</u>   es *<u>alta</u>   y   luminoso.
   the lighthouse-MASC-SG is   high-FEM-SG and bright

(Adapted from Barber & Carreiras, 2005, p. 151)

The late portion of the P600 (700-900 ms), however, showed greater amplitude for gender (32c, 33c) than number violations (32b, 33b), revealing some late differences in the processing of number and gender agreement (cf. Gillon-Dowens et al., 2010, who found no difference between number and gender violations with the same stimuli). Barber and Carreiras (2005) interpret this finding as evidence that repairing gender violations is costlier than repairing number violations, and argue in support of Faussart et al.'s (1999) lexical retrieval model. Recall that, under Faussart et al.'s (1999) model, lexical information is processed at an earlier stage than syntactic information. Assuming that number is a syntactic head (Ritter, 1991) and gender a lexical feature (Ritter, 1991; 1993; Carstens, 2000; but see Picallo, 1991), Faussart et al.'s model predicts that, after encountering a gender error, the parser must return to the initial stage of lexical retrieval (identification) to check for lexical gender. In contrast, for number violations, the parser only needs to return to a later stage (recognition and integration) to check for syntactic information, which would explain the greater costs for gender than number in Barber and Carreiras' (2005) study.

O'Rourke and Van Petten (2011) examined the processing of number and gender agreement in Spanish sentences like (34) and (35) and found a LAN and a P600 for the

gender violations (35b, relative to 35a), but not for the number violations (34b, relative to 34a), where the LAN failed to reach statistical significance and the P600 was only marginal.

(34)

Number Grammatical
a. Una <u>chaqueta</u> <u>mona</u>   es lo que necesitas   para la entrevista.
   a   jacket-SG pretty-SG is what   you-need for   the interview
   "A pretty jacket is what you need for the interview"

Number Violation
b. Una <u>chaqueta</u> *<u>monas</u>   es lo que necesitas   para la entrevista.
   a   jacket-SG   pretty-PL is what   you-need for   the interview

(35)

Gender Grammatical
a. Llegamos hace poco y   vimos   el <u>piano</u>   <u>roto</u>   en la sala.
   we-arrived ago little and we-saw the piano-MASC broken-MASC in the room
   "We arrived not long ago and saw the broken piano in the room."

Gender Violation
b. Llegamos hace poco y   vimos   el <u>piano</u>   *<u>rota</u>   en la sala.
   we-arrived ago little and we-saw the piano-MASC broken-FEM in the room

(Adapted from O'Rourke & Van Petten, 2011, p. 63)

It is unclear why number violations yielded weaker brain responses than gender violations in O'Rourke and Van Petten's (2011) study, and why the effects for number failed to reach significance. The authors argue that number violations may be more difficult to detect than gender violations, and provide additional evidence from an error detection task where participants showed higher accuracy rates detecting gender than number violations. Despite these considerable differences between the two features at the brain level, it must be noted that number and gender in O'Rourke and Van Petten's (2011) study were examined in sentences with different baselines (gender violations occurred deeper in the sentence and the agreeing elements occupied different syntactic positions), which complicates a direct comparison of the two features.

Finally, the results by Nevins et al. (2007) are at odds with those by Barber and Carreiras (2005). Nevins et al. (2007) compared the processing of subject-verb number and gender agreement in Hindi future tense verbs, in sentences like (36a-c):

(36)
            Grammatical

a. Haalanki vo <u>sarfiraa</u>   sangiitkaar gaanaa <u>gaayegaa</u>
   Although that crazy-MASC-SG musician   song   will-sing-MASC-SG

   lekin Shrotaa hoNslaa nahiiN baRhaayengee.
   but   listeners morale   not   enhance

   "Although that crazy singer will sing a song, the listeners won't boost his morale."

         Number Violation

b. Haalanki vo <u>sarfiraa</u>   sangiitkaar gaanaa *<u>gaayengee</u>
   Although that crazy-MASC-SG musician   song   will-sing-MASC-PL

   lekin Shrotaa hoNslaa nahiiN baRhaayengee.
   but   listeners morale   not   enhance

         Gender Violation

c. Haalanki vo <u>sarfiraa</u>   sangiitkaar gaanaa *<u>gaayegii</u>
   Although that crazy-MASC-SG musician   song   will-sing-FEM-SG

   lekin Shrotaa hoNslaa nahiiN baRhaayengee.
   but   listeners morale   not   enhance

(Adapted from Nevins et al., 2007, p. 91)

The results showed equally robust P600 effects (and no LAN) for both number and gender violations, suggesting that these two features are processed similarly at the brain level.[16] It should be noted, however, that Hindi future tense verbs mark number in two adjacent suffixes but only mark gender in the last suffix. Therefore, number violations involved two mismatching morphemes, while gender violations only involved one. It remains an open question whether the presence of an extra number morpheme in the critical word might have masked underlying differences in the processing of the two features.

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[16] Nevins et al.'s (2007) study also included person agreement violations and double violations (person-number, number-gender), which will not be discussed here.

To sum up, previous studies examining the processing of agreement dependencies in Spanish have consistently reported the P600 for agreement violations in sentential contexts (e.g., Demestre et al., 1999; Wicha et al., 2004; Barber & Carreiras, 2005; Martín-Loeches et al., 2006; Silva-Pereyra & Carreiras, 2007; O'Rourke & Van Petten, 2011; Mancini et al., 2011), which is sometimes, although not always, preceded by a Left Anterior Negativity (e.g., Demestre et al., 1999; Barber & Carreiras, 2005; O'Rourke & Van Petten, 2011; Mancini et al., 2011). In addition, studies directly comparing the processing of number and gender have reported some differences in the P600 component (Barber & Carreiras, 2005), although not consistently (Nevins et al., 2007; Gillon-Dowens et al., 2010). As to the LAN, it remains difficult to evaluate how differences in agreement category affect this component due the variability in its elicitation for agreement errors.

4.3. Effects of Structural Distance on the Online Processing of Agreement

Only a few studies have used ERPs to investigate the impact of structural distance or structural complexity on the online processing of agreement (Münte et al., 1997; Vos et al., 2001; Kaan, 2002; Kaan & Swaab, 2003; Kolk et al., 2003; Barber & Carreiras, 2005; Hammer et al., 2008; O'Rourke & Van Petten, 2011). These studies manipulate distance or complexity differently and report heterogeneous results, largely implicating the P600.[17] For example, Münte et al. (1997) examined the processing of German subject-verb number agreement in two types of sentences differing in structural complexity: declarative sentences (simple), as in (37), and embedded sentences (complex), as in (38):

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[17] Vos et al. (2001) suggest that the LAN may also be sensitive to syntactic complexity. They compared subject-verb number violations in Dutch in simple and complex sentences in two memory load conditions, and found a LAN for the simple sentences in the high load condition, but not for the complex sentences, which they interpret as evidence that syntactic complexity and working memory load decrease the parser's efficiency to detect agreement mismatches. The fact that no LAN was found for violations in simple sentences in the low load condition is further evidence of the variability in LAN elicitation for morphosyntactic anomalies.

(37)

      Declarative: Grammatical

a. Der Opa   hat zwei Maikaefer gefunden.
     the grandfather has two june-bugs found

     <u>Sie</u>   <u>brummen</u> beim Fliegen laut.
     they$_{-PL}$ hum$_{-PL}$ when flying   loudly

     "The grandfather has found two June bugs. They hum loud when flying."

        Declarative: Number Violation

b. Der Opa   hat zwei Maikaefer gefunden.
     the grandfather has two june-bugs found

     <u>Sie</u>   *<u>brumt</u> beim Fliegen laut.
     they$_{-PL}$ hum$_{-SG}$ when flying   loudly

(38)

        Embedded: Grammatical

a. Zwei Maikaefer, <u>die</u>   beim Fliegen laut <u>brummen</u>
     two   june-bugs   which$_{-PL}$ when flying   loud hum$_{-PL}$

     hat der Opa   gefunden.
     has the grandfather found

     "The grandfather has found two June bugs, which hum loud when flying."

        Embedded: Subject-Verb Number Agreement Violation

b. Zwei Maikaefer, <u>die</u>   beim Fliegen laut *<u>brumt</u>
     two   june-bugs which$_{-PL}$ when flying   loud   hum$_{-SG}$

     hat der Opa   gefunden.
     has the grandfather found

                         (Adapted from Münte et al., 1997, p. 106)

Agreement violations realized within embedded (complex) sentences (38b) yielded a

larger P600 than violations in declarative (simple) sentences (37b), which the authors

interpret as evidence that, as structural complexity increases, the amount of resources needed

to repair agreement violations also augment, causing an increase in P600 amplitude.

However, it should be noted that the declarative and embedded conditions in Münte et al.'s

(1997) study were not controlled for linear distance. As shown in (37) and (38), the agreeing

elements were adjacent in the declarative (simple) conditions, but linearly apart in the

embedded (complex) conditions. Thus, the greater P600 for violations in complex sentences could be an effect of linear distance, structural complexity, or both.

Barber and Carreiras (2005) examined the processing of number and gender agreement in Spanish at two levels of structural distance: within the determiner phrase (39) and across a verb phrase (40):

(39)

Within-Phrase: Grammatical
a. [El   piano]$_{DP}$ estaba viejo y   desafinado.
   the$_{-MASC-SG}$ piano$_{-MASC-SG}$ was   old   and off-key
   "The piano was old and off-key."

Number Violation
b. [Los   *piano]$_{DP}$ estaba viejo y   desafinado.
    the$_{-MASC-PL}$ piano$_{-MASC-SG}$ was   old   and off-key

Gender Violation
c. [La   *piano]$_{DP}$ estaba viejo y   desafinado.
    the$_{-FEM-SG}$ piano$_{-MASC-SG}$ was   old   and off-key

(40)

Across-Phrase: Grammatical
a. El faro   [es alto   y   luminoso.]$_{VP}$
   the lighthouse$_{-MASC-SG}$ is   high$_{-MASC-SG}$ and bright
   "The lighthouse is high and bright"

Number Violation
b. El faro   [es *altos   y   luminoso.]$_{VP}$
   the lighthouse$_{-MASC-SG}$ is   high$_{-MASC-PL}$ and bright

Gender Violation
c. El faro   [es *alta   y   luminoso.]$_{VP}$
   the lighthouse$_{-MASC-SG}$ is   high$_{-FEM-SG}$ and bright

(Adapted from Barber & Carreiras, 2005, p. 151)

Results revealed a larger P600 for across-phrase violations in the 700-900 ms time window, which Barber and Carreiras (2005) take as evidence that repairing agreement errors across phrases incurs greater processing costs, in line with Münte et al. (1997). Crucially, linear and structural distance were not teased apart in Barber and Carreiras' (2005) study either. As shown in (39) and (40), the agreeing elements were adjacent in the within-phrase

conditions, and separated by one word in the across-phrase conditions. Furthermore, within-phrase and across-phrase agreement in Barber and Carreiras' (2005) study involved elements of different syntactic categories (within-phrase agreement: determiner-noun; across-phrase agreement: noun-adjective), which has been shown to modulate the amplitude of the P600 (O'Rourke & Van Petten, 2011).

In contrast to the results by Münte et al. (1997) and Barber and Carreiras (2005), both of which reported a larger P600 for violations in more complex sentences, other studies on agreement have reported a reduced P600 for increased distance or complexity (Kolk et al., 2003; Kaan & Swaab, 2003; Hammer et al., 2008; O'Rourke & Van Petten, 2011). The fact that complexity has been associated with either an increase or a decrease in P600 amplitude is not necessarily a contradiction. An increase in P600 amplitude may reflect the allocation of extra resources to recover from a violation. In contrast, a reduced P600 may simply reflect reduced sensitivity to the violations or, as pointed out by O'Rourke and Van Petten (2011), disinclination to repair them.

Kolk et al. (2003) investigated the processing of subject-verb number agreement in Dutch sentences of varying syntactic complexity. The structures being compared were subject relative clauses (41) and object relative clauses (42), which the authors assume to be more complex, since they require greater memory resources due to their non-canonical word order:

(41)
        Subject Relative: Grammatical
  a. De <u>agenten</u> die op de boef <u>shoten</u> zaten achter de auto.
      the cop$_{-PL}$ who at the crook shot$_{-PL}$ sat   behind the car
      "The cops who shot at the crook sat behind the car."

        Number Violation
  b. De <u>boef</u>   die op de agenten *<u>shoten</u> zat achter de auto.
      the crook$_{-SG}$ who at the cops   shot$_{-PL}$ sat behind the car
      Intended meaning: "The crook who shot at the cops sat behind the car."

(42)

Object Relative: Grammatical
a. De boef   waarop   de <u>agenten</u> <u>shoten</u> zaten achter de auto.
   the crook whereon the cops-PL shot-PL sat   behind the car
   "The crook the agents shot at sat behind the car."

Number Violation
b. De agenten waarop   de <u>boef</u>   *<u>shoten</u> zaten achter de auto.
   the cop   whereon the crook-SG shot-PL sat   behind the car
   Intended meaning: "The cops the crook shot at sat behind the car."

(Adapted from Kolk et al., 2003, p. 9)

Agreement violations in object relative clauses (42b) showed a reduced P600 compared to violations realized in subject relatives (41b), which the authors interpret as evidence that syntactic complexity impacts the detection of syntactic anomalies. However, as was the case in the above studies, linear and structural distance were not controlled for in Kolk et al. (2003). While the agreeing elements were separated by several words in the subject relatives (41a-b), they were sometimes adjacent in the object relative conditions (42a-b), meaning that the reduced P600 for structural complexity may also be an effect of linear distance. Notice that this is consistent with Münte et al.'s (1997) and Barber and Carreiras' (2005) findings of a smaller P600 for violations realized between elements that were linearly closer together.

Kaan and Swaab (2003) examined the effects of syntactic complexity on the P600 by comparing English subject-verb number agreement violations in two types of sentences: unambiguous sentences with one possible subject (43) and ambiguous sentences with two possible subjects (44), which the authors consider to be more complex due to the presence of an extra (although non preferred) referent (e.g., *cake*, in (44)):

(43)

One Subject Conditions (Simple): Grammatical
a. The man in the restaurant doesn't like the <u>hamburgers</u> that <u>are</u> on his plate.

Number Violation
b. The man in the restaurant doesn't like the <u>hamburger</u> that *<u>are</u> on his plate.

(44)
Two Subject Conditions (Complex): Grammatical
a. I cut the <u>cake</u> beside the <u>pizzas</u> that <u>were</u> brought by Jill.

Number Violation
b. I cut the <u>cake</u> beside the <u>pizza</u> that *<u>were</u> brought by Jill.

(Adapted from Kaan & Swaab et al., 2003, p. 99)

Agreement violations in the more complex sentences (44b) yielded a smaller P600 than violations realized in simple sentences (43b), suggesting that complexity decreases sensitivity to agreement violations, in line with Kolk et al. (2003). More specifically, Kaan and Swaab (2003) argue that the detection of subject-verb disagreements is more difficult when the subject is ambiguous (44b), since the parser needs to check agreement features with both potential antecedents, especially after the preferred one (e.g., *pizza* in (44)) is ruled out due to an agreement mismatch. It should be noted that the agreeing elements in the two conditions being compared in Kaan and Swaab's (2003) study appear to be controlled for linear distance (…*hamburger* that <u>are</u>… vs. …*pizza* that <u>are</u>…). However, in (44), if the parser does check agreement with the non preferred antecedent (e.g., *cake*) after ruling out the preferred one (e.g., *pizza*), as suggested by the authors, then linear distance is greater in the more complex sentences, suggesting that the reduction in P600 amplitude for violations in complex sentences could also be an effect of linear distance.

The results in Kolk et al. (2003) and Kaan and Swaab (2003), where the focus is on syntactic complexity, are consistent with studies which examine the impact of linear distance on agreement (Hammer et al., 2008; O'Rourke & Van Petten, 2011).[18] One exception is Kaan (2002), who examined subject-verb number agreement violations in Dutch at two levels of linear distance (short distance (45) vs. long distance (46)), and found equally robust ERP effects for both conditions: a bilateral central negativity between 300-500 ms and a P600.

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[18] Similar to Kolk et al. (2003), Kaan & Swaab (2003), Hammer et al. (2008), and O'Rourke & Van Petten (2011), Gunter et al. (1997) also reported a reduced P600 for tense violations in more complex sentences, where the distance between the agreeing elements was greater.

(45)

Short Distance: Grammatical

a. Hoewel volgens   het gerucht de <u>keizer</u>   de dissident <u>zal</u>
   although according-to the rumor   the emperor-SG the dissident will-SG

   gaan verbannen is er   veel tegenstand.
   go   ban   is there much opposition

   "Although, according to the rumor, the emperor will ban the dissident, there is a lot of opposition."

Number Violation

b. Hoewel volgens   het gerucht de <u>keizer</u>   de dissident *<u>zullen</u>
   although according-to the rumor   the emperor-SG the dissident   will-PL

   gaan verbannen is er   veel tegenstand.
   go   ban   is there much opposition

(46)

Long Distance: Grammatical

a. Hoewel de <u>keizer</u>   volgens   het gerucht de dissident <u>zal</u>
   although the emperor-SG according-to the rumor   the dissident will-SG

   gaan verbannen is er   veel tegenstand.
   go   ban   is there much opposition

   "Although the emperor—according to the rumor—will ban the dissident, there is a lot of opposition."

Number Violation

b. Hoewel de <u>keizer</u>   volgens   het gerucht de dissident *<u>zullen</u>
   although the emperor-SG according-to the rumor   the dissident   will-PL

   gaan verbannen is er   veel tegenstand.
   go   ban   is there much opposition

(Adapted from Kaan, 2002, p. 173)

It should be noted that, despite the lack of linear distance effects in Kaan's (2002) ERP results, accuracy rates in the grammaticality judgment task were lower for the long-distance conditions (46), providing evidence that linear distance does impact the detection of agreement violations, at least behaviorally. Importantly, Kaan's (2002) results also suggest that behavioral and electrophysiological results do not necessarily pattern together.

Hammer et al. (2008) examined the processing of gender agreement in German sentences at two levels of linear distance: three words (47) and seven words (48).

(47)
Short Distance: Grammatical
a. Der <u>Apfel</u>   ist süß, weil   <u>er</u>   reif ist.
    the apple-MASC is sweet because it-MASC ripe is
    "The apple is sweet because it is ripe."

Gender Violation
b. Der <u>Apfel</u>   ist süß, weil   *<u>sie</u>   reif ist.
    the apple-MASC is sweet because it-FEM ripe is

(48)
Long Distance: Grammatical
a. Der <u>Apfel</u>   ist sher saftig und ist süß, weil   <u>er</u>   reif ist.
    the apple-MASC is very juicy and is sweet because it-MASC ripe is
    "The apple is very juicy and is sweet because it is ripe."

Gender Violation
b. Der <u>Apfel</u>   ist sher saftig und ist süß, weil   *<u>sie</u>   reif ist.
    the apple-MASC is very juicy and is sweet because it-FEM ripe is

(Adapted from Hammer et al., 2008, pp. 178-179)

Gender violations in the short distance condition (47b) yielded a P600, but no effects were found for long-distance gender violations (48b), which Hammer et al. (2008) interpret as evidence that linear distance decreases sensitivity to syntactic anomalies. It should be noted, however, that the agreeing elements in both conditions were located across an adverbial clause and, therefore, the gender violations were not syntactic in nature, but were determined by the discourse, which might have impacted the participants' brain responses to the violations (especially in the long-distance condition).

Similar to Hammer et al. (2008), O'Rourke and Van Petten (2011) found a reduction in P600 amplitude for increased distance when they examined the processing of gender agreement in Spanish in three conditions: adjacent noun-adjective agreement (49), noun-adjective agreement with an intervening copula (50), and noun-adjective agreement with an intervening complementizer phrase (CP) (51):

(49)

Adjacent Noun-Adjective: Grammatical

a. Llegamos   hace poco y   vimos   el <u>piano</u>   <u>roto</u>
   we-arrived ago little and we-saw   the piano-MASC broken-MASC

   en la sala.
   in the room

   "We arrived not long ago and saw the broken piano is the room."

Gender Violation

b. Llegamos   hace poco y   vimos   el <u>piano</u>   *<u>rota</u>
   we-arrived ago little and we-saw   the piano-MASC broken-FEM

   en la sala.
   in the room

(50)

Noun (Copula) Adjective: Grammatical

a. Me han   dicho que el <u>piano</u>   está <u>roto</u>
   me they-have told   that the piano-MASC is   broken-MASC

   y   ya   no funciona.
   and any-more not works

   "They've told me that the piano is broken and no longer works."

Gender Violation

b. Me han   dicho que el <u>piano</u>   está *<u>rota</u>
   me they-have told   that the piano-MASC is   broken-FEM

   y   ya   no funciona.
   and any-more not works

(51)

Noun (CP) Adjective: Grammatical

a. El <u>piano</u>   que compramos ayer   está <u>roto</u>
   the piano-MASC that we-bought yesterday is   broken-MASC

   y   ya   no funciona.
   and any-more not works

   "The piano that we bought yesterday is broken and no longer works."

Gender Violation

b. El <u>piano</u>   que compramos ayer   está *<u>rota</u>
the piano$_{-MASC}$ that we-bought yesterday is   broken$_{-FEM}$

y   ya   no funciona.
and any-more not works

(Adapted from O'Rourke & Van Petten, 2011, p. 63)

However, as with Barber and Carreiras' (2005) study, structural and linear distance were not teased apart in O'Rourke and Van Petten (2011), such that greater linear distance involved greater structural distance. Thus, the reduction in P600 amplitude as a function of linear distance could also be an effect of structural distance. Importantly, the authors also found a reduced P600 for agreement violations between adjacent nouns and adjectives (49b, relative to 49a) compared to violations between adjacent determiners and nouns (52b, relative to 52a), suggesting that the processing of agreement is also impacted by the syntactic category of the agreeing elements.

(52)

Determiner-Noun Grammatical

a. Acabo   de   llegar y   creo   que <u>el</u>   piano   está aquí.
I-finnish PREP arrive and I-think that the$_{-MASC}$ piano$_{-MASC}$ is   here
"I've just arrived and I think that the piano is here."

Gender Violation

b. Acabo   de   llegar y   creo   que <u>la</u>   *<u>piano</u>   está aquí.
I-finnish PREP arrive and I-think that the$_{-FEM}$ piano$_{-MASC}$ is   here

(Adapted from O'Rourke & Van Petten, 2011, p. 63)

O'Rourke and Van Petten (2011) account for this finding in terms of predictability. They argue that, in Spanish, almost all determiners are gendered and they almost always precede nouns. Therefore, in determiner-noun combinations, the gender of the subsequent noun can be reliably predicted after encountering the agreement features of the determiner. However, the same is not true of noun-adjective combinations, as nouns are not always followed by adjectives and, thus, the parser does not necessarily make any predictions after encountering

a noun. What is most important about this finding is that it provides evidence that differences in syntactic category can modulate the online processing of agreement dependencies.

To sum up, a review of the previous literature suggests that the online processing of agreement is influenced by a variety of factors, including linear distance (e.g., Hammer et al., 2008), structural distance (e.g., Barber & Carreiras, 2005), and the syntactic category of the agreeing elements (e.g., O'Rourke & Van Petten, 2011). However, the unique contribution of structural distance to and its impact on the establishment of agreement remains unclear, since previous studies do not control for linear distance or other factors, such as the syntactic category of the agreeing elements. The present study will systematically investigate the effects of structural distance on the processing of number and gender agreement in Spanish by comparing agreement realized within the same phrase (e.g., *edificio muy seguro* "building$_{\text{-MASC-SG}}$ very safe$_{\text{-MASC-SG}}$") and agreement realized across a verb phrase (e.g., *cuento es anónimo* "story$_{\text{-MASC-SG}}$ is anonymous$_{\text{-MASC-SG}}$"). Across both levels of structural distance, linear distance is controlled for (one word), as is the syntactic category of the agreeing elements (noun-adjective), allowing for a more systematic examination of the role of structural distance on the processing of agreement.

CHAPTER 5:

MORPHOSYNTACTIC PROCESSING IN ADULT L2 LEARNERS

5.1. Age of Acquisition vs. Proficiency

Early ERP studies on L2 processing focus mainly on how age of acquisition (e.g., Weber-Fox & Neville, 1996; Hahne & Friederici, 2001; Kessler, 2003) and proficiency (e.g., Kessler, 2003; Ojima et al., 2005; Rossi et al., 2006) impact L2 semantic and morphosyntactic processing. While most studies testing knowledge of L2 lexical semantics have reported no qualitative differences between monolingual speakers and L2 learners (e.g., Weber-Fox & Neville, 1996; Hahne & Friederici, 2001; Ojima et al., 2005), even after only one month of exposure to the L2 (Osterhout et al., 2006), a number of early ERP studies do not report native-like ERP-patterns for syntactic and morphosyntactic dependencies, including phrase structure building (Weber-Fox & Neville, 1996; Hahne & Friederici, 2001) and agreement (Weber-Fox & Neville, 1996; Kessler, 2003). For example, Weber-Fox and Neville (1996) examined semantic and syntactic processing (e.g., phrase structure building) in Chinese-speaking learners of English across a range of ages of acquisition (1-3, 4-6, 7-10, 11-13, age 16 or above). In the native speaker group, phrase structure violations like (53b, relative to 53a) yielded an Early Left Anterior Negativity, which was followed by a LAN and a P600. The Early Left Anterior Negativity, also known as *ELAN*, is a negative-going wave between 150-300 ms with a left anterior bias that has been argued to reflect early and automatic phrase structure building processes (Neville et al., 1991; Friederici, 2002). In contrast, while all L2 learners showed a LAN and a P600 for the same violations (similar to the native speakers), those who were first exposed to English at the age of one showed no reliable ELAN.

(53)

       Grammatical
a.   The scientist criticized Max's proof of the theorem.

       Phrase Structure Violation
b.   The scientist criticized Max's *of proof the theorem.

                      (Adapted from Weber-Fox & Neville, 1996, p. 233)

In addition, the Chinese-speaking learners with the latest age of acquisition in Weber-Fox and Neville's (1996) study (age 16 or above) elicited a non-canonical LAN and no P600 for this type of violation, which the authors interpret as evidence for age effects in L2 syntactic processing.

Hahne and Friederici (2001) found that late (age 18 or above) Japanese-speaking learners of L2 German could not discriminate grammatical sentences like (54a) from phrase structure violations like (54b), as suggested by the lack of any reliable ERP effects for the ungrammatical sentences compared to their grammatical counterparts:

(54)

       Grammatical
a.   Das Ice   wurde gegessen
     the ice-cream was   eaten
     "The ice-cream was eaten."

       Phrase Structure Violation
b.   Das Ice   wurde im   *gegessen
     the ice-cream was   in-the eaten

                      (Adapted from Hahne & Friederici, 2001, p. 126)

Crucially, neither study teased age of acquisition and L2 proficiency apart. In Weber-Fox and Neville (1996), the subjects with the latest age of acquisition (age 16 or above) were also the least proficient ones, and in Hahne and Friederici (2001), all participants were beginners, which suggests that the lack of sensitivity to syntactic and morphosyntactic violations in both studies could very well be an effect of proficiency. In fact, subsequent studies by Ojima et al. (2005), Rossi et al. (2006), Bowden (2007), Tanner et al. (2009), and Morgan-Short et al.

(2010), all of which examine how language proficiency impacts the processing of a late-acquired L2, provide evidence that native-like processing of highly automatic computations, such as phrase structure building, agreement, or inflection may be a function of proficiency rather than age of acquisition (see Kotz, 2009 and Steinhauer et al., 2009 for reviews).[19]

For example, Ojima et al. (2005) examined lexical semantic and morphosyntactic processing by adult Japanese-speaking learners of English at two levels of proficiency (high and low) and found that, while both learner groups elicited an N400 for semantic violations (55b compared to 55a), only the high-proficiency learners elicited a LAN for subject-verb number agreement violations (56a compared to 56b), a pattern which is partially native-like, since agreement violations elicited both a LAN and a P600 in the English controls. In contrast, the low-proficiency learners, who were matched in age of acquisition with the high proficiency group, failed to show any native-like ERP components for the agreement violations. Ultimately, these results suggest that a high level of proficiency in the L2 can make up for a late age of acquisition, at least, to a certain extent.

(55)
    Grammatical
a. Please, spell your name clearly.

    Semantic Violation
b. Please, spell your *face clearly.

(56)
    Grammatical
a. Some scientists find solutions by chance.

    Agreement Violation
b. Some scientists *finds solutions by chance.

                           (Adapted from Ojima et al., 2005, p. 1226)

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[19]However, see Kessler (2003) for a study where early and late learners matched for proficiency (both groups were high-proficiency) elicited different ERP-patterns, the early learners being more native-like (although not completely native-like) than the late learners.

It remains an open question whether the absence of a P600 for agreement violations in Ojima et al.'s (2005) high-proficiency learners was an effect of age of acquisition or proficiency. While it is possible that a P600 might have been elicited after further development of the learners' morphosyntax, it is also true that this group scored very high in an independent proficiency test and reported using English on a daily basis and having resided in an English-speaking country for an extensive period of time (mean length of stay = approximately 4 years), suggesting that they might be at their end state. The fact that they were tested on English subject-verb number agreement, which is an agreement type not instantiated in their L1 (Japanese), may account for the lack of a completely native-like ERP-pattern in the morphosyntactic condition. I will come back to this point in the next section.

A bidirectional study by Rossi et al. (2006) also supports the claim that L2 morphosyntactic processing tends to become progressively native-like with increasing proficiency. Rossi et al. (2006) examined the processing of phrase structure building and subject-verb agreement by both Italian-speaking learners of German and German-speaking learners of Italian at two levels of proficiency (high and low). Compared to their grammatical counterparts (German: 57a; Italian: 58a), phrase structure violations (German: 57b; Italian: 58b) and agreement violations (German: 57c; Italian: 58c) elicited a native-like ERP pattern in the two high-proficiency groups.[20]

(57)
    Grammatical
    a. Der Junge   im   Kindergarten singt   ein Leid.
       the boy$_{-3rd-SG}$ in-the kindergarten sing$_{-3rd-SG}$ a   song
       "The boy in the kindergarten sings a song."

    Phrase Structure Violation
    b. Der Junge im   *singt ein Leid.
       the boy   in-the   sings a   song

---

[20] No control group of L1 Italian speakers was tested in the Italian materials. Therefore, the German learners of L2 Italian were compared against the control group of German native speakers (Rossi et al., 2005) as the types of violations used with the two learner groups were the same (phrase structure and agreement violations).

Agreement Violation

c. Der <u>Junge</u>   im   Kindergarten *<u>singst</u>   ein Leid.

the boy$_{-3rd-SG}$ in-the kindergarten sing$_{-2nd-SG}$ a   song

(58)

Grammatical

a. Il <u>signore</u>   nel   bar <u>beve</u>   un caffè.

the man$_{-3rd-SG}$ in-the bar drink$_{-3rd-SG}$ a   coffee

 "The man in the bar drinks a coffee."

Phrase Structure Violation

b. Il   signore nel   *beve un caffè.

the man   in-the   drinks a   coffee

Agreement Violation

c. Il <u>signore</u>   nel   bar *<u>bevo</u>   un caffè.

the man$_{-3rd-SG}$ in-the bar drink-$_{1st-SG}$ a   coffee

(Adapted from Rossi et al., 2006, p. 2034)

The two groups of low-proficiency learners elicited a qualitatively native-like ERP pattern for phrase structure violations (ELAN-P600), but failed to show the LAN for agreement violations. In addition, their ERP patterns exhibited quantitative differences in both latency and amplitude compared to native speakers. These results, similar to Ojima et al.'s (2005) study, indicate that L2 proficiency is a stronger predictor of native-like morphosyntactic processing than age (cf. Weber-Fox & Neville, 1996; Hahne & Friederici, 2001). Most importantly, Rossi et al.'s results (2006) provide evidence that even less proficient learners can show native-like sensitivity to highly automatic syntactic processes, such as phrase structure building, as suggested by the presence of an ELAN for phrase structure violations. [21]

Bowden (2007) and Morgan-Short et al. (2010) provide additional evidence that, with increasing proficiency and experience, L2 morphosyntactic processing tends to become

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[21] Isel (2007) argues that the presence of the ELAN for phrase structure violations in late L2 learners is dependent upon the status of the constituent where the violation is realized, that is, whether the constituent is syntactically obligatory or optional. In Isel's study (2007), adult German-speaking learners of French showed an ELAN for phrase structure violations realized in obligatory constituents (e.g., the predicative PP of a subject-modifying relative clause, as in *Le chauffeur qui est dans la *dort* "the chauffeur who is in the sleeps").

increasingly native-like at the brain level, which they argue is consistent with Ullman's Declarative/Procedural Model (Ullman, 2001). Under the Declarative/Procedural Model, native language processing is hypothesized to rely on two different but interactive memory systems with different neural generators: declarative memory (temporal lobe structures) and procedural memory (frontal/basal ganglia structures). The declarative memory system is assumed to control explicit knowledge (i.e., lexical semantics, idiomatic expressions, irregular inflection, et cetera), and, thus, to be involved in explicit learning. In contrast, the procedural memory system is assumed to control implicit knowledge (e.g., phrase structure building, agreement), which is acquired and implemented automatically and unconsciously. Ullman (2001) argues that, at low proficiency, L2 processing mainly relies on the declarative memory system, even for computations for which native speakers rely on procedural memory (e.g., morphosyntactic dependencies). However, as L2 proficiency increases, the procedural memory system is hypothesized to become gradually involved in L2 processing, and grammatical aspects of the L2 are assumed to become increasingly automatized. According to Ullman (2001), this explains why lexical semantic processing, which is assumed to be controlled by the declarative system, has been systematically found to be unproblematic for adult L2 learners, regardless of proficiency (e.g., Weber-Fox & Neville, 1996; Hahne & Friederici, 2001; Ojima et al., 2005), and why automatic processes like phrase structure building or agreement, which are assumed to be controlled by the procedural memory system, have been found to be vulnerable even at high levels of proficiency (Ojima et al., 2005; but see Rossi et al., 2006). Bowden (2007) puts the Declarative/Procedural Model to the test by examining both lexical semantic and syntactic processing in adult English-speaking learners of Spanish at two levels of proficiency and experience (low and advanced). Similar to the Spanish controls, both learner groups in the study elicited an N400 for lexical semantic violations (59b, compared to 59a), which is in line with the model. However, while both the

Spanish controls and the advanced learners elicited a LAN and a P600 for phrase structure violations (59c relative to 59a), the low proficiency learners elicited no significant ERP components, which is also in line with the Declarative/Procedural Model. It should be noted, however, that some of the phrase structure violations in Bowden (2007) were not outright violations at the critical word (e.g., *amigos* "friends" in 59c). Importantly, this is a factor that has been argued to impact the presence of the ELAN for phrase structure violations, which might account for the lack of results in the low-proficiency group.[22]

(59)
Grammatical
a. El   estudiante espera salir   con   sus amigos esta noche.
   the   student   hopes go-out with his friends this night
   "The student hopes to go out with his friends tonight"

Semantic Violation
b. El   estudiante espera salir   con   sus amigos esta *música.
   the   student   hopes go-out with his friends this   music

Phrase Structure Violation
c. El   estudiante espera *amigos con   sus salir   esta noche.
   the student   hopes   friends with his go-out this night

(Adapted from Bowden, 2007, p. 190)

In another study testing the predictions of the Declarative/Procedural Model, Morgan-Short et al. (2010) tested noun-adjective gender agreement (60a, 60b) and noun-determiner gender agreement (60a, 60c) in Brocanto2, an artificial language modeled after the Romance languages. The participants in the study were adult native speakers of English who had received either implicit or explicit instruction in Brocanto2, and who were tested both at low-proficiency and at high-proficiency. Importantly, the property under investigation (syntactic gender agreement) is not realized in the learners' L1 (English).

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[22] One example is (59c), where a possible grammatical continuation of the sentence would be *El estudiante espera amigos sinceros que le puedan ayudar* "The student expects honest friends who can help him".

(60)
>
> **Grammatical**
> a. <u>Blom</u>   <u>neim-o</u>   <u>lu</u>   neep li praz.
>   Blom$_{-FEM}$ square$_{-FEM}$ the$_{-FEM}$ neep the switch
>   "The square blom switches the neep."
>
> **Noun-Adjective Gender Violation**
> b. <u>Blom</u>   *<u>neim-e</u>   lu   neep li praz.
>   Blom$_{-FEM}$ square$_{-MASC}$ the$_{-FEM}$ neep the switch
>
> **Noun-Determiner Gender Violation**
> c. <u>Blom</u>   neim-o   *<u>li</u>   neep li praz.
>   Blom$_{-FEM}$ square$_{-FEM}$ the$_{-MASC}$ neep the switch

(Adapted from Morgan-Short et al., 2010, p. 166)

At low proficiency, both noun-adjective (60b) and noun-determiner (60c) gender violations elicited N400 effects, which varied depending upon training type (implicit vs. explicit). At high proficiency, however, results were similar for learners in both training conditions: the N400 for noun-determiner gender violations (60c) shifted into a P600; in contrast, noun-adjective gender violations (60b) still elicited an N400. Morgan-Short et al. (2010) interpret these results as evidence that, at low proficiency, the processing mechanisms used for rule-based computations (e.g., agreement) are not yet native-like, as suggested by the presence of an N400 for agreement violations in contexts where native speakers typically elicit a P600. Crucially, the fact that noun-determiner gender violations yielded a P600 at high proficiency indicates that adult L2 learners' processing mechanisms tend to become native-like with increasing proficiency. As to the presence of an N400 for noun-adjective violations (60b) at high proficiency, Morgan-Short et al. (2010) argue that it may be more difficult to acquire agreement on adjectives than other contexts, such as determiners (see also Bruhn de Garavito & White, 2002; McLaughlin et al., 2010; Foucart & Frenck-Mestre, 2011).

Another study investigating the extent to which proficiency (or to be more precise, amount of L2 instruction) impacts L2 morphosyntactic processing is Tanner et al. (2009).

The authors examined the processing of subject-verb number agreement in German (61a-b) by adult English-speaking learners who had received different amounts of instruction in the L2 (first-year vs. third-year learners).

(61)

Grammatical

a. <u>Ich</u> <u>wohne</u>   in Berlin.
   I   live-1st-SG in Berlin
    "I live in Berlin."

Agreement Violation

b. <u>Ich</u> *<u>wohnt</u>   in Berlin.
   I   live-3rd-SG in Berlin

Adapted from McLaughlin et al. (2010, p. 127-128)

While first-year students showed an N400 for agreement violations (61b, relative to 61a), both the third-year students and the German controls showed a P600 (not preceded by a LAN), which provides additional evidence that proficiency modulates adult L2 learners' brain responses to morphosyntactic violations, in line with Rossi et al. (2006), Bowden (2007), and Morgan-Short et al. (2010). Most importantly, Tanner et al.'s results (2009) and Morgan-Short et al.'s (2010) suggest that learners may process morphosyntactic dependencies differently at low vs. high levels of proficiency (see also McLaughlin et al., 2010), as suggested by the qualitatively different components elicited for agreement violations at different levels of proficiency (low-proficiency: N400; high-proficiency: P600).

The possibility that adult L2 learners rely on different processing mechanisms at different stages of development is also consistent with the results reported in Osterhout et al.'s (2006, 2008) longitudinal study (see also Foucart & Frenck-Mestre, 2012). Osterhout et al. examined both semantic and morphosyntactic (agreement) processing in adult English-speaking learners of French as they progressed throughout their first year of instruction (after one month, after four months, and after eight months). In addition, they investigated the extent to which L1-L2 similarity impacts L2 morphosyntactic processing by

examining subject-verb number agreement (63a-b), which is a syntactic context where both

English and French instantiate number agreement, and noun-adjective number agreement

(64a-b), which is a syntactic context where only French realizes number.

(62)

Grammatical
a.   Sept   plus cinq font   douze.
seven plus five make twelve
"Seven plus five make twelve"

Semantic Violation
b.   Sept   plus *livre font   douze.
seven plus   book make twelve
"Seven plus book make twelve"

(63)

Subject-Verb Grammatical
a.   <u>Tu</u>   <u>adores</u>   le   français.
you$_{-2nd\text{-}SG}$ love$_{-2nd\text{-}SG}$ the   french
"You love French"

Subject-Verb Agreement Violation
b.   <u>Tu</u>   *<u>adorez</u>   le   français.
you$_{-2nd\text{-}SG}$ love$_{-2nd\text{-}PL}$ the   French

(64)

Article-Noun Grammatical
a.   Tu   manges <u>des</u>   <u>hamburgers</u>   pour dîner.
you   eat   a$_{-PL}$ hamburger$_{-PL}$ for   dinner
"You eat hamburgers for dinner"

Article-Noun Agreement Violation
b.   Tu   manges <u>des</u>   *<u>hamburger</u>   pour dîner.
you   eat   *indefinite article*$_{-PL}$ hamburger$_{-SG}$ for   dinner

(Adapted from Osterhout et al., 2006, p. 217)

After only one month of instruction, the novice L2 learners, similar to the French

controls, showed an N400 to semantic violations (62b, compared to 62a), a finding that is

consistent with previous studies on the L2 processing of lexical semantics (Weber-Fox &

Neville, 1996; Hahne & Friederici, 2001; Ojima et al., 2005; Bowden, 2007). As to the

morphosyntactic conditions, French native speakers elicited a robust P600 (not preceded by a

LAN) for both types of agreement violations. In the novice learners, subject-verb agreement violations (63b, relative to 63a) yielded an N400 after one month of instruction, which the authors interpret as evidence that learners noticed the violations and processed them at the lexical level (similar to the native speakers in Barber & Carreiras (2003, 2005) for agreement violations in word pairs, and to the L2 learners in Tanner et al. (2009)). After four months of instruction, subject-verb agreement violations no longer elicited an N400, but a small P600, which became more robust and native-like after eight months of instruction. These findings suggest that, with increasing proficiency, adult L2 learners' brain responses to morphosyntactic violations become increasingly native-like, at least for properties that are similar in the L1 and the L2. In contrast, article-noun agreement violations (64b, relative to 64a) did not yield any effects at any point, suggesting that L1-L2 differences affect processing, at least in novice learners.[23] In fact, the possibility that crosslinguistic similarity impacts morphosyntactic L2 processing is consistent with the previous literature (Ojima et al. 2005; Rossi et al., 2006; Tanner et al., 2009). Recall that the advanced Japanese learners of English in Ojima et al. (2005) did not show a completely native-like ERP pattern for subject-verb agreement, a syntactic dependency that is not present in their L1. In contrast, the two advanced learner groups in Rossi et al. (2006) showed native-like processing for person agreement, which is a syntactic dependency that is instantiated in the two languages under investigation.[24] This is also the pattern revealed in Tanner et al.'s (2009) study, where advanced English-speaking learners of German showed a native-like ERP pattern for subject-verb agreement violations, a property that is realized in both English and German. Therefore, the more native-like ERP patterns in Rossi et al. (2006) and Tanner et al. (2009) could also be due to crosslinguistic similarities. In this regard, recent reviews of neurolinguistic studies on L2 processing (e.g., Kotz, 2009; Van Hell & Tokowicz, 2010)

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[23] Another possibility is that article-noun number agreement in French is more difficult to acquire, since the number morpheme is present in the orthography, but it is not phonologically realized.

[24] German and Italian are, in fact, two languages with very rich agreement/inflectional systems.

highlight the importance of exploring the effects of L1 transfer on L2 morphosyntactic processing, a factor that appears not to have received sufficient attention in the L2 ERP literature (Tokowicz & MacWhinney, 2005; Sabourin & Stowe, 2008; Gillon-Dowens et al., 2010, 2011; Foucart & Frenck-Mestre, 2011, 2012). An investigation of the extent to which crosslinguistic similarity impacts L2 morphosyntactic processing at the brain level can ultimately inform us of the extent to which transfer effects can account for the well-attested fact that adult L2 learners are variable in their morphological competence.

To sum up, the above studies on L2 processing suggest that, at high levels of proficiency, adult L2 learners can show native-like processing of morphosyntactic dependencies, as shown by the presence of native-like components such as the P600 (Rossi et al., 2006; Osterhout et al., 2006, 2008; Tanner et al., 2009; Morgan-Short et al., 2010) or the LAN (Ojima et al., 2005, Rossi et al., 2006) for morphosyntactic anomalies. At lower levels of proficiency, the previous literature has revealed two possible outcomes. One possibility is that learners are insensitive to morphosyntactic dependencies, at least at the brain level, as suggested by the lack of ERP effects for morphosyntactic anomalies (e.g., Hahne & Friederici, 2001; Ojima et al., 2005; Bowden, 2007). Another possibility is that learners process morphosyntactic dependencies in a nonnative-like manner (e.g., Osterhout et al., 2006, 2008; Tanner et al., 2009; Morgan-Short et al., 2010; Foucart & Frenck-Mestre, 2012), as suggested by the presence of an N400 for morphosyntactic errors, a component that is sensitive to the strength of lexical associations (e.g., Holcomb & Neville, 1990) and which is not typically found for morphosyntactic anomalies in native speakers. Crucially, these studies also provide evidence that similarity between the L1 and the L2 does impact L2 morphosyntactic processing, a point which will be discussed next.

5.2. The Effects of L1-L2 Similarity on L2 Morphosyntactic Processing

A few studies have investigated the role of the L1 in L2 morphosyntactic processing, focusing on whether L2 features that are absent in the L1 can be acquired by adult L2 learners or whether novel instantiations of a feature that exists in both the L1 and the L2 can be processed in a native-like manner (e.g., Tokowicz & MacWhinney, 2005; Sabourin & Stowe, 2008; Gillon-Dowens et al., 2010; 2011; Foucart & Frenck-Mestre, 2011, 2012; see Tolentino & Tokowicz, 2011 for a review).

Tokowicz and MacWhinney (2005) examined whether adult English-speaking learners of Spanish showed native-like processing for a structure that is similar in the L1 and the L2 (tense marking, as in (65a-b)), a structure that is realized differently in the L1 and the L2 (article-noun number agreement, as in (66a-b)), and a structure that is unique to the L2 (gender agreement, as in (67a-b)).

(65)
    Tense Marking Grammatical (Similar in L1 and L2)
    a. Su   abuela   <u>cocina</u> muy bien.
        his   grandmother cooks very well
        "His grandmother cooks very well."

    Tense Marking Ungrammatical
    b. Su   abuela   *<u>cocinando</u> muy bien.
        his   grandmother   cooking   very well

(66)
    Article-Noun Number Agreement Grammatical (Different in L1-L2)
    a. <u>Los</u>   <u>niños</u> están jugando.
        the-PL boy-PL are   playing
        "The boys are playing."

    Article-Noun Number Violation
    b. *<u>El</u>   <u>niños</u> están jugando.
         the-SG   boy-PL are   playing

(67)
    Gender Agreement Grammatical (Unique to L2)
    a. Ellos fueron a <u>una</u>   <u>fiesta</u>.
        they   went   to a-FEM party-FEM
        "They went to a party."

Gender Violation

b. Ellos fueron a *<u>un</u>   <u>fiesta</u>.
   they went to a$_{MASC}$ party$_{FEM}$

(Adapted from Tokowicz & MacWhinney, 2005, p. 178)

Violations of the structure that is similar in the L1 and the L2 (65b, relative to 65a) and the structure that is unique to the L2 (67b, relative to 67a) yielded a P600, an effect that can be considered native-like on the basis of other studies which targeted agreement in Spanish native speakers.[25] However, violations of the structure that is realized differently in the L1 and the L2 (66b, relative to 66a) yielded no ERP effects. These results provide evidence that L1-L2 similarity affects L2 processing, as shown by the presence of a P600 for the condition where the L1 and the L2 are similar (positive transfer) and the absence of a P600 in the condition where the L1 and the L2 are different (negative transfer). Crucially, these findings also demonstrate that L2 acquisition is not constrained by the properties of the L1, as shown by the P600 for gender violations, a feature of Spanish that is not instantiated in English (e.g., Morgan-Short et al., 2010). It is important to keep in mind that the participants in Tokowicz and MacWhinney (2005) included learners from four different levels of beginning Spanish and, therefore, it remains an open question whether more advanced learners are also affected by L1-L2 similarity in a comparable way.[26]

Sabourin and Stowe (2008) examined gender agreement in L2 Dutch by native speakers of two gendered languages, German and Romance. While both German and Romance instantiate gender agreement at the abstract level, only German has a congruous gender

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[25] A control group of native speakers of Spanish was not included in the study.

[26] Tolentino & Tokowicz (2011) report on a similar study testing the role of crosslinguistic similarity on L2 processing. In their study, low-proficiency English-speaking learners of Spanish showed a P600 for structures that are shared by the L1 and the L2, regardless of morphological similarities (demonstrative-noun number agreement and noun-article number agreement), but not for structures that are unique to the L2 (gender agreement).

system with Dutch at the lexical level.[27] Sabourin and Stowe (2008) investigate whether these surface differences affect sensitivity to gender agreement at the brain level. Similar to the Dutch controls, the German group showed a P600 for gender violations (68b, relative to 68a). The Romance group, in contrast, elicited a frontal negativity between 300-900 ms.

(68)
Gender Agreement Grammatical
a. Hij komt eran met <u>de</u>   verse <u>koffie</u>.
   he comes to   with the$_{-COM}$ fresh coffee$_{-COM}$
   "He's coming with the fresh coffee."

Gender Agreement Ungrammatical
b. Hij komt eran met <u>het</u>   verse *<u>koffie</u>.
   he comes to   with the$_{-NEUT}$ fresh coffee$_{-COM}$

(Adapted from Sabourin & Stowe , 2008, p. 178)

Sabourin and Stowe (2008) interpret these differences as evidence that having a feature in both the L1 and L2 does not guarantee native-like processing (e.g., Tokowicz & MacWhinney, 2005) and that L1-L2 similarity plays a crucial role in L2 processing. Since no independent proficiency measure was administered in the study, it is also possible that the qualitative differences between the German and Romance groups were an effect of proficiency (e.g., Tanner et al., 2009), especially since the Romance group performed slightly above chance in the grammaticality judgment and was significantly less accurate than both the Dutch and German groups. An earlier version of the study (Sabourin, 2003) included a group of English-speaking learners who showed no sensitivity to the gender violations. Sabourin (2003) interprets the lack of effects in the L1 English group as evidence that features not instantiated in the L1 cannot be processed natively in a late-acquired L2 (cf. Morgan-Short et al., 2010). An alternative interpretation for Sabourin's (2003) results is that the English-speaking learners were not proficient enough to detect the gender violations,

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[27] That is, most German neuters are neuters in Dutch, and most masculine/feminine nouns in German fall into the "common" gender category in Dutch.

since they performed less accurately than both the German and Romance groups in the

grammaticality judgment.

Gillon-Dowens et al. (2010) examined the processing of number and gender agreement in

L2 Spanish in two sentence positions: within a determiner phrase (69a-c) and across a verb

phrase (70a-c):

(69)
> **Within the DP: Grammatical**
>
> a. <u>El</u>   <u>suelo</u>   está plano y   bien acabado.
> the-$_{\text{MASC-SG}}$ floor-$_{\text{MASC-SG}}$ is   flat   and well finished
> "The floor is flat and well finished."

> **Number Violation**
>
> b. <u>Los</u>   *<u>suelo</u>   está plano y   bien acabado.
> the-$_{\text{MASC-PL}}$ floor-$_{\text{MASC-SG}}$ is   flat   and well finished

> **Gender Violation**
>
> c. <u>La</u>   *<u>suelo</u>   está plano y   bien acabado.
> the-$_{\text{FEM-SG}}$ floor-$_{\text{MASC-SG}}$ is   flat   and well finished

(70)
> **Across the DP: Grammatical**
>
> a. el <u>suelo</u>   está <u>plano</u>   y   bien acabado
> the floor-$_{\text{MASC-SG}}$ is   flat-$_{\text{MASC-SG}}$ and well finished
> "The floor is flat and well finished."

> **Number Violation**
>
> b. el <u>suelo</u>   está *<u>planos</u>   y   bien acabado
> the floor-$_{\text{MASC-SG}}$ is   flat-$_{\text{MASC-PL}}$ and well finished

> **Gender Violation**
>
> c. el <u>suelo</u>   está *<u>plana</u>   y   bien acabado
> the floor-$_{\text{MASC-SG}}$ is   flat-$_{\text{FEM-SG}}$ and well finished

(Adapted from Gillon-Dowens et al., 2010, p. 1874)

The participants in their study were late English-speaking learners who had been

immersed in a Spanish-speaking country for at least 12 years and reached a very high level of

proficiency. In native speakers, number and gender violations elicited a similar ERP pattern,

a LAN and a P600. Moreover, effects did not differ between within-phrase and across-phrase

violations. Similar to the native speakers, L2 learners showed a LAN and a P600 for number

and gender violations realized within the phrase (69b, 69c). However, number and gender violations realized across the phrase (70b, 70c) only elicited a P600. In addition, the P600 was larger for number than gender in both sentence positions. The authors conclude that L2 features not instantiated in the L1 (gender) can be processed in a native-like manner, as suggested by the presence of a P600 for both number and gender violations, and argue for positive transfer effects to account for the larger P600 for number (present in the L1) than gender (absent in the L1). The absence of a LAN for across-phrase violations is interpreted as evidence that the distance between the agreeing elements impacts L2 processing.[28]

In a subsequent study with the same experimental stimuli looking at advanced Chinese-speaking learners of Spanish, Gillon-Dowens et al. (2011) found equally robust P600 effects for number and gender violations in both sentence positions. As Chinese lacks both number and gender agreement, the results of Gillon-Dowens et al.'s (2011) study provide further evidence that, at an advanced level of proficiency, late L2 learners can show sensitivity to features not present in the L1 (e.g., Tokowicz & MacWhinney, 2005; Morgan-Short et al., 2010). Furthermore, the similarity between the number and gender effects in Gillon-Dowens et al. (2011) provides evidence that, in the absence of positive L1 transfer (Chinese instantiates neither number nor gender), number and gender are processed similarly.

Foucart and Frenck-Mestre (2011) examined whether morphological differences in how the L1 and the L2 realize a shared feature (grammatical gender) impact L2 processing. The participants were advanced German-speaking learners of French with a late age of acquisition. Agreement was examined between definite articles and nouns (71), where both

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[28] Another possibility is that across-phrase violations were realized in a context where English does not instantiate agreement (noun-adjective), whereas within-phrase violations were realized in a syntactic context in which English instantiates agreement between demonstratives and nouns, as in *this house/these houses*.

French and German instantiate gender agreement, and between plural nouns and post-nominal adjectives (72), a context where only French instantiates gender agreement.

(71)

Article-Noun Gender Agreement (Similar in L1 and L2)
a. Hier   <u>la</u>   <u>chaise</u>   était dans le salon.
   yesterday the-FEM chair-FEM was in   the living-room
   "Yesterday the chair was in the living room"

Article-Noun Gender Violation
b. Hier   <u>le</u>   *<u>chaise</u>   était dans le salon.
   yesterday the-MASC chair-FEM was in   the living-room

(72)

Noun-Adjective Gender Agreement (Dissimilar in L1 and L2)
a. En été,   les <u>chaises</u>   <u>blanches</u> sont dans le jardin.
   in summer the chairs-FEM white-FEM are in   the garden.
   "In the summer, the white chairs are in the garden."

Noun-Adjective Gender Violation
b. En été,   les <u>chaises</u>   *<u>blancs</u>   sont dans le jardin.
   in summer the chairs-FEM white-MASC are in   the garden.

(Adapted from Foucart & Frenck-Mestre, 2011, pp. 5, 12)

In French native speakers, violations elicited a P600 in both contexts. In contrast, L2 learners only elicited a P600 for violations between definite articles and nouns (71b, relative to 71a), where both the L1 and the L2 instantiate gender agreement. Foucart and Frenck-Mestre (2011) argue that the German learners may have transferred the agreement rules of L1 German to L2 French, which would explain the lack of brain sensitivity to gender violations in a context where the L1 does not realize gender agreement (e.g., Tokowicz & MacWhinney, 2005; cf. Gillon-Dowens et al., 2010). Ultimately, these results provide additional evidence that sharing a feature in the L1 and L2 does not guarantee native-like processing in the L2 and that L1-L2 similarity impacts processing at the brain level. Another possibility is that noun-adjective agreement is more difficult to acquire than article-noun agreement, in line with previous behavioral (e.g., Bruhn de Garavito & White, 2002) and ERP studies (e.g., Morgan-Short et al., 2010). It should also be noted that language

proficiency in Foucart and Frenck-Mestre (2011) was not independently tested. Subjects self-rated their proficiency and they were assumed to be advanced because they had passed the required test to be able to attend courses at a French university. Differences in proficiency may explain why the learners in Foucart and Frenk-Mestre (2011) were insensitive to the gender violations realized in a context where the L1 does not realize gender agreement, but why the English-speaking learners of Spanish in Gillon-Dowens et al. (2010) showed robust P600 effects for number violations realized in two syntactic contexts where English does not instantiate number agreement (definite article and adjective).

Finally, in a subsequent study, Foucart and Frenck-Mestre (2012) examined the processing of gender agreement in L2 French by advanced L2 learners who were native speakers of a [–gender] language, English. Gender agreement was tested in three different contexts: within-phrase noun-adjective agreement in a word order that is different in the learners' L1 (73), within-phrase adjective-noun agreement in a word order that is similar in the L1 and the L2 (74), and across-phrase noun-adjective agreement (75):

(73)
   Noun-Adjective Gender Agreement Grammatical
   a. Depuis une semaine, les <u>chaises</u>   <u>vertes</u>   sont dans le jardin.
      For   a   week,   the chairs$_{FEM}$ green$_{FEM}$ are in   the garden.
      "The green chairs have been in the garden for one week."

   Noun-Adjective Gender Violation
   b. Depuis une semaine, les <u>chaises</u>   *<u>verts</u>   sont dans le jardin.
      For   a   week,   the chairs$_{FEM}$ green$_{MASC}$ are in   the garden.

(74)
   Within the DP Adjective-Noun Gender Agreement: Grammatical
   a. De nos jours, les <u>anciennes</u> <u>montres</u>   sont rares.
      of our days   the old$_{FEM}$ watches$_{FEM}$ are rare.
      "Nowadays, old watches are rare"

   Within the DP Adjective-Noun Gender Violation
   b. De nos jours, les <u>anciens</u>   *<u>montres</u>   sont rares.
      of our days   the old$_{MASC}$ watches$_{FEM}$ are rare.

(75)

Across the VP Adjective-Noun Gender Agreement: Grammatical

a. Au   printemps, les <u>pommes</u>   sont   <u>vertes</u>   sur cet arbre.
    in-the   spring   the apples._{FEM} are   green._{FEM} on   this tree.
    "In the spring, the apples from this tree are green."

Across the VP Adjective-Noun Gender Violation

b. Au   printemps, les <u>pommes</u>   sont *<u>verts</u>   sur cet arbre.
    in-the   spring   the apples._{FEM} are   green._{MASC} on   this tree.

(Adapted from Foucart & Frenck-Mestre, 2012, pp. 231, 235, 239)

While the native speakers showed a P600 for all violation types, the L2 learners only showed a P600 for noun-adjective gender violations realized within the phrase (73b, relative to 73a). For gender violations realized between preposed adjectives and nouns (74b, relative to 74a), the L2 learners showed an N400, which the authors interpret as evidence that they have not completely grammaticalized gender agreement, at least when it is realized in a syntactic context which is rare in the L2 (despite its being the canonical word order in the L1). Finally, gender violations realized across the verb phrase (75b, relative to 75a) yielded no effects, suggesting that hierarchical structure impacts L2 morphosyntactic processing (e.g., Gillon-Dowens et al., 2010).

In sum, there are different proposals with respect to the way in which the properties of the L1 impact L2 processing, with some researchers focusing on a comparison of the inventory of features (e.g., Sabourin, 2003; Gillon-Dowens et al., 2010, 2011; Foucart & Frenck-Mestre, 2012) and others focusing on the morphological realization of features (e.g., Tokowicz & MacWhinney, 2005; Sabourin & Stowe, 2008; Foucart & Frenck-Mestre, 2011, 2012). Both questions will be directly addressed in the present study. In addition, the results by Gillon-Dowens et al. (2010) and Foucart and Frenck-Mestre (2012) also suggest that L2 morphosyntactic processing is impacted by the structural distance between the agreeing elements, a point that will be discussed next.

5.3. Effects of Structural Distance on L2 Morphosyntactic Processing

Only a few studies have investigated the extent to which structural distance impacts the establishment of syntactic dependencies, such as agreement, in a late-acquired L2 (Myles, 1995; Keating, 2009, 2010; Gillon-Dowens et al., 2010, 2011; Foote, 2011; Foucart & Frenck-Mestre, 2012). In addition, most of these studies do not tease linear and structural distance apart and, therefore, the unique contribution of structural distance to the resolution of morphosyntactic dependencies in an L2 remains an important open question, since theories such as the Shallow Structure Hypothesis (Clahsen & Felser, 2006; Clahsen et al., 2010) have argued that adult L2 learners cannot establish syntactic dependencies outside of local domains (such as within the same phrase).

Myles (1995) examined the extent to which sensitivity to gender agreement violations in adult Anglophone learners of French was modulated by the structural distance between the agreeing elements. In her study, gender agreement violations were realized at four levels of structural distance: within a noun phrase (76a), across a verb phrase (76b), across a complementizer phrase (76c), or across different sentences, as shown in (76d) below:

(76)
    Within the NP
  a. son <u>sac</u>   <u>noir</u>
      her $_{DP}$[bag$_{-MASC}$ black$_{-MASC}$]
      "Her black bag"

    Across the VP
  b. son <u>frère</u>   était <u>content</u>
      her brother$_{-MASC}$ $_{VP}$[was happy$_{-MASC}$]
      "Her brother was happy"

    Across the CP
  c. sa <u>valise</u>   dans <u>laquelle</u>
      her suitcase$_{-FEM}$ $_{CP}$[in   which$_{-FEM}$]
      "Her suitcase in which…"

Across the Sentence

d. <u>content</u>   de   son travail, <u>Jean</u>…
   happy-MASC of   his   work, s[Jean-MASC]
   "Happy with his work, Jean…"

<div align="right">(Adapted from Myles, 1995, p. 257)</div>

The participants, who were divided into five different proficiency levels, completed an error detection and correction task which included various types of errors (syntactic and orthographic). The results of the task revealed that, overall, learners' ability to detect gender agreement violations decreased as the structural distance between the agreeing elements increased, especially in lower proficiency L2 learners.[29] Myles (1995) interprets these findings as evidence that structural distance diminishes adult L2 learners' ability to establish syntactic dependencies, due to increased processing burden. However, there is a number of factors that were not teased apart across the four levels of structural distance in Myles' (1995) study, including the syntactic category of the agreeing elements, syntactic vs. biological gender, the number of tokens per level of structural distance, and, most importantly, linear distance. Therefore, it is not possible to tell whether the gradual decrease in sensitivity to the gender violations reported by Myles was uniquely due to structural distance. It should also be noted that an offline task, such as the one used by Myles, does not really tap on L2 processing *per se*, and therefore it is difficult to interpret how structural distance and processing burden interact from Myles' results. The studies reviewed below address this question more directly.

Keating (2009) used eye-tracking to investigate how the online processing of gender agreement in L2 Spanish was impacted by the structural distance between the agreeing elements, which could be located within a DP (77a), across a VP (77b), or across a CP (77c):

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[29] Interestingly, the learners in Myles' (1995) study were not affected by the distance manipulation when the agreeing elements were located in separate sentences (as in 76d).

(77)

Within the NP

a. una   <u>casa</u>   <u>pequeña/*pequeño</u>   cuesta mucho en San Francisco.
     a $_{NP}$[house$_{-FEM}$ small$_{-FEM}$/*small$_{-MASC}$] costs   much   in   San Francisco

"A small house costs a lot in San Francisco."

Across the VP

b. la <u>casa</u>   es bastante <u>pequeña/*pequeño</u>   y   necesita
     the house$_{-FEM}$ $_{VP}$[is quite   small$_{-FEM}$/*small$_{-MASC}$] and needs

muchas   reparaciones.
many   repairs

"The house is quite small and needs a lot of repairs."

Across the CP

c. una <u>casa</u>   cuesta menos si   es <u>pequeña/*pequeño</u>   y   necesita
     a   house$_{-FEM}$ costs   less $_{CP}$[if $_{VP}$[is   small$_{-FEM}$/*small$_{-MASC}$] and needs

reparaciones.
repairs

"A house costs less if it is small and needs repairs."

(Adapted from Keating, 2009, p. 505-506)

The participants in Keating (2009) were English-speaking learners of Spanish at three proficiency levels (beginning, intermediate, advanced) and a control group of Spanish natives. The latter showed sensitivity to the gender violations at every level of structural distance. That is, if the adjective disagreed in gender with its controller noun (e.g., *pequeño* "small$_{-MASC}$" in (77a-c)), native speakers spent more time looking at it (longer fixations) and regressed to the controller noun (e.g., *casa* "house$_{-FEM}$" in (77a-c)) more often to check for gender information.

Moreover, sensitivity to the gender errors was similar across the three levels of distance in the native speaker group. In contrast, the advanced learners only showed sensitivity to agreement violations realized within the DP, but were insensitive to violations realized outside of local domains (across a VP or a CP). Furthermore, neither the beginning nor the

intermediate L2 learners showed sensitivity to the gender errors at any level of structural distance. These findings suggest that, at an advanced level of proficiency, adult L2 learners can establish syntactic dependencies online, even if they involve a feature that is absent in the L1 feature inventory, as indicated by the fact that advanced learners were sensitive to gender violations within the DP. However, Keating's (2009) results also suggest that L2 processing is impacted by the distance between structurally related elements and that adult L2 learners may be sensitive to hierarchical structure. However, as was the case in Myles (1995), it should be kept in mind that structural and linear distance were also confounded in Keating's (2009) study, such that greater structural distance involved greater linear distance. Therefore, the decrease in sensitivity to the gender violations in Keating's L2 learners could be an effect of structural distance, linear distance, or both.

In a subsequent eye-tracking study, Keating (2010) examined the unique contribution of linear distance to the processing of gender agreement in Spanish by advanced Anglophone learners. As shown in (78), Keating's design manipulates the number of intervening words between the agreeing elements while keeping structural distance constant (the agreeing nouns and adjectives were always located across a VP). Linear distance could be one word (78a), four words (78b), or seven words (78c):

(78)
    1-word
  a. la <u>tienda</u>   está <u>abierta/*abierto</u>   los sábados y   domingos
       the store$_{-FEM}$ $_{VP}$[is   open$_{-FEM}$/*open$_{-MASC}$] the saturdays and sundays

       por la   tarde.
       in   the afternoon

       "The store is open Saturdays and Sundays in the afternoon."

    4-word
  b. la <u>mochila</u>   de la estudiante está <u>llena/*lleno</u>   de libros
       the backpack$_{-FEM}$ of the student $_{VP}$[is   filled$_{-FEM}$/*filled$_{-MASC}$] of   books

       "The backpack of the student is filled with books."

7-word

c. la <u>falda</u>   en la tienda de ropa   femenina   es <u>roja/*rojo</u>
   the skirt_FEM in the store   of clothing feminine VP[is red_-FEM/*red_-MASC]

   y   viene de   Italia
   and comes from Italy

"The skirt in the store of women's clothing is red and comes from Italy."

(Adapted from Keating, 2010)

Both the native controls and the advanced L2 learners were impacted by the linear

distance between the agreeing elements, as indicated by the fact that neither group showed

sensitivity to the gender violations in the 7-word condition (78c). In addition, the advanced

L2 learners were also insensitive to the gender agreement errors in the 4-word condition

(78b). This is an important and relevant finding, since it shows that linear distance can impact

processing in both native (e.g., Hammer et al., 2008) and nonnative speakers and, therefore, it

is a factor that must be controlled for in studies evaluating the unique contribution of

structural distance to the processing of syntactic dependencies (recall that neither Myles

(1995) nor Keating (2009) teased linear and structural distance apart).[30] Importantly, despite

the lack of sensitivity to gender errors in the 4-word and 7-word conditions, the advanced

learners in Keating (2010) showed sensitivity to across-phrase gender violations in the

1-word condition, which provides evidence against claims that adult L2 learners can only

establish syntactic dependencies in local domains (Clahsen & Felser, 2006; Clahsen et al.,

2010).

Foote (2011) investigated the extent to which linear distance and the properties of the L1

affect the online processing of syntactic dependencies in a late-acquired L2. The participants

in the study were advanced English-speaking learners of Spanish with a late age of

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[30] An alternative interpretation for the linear distance effects in Keating (2010) concerns the presence of
intervening gendered nouns between the agreeing elements in both the 4-word and 7-word conditions. Given
that the gender value of the intervening nouns could differ from that of the controller nouns, the possibility of
attraction errors cannot be ruled out.

acquisition and a control group of native speakers of Spanish.[31] As can be seen in (79) and

(80), Foote's study examined the processing of a feature that is instantiated and realized

similarly in the learners' L1 (subject-verb number agreement) and the processing of a feature

that is unique to the learners' L2 (gender agreement). In addition, the role of linear distance

on L2 syntactic processing was evaluated by comparing agreement between adjacent words

(79a, 80a) and agreement between non adjacent words (79b, 80b):

(79)
Subject-Verb Number Agreement Adjacent
a. Veo que tu <u>padre</u> <u>es/*son</u> de Texas
I-see that your father$_{-SG}$ be$_{-3rd-SG/*PL}$ from Texas
"I see your father is from Texas."

Non Adjacent
b. El <u>reloj</u> del hombre <u>es/*son</u> de Suiza
the watch$_{-SG}$ of-the man be$_{-3rd-SG}$/*be$_{-PL}$ from Switzerland
"The man's watch is from Switzerland."

(80)
Gender Agreement Adjacent
a. Dicen que el <u>libro</u> <u>blanco/*blanca</u> está en esa mesa
they-say that the book$_{-MASC}$ white$_{-MASC}$/*white$_{-FEM}$ is on that table
"They say that the white book is on that table."

Non Adjacent
b. El <u>pollo</u> del taco está <u>rico/*rica</u> pero picante
the chicken$_{-MASC}$ of-the taco is tasty$_{-MASC}$/*tasty$_{-FEM}$ but spicy
"The chicken of the taco is tasty but spicy."

(Adapted from Foote, 2011, p. 201-202)

The results of a self-paced reading task showed that both the native speakers and the adult

L2 learners were sensitive to the two types of agreement violations, as suggested by a

slowdown at the violating word in the sentence (e.g., *blanca* "white$_{-FEM}$" in 80a), compared to

its grammatical counterpart (e.g., *blanco* "white$_{-MASC}$" in 80a). In addition, both groups

slowed down more for agreement errors involving adjacent words (79a, 80a) than for

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[31] Foote's study also includes a group of early bilinguals that will not be discussed here, since their pattern of results is similar to that of the late L2 learners'.

violations where the agreeing elements were non adjacent. These results suggest that adult L2 learners can develop sensitivity to syntactic properties of the L2, regardless of whether or not they are instantiated in the L1, consistent with previous studies (e.g., Gillon-Dowens et al., 2010). Furthermore, in line with Keating (2010), Foote's (2011) results provide evidence that both native and nonnative processing are impacted by the linear distance between the agreeing elements.

To my knowledge, the only studies to date that have used the ERP methodology to investigate the effects of distance on the L2 processing of agreement are the abovementioned studies by Gillon-Dowens et al. (2010, 2011) and Foucart and Frenck-Mestre (2012), both of which tested advanced English-speaking learners of a Romance language. As mentioned above, Gillon-Dowens et al. (2010, 2011) compared the processing of agreement realized within a DP and across a VP, as shown in (69) and (70) above, which are repeated below as (81a) and (81b), respectively:

(81)
        Within the DP
  a. <u>el/*los/*la</u>   <u>suelo</u>   está plano y bien acabado.
      the-MASC-SG/*the-MASC-PL/*the-FEM-SG floor-MASC-SG is   flat and well finished
       "The floor is flat and well finished."

        Across the DP
  b. el <u>suelo</u>   está <u>plano/*planos/*plana</u>   y   bien acabado
      the floor-MASC-SG is   flat-MASC-SG/*flat-MASC-PL/*flat-FEM-SG and well finished
      "The floor is flat and well finished."

                                (Adapted from Gillon-Dowens et al., 2010, p. 1874)

Recall that, while the Spanish native speakers in Gillon-Dowens et al.'s (2010) study were insensitive to the distance manipulation (similar LAN-P600 pattern across both levels of distance), the advanced English-speaking learners only showed a LAN for within-phrase violations. The P600, however, was equally robust for both within-phrase and across-phrase violations in this group, suggesting that the distance manipulation did not affect the

computations reflected by this component. Since the LAN is argued to index automatic morphosyntactic processing, Gillon-Dowens et al. (2010) interpret these findings as evidence that adult L2 learners may have limited access to the cognitive resources required for more taxing computations (see also McDonald, 2006), such as the establishment of agreement across a VP between non adjacent elements. For their part, the advanced Chinese-speaking learners of Spanish in Gillon-Dowens et al. (2011) also elicited equally robust P600s for within-phrase and across-phrase violations. However, they did not elicit a LAN at either level of structural distance, which complicates a comparison of how structural distance impacts the processing of agreement in the two L2 groups. Importantly for the purposes of the present study, it remains an open question whether the absence of the LAN for agreement violations can be taken as a reliable indicator of L2 processing difficulty, since native speakers often fail to elicit a LAN for agreement violations, even in local domains (e.g., Martín-Loeches et al., 2006; Wicha et al., 2004). Furthermore, since the stimuli in Gillon-Dowens et al.'s (2010, 2011) study were the same as those in Barber & Carreiras' (2005), they suffer from the same limitations. As can be seen in (81a-b), within-phrase and across-phrase agreement were not controlled for linear distance, such that greater structural distance involved greater linear distance (*el suelo* "the-$_{MASC-SG}$ floor-$_{MASC-SG}$" vs. *suelo está plano* "floor-$_{MASC-SG}$ is flat-$_{MASC-SG}$"). Moreover, the two configurations involved elements of different syntactic categories (within-phrase agreement: determiner-noun; across-phrase agreement: noun-adjective). Recall from the findings by Hammer et al. (2008) and O'Rourke and Van Petten, (2011) that both factors have been found to impact processing in native speakers. Likewise, the findings by Keating (2010), Foote (2011), and Morgan-Short et al. (2010) provide evidence that both factors have also been found to affect L2 processing, suggesting that the unique contribution of structural distance to the online processing of agreement in an L2 remains an open question.

Finally, Foucart and Frenck-Mestre (2012) used both eye-tracking and ERPs to investigate the role of structural distance in the L2 processing of gender agreement in French. In their study, agreement was examined both within the DP and across the VP, as shown in (73)-(75) above, repeated below as (82a) and (82b):

(82)
    Within the DP
    a. Depuis une semaine, les <u>chaises</u>   <u>vertes/*verts</u>
        For   a   week,   the chairs-FEM green-FEM/*green-MASC

        sont dans le   jardin.
        are   in   the garden

        "The green chairs have been in the garden for one week."

    Across the VP
    b. Au   printemps, les <u>pommes</u>   sont   <u>vertes/*verts</u>
        in-the spring   the apples-FEM are   green-FEM/*green-MASC

        sur cet arbre.
        on this tree.

        "In the spring, the apples from this tree are green."

                         (Adapted from Foucart & Frenck-Mestre, 2012, pp. 231, 239)

The French controls in the study elicited a similar P600 for both within-phrase and across-phrase violations, suggesting that they were sensitive to the gender violations overall, but impervious to the distance manipulation. In contrast, the advanced L2 learners only showed a P600 for gender violations within the DP (82a), but no effects for violations realized across the VP (82b). These results suggest that L2 morphosyntactic processing is indeed impacted by distance. However, it should be taken into account that, while Foucart and Frenck-Mestre's (2012) study does control for the syntactic category of the agreeing elements (noun-adjective), it does not control for linear distance, similar to Gillon-Dowens et al. (2010, 2011) and, therefore, it remains an open question whether L2 learners are sensitive to hierarchical structure *per se*. Interestingly, when the same violations were examined with

eye-tracking, the L2 learners were sensitive to the gender violations across the phrase and, therefore, the authors conclude that the resolution of syntactic dependencies in a late-acquired L2 is not confined to local domains.[32]

In sum, previous studies have provided evidence that distance impacts the L2 processing of agreement. However, the unique contribution of structural distance to the online processing of agreement remains an open question, since previous investigations do not control for linear and structural distance (e.g., Keating, 2009; Gillon-Dowens et al., 2010; 2011; Foucart & Frenck-Mestre, 2012) or for other factors, such as the syntactic category of the agreeing elements (Gillon-Dowens et al., 2010, 2011). Both questions will be directly addressed in the present study, which is presented and described in the next chapter.

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[32] It should be noted that Foucart & Frenck-Mestre's eye-tracking study (2012) only examined gender agreement realized across the phrase. Therefore, is not possible to evaluate how distance modulates sensitivity to the gender violations at different levels of distance (as was done, for example, by Keating (2009, 2010) and Foote (2011)) .

CHAPTER 6:

PRESENT STUDY AND PREDICTIONS

6.1. Agreement Processing in Native Speakers

The present study uses EEG to investigate the neurophysiological processing of number and gender agreement in Spanish by both native speakers and advanced English-speaking learners with a late age of acquisition. With respect to native processing, the main aim of the study is to examine how different agreement features (number, gender) are processed at the brain level, and the extent to which agreement is impacted by the structural distance between the agreeing elements. As discussed in Chapter 4, previous ERP studies on the native processing of agreement have made different proposals with respect to whether number and gender are represented and processed similarly at the neurological level (Barber & Carreiras, 2005; Nevins et al., 2007), and with respect to how distance modulates the processing of agreement dependencies (e.g., Barber & Carreiras, 2005; Hammer et al., 2008; O'Rourke & Van Petten, 2011). Importantly, the unique contribution of structural distance to the native processing of agreement remains an open question, since previous studies have confounded linear and structural distance (e.g., Barber & Carreiras, 2005; O'Rourke & Van Petten, 2011). As shown in Table 1 below (p. 79), agreement in the present study was manipulated both within the same phrase (Experiment 1) and across a verb phrase (Experiment 2). Crucially, across both levels of structural distance, linear distance was controlled for (one word), as was the syntactic category of the agreeing elements (noun-adjective). As can be seen in Table 1, agreement was also examined between demonstratives and nouns in Experiment 3 (context where both English and Spanish realize number agreement), for which the native speakers serve as the control group. Importantly, number and gender violations were examined with identical baselines in all three experiments, allowing for a direct comparison of the two features.

Table 1: Sample sentences for the grammatical, number violation, and gender violation conditions in Experiment 1 (within-phrase agreement), Experiment 2 (across-phrase agreement), and Experiment 3 (context where both English and Spanish instantiate agreement). The agreeing elements are underlined.

EXPERIMENT 1
Within-Phrase Agreement
Grammatical   El banco es un $_{DP}$[edificio muy seguro] y el juzgado también.   the bank is a building$_{-MASC-SG}$ very safe$_{-MASC-SG}$ and the courthouse too
Number Violation   El banco es un $_{DP}$[edificio muy *seguros] y el juzgado también.   the bank is a building$_{-MASC-SG}$ very safe$_{-MASC-PL}$ and the courthouse too
Gender Violation   El banco es un $_{DP}$[edificio muy *segura] y el juzgado también.   the bank is a building$_{-MASC-SG}$ very safe$_{-FEM-SG}$ and the courthouse too
EXPERIMENT 2
Across-Phrase Agreement
Grammatical   El cuento $_{VP}$[es anónimo] y el manuscrito también.   the story$_{-MASC-SG}$ is anonymous$_{-MASC-SG}$ and the manuscript too
Number Violation   El cuento $_{VP}$[es *anónimos] y el manuscrito también.   the story$_{-MASC-SG}$ is anonymous$_{-MASC-PL}$ and the manuscript too
Gender Violation   El cuento $_{VP}$[es *anónima] y el manuscrito también.   the story$_{-MASC-SG}$ is anonymous$_{-FEM-SG}$ and the manuscript too
EXPERIMENT 3
Context where both English and Spanish instantiate agreement
Grammatical   Mateo limpió este apartamento el sábado pasado.   mateo cleaned this$_{-MASC-SG}$ apartment$_{-MASC-SG}$ the saturday last
Number Violation   Mateo limpió estos *apartamento el sábado pasado.   mateo cleaned this$_{-MASC-PL}$ apartment$_{-MASC-SG}$ the saturday last
Gender Violation   Mateo limpió esta *apartamento el sábado pasado.   mateo cleaned this$_{-FEM-SG}$ apartment$_{-MASC-SG}$ the saturday last

Specific research questions relative to the online processing of agreement dependencies in native speakers are presented below:

Research Question 1:

Is the processing of number and gender similar at the brain level (Nevins et al., 2007) or is gender costlier to repair than number due to its lexical status (Barber & Carreiras, 2005; Faussart et al., 1999)?

Research Question 2:

In the course of online processing, are native speakers sensitive to the structural distance between the elements in a syntactic dependency (e.g., Barber & Carreiras, 2005; O'Rourke & Van Petten, 2011), after controlling for linear distance?

6.1.1. Predictions for Spanish Native Speakers

First, based upon previous studies investigating the processing of agreement in Spanish (e.g., Demestre et al., 1999; Wicha et al., 2004; Barber & Carreiras, 2005; Martín-Loeches et al., 2006; O'Rourke & Van Petten, 2011) and other languages (e.g., Osterhout & Mobley, 1995; Hagoort, 2003; Nevins et al., 2007), number and gender violations across all three experiments should yield a P600 and possibly a LAN, relative to their grammatical counterpart.

Second, if gender is costlier to repair than number (Faussart et al., 1999; Barber & Carreiras, 2005), gender violations overall should yield a greater positivity than number violations in the late phase of the P600 (700-900 ms). However, if the two features are processed similarly at the brain level (Nevins et al., 2007) no differences in P600 amplitude should be observed between number and gender violations.

Third, if structural distance impacts the processing of agreement, as reflected in the amplitude of the P600 (Münte et al., 1997; Kolk et al., 2003, Kaan & Swaab, 2003; Barber & Carreiras, 2005; O'Rourke & Van Petten, 2011), we should observe amplitude differences between the P600 for violations realized within the phrase (Experiment 1, _edificio muy *segura_ "building-MASC-SG very safe-FEM-SG") and the P600 for violations realized across the phrase (Experiment 2, _cuento es *anónima_ "story-MASC-SG is anonymous-FEM-SG"). If the parser requires extra resources to establish agreement between structurally distant elements, an increase in P600 amplitude is expected. Alternatively, if structural distance reduces brain

sensitivity to the establishment of agreement, a decrease in P600 amplitude is predicted.

Differences in P600 amplitude between within-phrase and across-phrase violations are not

necessarily predicted to pattern together with accuracy rates in the Grammaticality Judgment

Task, given the high accuracy rates predicted across the board for native speakers. I reserve

predictions regarding the effects of structural distance on the LAN, due to the variability

regarding its elicitation for agreement violations and the paucity of evidence for distance

effects.

6.2. Morphosyntactic Processing in Adult L2 Learners

The second aim of this dissertation is to investigate whether L2 morphosyntactic

processing is impacted by the properties of the learners' L1 and by structural distance. As

discussed in Chapter 5, previous studies on L2 morphosyntactic processing have provided

evidence that the properties of the learners' L1 do impact L2 processing, although they differ

with respect to whether or not L2 processing is argued to be constrained by the L1 (e.g.,

Gillon-Dowens et al., 2010; but see Sabourin & Stowe, 2008 and Foucart & Frenck-Mestre,

2011). In addition, evidence has been provided that the L2 processing of agreement is

impacted by hierarchical structure (e.g., Foucart & Frenck-Mestre, 2012), although the

unique contribution of structural distance to the resolution of agreement in a late-acquired L2

remains unclear, since previous studies do not tease linear and structural distance apart. This

is an important confound, since the previous literature has demonstrated that linear distance

modulates processing in both L2 learners (e.g., Keating, 2010; Foote, 2011) and native

speakers (e.g., Hammer et al., 2008).

In the present study, the role of L1 transfer in L2 processing is addressed in two ways.

First, the study examines the processing of a feature that is present in the learners' L1

(number) and a feature that is absent (gender), in order to investigate whether novel features

can be processed in a native-like manner. Second, the study examines whether morphological differences in how the L1 and the L2 realize a shared feature (number) affect L2 processing. This question is addressed by comparing number agreement between demonstratives and nouns (Experiment 3, see Table 1, p. 79), which is a syntactic context where both English and Spanish realize number agreement, and between nouns and adjectives (Experiment 1), which is a syntactic context where only Spanish instantiates number agreement. This comparison will be limited to Experiments 1 and 3, since they are most similar in terms of structural distance (agreement is realized within the phrase in both experiments). The comparison will also be conducted for gender, in order to examine whether there is an advantage for gender agreement in a context where English instantiates another type of agreement (number). Finally, the role of structural distance on the establishment of syntactic dependencies in a late-acquired L2 is addressed by comparing the processing of agreement realized both within the phrase (Experiment 1) and across the phrase (Experiment 2). To my knowledge, this is the first study to systematically examine the unique contribution of structural distance to the online processing of agreement in both native speakers and adult L2 learners, while controlling for both linear distance and the syntactic category of the agreeing elements.

As discussed in Chapter 1, this dissertation also aims at testing current theoretical models of SLA which make different claims regarding the possibilities and limits of adult second language acquisition, such as the Full Transfer/Full Access Hypothesis (Schwartz & Sprouse, 1996), the Interpretability Hypothesis (Tsimpli & Dimitrakopoulou, 2007), and the Shallow Structure Hypothesis (Clahsen & Felser, 2006), which will be briefly reviewed in the next section.

6.2.1. Theoretical Models of Second Language Acquisition

Two of the hypotheses to be tested, the Full Transfer/Full Access Hypothesis (Schwartz & Sprouse, 1996) and the Interpretability Hypothesis (Tsimpli & Dimitrakopoulou, 2007) are parameter resetting hypotheses, that is, they make claims as to whether or not novel features (e.g., gender) can be acquired to native-like levels in post-puberty L2 acquisition. Under Full Transfer/Full Access (Schwartz & Sprouse, 1996), adult L2 acquisition is characterized by an initial stage where the entire L1 grammar is transferred to the L2. However, it is also assumed that learners are not constrained by the properties of their L1 and have full access to Universal Grammar (UG), the human genetic endowment for language acquisition. Thus, as learners become increasingly exposed to L2 input that cannot be parsed under the L1 grammar (i.e., a feature that is unique to the L2), they are forced to restructure their mental representation of the L2, which they do via UG. Full Transfer/Full Access being a full access hypothesis, ultimate attainment is predicted to be possible, although it is not guaranteed, as the L2 input may be scarce and obscure, which can make learners build a nonnative-like (although UG constrained) mental representation of the L2.

In contrast, the Interpretability Hypothesis (Tsimpli & Dimitrakopoulou, 2007) relies on the notion that there is a critical period for the acquisition of uninterpretable functional features. Therefore, uninterpretable functional features selected by the L1 are predicted to be fully acquirable in late L2 acquisition, as they were instantiated within the critical period. In contrast, uninterpretable functional features that are unique to the L2 are predicted to be permanently inaccessible in late L2 acquisition, regardless of proficiency. Under this model, it is assumed that L2 learners must use compensatory strategies to deal with novel features, even when their performance appears native-like, since their mental representation is assumed to be divergent and non UG-constrained.

Finally, the Shallow Structure Hypothesis (Clahsen & Felser, 2006; Clahsen et al., 2010) argues that adult L2 learners do not rely on abstract syntactic representations as much as native speakers in the course of online processing and, thus, they can only establish syntactic dependencies online when the agreeing elements are in a local relationship, such as within the same phrase. Under this model, adult L2 learners are assumed to have a permanent syntactic deficit which cannot be accounted for by the properties of their L1. Moreover, it is also assumed that shallow processing in the L2 cannot exclusively be accounted for by the unavailability of cognitive resources (i.e., working memory).

6.2.2. Research Questions

Specific research questions relative to the online processing of morphosyntactic dependencies in a late-acquired L2 are listed below:

Research question 3:

Can adult L2 learners at a high level of proficiency process novel features in a native-like manner, as proposed by the Full Transfer/Full Access Hypothesis (Schwartz & Sprouse, 1996), or do post-puberty L2 learners use nonnative-like strategies for the processing of novel uninterpretable functional features, as proposed by the Interpretability Hypothesis (Tsimpli & Dimitrakopoulou, 2007)?

Research Question 4:

Do morphological differences in how the L1 and the L2 realize a shared feature impact L2 morphosyntactic processing, as suggested by previous studies (e.g., Tokowicz & MacWhinney, 2005; Foucart & Frenck-Mestre, 2011; Morgan-Short et al., 2010)?

Research Question 5:

Is the establishment of syntactic dependencies in a late-acquired L2 limited to local domains, as suggested by the Shallow Structure Hypothesis (Clahsen & Felser, 2006; Clahsen

et al., 2010) or can adult L2 learners successfully resolve syntactic dependencies when the agreeing elements are located across phrases?

6.2.3. Predictions for Adult L2 Learners

6.2.3.1. Number

Both Full Transfer/Full Access and the Interpretability Hypothesis predict a native-like ERP pattern for number violations (a P600 and, possibly, a LAN), since number is instantiated by the learners' L1. Neither hypothesis predicts differences between noun-adjective number agreement (Experiment 1) and demonstrative-noun number agreement (Experiment 3). However, since previous studies have provided evidence that morphological differences in how the L1 and the L2 realize a shared feature impact processing (e.g., Foucart & Frenck-Mestre, 2011), the two syntactic contexts will be compared.

6.2.4. Gender

Under Full Transfer/Full Access, it is possible that the advanced L2 learners in the present study will elicit a native-like ERP pattern for gender violations in the three experiments (a P600 and, possibly, a LAN), since processing is assumed not to be constrained by the properties of the L1. In contrast, the Interpretability Hypothesis predicts that adult L2 learners will not exhibit native-like sensitivity to uninterpretable gender overall, regardless of their proficiency level.[33] According to the Interpretability Hypothesis (Tsimpli & Dimitrakopoulou, 2007), gender violations would be predicted to elicit a component which is sensitive to the strength of lexical associations, the N400 (L1 processing: Barber & Carreiras, 2003; 2005; L2 processing: Osterhout et al., 2006; 2008; Tanner et al., 2009;

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[33] Gender violations in Experiment 3 become noticeable on the noun, where the gender feature is assumed to be interpretable (Carstens, 2000). However, the violation is determined by the preceding determiner, where gender is assumed to be uninterpretable.

Morgan-Short et al., 2010). If L2 learners are using a simple matching strategy to establish gender agreement, then an N400 should be found when these associations fail (e.g., masculine *–o* cannot be associated with feminine *–a*) (e.g., Coch et al., 2008; McPherson et al., 1998).

6.2.5. Structural Distance: Within vs. Across-phrase Agreement

The Shallow Structure Hypothesis predicts that native-like processing of syntactic agreement is possible when agreement is local. Thus, within-phrase agreement violations (Experiment 1) may elicit a native-like ERP pattern (a P600 and, possibly, a LAN), although it is not guaranteed. For across-phrase violations (Experiment 2), a nonnative-like ERP pattern is predicted. Number and gender violations are not predicted to be treated differently under the Shallow Structure Hypothesis, which assumes that L1 transfer does not play a major role in L2 syntactic processing (e.g., Marinis et al., 2005; Clahsen & Felser, 2006; Clahsen et al., 2010).

CHAPTER 7:

MATERIALS AND METHODS

7.1. Participants

Twenty five native speakers of Spanish (13 females) and twenty six English-speaking

learners of Spanish (13 females) provided their informed consent to participate in the study.

Data from one native speaker and one L2 learner were excluded before analysis due to

excessive artifacts in the recording. The two groups had similar age ranges (native speakers:

18 to 38; L2 learners: 21-41). All participants were right-handed, as assessed by the

Edinburgh Handedness Inventory (Oldfield, 1971), had normal or corrected to normal vision,

and reported no history of neurological or linguistic disabilities. Participants received $5 per

half hour of participation.

7.1.1   Spanish Native Speakers

This group included 12 native speakers of Castilian Spanish, 11 native speakers of

Bolivian Spanish, and one native speaker of Paraguayan Spanish. Importantly, all three

varieties of Spanish realize number and gender agreement similarly. Furthermore, only nouns

which have the same gender value in the three varieties were used in the present study.[34] All

participants reported having been raised in a Spanish-speaking country until at least age 17

and having being schooled in Spanish.

All of the participants in this group were adult second language speakers of English, and

ten of them reported having studied other languages (Italian, French, Portuguese, or German)

to different degrees of proficiency. In addition, 11 out of the 24 participants reported being

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[34] Since the experimental materials were designed by a native speaker of Castilian Spanish, non-Castilian speakers were provided in advance with a short vocabulary list containing words that may not be as common in the other two varieties. The list, developed by native speakers of Bolivian and Paraguayan Spanish, included a total of 39 words.

bilingual speakers of Spanish and another language (Galician, Catalan, or Basque). All of the

bilingual participants reported having acquired both of their languages at birth and feeling

equally fluent in both of them.[35]

7.1.2   Advanced English-Speaking Learners of Spanish

All of the adult L2 learners were native speakers of English with no significant exposure

to Spanish or other languages before puberty (age of acquisition range: 11-22). Their

proficiency level was advanced, as assessed by a combination of the MLA Cooperative

Language Test (Spanish Embassy, Washington, DC, USA) and the Diploma de Español

como Lengua Extranjera (Educational Testing Service, Princeton, NJ, USA), a 50-item test

which has been used in previous studies on the acquisition of number and gender agreement

by English-speaking learners (mean score: 44; range: 40-50) (White et al., 2004; Montrul et

al., 2008; McCarthy, 2008; Foote, 2011).[36] The majority of the L2 learners were graduate

students in a Spanish department, upper level undergraduate students majoring in Spanish, or

high school Spanish teachers. On average, the L2 learners reported having studied Spanish at

the university level for approximately four years, and having lived in a Spanish-speaking

country for approximately 1.22 years. In addition, they reported using Spanish on a daily

basis.

7.2. Stimuli

7.2.1. Experiment 1: Within-Phrase Agreement

Experiment 1 examines the processing of within-phrase agreement. It includes 120

triplets of 11-word sentences. Each triplet encompasses a grammatical sentence, a sentence

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[35] Three of the bilingual participants reported having Spanish monolingual parents and the remaining eight
reported having bilingual parents, Spanish being one of their languages. All bilingual participants attended
elementary school and high school in their two languages. In addition, three of them reported having attended
college exclusively in Spanish and eight reported having attended college in both languages.
[36] A sample of the proficiency test is provided in Appendix 1 (p. 164).

with a number agreement violation, and a sentence with a gender agreement violation. An

example is provided in (83). The agreeing elements are underlined.

(83) **Grammatical**
a. El   banco   es   un <u>edificio</u>   muy   <u>seguro</u>
    the   bank   is   DP[a building-MASC-SG very   safe-MASC-SG]

    y   el   juzgado   también.
    and   the courthouse also.
    "The bank is a very safe building and so is the courthouse."

Number Violation
b. El   banco   es   un <u>edificio</u>   muy   *<u>seguros</u>
    the   bank   is   DP[a building-MASC-SG very   safe-MASC-PL]

    y   el   juzgado   también.
    and   the courthouse also.

Gender Violation
c. El   banco   es   un <u>edificio</u>   muy   *<u>segura</u>
    the   bank   is   DP[a building-MASC-SG very   safe-FEM-SG]

    y   el   juzgado   también.
    and   the courthouse also.

As shown in (83a-c), the agreeing elements in Experiment 1 are located within the same

phrase, a determiner phrase (DP). Therefore, the parser does not cross a phrase boundary to

establish agreement. Agreement is realized between a noun and an adjective, a syntactic

context where English, the L2 learners' L1, does not realize agreement. Violations become

noticeable on the adjective, where number and gender are assumed to be uninterpretable

(Carstens, 2000). Linear distance between the agreeing elements is one word, the adverb *muy*

"very". A complete list of the sentences in Experiment 1 is provided in Appendix 2 (p. 170).

7.2.2. Experiment 2: Across-Phrase Agreement

Experiment 2 examines agreement realized across the phrase. It consists of 120 triplets of

8-word sentences. Each triplet encompasses a grammatical sentence, a number violation, and

a gender violation (see (84) below).

(84)   **Grammatical**
   a. El <u>cuento</u>   es <u>anónimo</u>   y   el manuscrito también.
       the story_{-MASC-SG} _{VP}[is anonymous_{-MASC-SG}] and the manuscript also

       "The story is anonymous and so is the manuscript."

       Number Violation
   b. El <u>cuento</u>   es *<u>anónimos</u>   y   el manuscrito también.
       the story_{-MASC-SG} _{VP}[is   anonymous_{-MASC-PL}] and the manuscript also

       Gender Violation
   c. El <u>cuento</u>   es *<u>anónima</u>   y   el manuscrito también.
       the story_{-MASC-SG} _{VP}[is   anonymous_{-FEM-SG}] and the manuscript also

As shown in (84), the agreeing elements in Experiment 2 are located across a verb phrase
(VP). Therefore, the parser must cross a phrase boundary to establish agreement. Similar to
Experiment 1, violations become noticeable on adjectives, a syntactic context where English
does not require any type of agreement, and linear distance is one word, the copula "be"
inflected for third person singular present tense, *es*. A complete list of the sentences in
Experiment 2 is provided in Appendix 3 (p. 173).

7.2.3. Experiment 3: Demonstrative-Noun Agreement

Experiment 3 examines agreement between demonstratives and nouns, which is a
syntactic context where English instantiates number agreement (*this apartment* vs. *these
apartments*). Experiment 3 consists of 120 triplets of 7-word sentences. Each triplet includes
a grammatical sentence, a number violation, and a gender violation (see (85) below).

(85)   **Grammatical**
   a. Mateo limpió <u>este</u>   <u>apartamento</u>   el sábado pasado
       Mateo cleaned this_{-MASC-SG} apartment_{-MASC-SG} the saturday last

       "Mateo cleaned this apartment last Saturday"

       Number Violation
   b. Mateo limpió <u>estos</u>   *<u>apartamento</u>   el sábado pasado
       Mateo cleaned this_{-MASC-PL} apartment_{-MASC-SG} the saturday last

Gender Violation

c. Mateo limpió <u>esta</u>   *<u>apartamento</u>   el sábado pasado
   Mateo cleaned this$_{FEM-SG}$ apartment$_{MASC-SG}$ the saturday last

As can be seen in (85), violations become noticeable on nouns, but they are determined

by the disagreeing demonstrative, where number and gender are assumed to be

uninterpretable (Carstens, 2000). A complete list of the sentences in Experiment 3 is provided

in Appendix 4 (p. 176).

7.3. Item Controls

The LEXESP database was used to compute the mean log frequency of the nouns and

adjectives where agreement was manipulated (via BuscaPalabras, Davis & Perea, 2005). The

nouns in the three experiments were controlled for frequency and length (frequency: $F(2,$

$357) = .52$, $p = .59$; length: $F(2, 357) = .16$, $p = .84$) and the adjectives in Experiment 1 were

matched in frequency and length with the adjectives in Experiment 2 (frequency: $t(238) =$

$-.678$, $p = .45$; length: $t(238) = -.414$, $p = .68$). Table 2 includes the mean log frequency and

mean length of the nouns in all three experiments, and the mean log frequency and mean

length of the adjectives in Experiments 1 and 2.

Table 2. Mean log frequency and length of the nouns in Experiments 1-3 and the adjectives in Experiments 1-2.

	Mean Log Frequency		*Mean Length*	
	Nouns	Adjectives	Nouns	Adjectives
Experiment 1	1.37	1.26	7.1	7.4
Experiment 2	1.30	1.32	6.9	7.5
Experiment 3	1.21	---	7.2	---

Importantly, in Experiment 1 (within-phrase agreement) and Experiment 2 (across-phrase

agreement), which examine the extent to which structural distance impacts the processing of

agreement, the linear distance between the agreeing elements was controlled for, and so was

the syntactic category of the agreeing elements.

All of the nouns in the study were singular and they all referred to inanimate entities, which prevented learners from using biological gender cues to perform agreement, in line with previous studies (e.g., Gillon-Dowens et al., 2010, 2011; Foucart & Frenck-Mestre, 2011, 2012). All of the nouns and adjectives in the study formed the plural with a final -*s*, as in *caja/cajas*, "box/boxes". Similar to previous investigations (e.g., Gillon-Dowens et al., 2010, 2011), all nouns and adjectives exhibited canonical gender marking (masculine *–o* and feminine *–a*). This was also true of the demonstratives in Experiment 3, the masculine singular demonstrative (*este* "this-MASC") being the sole exception in the study. The use of canonical number and gender marking ensured that participants received overt and clear cues to perform both number and gender agreement, a factor which has been argued to impact both the processing of agreement in native speakers (Molinaro et al. 2011a; Molinaro et al. 2011b) and the ease of acquisition in adult L2 learners (Schwartz & Sprouse, 1996). The study included an equal number of masculine and feminine nouns. Lexical gender was held constant within a given sentence and there were no intervening nouns between the agreeing elements in any of the three experiments.[37] In order to make sure that learners were familiar with all lexical items, all critical nouns and adjectives were used twice, and so were the lexical verbs in Experiment 3. Since the testing was carried out in two separate sessions (see "Procedure", p. 94), stimulus lists were designed such that, in a given session, participants would only see one version of each critical word (the adjective in Experiments 1 and 2; the noun in Experiment 3).

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[37] Experiment 1 included a gendered noun which appeared before the noun phrase in which agreement was manipulated. Importantly, that noun does not trigger agreement on the critical adjective (in fact, they could be of different genders) and it does not intervene between the agreeing elements. Therefore, it is unlikely that it could potentially cause interference, especially if we take into account (1) that it was consistently matched with the critical noun in number and gender and (2) that it was always singular, since previous studies have shown that attraction errors involving singulars occur very rarely (e.g., only 3% of the time in the study by Eberhard, 2005; see also Eberhard, 1997).

7.4. Fillers

One hundred and twenty grammatical sentences were added to the study as fillers. One of the main purposes of the grammatical fillers was to balance the number of grammatical and ungrammatical sentences in the study (ratio: 1/1). This is especially important, since previous studies have shown that an excessive number of ungrammatical sentences can attenuate components associated with controlled processes, such as the P600 (e.g., Coulson et al., 1998; Hahne & Friederici, 1999), the ERP component that is most consistently reported for agreement violations in native processing. In addition, too many ungrammatical sentences could create a *no* response bias in the behavioral task (Grammaticality Judgment Task).

Fillers were matched in length with the sentences in the three experiments. This resulted in forty 11-word fillers, forty 8-word fillers, and forty 7-word fillers. A sample of the three types of fillers is provided in (86) below:

(86)   **11-Word Filler**
       a. Lidia habló con una señora muy educada durante toda la mañana.
           lidia talked with a lady very polite during all the morning

          "Lydia talked to a very polite lady for the whole morning."

       8-Word Filler
       b. Celia llamó a esta secretaria y Luisa también.
           celia called *a* this secretary and luisa also

          "Celia called this secretary and so did Luisa."

       7-Word Filler
       c. Violeta entrevistó a una escritora muy distinguida.
           violeta interviewed *a* a writer very distinguished

          "Violeta interviewed a very distinguished writer."

Similar to Experiments 1, 2, and 3, fillers included an equal number of masculine and feminine nouns, and all nouns and adjectives exhibited canonical number and gender

marking, at least in the form which was presented.[38] Unlike the experimental stimuli, only nouns that provide biological gender cues (e.g., *niña* "girl") were used in the fillers, which allowed for the use of semantic information to judge the grammaticality of the sentences. Moreover, they all involved lexical verbs inflected for third person singular past tense. A complete list of the fillers is provided in Appendix 5 (pp. 179).

7.5. Procedure

The testing was conducted in two sessions (e.g., O'Rourke & Van Petten, 2011), in order to avoid data loss due to an excessive number of artifacts (see Tokowicz & MacWhinney, 2005). The sessions, which were carried out at the University of Kansas Neurolinguistics and Language Processing Lab, were separated by a minimum of two days and a maximum of two weeks. Before the first session, all of the L2 learners were provided in advance with a vocabulary list containing words which were deemed to be difficult for nonnative speakers. The purpose of the list was to minimize lexical effects on the processing of syntactic agreement. Two graduate teaching assistants from the Spanish & Portuguese Department at the University of Kansas aided in the design of the list.

During the first session, participants provided their informed consent to participate in the study, filled out a background questionnaire and the Edinburgh Handedness Inventory (Oldfield, 1971), and completed the first EEG recording. Immediately after the first EEG recording, the L2 learners were administered the Spanish proficiency test (White et al., 2004; Montrul et al., 2008; McCarthy, 2008; Foote, 2011). During the second visit to the lab, participants completed the second EEG recording and a Gender Assignment Task (p. 96). In addition, the L2 learners took a Vocabulary Task (p. 97).

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[38] Some of the items in the fillers only exhibited canonical gender marking in one of the genders (i.e., *profesor/profesora* "teacher", *trabajador/trabajadora*, "hard-working"). In those cases, only the forms that exhibited canonical gender marking (e.g., *profesora*) were used.

7.5.1. EEG Recording and Grammaticality Judgment Task

Participants were comfortably seated in a dimly lit room facing a computer monitor. They were instructed to silently read a series of Spanish sentences and judge whether they were good or bad sentences of Spanish (L1 processing: Osterhout & Mobley, 1995; Hagoort & Brown, 1999; Kaan, 2002; Hagoort, 2003; Kaan & Swaab, 2003; Barber & Carreiras, 2005; Martín-Loeches et al., 2006; Nevins et al., 2007; Molinaro et al., 2008a; L2 processing: Tokowicz & MacWhinney, 2005; Sabourin & Stowe, 2008; Gillon-Dowens et al., 2010, 2011; Morgan-Short et al., 2010). The motivation for choosing a Grammaticality Judgment Task is that it allows us to compare the learners' accuracy on the judgment task with their brain responses to the agreement errors. As discussed in the introduction, the proponents of the Interpretability Hypothesis argue that adult learners whose L1 is [–gender] cannot form a native-like mental representation of syntactic gender agreement in the L2 and, therefore, must rely on compensatory strategies to "establish" gender agreement. However, through careful monitoring of the input, learners are predicted to be able to achieve rather high accuracy rates with gender agreement. The proposal in the present study is that, if the proponents of the Interpretability Hypothesis are on the right track, the advanced learners in the present study may be highly accurate detecting the gender errors, but might treat them as a phonological or orthographic mismatch, in which case an N400 is predicted. In order to test this proposal, a behavioral measure of accuracy, such as a Grammaticality Judgment, becomes necessary.

Each session began with nine practice trials, none of which included agreement errors. In order to avoid repetition effects, none of the nouns and adjectives in the practice sentences appeared in the experimental stimuli. Feedback was provided for the first three practice trials. Participants were asked to favor accuracy over speed. The experiment began right after the practice session. Each experimental session included six blocks of 40 sentences separated by five short breaks. Sentences were visually presented one word at a time using the RSVP

(Rapid Serial Visual Presentation) method and in random order. Within each block, sentences from the three experiments were intermixed. Words appeared in black text (Courier New font) on a grey background. All Spanish words exhibited the appropriate diacritics and the last word of each sentence was followed by a period. The presentation of the stimuli was carried out using *Paradigm* by Perception Research Systems, Inc. (Tagliaferri, 2005).

The trial structure was as follows: a fixation cross remained in the middle of the screen for 500 ms. Immediately after, the first word of the sentence was presented. Each word was shown for 450 ms, followed by a 300 ms pause. At the end of each sentence, there was a 1000 ms pause followed by the prompts for the Grammaticality Judgment Task, the word *Bien* "good" for correct sentences (on the left of the screen) and the word *Mal* "bad" for ungrammatical sentences (on the right). Responses to correct and incorrect sentences were made with the middle and index fingers of the left hand, respectively. The prompts remained on the screen until the participant pressed one of two buttons on the response pad. Following the behavioral response, there was an interval between trials ranging from 500-1000 ms, pseudorandomly varied at 50 ms increments. Right after this interval, the next trial began.

7.5.2. Gender Assignment Task

The purpose of the Gender Assignment Task was to make sure that participants knew the gender of the nouns they had been tested on. All 180 nouns where agreement was manipulated (60 per experiment) were tested. Participants were seated in front of a computer monitor and asked to silently read a series of nouns and choose the correct definite article: *La* (feminine singular) or *El* (masculine singular). Each noun was presented for 450 ms, as in the Grammaticality Judgment Task. The task began with five trials trials. Participants did not receive any feedback during the practice to avoid providing too much explicit information about the nature of the task. In addition, none of the nouns in the practice appeared in any of

the three experiments. Immediately after the practice, the task began. Presentation of the nouns was randomized. Both the native speakers and the L2 learners performed above 99% in the Gender Assignment Task, suggesting they had no problems with gender assignment.

7.5.3. Vocabulary Task

After the Gender Assignment Task, the learners completed a Vocabulary Task in order to make sure that they knew the vocabulary from the stimuli. Participants were presented with 110 Spanish words and asked to circle the correct English translation (from among two options). The task included 20 nouns and 20 adjectives from Experiment 1, 20 nouns and 20 adjectives from Experiment 2, and 20 nouns and 10 verbs from Experiment 3. The learners' accuracy rate in the task was above 99%, indicating that they were familiar with the vocabulary of the stimuli. A copy of the Vocabulary Task is provided in Appendix 6 (p. 182).

7.6. EEG Recording and Analysis

The EEG was continuously recorded from 32 sintered Ag/AgCl scalp electrodes mounted on an elastic cap (Electro-Cap International, Inc.) and placed in a modified 10-20 layout (midline: FPZ, FZ, FCZ, CZ, CPZ, PZ, OZ; lateral: FP1/2, F7/8, F3/4, FT7/8, FC3/4, T3/4, C3/4, TP7/6, CP3/4, T5/6, P3/4, O1/2). All electrodes were referenced online to the linked mastoids. Electrode AFZ served as ground. The horizontal and vertical electro-oculograms were measured with an additional six electrodes placed on the left and right outer canthi, and above and below each eye. Impedance was maintained below 5 kΩ. The recordings were amplified by a Neuroscan Synamps2 amplifier (Compumedics Neuroscan, Inc.) with a bandpass filter of 0.1 to 200 Hz, and digitized continuously with a sampling rate of 1 kHz.

The EEG data were analyzed using the Neuroscan Edit software (Compumedics Neuroscan, Inc.). Two types of analyses were conducted. In the first one, all experimental

trials were included, regardless of accuracy in the Grammaticality Judgment Task. In the second one, only trials associated to correct responses were considered.[39] Trials with artifacts (blinks, horizontal eye movements, excessive muscle activity or alpha waves) were eliminated prior to analysis. After artifact rejection, approximately the same number of trials was kept per condition (range in native speakers: 36 to 37 out of 40 across conditions; range in L2 learners: 37 to 38 out of 40 across conditions).[40] Following manual artifact rejection, the continuous EEG was segmented into epochs in the interval between –300 and +1200 ms relative to the critical word. Epochs were then averaged per condition and baseline-corrected relative to the 300 ms pre-stimulus interval. Finally, a 30 Hz low-pass digital filter was applied to the averaged waveform before analysis.

Grand-averaged waveforms were generated for all conditions in order to determine the time windows of interest for calculating ERPs. Upon visual inspection of the grand-averaged waveforms, ERPs were quantified via mean amplitudes within two time windows: the 250-400 ms time window, which includes the LAN (Friederici, 2002) and the N400 (Kutas et al., 2006) and the 400-900 ms time window, which includes the P600 (Osterhout & Holcomb, 1992; Hagoort et al., 1993; Friederici, 2002). Additional ERPs were computed via the mean amplitudes for the 400-650 ms and 650-900 ms time windows, corresponding to the early and late portions of the P600 (Hagoort & Brown, 2000; Barber & Carreiras, 2005). Six regions of interest were computed for statistical analysis: Left Anterior (FP1, F7, F3, FT7, and FC3), Right Anterior (FP2, F8, F4, FT8, and FC4), Left Posterior (TP7, CP3, T5, P3, and O1), Right Posterior (TP6, CP4, T6, P4, and O2), Mid Anterior (FPZ, FZ, and FCZ), and Mid Posterior (CPZ, PZ, and OZ). Figure 1 below shows the distribution of electrodes across anteriority (anterior, posterior) and laterality (left, mid, right).

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[39] Due to the small number of errors across conditions in both populations, the results did not differ qualitatively between the two types of analyses (e.g., Kaan, 2002). Thus, only analyses including all trials will be reported.
[40] In addition, no significant differences emerged between the two groups in terms of number of trials kept ($F(1, 47) = 1.21$, $p > .05$).

Figure 1. Map of the cap electrodes, organized according to regions of interest.
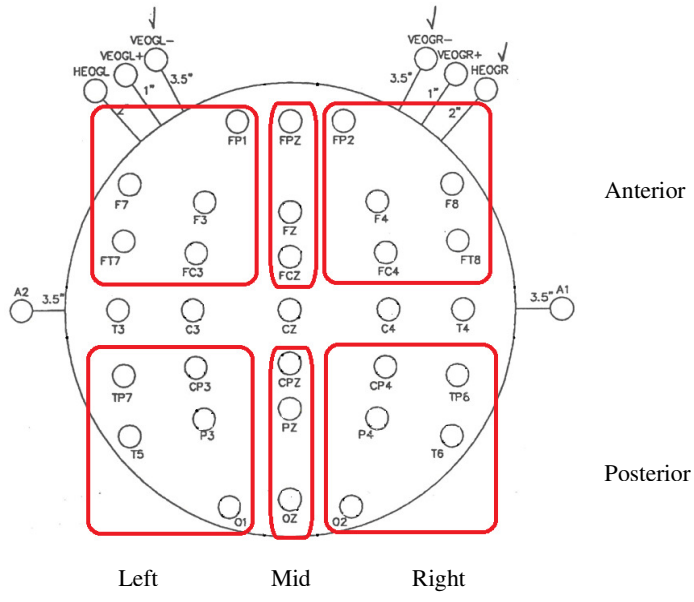
For Experiments 1 and 2, which investigate the impact of structural distance on the processing of agreement, a series of four-way repeated-measures ANOVAs were conducted with agreement (grammatical, number violation, gender violation), distance (within-phrase, across-phrase), laterality (left, mid, right) and anteriority (anterior, posterior) as the within-subjects factors (3 x 2 x 3 x 2). For Experiment 3, which examines the processing of agreement in a syntactic context where both the L1 and L2 require number agreement, additional three-way repeated-measures ANOVAs were carried out with agreement (grammatical, number violation, gender violation), laterality (left, mid, right) and anteriority (anterior, posterior) as the repeated factors. Additional analyses were carried out to examine potential topographical differences between the early and late phases of the P600 time window (e.g., Hagoort & Brown, 2000; Barber & Carreiras, 2005). Analyses were carried out separately for Spanish native speakers and L2 learners, in order to investigate whether similar patterns emerged within each group (e.g., White, 1990). The Geisser and Greenhouse correction was applied for violations of the sphericity assumption. Follow-up tests were evaluated at the .01 alpha level in order to control for Type I error.

CHAPTER 8:

RESULTS

8.1. Experiments 1 and 2: Within-Phrase vs. Across-Phrase Agreement

8.1.1. Spanish Native Speakers: Behavioral Results

Accuracy rates in the Grammaticality Judgment Task were above 97% for every

condition (see Table 3 below for mean accuracy rates), suggesting that the native speakers

understood the task correctly and could successfully detect number and gender violations. A

3 x 2 repeated measures ANOVA with agreement (grammatical, number violation, gender

violation) and distance (within-phrase, across-phrase) as within-subjects factors revealed no

significant main effect of agreement ($F[1.59, 36.75] = .82, p > .05$) or distance ($F[1, 23] =$

$.03, p > .05$) on accuracy, and no significant interaction ($F[2, 46] = .19, p > .05$).

8.1.2. Advanced L2 Learners: Behavioral Results

The advanced L2 learners performed at 93.9% or above in every condition of the

Grammaticality Judgment Task (see Table 3 below for mean accuracy rates), suggesting that

they also understood the task correctly and could detect number and gender violations at the

behavioral level. Similar to the native speakers, a 3 x 2 repeated measures ANOVA with

agreement (grammatical, number violation, gender violation) and distance (within-phrase,

across-phrase) as repeated factors revealed no significant main effect of agreement ($F[2, 48]$

$= 1.77, p > .05$) or distance ($F[1, 24] = 1.12, p > .05$) on accuracy, and no significant

interaction ($F[2, 48] = .55, p > .05$).

Table 3: Native speakers' and advanced L2 learners' mean accuracy rates in the Grammaticality Judgment Task. Results are provided for Experiment 1 (within-phrase agreement) and Experiment 2 (across-phrase agreement).

	Exp. 1 Grammatical	Exp. 1 *Number	Exp. 1 *Gender	Exp. 2 Grammatical	Exp. 2 *Number	Exp. 2 *Gender
Native Speakers	97.3	97.4	98.1	97.6	97.5	97.9
Advanced L2 Learners	96.9	97.1	95.4	96.5	96.9	93.9

8.1.3. ERP Results

Upon visual inspection (see Figures 2-5, pp. 102-105), the grand-averaged waveforms for the grammatical, number violation and gender violation conditions reveal clear differences between the grammatical sentences and their ungrammatical counterparts, both in native speakers and in the advanced L2 learners. As shown in Figures 2-5, number and gender violations across both levels of structural distance were more positive than grammatical sentences. This positivity emerged at approximately 400 ms, peaked at roughly 600 ms, and was evident until approximately 900 ms. In the native speaker group, the positivity appears equally robust for number and gender violations. In the L2 learner group, however, the positivity appears larger for number than gender violations. The timing and topography (mainly posterior, but with some early involvement of the anterior electrodes) of this positive-going wave are consistent with the P600.

In addition, as shown in Figures 6 and 7 (pp. 104-105), within-phrase agreement (Experiment 1, _edificio muy seguro_ "building-MASC-SG very safe-MASC-SG") elicited more positive waveforms than across-phrase agreement (Experiment 2, _cuento es anónimo_ "story-MASC-SG is anonymous-MASC-SG") in both groups of participants, both for grammatical and ungrammatical sentences.

The following statistical analyses were conducted separately for native speakers and L2 learners in the 250-400 ms (LAN) and 400-900 ms (P600) time windows. Additional analyses were performed in the 400-650 ms and 650-900 ms time windows (early and late portions of

the P600). Results of the omnibus ANOVAs are provided in Tables 4 and 5 below (pp. 106-107). Only significant results and marginal results that are critical to the theoretical discussion are reported. I will consider results where p is between .05 and .1 as marginal and results where p is less than .05 as significant. Significant effects involving topographical factors (laterality, anteriority) are only reported if they interact with the linguistic factors of interest (agreement, distance). All other effects are reported. However, in the presence of a significant higher-level interaction, lower-level interactions and main effects are not interpreted. Post-hoc tests for the interpreted effects are reported in the main text.

Figure 2: Native speakers' grand average ERPs of the within-phrase agreement conditions (Experiment 1): grammatical, number violation, and gender violation, plotted at the representative electrode of each region of interest.
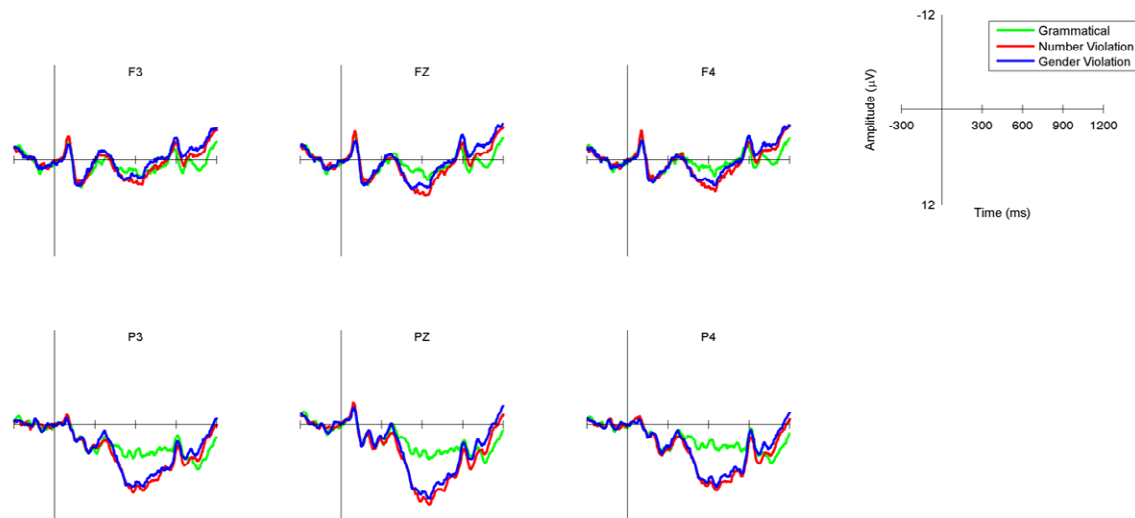
Figure 3: Native speakers' grand average ERPs of the across-phrase agreement conditions (Experiment 2): grammatical, number violation, and gender violation, plotted at the representative electrode of each region of interes
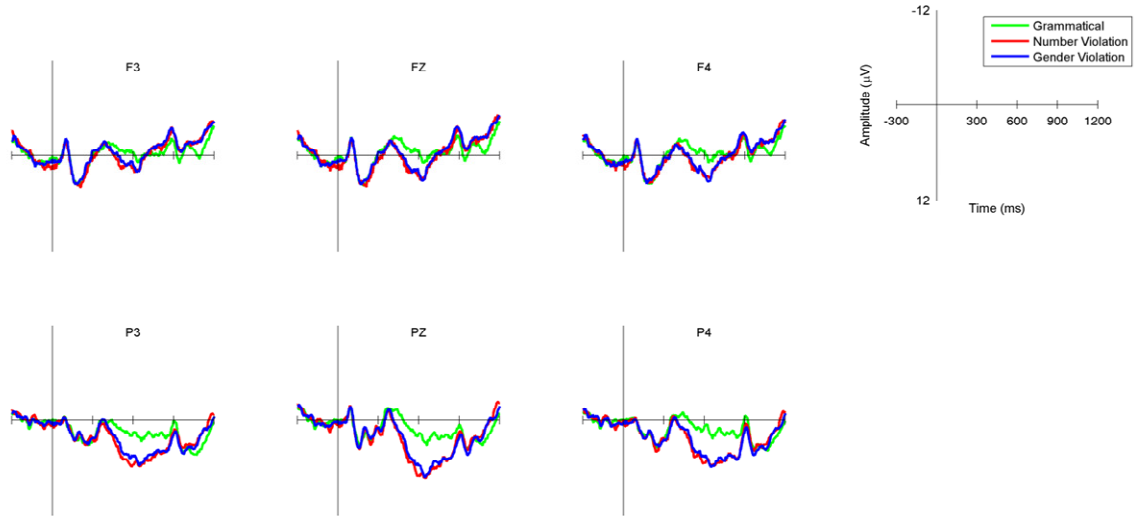
Figure 4: Advanced Learners' grand average ERPs of the within-phrase agreement conditions (Experiment 1): grammatical, number violation, and gender violation, plotted at the representative electrode of each region of interest.
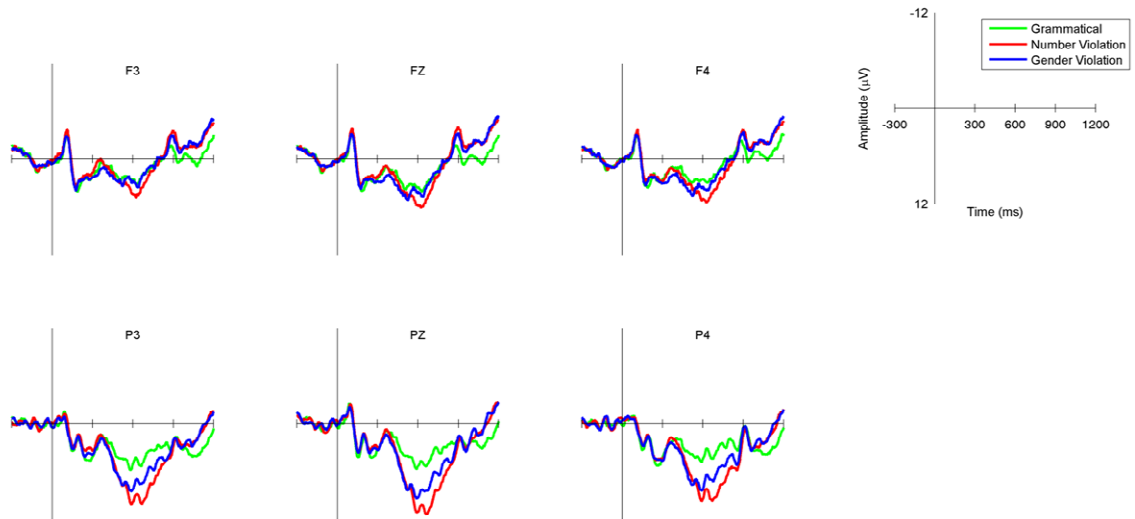
Figure 5: Advanced Learners' grand average ERPs of the across-phrase agreement conditions (Experiment 2): grammatical, number violation, and gender violation, plotted at the representative electrode of each region of interest.
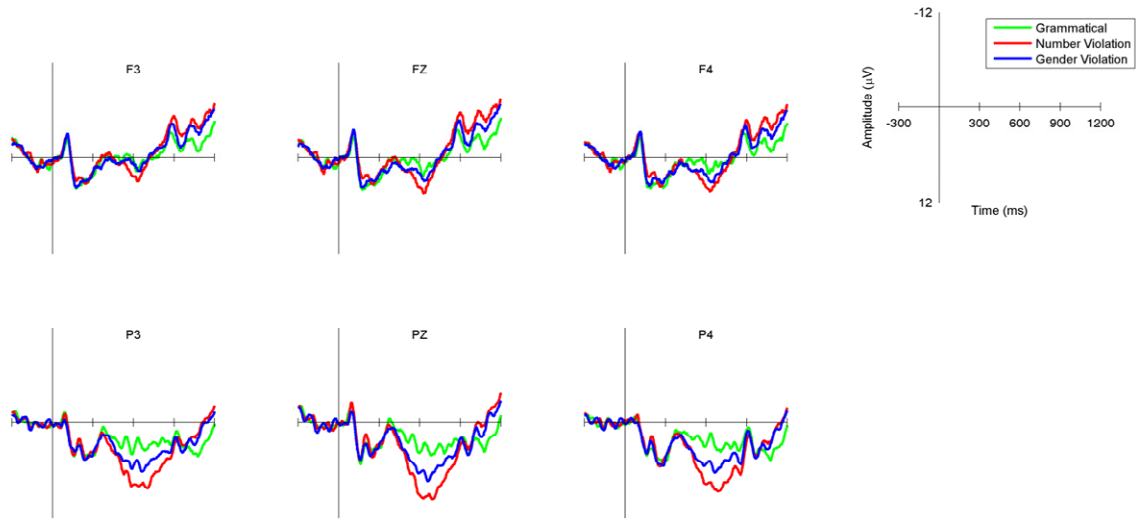
Figure 6. Average ERPs of the within-phrase (Experiment 1) and across-phrase (Experiment 2) conditions in the native speaker group. Each distance condition was computed by averaging across the three levels of agreement (grammatical, number violations, gender violation).
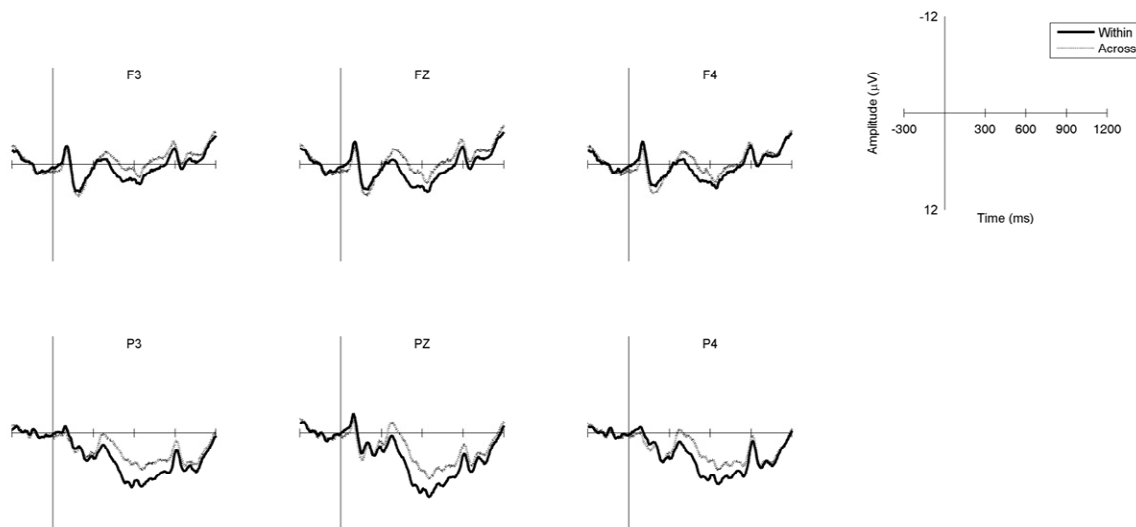
Figure 7. Average ERPs of the within-phrase (Experiment 1) and across-phrase (Experiment 2) conditions in the L2 learner group. Each distance condition was computed by averaging across the three levels of agreement (grammatical, number violations, gender violation).
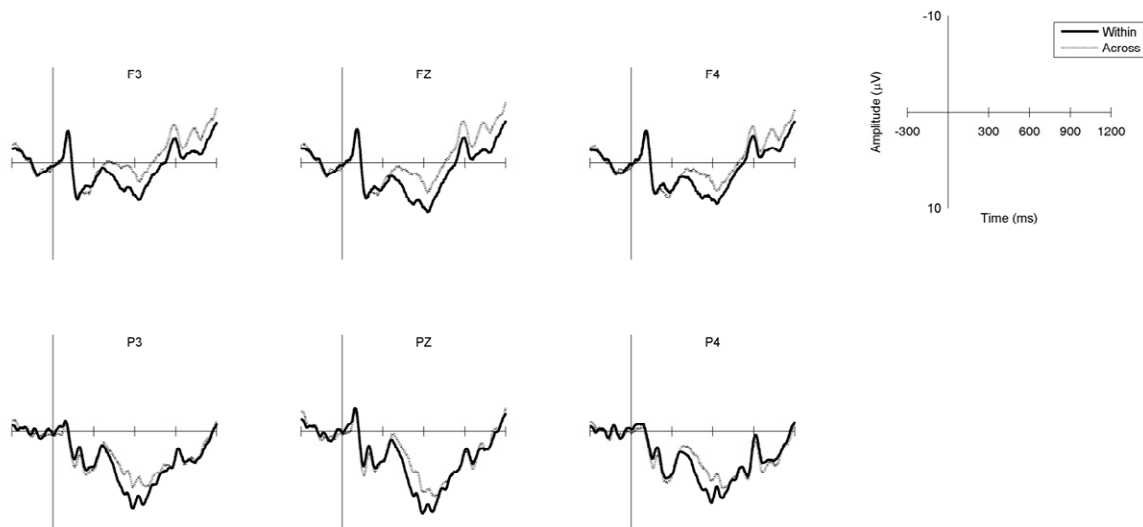
8.1.4. 250-400 ms Time Window: Spanish Native Speakers

As shown in Table 4 (p. 116), the omnibus ANOVA revealed a significant agreement x laterality interaction and a significant distance x laterality interaction, as well as a marginal distance x anteriority interaction. Follow-up analyses for the agreement x laterality interaction revealed no effects. Follow-up analysis for the distance x laterality interaction also revealed no effects. Finally, follow-up analyses for the marginal distance x anteriority interaction revealed a marginal effect of distance in the posterior area ($F[1, 23] = 4.36$, $p <$ .1), driven by the fact that within-phrase agreement yielded more positive waveforms than across-phrase agreement overall.

Table 4: Native speakers' results of the four-way ANOVA conducted on Experiment 1 (within-phrase agreement) and Experiment 2 (across-phrase agreement). Results are provided for all time windows of interest.

	250-400ms	400-900ms	400-650ms	650-900ms
distance x agreement x laterality x anteriority				
agreement x laterality x anteriority	---	$F[2.75, 63.35] = 5.24$, $p = .001$	---	$F[2.42, 55.81] = 7.47$, $p = .001$
distance x laterality x anteriority	---	---	$F[2, 46] = 3.15$, $p < .1$	---
distance x agreement x anteriority	---	---	$F[2, 46] = 3.59$, $p < .05$	---
agreement x anteriority	---	$F[2, 46] = 37.56$, $p < .001$	$F[2, 46] = 8.71$, $p = .001$	$F[2, 46] = 52.34$, $p < .001$
distance x anteriority	$F[1, 23] = 3.47$, $p = .08$	$F[1, 23] = 6.61$, $p < .05$	$F[1, 23] = 9.13$, $p < .01$	$F[1, 23] = 4.35$, $p < .05$
distance x agreement x laterality	---	---	---	---
agreement x laterality	$F[4, 92] = 6.19$, $p < .001$	$F[4, 92] = 23.74$, $p < .001$	$F[4, 92] = 18.38$, $p < .001$	$F[4, 92] = 24.04$, $p < .001$
distance x laterality	$F[2, 46] = 5.14$, $p = .01$	$F[2, 46] = 15.81$, $p < .001$	$F[1.58, 36.51] = 20.97$, $p < .001$	$F[2, 46] = 10.51$, $p < .001$
distance x agreement	---	---	---	---
agreement	---	$F[2, 46] = 29.86$, $p < .001$	$F[1.43, 32.91] = 22.41$, $p < .001$	$F[2, 46] = 17.51$, $p < .001$
distance	---	$F[1, 23] = 10.77$, $p < .01$	$F[1, 23] = 17.35$, $p < .001$	$F[1, 23] = 5.21$, $p < .05$

Table 5: Advanced L2 learners' results of the four-way ANOVA conducted on Experiment 1 (within-phrase agreement) and Experiment 2 (across-phrase agreement). Results are provided for all time windows of interest.

	250-400ms	400-900ms	400-650ms	650-900ms
distance x agreement x laterality x anteriority	---	---	---	---
agreement x laterality x anteriority	$F[4, 96] = 5.42$, $p = .001$	$F[2.87, 68.87] = 6.77$, $p = .001$	$F[2.94, 70.58] = 4.46$, $p < .01$	$F[3.01, 72.33] = 7.98$, $p < .001$
distance x laterality x anteriority	---	$F[2, 48] = 4.23$, $p < .05$	$F[2, 48] = 3.76$, $p < .05$	$F[2, 48] = 4.21$, $p < .05$
distance x agreement x anteriority	---	---	---	---
agreement x anteriority	---	$F[2, 48] = 22.81$, $p < .001$	$F[2, 48] = 8.86$, $p = .001$	$F[2, 48] = 27.84$, $p < .001$
distance x anteriority	---	---	---	$F[1, 24] = 6.26$, $p < .05$
distance x agreement x laterality	$F[4, 96] = 2.81$, $p < .05$		---	---
agreement x laterality	$F[4, 96] = 3.24$, $p < .05$	$F[2.99, 71.96] = 10.78$, $p < .001$	$F[3.05, 73.21] = 9.76$, $p < .001$	$F[4, 96] = 8.79$, $p < .001$
distance x laterality	---	$F[2, 48] = 8.56$, $p = .001$	$F[2, 48] = 8.43$, $p = .001$	$F[2, 48] = 11.72$, $p < .001$
distance x agreement	---	---	---	---
agreement	$F[2, 48] = 3.07$, $p < .1$	$F[2, 48] = 27.25$, $p < .001$	$F[1.38, 33.23] = 16.66$, $p < .001$	$F[2, 48] = 17.58$, $p < .001$
distance	---	$F[1, 24] = 16.72$, $p < .001$	$F[1, 24] = 27.41$, $p < .001$	$F[1, 24] = 6.38$, $p < .05$

8.1.5. 250-400 ms Time Window: Advanced L2 Learners

As shown in Table 5 (p. 107), the omnibus ANOVA revealed a significant agreement x laterality x anteriority interaction. Follow-up analyses were conducted separately within each level of anteriority (anterior, posterior) in order to better understand the nature of the interaction. Within the anterior electrodes, analyses revealed an agreement x laterality interaction (F[2.81, 67.57] = 5.99, p = .001). Post-hoc tests revealed a main effect of agreement in Left Anterior (F[2, 48] = 6.78, p < .01), driven by the fact that number violations yielded more negative waveforms than gender violations (F[1, 24] = 10.93, p < .01). Number violations also yielded more negative waveforms than grammatical sentences, although the effect was only marginal (F[1, 24] = 4.22, p < .1). Within the posterior region, analyses revealed no effects.

The omnibus ANOVA also revealed a significant distance x agreement x laterality interaction. Follow-up analyses were conducted within each level of laterality (left, mid, right) in order to evaluate the nature of the interaction. Within the left hemisphere, analyses revealed a significant main effect of agreement (F[2, 48] = 6.31, p < .01), driven by the fact that number violations yielded more negative waveforms than grammatical sentences, although the effect was only marginal after correcting for Type I error (F[1, 24] = 4.71, p = .04).

8.1.6. 250-400 ms Time Window: Summary

Neither the native speakers nor the advanced L2 learners showed a statistically reliable Left Anterior Negativity (LAN) for noun-adjective agreement violations in the 250-400 ms time window. In the L2 learner group, number violations yielded more negative waveforms than gender violations in the left hemisphere, but neither significantly differed from grammatical sentences. In addition, in the native speakers' group, analyses revealed a

marginal effect of distance, driven by the fact that within-phrase agreement yielded more positive waveforms than across-phrase agreement overall.

8.1.7. 400-900 ms Time Window: Spanish Native Speakers

As can be seen in Table 4 (p. 106), the omnibus ANOVA revealed a significant agreement x laterality x anteriority interaction. Follow-up analyses were conducted within each level of anteriority (anterior, posterior) for an examination of the interaction. Within the anterior regions, analyses revealed an agreement x laterality interaction (F[4, 92] = 15.69, $p <$ .001) and a main effect of agreement (F[2, 46] = 4.46, $p <$ .05). Post-hoc tests revealed a main effect of agreement in Right Anterior (F[2, 46] = 10.02, $p <$ .001) and Mid Anterior (F[2, 46] = 7.59, $p =$ .001), driven by the fact that number and gender violations yielded more positive waveforms than grammatical sentences (Right Anterior, number: F[1, 23] = 13.98, $p <$ .01; gender: F[1, 23] = 11.91, $p <$ .01; Mid Anterior, number: F[1, 23] = 13.39, $p <$ .01).

Within the posterior area, analyses revealed an agreement x laterality interaction (F[4, 92] = 25.04, $p <$ .001) and a main effect of agreement (F[1.53, 35.18] = 61.13, $p <$ .001). Post-hoc tests revealed a main effect of agreement in all posterior regions (Left Posterior: F[2, 46] = 33.74, $p <$ .001; Right Posterior: F[1.52, 35.14] = 71.12, $p <$ .001; Mid Posterior: F[1.53, 35.30] = 65.49, $p =$ .001), driven by the fact that both number and gender violations yielded more positive waveforms than grammatical sentences (Left Posterior, number: F[1, 23] = 49.98, $p <$ .001; gender: F[1, 23] = 31.69, $p <$ .001; Right Posterior, number: F[1, 23] = 95.06, $p <$ .001; gender: F[1, 23] = 72.93, $p <$ .001; Mid Posterior, number: F[1, 23] = 90.82, $p <$ .001; gender: F[1, 23] = 64.32, $p <$ .001).

As shown in Table 4 (p. 106), the omnibus ANOVA also revealed a significant distance x laterality interaction and a significant distance x anteriority interaction (F[1, 23] = 6.61, $p <$ .05). Post-hoc tests for the distance x laterality interaction revealed that within-phrase

agreement yielded more positive waveforms than across-phrase agreement in the left hemisphere ($F[1, 23] = 9.16$, $p < .05$) and in the midline ($F[1, 23] = 15.65$, $p < .01$). Post-hoc analyses for the distance x anteriority interaction further revealed that the distance effect emerged in the posterior regions ($F[1, 23] = 34.39$, $p < .001$).

8.1.8. 400-900 ms Time Window: Advanced L2 Learners

As shown in Table 5 (p. 107), the omnibus ANOVA revealed a significant agreement x laterality x anteriority interaction. Follow-up analyses were conducted within each level of anteriority (anterior, posterior) in order to better understand the quality of the interaction. In the anterior electrodes, analyses revealed an agreement x laterality interaction ($F[2.61, 62.59] = 7.44$, $p < .001$). Post-hoc tests revealed a main effect of agreement in Right Anterior ($F[2, 48] = 7.47$, $p = .001$), driven by the fact that number and gender violations yielded more positive waveforms than grammatical sentences (number: $F[1, 24] = 9.89$, $p < .01$; gender: $F[1, 24] = 7.87$, $p = .01$). Within the posterior electrodes, analyses revealed an agreement x laterality interaction ($F[4, 96] = 12.81$, $p < .001$) and a main effect of agreement ($F[2, 48] = 40.21$, $p < .001$). Post-hoc tests revealed a main effect of agreement in all posterior regions (Left Posterior: $F[1.51, 36.28] = 31.91$, $p < .001$; Right Posterior: $F[2, 48] = 41.41$, $p < .001$; Mid Posterior: $F[1.55, 37.28] = 37.19$, $p < .001$), driven by the fact that both number and gender violations yielded more positive waveforms than grammatical sentences (Left Posterior, number: $F[1, 24] = 41.04$, $p < .001$; gender: $F[1, 24] = 35.21$, $p < .001$; Right Posterior, number: $F[1, 24] = 59.63$, $p < .001$; gender: $F[1, 24] = 52.15$, $p < .001$; Mid Posterior, number: $F[1, 24] = 48.25$, $p < .001$; gender: $F[1, 24] = 57.43$, $p < .001$). In addition, number violations also elicited more positive effects than gender violations in all posterior regions (Left Posterior: $F[1, 24] = 13.37$, $p = .001$; Right Posterior: $F[1, 24] = 9.75$, $p < .01$; Mid Posterior: $F[1, 24] = 8.17$, $p < .01$).

As can be seen in Table 5 (p. 107), the omnibus ANOVA also revealed a significant distance x laterality x anteriority interaction. Post-hoc tests were conducted within each level of anteriority (anterior, posterior) to evaluate the nature of the interaction. Within the anterior area, analyses revealed a distance x laterality interaction (F[2, 48] = 9.27, p < .001) and a main effect of distance (F[1, 24] = 18.98, p = .001). Follow-up tests revealed that within-phrase agreement yielded more positive waveforms than across-phrase agreement in Left Anterior (F[1, 24] = 16.87, p < .001) and Mid Anterior (F[1, 24] = 26.59, p < .001). In the posterior regions, analyses revealed no significant effects.

8.1.9. 400-900 ms Time Window: Summary

Between 400-900 ms, both the native speakers and the advanced L2 learners showed a broadly distributed P600 for both number and gender agreement violations, effects being more prominent in the posterior electrodes of the EEG cap (see Figures 2-5). In the native speaker group, effects did not differ for number and gender violations. In the L2 learner group, however, the P600 for number showed greater amplitude than the P600 for gender. In addition, in both groups of participants, within-phrase agreement yielded more positive waveforms than across-phrase agreement overall, an effect that was posteriorly distributed in the native speakers, and anteriorly distributed in the advanced L2 learners (see Figures 6-7).

8.1.10. 400-650 ms Time Window: Spanish Native Speakers

As shown in Table 4 (p. 106), the omnibus ANOVA revealed a significant agreement x laterality interaction. Post-hoc tests for the interaction revealed a broadly distributed main effect of agreement (Left Hemisphere: F[1.52, 34.62] = 11.11, p < .001; Right Hemisphere (F[1.45, 33.51] = 26.74, p < .001; Midline (F[1.43, 33.05] = 26.67, p < .001), driven by the fact that number and gender violations yielded more positive waveforms than grammatical

sentences (Left Hemisphere, number: $F[1, 23] = 15.61$, $p = .001$; Left Hemisphere, gender: $F[1, 23] = 9.92$, $p < .01$; Right Hemisphere, number: $F[1, 23] = 30.97$, $p < .001$; Right Hemisphere, gender: $F[1, 23] = 30.47$, $p < .001$; Midline, number: $F[1, 23] = 34.84$, $p < .001$; Midline, gender: $F[1, 23] = 25.79$, $p < .001$).

The omnibus ANOVA also revealed a marginal distance x laterality x anteriority interaction. Follow-up analyses were conducted within each level of anteriority (anterior, posterior) in order to better understand the interaction. In the anterior region, results showed a distance x laterality interaction ($F[1.49, 34.28] = 17.23$, $p < .001$), but post-hoc tests revealed no effects. Within the posterior region, results showed a distance x laterality interaction ($F[2, 46] = 14.92$, $p < .001$) and a main effect of distance ($F[1, 23] = 39.68$, $p < .001$). Post-hoc tests for the distance x laterality interaction revealed a main effect of distance in all posterior regions (Left Posterior: ($F[1, 23] = 31.94$, $p < .001$; Right Posterior: ($F[1, 23] = 36.82$, $p < .001$; Mid Posterior: ($F[1, 23] = 45.16$, $p < .001$), driven by the fact that within-phrase agreement yielded more positive waveforms than across-phrase agreement overall.

8.1.11. 400-650 ms Time Window: Advanced L2 Learners

As shown in Table 5 (p. 107), the omnibus ANOVA revealed a significant agreement x laterality x anteriority interaction. In order to examine the nature of this interaction, follow-up analyses were conducted within each level of anteriority (anterior, posterior). Within the anterior region, analyses revealed an agreement x laterality interaction ($F[2.61, 62.86] = 7.45$, $p < .001$) and a main effect of agreement ($F[2, 48] = 6.35$, $p < .01$). Post-hoc tests revealed a main effect of agreement in Right Anterior ($F[1.58, 38.12] = 7.27$, $p < .01$) and Mid Anterior ($F[2, 48] = 10.22$, $p < .001$), driven by the fact that number and gender violations yielded more positive waveforms than grammatical sentences (Right Anterior, number: $F[1, 24] =$

8.91, $p < .01$; Right Anterior, gender: $F[1, 24] = 10.52$, $p < .01$; Mid Anterior, number: $F[1, 24] = 14.19$, $p = .001$; Mid Anterior, gender: $F[1, 24] = 13.96$, $p = .001$).

In the posterior electrodes, analyses revealed an agreement x laterality interaction ($F[2.71, 64.82] = 9.98$, $p < .001$) and a main effect of agreement ($F[1.36, 32.72] = 18.21$, $p < .001$). Post-hoc tests for the interaction revealed a main effect of agreement in all posterior regions (Left Posterior: $F[1.26, 30.24] = 14.78$, $p < .001$; Right Posterior: $F[1.61, 38.41] = 17.99$, $p < .001$; Mid Posterior: $F[1.37, 32.89] = 18.13$, $p < .001$), driven by the fact that number and gender violations yielded more positive waveforms than grammatical sentences (Left Posterior, number: $F[1, 24] = 16.61$, $p < .001$; gender: $F[1, 24] = 28.51$, $p < .001$; Right Posterior, number: $F[1, 24] = 21.34$, $p < .001$; gender: $F[1, 24] = 37.05$, $p < .001$; Mid Posterior, number: $F[1, 24] = 20.65$, $p < .001$; gender: $F[1, 24] = 46.61$, $p < .001$). Interestingly, the difference between number and gender did not reach significance in this time window.

The omnibus ANOVA also revealed a significant distance x laterality x anteriority interaction. Post-hoc tests were conducted within each level of anteriority (anterior, posterior), in order to better understand the nature of the interaction. Within the anterior area, analyses revealed a distance x laterality interaction ($F[2, 48] = 9.24$, $p < .001$) and a main effect of distance ($F[1, 24] = 25.45$, $p < .001$). Post-hoc tests for the interaction revealed that within-phrase agreement yielded more positive waveforms than across-phrase agreement in all anterior regions (Left Anterior: $F[1, 24] = 17.96$, $p < .001$; Right Anterior: $F[1, 24] = 14.29$, $p = .001$; Mid Anterior: $F[1, 24] = 34.26$, $p < .001$). In the posterior electrodes, analyses revealed a main effect of distance ($F[1, 24] = 16.18$, $p < .001$), driven by the fact that within-phrase agreement yielded more positive waveforms than across-phrase agreement overall.

8.1.12. 400-650 ms Time Window: Summary

In this time window, both the native speakers and the advanced L2 learners showed a very broadly distributed P600 for both number and gender agreement violations. In neither group did effects differ for number and gender violations. In addition, in the two groups, within-phrase agreement yielded more positive waveforms than across-phrase agreement overall, an effect that showed a posterior distribution in the native speakers, and a broad distribution in the advanced L2 learners.

8.1.13. 650-900 ms Time Window: Spanish Native Speakers

As shown in Table 4 (p. 106), the omnibus ANOVA revealed a significant agreement x laterality x anteriority interaction. In order to better understand the nature of the interaction, follow-up tests were conducted within each level of anteriority (anterior, posterior). Within the anterior region, analyses revealed an agreement x laterality interaction (F[4, 92] = 18.83, $p < .001$), but post-hoc tests for the interaction revealed no effects. Within the posterior area, analyses revealed an agreement x laterality interaction (F[4, 92] = 20.98, $p < .001$) and a main effect of agreement (F[2, 46] = 69.93, $p < .001$). Post-hoc tests revealed a main effect of agreement in all posterior regions (Left Posterior: F[4, 46] = 36.92, $p < .001$; Right Posterior: F[4, 46] = 73.28, $p < .001$; Mid Posterior: F[4, 46] = 75.01, $p < .001$), driven by the fact that both number and gender violations resulted in more positive waveforms than grammatical sentences (Left Posterior, number: F[1, 23] = 44.96, $p < .001$; Left Posterior, gender: F[1, 23] = 59.53, $p < .001$; Right Posterior, number: F[1, 23] = 102.71, $p < .001$; Right Posterior, gender: F[1, 23] = 89.59, $p < .001$; Mid Posterior, number: F[1, 23] = 96.51, $p < .001$; Mid Posterior, gender: F[1, 23] = 109.87, $p < .001$).

The omnibus ANOVA also revealed a significant distance x anteriority interaction, driven by the fact the within-phrase agreement yielded more positive waveforms than across-phrase

agreement overall and only in the posterior electrodes (F[1, 23] = 21.91, $p < .001$). In addition, the omnibus ANOVA showed a significant distance x laterality interaction, but post-hoc tests revealed no hemispheric differences for the distance effect.

8.1.14. 650-900 ms Time Window: Advanced L2 Learners

The omnibus ANOVA revealed a significant agreement x laterality x anteriority interaction. Follow-up analyses were conducted within each level of anteriority (anterior, posterior) in order to better understand the nature of the interaction. Within the anterior area, analyses revealed an agreement x laterality interaction (F[3.03, 72.71] = 6.63, $p < .001$), but post-hoc tests for the interaction revealed no agreement effects at any level of laterality. Within the posterior area, analyses revealed an agreement x laterality interaction (F[4, 96] = 11.99, $p < .001$) and a main effect of agreement (F[2, 48] = 41.36, $p < .001$). Post-hoc tests revealed a main effect of agreement in all posterior regions (Left Posterior: F[2, 48] = 31.17, $p < .001$; Right Posterior: F[2, 48] = 43.54, $p < .001$; Mid Posterior: F[2, 48] = 39.71, $p < .001$), driven by the fact that both number and gender violations yielded more positive waveforms than grammatical sentences (Left Posterior, number: F[1, 24] = 54.11, $p < .001$; gender: F[1, 24] = 15.46, $p = .001$; Right Posterior, number: F[1, 24] = 75.76, $p < .001$; gender: F[1, 24] = 26.95, $p < .001$; Mid Posterior, number: F[1, 24] = 67.73, $p < .001$; gender: F[1, 24] = 25.67, $p < .001$). In addition, number violations elicited more positive waveforms than gender violations in all posterior regions (Left Posterior: F[1, 24] = 18.68, $p < .001$; Right Posterior: F[1, 24] = 20.58, $p < .001$; Mid Posterior: F[1, 24] = 17.31, $p < .001$).

As shown in Table 5 (p. 107), the omnibus ANOVA also revealed a significant distance x laterality x anteriority interaction. Post-hoc tests were conducted within each level of anteriority (anterior, posterior) in order to evaluate the quality of this interaction. In the

anterior electrodes, analyses revealed a distance x laterality interaction (F[1.55, 37.35] = 9.93, p < .001) and a main effect of distance (F[1, 24] = 11.74, p < .01). Post-hoc tests for the interaction showed that within-phrase agreement yielded more positive waveforms than across-phrase agreement in Left Anterior (F[1, 24] = 14.18, p < .001) and Mid Anterior (F[1, 24] = 16.82, p < .001). In the posterior regions, analyses revealed a distance x laterality interaction (F[2, 48] = 10.13, p < .001), but post-hoc tests revealed no effects.

8.1.15. 650-900 ms Time Window: Summary

Between 650-900 ms, both the native speakers and the advanced L2 learners showed a posteriorly-distributed P600 for both number and gender agreement violations. Effects for number and gender did not differ for native speakers. For the advanced L2 learners, however, number violations yielded a larger P600 for number than gender violations. In addition, in both groups of participants, within-phrase agreement yielded more positive waveforms than across-phrase agreement overall, an effect that showed a posterior distribution in the native speaker group, and an anterior distribution in the advanced L2 learner group.

8.2. Experiment 3: Demonstrative-Noun Agreement

8.2.1. Spanish Native Speakers: Behavioral Results

Spanish native speakers performed above 96% in every condition of Experiment 3 (see Table 6, p. 117). A 3 x 2 repeated measures ANOVA with agreement (grammatical, number violation, gender violation) as a repeated factor revealed no significant main effect of agreement (F[2, 46] = .83, p > .05).

8.2.2. Advanced L2 Learners: Behavioral Results

L2 learners' accuracy rates for grammatical sentences and number violations were above 95% (mean accuracy rates are provided in Table 6 below). For gender violations, L2 learners performed at 83.1%. A 3 x 2 repeated measures ANOVA with agreement (grammatical, number violation, gender violation) as the repeated factor revealed a significant main effect of agreement ($F[1.31, 31.35] = 22.39$, $p < .001$). Follow-up tests revealed that grammatical sentences were judged more accurately than gender violations ($F[1, 24] = 25.41$, $p < .001$), and so were number violations ($F[1, 24] = 22.84$, $p < .001$).

Table 6: Native speakers' and advanced L2 learners' accuracy rates in the Grammaticality Judgment Task for Experiment 3 (demonstrative-noun agreement).

	Exp. 3 Grammatical	Exp. 3 *Number	Exp. 3 *Gender
Native Speakers	97.8	96.4	96.9
Advanced Learners	97.4	95.8	83.1

8.2.3. ERP Results

Visual inspection of the grand-averaged waveforms in Experiment 3 (see Figures 8 and 9, p. 118) reveals that, in both native speakers and L2 learners, number and gender violations yielded more positive waveforms than their grammatical counterpart in the 400-900 ms time window. In the native speaker group, this positivity has an onset at approximately 400 ms, an offset at approximately 900 ms, and a peak at roughly 600 ms. In the L2 learner group, the latency of the positivity appears similar to that of the native speakers' (400-900 ms), but the positivity does not exhibit a clear peak. In addition, while the positivity appears equally robust for number and gender violations in the native speakers, it appears greater for gender than number in the advanced L2 learner group. The following statistical analyses were conducted separately for native speakers and L2 learners in the time windows of interest.

Figure 8. Native speakers' grand average ERPs for the determiner-noun agreement conditions (Experiment 3): grammatical, number violation, and gender violation. ERPs are plotted for a representative electrode within each region of interest.
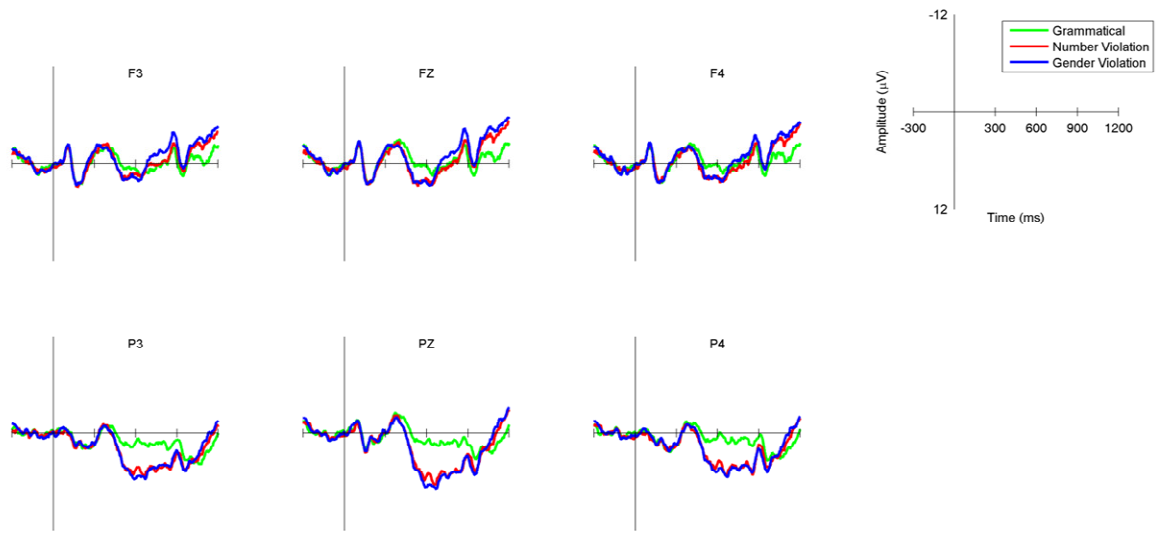
Figure 9. Advanced L2 learners' grand average ERPs for the determiner-noun agreement conditions (Experiment 3): grammatical, number violation, and gender violation. ERPs are plotted for a representative electrode within each region of interest.
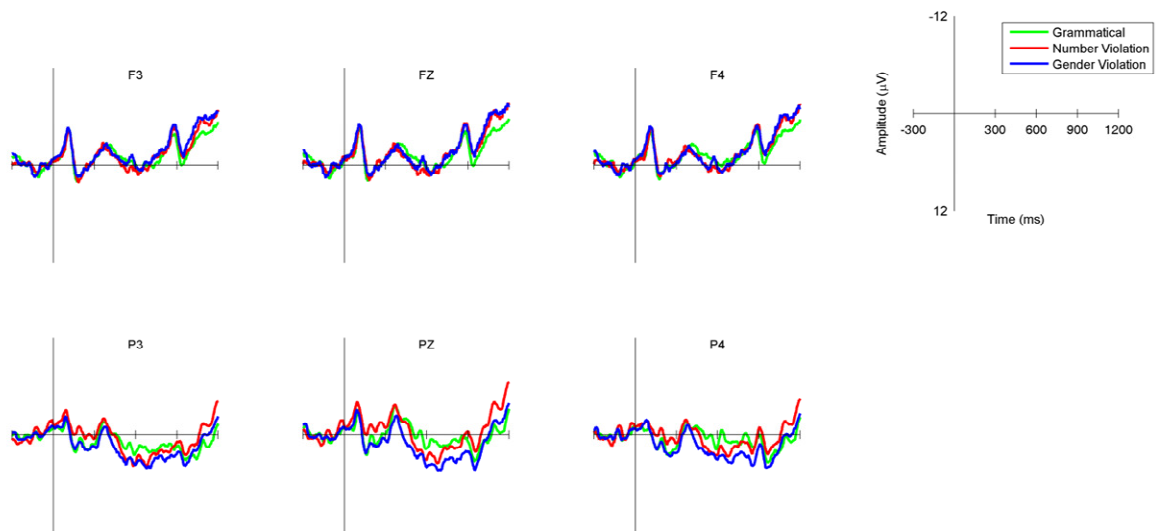
8.2.4. 250-400 ms Time Window: Spanish Native Speakers

As shown in Table 6 (p. 121), the omnibus ANOVA revealed a marginal agreement x laterality interaction. Follow-up analyses to the interaction revealed no effects of agreement at any level of laterality.

8.2.5. 250-400 ms Time Window: Advanced L2 Learners

As shown in Table 7 (p. 122), the omnibus ANOVA revealed a marginal agreement x anteriority interaction. Follow-up analyses were conducted within each level of anteriority in order to evaluate the interaction. Within the anterior area, analyses revealed no effects. Within the posterior area, analyses revealed a main effect of agreement ($F[2, 48] = 7.07$, $p < .01$), driven by the fact that number violations yielded more negative waveforms than gender violations ($F[1, 24] = 11.61$, $p < .01$).

8.2.6. 250-400 ms Time Window: Summary

Analyses conducted in the 250-400 ms time window revealed no evidence of a LAN for either number or gender violations in either the native speaker group or the L2 learner group. In the L2 learner group, analyses revealed that number violations yielded more negative waveforms than gender violations, but neither significantly differed from grammatical sentences.

8.2.7. 400-900 ms Time Window: Spanish Native Speakers

The omnibus ANOVA (Table 6, p. 121) revealed a significant agreement x laterality x anteriority interaction. Follow-up analyses were conducted within each level of anteriority (anterior, posterior) in order to evaluate the nature of the interaction. Within the anterior region, analyses revealed an agreement x laterality interaction ($F[4, 92] = 8.89$, $p < .001$), but

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post-hoc tests revealed no agreement effects. In the posterior electrodes, analyses revealed an agreement x laterality interaction ($F[4, 92] = 17.64$, $p < .001$) and a main effect of agreement ($F[2, 46] = 40.36$, $p < .001$). Post-hoc tests revealed a main effect of agreement in all posterior regions (Left Posterior: $F[2, 46] = 30.13$, $p < .001$; Right Posterior: $F[2, 46] = 41.64$, $p < .001$; Mid Posterior: $F[2, 46] = 39.81$, $p < .001$), driven by the fact that both number and gender violations yielded more positive waveforms than grammatical sentences (Left Posterior, number: $F[1, 23] = 37.57$, $p < .001$; Left Posterior, gender: $F[1, 23] = 48.44$, $p < .001$; Right Posterior, number: $F[1, 23] = 48.16$, $p < .001$; Right Posterior, gender: $F[1, 23] = 66.91$, $p < .001$; Mid Posterior, number: $F[1, 23] = 41.47$, $p < .001$; Mid Posterior, gender: $F[1, 23] = 73.11$, $p < .001$).

Table 6: Native speakers' results of the three-way ANOVA conducted on Experiment 3 (demonstrative-noun agreement). Results are provided for all time windows of interest.

	250-400ms	400-900ms	400-650ms	650-900ms
agreement x laterality x anteriority	---	$F[4, 92] = 5.91$, $p < .001$	---	$F[2.74, 63.11] = 10.22$, $p < .001$
agreement x anteriority	---	$F[4, 46] = 22.29$, $p < .001$	$F[2, 46] = 3.88$, $p < .05$	$F[2, 46] = 38.14$, $p < .001$
agreement x laterality	$F[4, 92] = 2.21$, $p = .074$	$F[4, 92] = 15.13$, $p < .001$	$F[4, 92] = 13.11$, $p < .001$	$F[4, 92] = 13.05$, $p < .001$
agreement	---	$F[2, 46] = 10.21$, $p < .001$	$F[2, 46] = 9.54$, $p < .001$	$F[2, 46] = 6.33$, $p < .01$

Table 7: Advanced L2 learners' results of the three-way ANOVA conducted on Experiment 3 (demonstrative-noun agreement). Results are provided for all time windows of interest.

	250-400ms	400-900ms	400-650ms	650-900ms
agreement x laterality x anteriority	---	$F[4, 96] = 2.98$, $p < .05$	$F[4, 96] = 3.83$, $p < .01$	$F[2.77, 66.63] = 15.44$, $p < .001$
agreement x anteriority	$F[1.56, 37.57] = 3.46$, $p = .052$	$F[2, 48] = 5.05$, $p = .01$	$F[2, 48] = 3.74$, $p < .05$	---
agreement x laterality	---	$F[4, 96] = 5.71$, $p < .001$	$F[2.77, 66.48] = 4.34$, $p < .01$	$F[2.19, 52.76] = 9.37$, $p < .001$
agreement	$F[2, 48] = 2.81$, $p = .07$	$F[2, 48] = 3.34$, $p < .05$	$F[2, 48] = 4.44$, $p < .05$	---

8.2.8.   400-900 ms Time Window: Advanced L2 Learners

As shown in Table 7 (p. 122), the omnibus ANOVA revealed a significant agreement x laterality x anteriority interaction. Follow-up analyses were conducted within each level of anteriority (anterior, posterior) in order to better understand the quality of the interaction. Within the anterior area, analyses revealed an agreement x laterality interaction (F[2.84, 68.31] = 4.55, $p < .01$), but post-hoc tests revealed no effects. In the posterior electrodes, analyses revealed an agreement x laterality interaction (F[4, 96] = 5.87, $p < .001$) and a main effect of agreement (F[2, 48] = 11.07, $p < .001$). Post-hoc tests revealed a main effect of agreement in all posterior regions (Left Posterior: F[2, 48] = 5.28, $p < .01$; Right Posterior: F[2, 48] = 11.94, $p < .001$; Mid Posterior: F[2, 48] = 11.51, $p < .001$), driven by the fact that gender violations yielded more positive waveforms than grammatical sentences (Left Posterior: F[1, 24] = 10.43, $p < .01$; Right Posterior: F[1, 24] = 24.21, $p < .001$; Mid Posterior: F[1, 24] = 26.62, $p < .001$; gender: F[1, 24] = 57.31, $p < .001$). In addition, gender violations elicited more positive waveforms than number violations in Right Posterior (F[1, 24] = 8.06, $p < .01$).

8.2.9.   400-900 ms Time Window: Summary

In this time window, both the native speakers and the advanced L2 learners showed a posteriorly-distributed P600 for gender agreement violations. However, only the native speakers showed a statistically reliable P600 for number agreement violations, an effect that was also posteriorly-distributed and similar in amplitude to the P600 for gender errors. In the advanced L2 learner group, the effect for number violations was numerically more positive than for grammatical sentences (see Figure 9), but the effect did not reach statistical significance.

8.2.10. 400-650 ms Time Window: Spanish Native Speakers

As shown in Table 6 (p. 121), the omnibus ANOVA revealed a significant agreement x anteriority interaction. Follow-up analyses for the interaction revealed no effects of agreement in the anterior region. In the posterior electrodes, analyses revealed a main effect of agreement ($F[2, 46] = 17.86$, $p < .001$), driven by the fact that number and gender violations yielded more positive waveforms than grammatical sentences in all posterior regions (number: $F[1, 23] = 20.18$, $p < .001$; gender: $F[1, 23] = 23.46$, $p < .001$).

The omnibus ANOVA also revealed a significant agreement x laterality interaction. Follow-up tests for the interaction revealed a main effect of agreement in the Right Hemisphere ($F[4, 46] = 8.76$, $p = .001$) and in the Midline ($F[4, 46] = 12.81$, $p < .001$). In both cases, number and gender violations yielded more positive waveforms than grammatical sentences (Right Hemisphere, number: $F[1, 23] = 11.03$, $p < .01$; Right Hemisphere, gender: $F[1, 23] = 11.31$, $p < .01$; Midline, number: $F[1, 23] = 13.41$, $p = .001$; Midline, gender: $F[1, 23] = 17.71$, $p < .001$).

8.2.11. 400-650 ms Time Window: Advanced L2 Learners

As shown in Table 7 (p. 122), the omnibus ANOVA revealed a significant agreement x laterality x anteriority interaction. Follow-up analyses were conducted within each level of anteriority (anterior, posterior) in order to evaluate the interaction. Within the anterior area, analyses revealed no effects. Within the posterior area, analyses revealed an agreement x laterality interaction ($F[4, 96] = 4.78$, $p = .001$) and a main effect of agreement ($F[2, 48] = 8.99$, $p < .001$). Post-hoc tests revealed a main effect of agreement in Right Posterior ($F[2, 48] = 9.67$, $p < .001$) and Mid Posterior ($F[2, 48] = 9.81$, $p < .001$), driven by the fact that gender violations yielded more positive waveforms than grammatical sentences (Right Posterior: $F[1, 24] = 18.31$, $p < .001$; Mid Posterior: $F[1, 24] = 17.89$, $p < .001$; gender: $F[1,$

24] = 57.30, $p < .001$). Number violations also showed more positive waveforms than grammatical sentences, although the effect was only marginal after correcting for Type I error (Right Posterior: $F[1, 24] = 5.71$, $p = .025$; Mid Posterior: $F[1, 24] = 5.56$, $p = .027$). Gender violations also yielded more positive waveforms than number violations, although the effect was only marginal after correcting for Type I error (Right Posterior: $F[1, 24] = 4.24$, $p = .05$; Mid Posterior: $F[1, 24] = 4.57$, $p = .04$).

8.2.12. 400-650 ms Time Window: Summary

Between 400-650 ms, both the native speakers and the advanced L2 learners showed a posteriorly-distributed P600 for gender agreement violations. As was the case in the 400-900 ms time window, only the native speakers showed a statistically reliable P600 for number errors, an effect that was also posteriorly-distributed and similar in amplitude to the P600 for gender violations. In the advanced L2 learner group, the P600 for number was marginal.

8.2.13. 650-900 ms Time Window: Spanish Native Speakers

As shown in Table 6 (p. 121), the omnibus ANOVA revealed a significant agreement x laterality x anteriority interaction. Follow-up analyses were conducted within each level of anteriority (anterior, posterior) for an examination of the interaction. Within the anterior area, analyses revealed an agreement x laterality interaction ($F[4, 92] = 10.55$, $p < .001$). Post-hoc tests for the interaction revealed a main effect of agreement in Left Anterior ($F[2, 46] = 6.92$, $p < .01$), driven by the fact that gender violations yielded more negative waveforms than grammatical sentences ($F[1, 23] = 11.22$, $p < .01$).

Within the posterior area, analyses revealed an agreement x laterality interaction ($F[4, 92] = 14.75$, $p < .001$) and a main effect of agreement ($F[4, 46] = 41.89$, $p < .001$). Post-hoc tests revealed a main effect of agreement in all posterior regions (Left Posterior: $F[2, 46] = 28.62$,

$p < .001$; Right Posterior: $F[2, 48] = 44.62$, $p < .001$; Mid Posterior: $F[2, 48] = 40.17$, $p <$

$.001$), driven by the fact that both number and gender violations yielded more positive

waveforms than grammatical sentences (Left Posterior, number: $F[1, 23] = 33.98$, $p < .001$;

Left Posterior, gender: $F[1, 23] = 47.33$, $p < .001$; Right Posterior, number: $F[1, 23] = 45.42$,

$p < .001$; Right Posterior, gender: $F[1, 23] = 85.19$, $p < .001$; Mid Posterior, number: $F[1, 23]$

$= 40.06$, $p < .001$; Mid Posterior, gender: $F[1, 23] = 86.67$, $p < .001$).

8.2.14. 650-900 ms Time Window: Advanced L2 Learners

The omnibus ANOVA revealed a significant agreement x laterality x anteriority

interaction. Follow-up analyses were conducted within each level of anteriority (anterior,

posterior) in order to evaluate the interaction. In the anterior electrodes, analyses revealed an

agreement x laterality interaction ($F[2.29, 55.11] = 10.44$, $p < .001$). Post-hoc tests revealed a

main effect of agreement in Right Anterior ($F[2, 48] = 7.15$, $p < .01$), driven by the fact that

gender violations yielded more positive waveforms than grammatical sentences ($F[1, 24] =$

12.53, $p < .01$) and number violations ($F[1, 24] = 9.98$, $p < .01$).

Within the posterior region, analyses revealed an agreement x laterality interaction

($F[2.65, 63.79] = 11.74$, $p < .001$). Post-hoc tests revealed a main effect of agreement in Mid

Posterior ($F[2, 48] = 10.12$, $p < .001$), driven by the fact that gender violations yielded more

positive waveforms than grammatical sentences ($F[1, 24] = 22.37$, $p < .001$) and number

violations ($F[1, 24] = 8.58$, $p < .01$).

8.2.15. 650-900 ms Time Window: Summary

Between 650-900 ms, both the native speakers and the advanced L2 learners showed a

P600 for gender agreement violations, although the effect showed a more restricted

topographical distribution in the advanced L2 learner group. For number violations, only the

native speakers showed a statistically reliable P600. In addition, gender violations yielded more negative waveforms than grammatical sentences in the native speaker group, an effect that reflects a polarity inversion of the P600 effect.

8.3. Additional Analyses

8.3.1. Noun-Adjective Agreement vs. Demonstrative-Noun Agreement

In order to examine whether morphological differences in how English and Spanish realize number agreement impacted processing in the learner group, additional analyses were conducted in the 400-900 ms time window, in order to compare the size of the P600 for noun-adjective violations (context where only Spanish realizes agreement) and for demonstrative-noun violations (context where both English and Spanish realize number agreement). As mentioned in Chapter 6, only noun-adjective violations from Experiment 1 (within-phrase agreement) were examined, since they are similar in terms of structural distance to demonstrative-noun violations (Experiment 3). P600 size was calculated by subtracting the grammatical condition from each violation condition, separately for each experiment. Analyses, which were conducted separately for number and gender, were limited to the posterior electrodes, since this is where agreement violations became more positive than grammatical sentences in both experiments.[41] In the native speaker group, a 2 x 3 repeated-measures ANOVA with context (noun-adjective, demonstrative-noun) and laterality (left, midline, right) as the repeated factors revealed no effects for either number or gender, suggesting that the size of the P600 did not differ in the two contexts, for either number or gender. In the advanced L2 learner group, the ANOVA revealed no effects for gender, suggesting that the size of the P600 for gender violations did not differ across contexts. For number violations, in contrast, the ANOVA revealed a context x laterality interaction (F[2,

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[41] While the P600 for number violations in Experiment 3 did not reach statistical significance in the learner group, the effect was marginal and went in the right direction.

48] = 4.55, $p < .05$) and a main effect of context ($F[1, 24] = 13.81$, $p = .001$), driven by the fact that the P600 for noun-adjective number violations was larger than the emerging positivity for demonstrative-noun number violations.

8.3.2. Early vs. Late Portions of the P600

Additional analyses were conducted in order to compare the topographical distribution of the early (400-650 ms) and late (650-900 ms) portions of the P600 (Barber & Carreiras, 2005; Hagoort & Brown, 2000). Analyses were conducted on P600 effect sizes, which were calculated following the procedure described in section 8.2.1 above. A 2 x 3 x 2 repeated-measures ANOVA was conducted with time window (early: 400-650 ms, late: 650-900 ms), laterality (left, midline, right), and anteriority (anterior, posterior) as within-subjects factors. Agreement type (number, gender) and experiment (Experiment 1, Experiment 2, Experiment 3) were not entered as factors, since they are not predicted to affect the topographical distribution of the P600.

As shown by Table 8 (p. 129), in the native speaker group, the omnibus ANOVA revealed a significant time window x laterality x anteriority interaction. Follow-up tests were conducted within each level of anteriority (anterior, posterior), in order to better understand the nature of the interaction. Within the anterior region, analyses revealed a time window x laterality interaction ($F[2, 46] = 22.27$, $p < .001$) and a main effect of time window ($F[1, 23] = 12.62$, $p < .01$). Post-hoc tests revealed that the early portion of the P600 (400-650 ms) was more positive than the late portion (650-900 ms) in Right Anterior and Mid Anterior. In the posterior electrodes, analyses revealed no effects.

As can be seen in Table 8, in the advanced L2 learners, the omnibus ANOVA revealed a significant time window x laterality x anteriority interaction. Follow-up tests were conducted within each level of anteriority (anterior, posterior), to examine the quality of the interaction.

In the anterior electrodes, analyses revealed a time window x laterality interaction (F[2, 48] = 22.27, $p < .001$). Post-hoc tests revealed that the early portion of the P600 (400-650 ms) was more positive than the late portion (650-900 ms) in Mid Anterior. In the posterior electrodes, analyses revealed no effects.

Overall, these results suggest that, in both participant groups, the early P600 is broadly distributed with involvement from both anterior and posterior electrodes, and that the late portion of the P600 shows an almost exclusively posterior distribution.

Table 8: Results of the omnibus ANOVA comparing the topographical distribution of the early and late portions of the P600. Results are provided for both native speakers and advanced L2 learners.

	Native speakers	**Advanced L2 Learners**
window x laterality x anteriority	F[2, 46] = 8.39, $p = .001$	F[2, 48] = 17.72, $p < .001$
window x anteriority	F[1, 23] = 31.13, $p < .001$	F[1, 24] = 4.99, $p < .05$
window x laterality	F[2, 46] = 15.36, $p < .001$	F[2, 48] = 5.52, $p < .01$
window	---	---

8.4. Overall Summary: Experiments 1, 2, and 3

The Spanish native speakers showed equally robust P600s for both number and gender violations in all three experiments. The P600 was broadly distributed between 400-650 ms and mainly posteriorly-distributed between 650-900 ms. In addition, the size of the P600 for both number and gender was unaffected by the syntactic context where agreement was examined. Finally, there was no evidence of a LAN for either number or gender violations in any of the three experiments.

The advanced L2 learners showed a P600 for gender violations overall. As for number, learners exhibited a P600 for noun-adjective number violations, but the effect for demonstrative-noun number violations was only marginal. The topographical distribution of

the P600 was similar to that of the native speakers' (broadly distributed between 400-650 ms and mainly posteriorly-distributed between 650-900 ms). For gender violations, the size of the P600 did not differ across contexts. For number violations, in contrast, the learners showed a larger effect for violations realized between nouns and adjectives. Similar to the native speakers, the advanced L2 learners showed no evidence of a LAN for either number or gender violations in any of the three experiments.

As to the distance manipulation, both groups of participants showed more positive waveforms for within-phrase than across-phrase agreement overall, suggesting that they were impacted by structural distance in a similar way. Table 9 below provides a summary of results for all three experiments:

Table 9: Summary of ERP results for all three experiments and for both native speakers and advanced L2 learners

	Experiment 1		Experiment 2		Experiment 3	
	Number	**Gender**	**Number**	**Gender**	**Number**	**Gender**
Native Speakers	P600	P600	P600	P600	P600	P600
	No difference		No difference		No difference	
Advanced L2 Learners	P600	P600	P600	P600	---	P600
	Larger for number		Larger for number		Larger for gender	

CHAPTER 9:

DISCUSSION AND CONCLUSION

9.1. Agreement Processing in Native Speakers

The present study utilized EEG to examine the native processing of number and gender agreement in Spanish in three different contexts: between nouns and adjectives located within the same phrase (e.g., *edificio muy seguro* "building-MASC-SG very safe-MASC-SG"), between nouns and adjectives located across a verb phrase (e.g., *cuento es anónimo* "story-MASC-SG is anonymous-MASC-SG"), and between demonstratives and nouns (e.g., *este apartamento* "this-MASC-SG apartment-MASC-SG"). The results showed equally robust P600s (400-900 ms) for number and gender violations overall, relative to their grammatical counterpart, a finding that is consistent with most studies examining the processing of agreement in sentential contexts in Spanish (e.g., Wicha et al., 2004; Barber & Carreiras, 2005; Martín-Loeches et al., 2006; O'Rourke & Van Petten, 2011) and other languages (e.g., Osterhout & Mobley, 1995; Hagoort, 2003; Nevins et al., 2007). The P600 was broadly distributed between 400-650 ms, and posteriorly distributed between 650-900 ms, consistent with previous studies that have shown different topographical distributions for the early and late phases of the P600 (e.g., Hagoort & Brown, 2000; Barber & Carreiras, 2005; Silva-Pereyra & Carreiras, 2007; Molinaro et al., 2008b; Mancini et al., 2011). It has been proposed that the P600 indexes syntactic integration and repair (e.g., Hagoort, 1993). In the present study, agreement violations were likely to trigger both integration and repair processes, which would explain the presence of this component for both number and gender violations. First, the parser attempts to integrate an incoming adjective into the previous structure via agreement. Upon failure to establish agreement due to a number or gender incongruence, repair processes are needed to integrate the deviant adjective and derive meaning of the sentences.

In the present study, the P600 for agreement violations was not preceded by a Left Anterior Negativity (LAN). Analyses carried out in the 250-400 ms time window revealed no significant effects of agreement for either number or gender violations.[42] These results are consistent with a number of studies that did not report the LAN for agreement violations in native speakers (e.g., Wicha et al., 2004; Martín-Loeches et al., 2006; Nevins et al., 2007). Importantly, the lack of a LAN for agreement violations in the present study cannot be attributed to the lack of morphophonological cues in the agreeing elements, as suggested by Molinaro et al. (2011a) and Molinaro et al. (2011b). This is because, in the present study, both number and gender exhibited overt morphology. Number violations consisted of a singular noun in disagreement with an adjective overtly marked with plural –s, and gender violations consisted of a noun with canonical gender marking in disagreement with an adjective that also exhibited canonical gender marking (masculine –o and feminine –a). Therefore, these results suggest that the presence of the LAN for agreement violations is not guaranteed by the availability of overt cues in the agreeing elements, in line with previous studies (e.g., Wicha et al., 2004; Martín-Loeches et al., 2006). Furthermore, it is unlikely that the absence of a LAN for the agreement violations in the present study is due to the choice of reference for the EEG recording. Molinaro et al. (2011a) suggest that choosing the left mastoid as a reference may cause the LAN to be attenuated or suppressed, due to the left-lateralization of this component. In the current study, the recording was referenced to the linked mastoids and yet, no reliable LAN was found for agreement violations, similar to other studies using a reference site other than the left mastoid (e.g., Münte et al., 1997; Schmitt et al., 2002; Wicha et al., 2004; Nevins et al., 2007; Hammer et al., 2008). As the emergence of ERP components is sensitive to factors such as the sample size and number of trials per condition (e.g., Molinaro et al., 2011a), it is worth noting that the sample size and the number

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[42] Additional analyses were conducted in the 300-500 ms time window, where previous studies have reported LAN effects (e.g., Barber & Carreiras, 2005), but they showed no evidence for the presence of the LAN.

of trials per condition in the present study were similar to previous studies which have reported the LAN for agreement violations (e.g., Barber & Carreiras, 2005; Silva-Pereyra & Carreiras, 2007; Molinaro et al., 2008a, 2008b; O'Rourke & Van Petten, 2011).

Specific research questions regarding differences between number and gender agreement and the role of structural distance on agreement resolution are repeated below and discussed in light of the findings reported in Chapter 8:

Research Question 1:

Is the processing of number and gender similar at the brain level (Nevins et al., 2007) or is gender costlier to repair than number due to its lexical status (Barber & Carreiras, 2005; Faussart et al., 1999)?

Research Question 2:

In the course of online processing, are native speakers sensitive to the structural distance between the elements in a syntactic dependency (e.g., Barber & Carreiras, 2005; O'Rourke & Van Petten, 2011), after controlling for linear distance?

9.1.1. Number and Gender (Research Question 1)

As shown by Figures 2, 4, and 8 (pp. 102, 103, 118, respectively), no significant differences were found between number and gender violations in any of the time windows associated with the P600, suggesting that both features are processed similarly at the brain level (Nevins et al., 2007). Barber and Carreiras (2005) examined the native processing of number and gender agreement in Spanish sentences, and found a larger P600 for gender violations in the late phase of the P600 (700-900 ms), which they interpret as evidence that gender is costlier to repair than number, due to its lexical status (Faussart et al., 1999; Ritter, 1991, 1993). The results of the present study are not in line with this proposal, as no evidence was found for a differential treatment of number and gender. The findings of the present

study are best accommodated by models that assign a similar status to the number and gender features, such as Picallo (1991), who proposes that both number and gender project their own syntactic phrase, placing both features at the syntactic level.

9.1.2. Effects of Distance (Research Question 2)

As shown in Figure 6 (p. 104), the results of the present study revealed more positive waveforms for within-phrase (e.g., *edificio muy seguro* "building-MASC-SG very safe-MASC-SG") than across-phrase agreement (e.g., *cuento es anónimo* "story-MASC-SG is anonymous-MASC-SG"), but unlike previous investigations (e.g., Kaan & Swaab, 2003; O'Rourke & Van Petten, 2011), the effect was not limited to the violation conditions, as suggested by the lack of a significant agreement by distance interaction. Previous studies investigating how the online processing of agreement is impacted by the structural distance between the agreeing elements have provided evidence that distance and complexity modulate the amplitude of the P600 (e.g., Barber & Carreiras, 2005; Kaan & Swaab, 2003; Hammer et al., 2008; O'Rourke & Van Petten, 2011). The results of the present study are consistent with the view that structural distance reduces sensitivity to the establishment of agreement overall, regardless of grammaticality, as suggested by the less positive effects for all across-phrase agreement conditions (Experiment 2) compared to their within-phrase counterparts (Experiment 1). Interestingly, this pattern was not reflected in the Grammaticality Judgment Task, in line with previous studies that have shown dissociation between ERP and behavioral results (e.g., Kaan, 2002; Kaan & Swaab, 2003). This suggests that, while participants might have not been affected by the structural distance manipulation at the time of performing the Grammaticality Judgment Task, the manipulation did indeed modulate online processing.

The less positive effects for across-phrase agreement in the present study cannot be attributed to differences in linear distance or in the syntactic category of the agreement elements, since both factors were controlled for.[43] Thus, the results of the present study are consistent with the view that hierarchical structure affects the establishment of agreement, in line with models of sentence processing which predict that structural distance will impact the online processing of syntactic dependencies (e.g., Gibson, 1998, 2000). However, since the results of the present study did not reveal an agreement by distance interaction, the possibility cannot be ruled out that the more positive waveforms for within-phrase agreement were driven by differences between the structures that contain agreement in the within-phrase and across-phrase configurations (other than differences in linear distance and syntactic category, which were controlled for). For example, although the critical word occurs midsentence across both levels of structural distance, it occurs three words later in the within-phrase conditions (see Table 1, p. 79). As discussed in Chapter 3 (p. 21), sentence position effects on ERPs have previously been reported, but mainly for the N400, whose amplitude is inversely proportional to the strength of semantic predictability (e.g., Kutas & Hillyard, 1980). For example, Van Petten and Kutas (1990) found a decrease in N400 amplitude over the course of the sentence, which they interpret as evidence that, as semantic context is built up, the following words become increasingly predictable, which causes a reduction in N400 amplitude. In the present study, the analyses conducted in the 250-400 ms time window revealed a marginal effect of distance in posterior electrodes. Since the 250-400 ms time window corresponds to the latency of the N400 and the N400 typically reaches its maximum

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[43] One difference between the within-phrase (Experiment 1) and across-phrase (Experiment 2) configurations is that the intervening word in the across-phrase conditions is an agreement element itself (*cuento es anónimo* "story-MASC-SG is-SG anonymous-MASC-SG"), which might have facilitated the establishment of agreement at the critical word (adjective). However, it should be noted that the intervening verb carries number but not gender features and, therefore, only number agreement could have been facilitated by the verb, in which case we should have observed a difference between number and gender violations on the following adjective. In contrast, results did not show any differences between number and gender violations realized across the phrase, which is also the pattern found in the within-phrase conditions, where the intervening adverb (*muy* "very") carries neither number nor gender features.

in posterior electrodes, additional analyses were carried out to verify that the distance effects in the P600 time window (400-900 ms) were independent from potential differences in N400 amplitude (the preceding time window). These analyses involved baseline-correcting the waveforms using the 250-400 ms time window (e.g., Hagoort, 2003; Wicha et al., 2004; Martín-Loeches et al., 2006), in order to correct for potential amplitude differences preceding the P600 time window. Those analyses revealed that, even after controlling for potential N400 differences, the distance effects persisted robustly.

While semantic predictability is unlikely to be an issue in the comparison of within-phrase and across-phrase agreement, differences in the overall syntactic predictability of the two configurations might have modulated the waveforms. In the within-phrase conditions (e.g., _edificio_ muy _seguro_ "building-MASC-SG very safe-MASC-SG"), the critical adjective is preceded by the adverb _muy_ 'very,' which is likely (though not required) to be followed by an adjective. In the across-phrase conditions (e.g., _cuento es anónimo_ "story-MASC-SG is anonymous-MASC-SG"), however, the critical adjective is preceded by the copulative verb _es_ "is", which may be followed by either an adjective or a determiner phrase (e.g., _el cuento es un género literario_ "the story is a literary genre"). One possibility is that the parser could make a stronger prediction regarding the syntactic category of the critical word in the within-phrase conditions (Experiment 1) than in the across-phrase conditions (Experiment 2), which might have modulated the effects. The present study does not allow to discriminate between the two possibilities. The question of how syntactic predictability modulates processing and affects brain responses in contexts like these is a very interesting open question that should be examined in future studies (see, e.g., Lau et al., 2006, who find effects of syntactic prediction on early negative-going ERP responses).

9.2. Morphosyntactic Processing in Adult L2 Learners

The second purpose of the present dissertation was to examine morphosyntactic processing in adult L2 learners at an advanced level of proficiency, in order to further our understanding of how processing is impacted by the properties of the learners' L1 and by structural distance.

9.2.1.   The Processing of Novel Features

The third research question of the study, which is concerned with the accessibility of novel uninterpretable features in adult L2 acquisition is repeated below:

Research question 3

Can adult L2 learners at a high level of proficiency process novel features in a native-like manner, as proposed by the Full Transfer/Full Access Hypothesis (Schwartz & Sprouse, 1996), or do post-puberty L2 learners use nonnative-like strategies for the processing of novel uninterpretable functional features, as proposed by the Interpretability Hypothesis (Tsimpli & Dimitrakopoulou, 2007)?

This question was addressed by comparing the processing of number and gender agreement in Spanish by advanced L2 learners who are native speakers of English, a language that instantiates number, but not gender. Recall that both the Full Transfer/Full Access Hypothesis (Schwartz & Sprouse, 1996) and the Interpretability Hypothesis (Tsimpli & Dimitrakopoulou, 2007) predict a native-like pattern of results for number violations (P600), since number is part of the learners' L1 feature inventory. However, only the Full Transfer/Full Access Hypothesis (Schwartz & Sprouse, 1996) predicts that advanced L2 learners could show a native-like ERP pattern for gender violations (P600), regardless of the properties of the L1. In contrast, the Interpretability Hypothesis, which assumes that novel uninterpretable features are inaccessible in late L2 acquisition, predicts that English-speaking

learners of a [+gender] language will have to rely on compensatory mechanisms to establish gender agreement. As previously mentioned, a possible strategy for Spanish gender agreement would be to match word endings that frequently co-occur (e.g., –*o* with –*o*, as in *edificio muy seguro*). If learners do indeed apply such a strategy, an N400 is predicted for cases where word endings do not match (e.g., *edificio muy *segura* "building$_{-MASC-SG}$ very safe$_{-FEM-SG}$") (e.g., L1 processing: Barber & Carreiras, 2003, 2005; L2 processing: Osterhout et al., 2006, 2008; see also Morgan-Short et al., 2010). Crucially, this prediction is consistent with the results of previous studies investigating the effects of phonological priming on lexical access, where participants are specifically instructed to determine whether a given word (e.g., *hour*) "matches" a previously present item (e.g., *flower*) (e.g., Coch et al., 2008; McPherson et al., 1998). The results of these studies show that non matching prime-target pairs modulate the N400 component, but do not yield a P600.

The results of the present study indicate that adult L2 learners showed native-like sensitivity to both number and gender violations, as suggested by the P600 for both violation types overall. The fact that the late L2 learners in the present study elicited a native-like component for both number (present in the L1) and gender (absent in the L1) violations provides evidence that adult L2 learners can process new uninterpretable features in a native-like manner, at least at high levels of proficiency. These results are not easily accommodated by models that posit a permanent representational deficit for the acquisition of new uninterpretable features in post-puberty learners, such as the Interpretability Hypothesis (e.g., Tsimpli & Dimitrakopoulou, 2007) or the Failed Functional Features Hypothesis (e.g., Hawkins and Franceschina, 2004; Franceschina, 2005). The results of the present study are more in line with the Full Transfer/Full Access Hypothesis (e.g., Schwartz & Sprouse, 1996), which posits that late L2 acquisition is influenced, but not constrained by the properties of the L1 and, therefore, L2 learners can show native-like processing for novel features.

Unlike the Spanish controls in the study, the P600 effects for number and gender violations in the L2 learner group showed differences in amplitude (see Figures 3 and 5, pp. 103, 104) effects being more positive for number than gender violations in Experiments 1 and 2 (noun-adjective agreement). Notice that this difference in the processing of the two features would have been obscured in an offline task, since the accuracy rates for number and gender violations in the two experiments were both very high and did not significantly differ. The stronger sensitivity for number than gender violations is consistent with the proposal that learners benefit from positive L1 transfer, since number is instantiated in the learners' L1. These findings are also in line with the Full Transfer/Full Access Hypothesis (e.g., Schwartz & Sprouse, 1996), which predicts facilitation for features instantiated during L1 acquisition. A similar quantitative advantage for features that are present in the learners' L1 has been reported in previous studies on L2 morphosyntactic processing (e.g., Gillon-Dowens et al., 2010; Hopp, 2010). For example, as discussed in Chapter 5, the advanced English-speaking learners of Spanish in Gillon-Dowens et al. (2010) showed a larger P600 for number than gender violations, an effect which was not present in the Spanish controls. Moreover, the fact that, in Gillon-Dowens et al. (2011), no advantage was found for the processing of number in native speakers of Chinese, a language that instantiates neither number nor gender, provides further evidence that, in the absence of positive L1 transfer, sensitivity to number and gender in L2 processing is similar. A recent study by Hopp (2010) provides further evidence that properties that are different in the learners' L1 and L2 are more likely to cause difficulty in online L2 morphosyntactic processing. In Hopp's (2010) study, near-native speakers of German with different L1 backgrounds (Russian, Dutch, and English) showed target knowledge of a series of morphosyntactic properties of the L2, such as case marking and agreement, in both offline and online tasks. However, under a high processing burden (speeded grammaticality judgment task), this sensitivity considerably decreased, especially if

the learners' L1 was different from the L2, as suggested by the fact that the native speakers of

Russian, a language that systematically marks case dependencies overtly, were more

target-like in the processing of case violations in German than both the English-speaking and

Dutch-speaking learners, whose L1s do not systematically mark for case.

Similar to the Spanish controls, agreement violations in the present study did not elicit a

Left Anterior Negativity (LAN). In the L2 learners, however, number violations overall were

more negative than gender violations in the 250-400 ms time window, although neither

number nor gender significantly differed from grammatical sentences. Given that the LAN is

assumed to index automatic morphosyntactic processing, the absence of the LAN for

morphosyntactic violations in L2 processing has traditionally been interpreted as evidence

that L2 learners do not process morphosyntactic dependencies in a native-like manner

(Weber-Fox & Neville, 1996; Hahne & Friederici, 2001; Clahsen & Felser, 2006). However,

the fact that the Spanish controls in the current study did not consistently elicit a LAN for

either number or gender violations in any of the contexts under investigation, a result which

is consistent with a number of previous studies on the native processing of agreement (e.g.,

Wicha et al., 2004; Martín-Loeches et al., 2006, *inter alia*), indicates that claims attributing

the absence of the LAN in L2 learners to processing or representational deficits may be

premature (see McLaughlin et al., 2010).

9.2.2. Morphological Differences in the Realization of Shared Features

The fourth research question, which examines whether surface differences in the

morphological realization of a feature that is instantiated by both the L1 and the L2 (e.g.,

number) affect processing is repeated below:

Research Question 4:

Do morphological differences in how the L1 and the L2 realize a shared feature impact L2 morphosyntactic processing, as suggested by previous studies (e.g., Tokowicz & MacWhinney, 2005; Foucart & Frenck-Mestre, 2011; Morgan-Short et al., 2010)?

This question was addressed by examining number agreement between demonstratives and nouns (Experiment 3), which is a syntactic context where both English and Spanish realize number agreement, and between nouns and adjectives (Experiment 1), which is a syntactic context where only Spanish realizes number agreement. Neither the Full Transfer/Full Access Hypothesis (Schwartz & Sprouse, 1996) nor the Interpretability Hypothesis (Tsimpli & Dimitrakopoulou, 2007) predict that morphological differences in the realization of a shared feature (number) should affect the acquisition process. That is, since the native controls in the study did not show a difference for demonstrative-noun vs. noun-adjective number violations (Experiment 1 vs. Experiment 3), neither should learners. However, previous ERP studies have provided evidence that, even at advanced levels of proficiency, learners do not show native-like sensitivity for properties realized differently in the L1 and the L2 (Foucart & Frenck-Mestre, 2011; cf. Gillon-Dowens et al., 2010).

The results of the present study suggest that adult L2 learners can show native-like processing for novel instantiations of a feature, as suggested by the P600 for number violations realized on adjectives (Experiments 1 and 2), which is a syntactic context where English does not realize any type of agreement. A surprising result in the present study is that number violations between nouns and adjectives (Experiment 1) yielded a more robust P600 than number violations realized between demonstratives and nouns (Experiment 3), where the P600 was only marginal and restricted to the 400-650 ms time window. Interestingly, this asymmetry was not found for gender violations. Previous investigations (e.g., Tokowicz & MacWhinney, 2005; Foucart & Frenck-Mestre, 2011) have shown an advantage for features

that are realized similarly in the L1 and the L2. For example, the English-speaking learners of Spanish in Tokowicz and MacWhinney (2005) elicited a P600 for tense violations (similar in English and Spanish), but not for article-noun number violations (dissimilar in L1 and L2). Similarly, the L1 German L2 French learners in Foucart and Frenk-Mestre (2011) showed a P600 for gender violations between articles and nouns, where both German and French realize gender agreement, but not for gender violations between pluralized nouns and postnominal adjectives, where only French instantiates gender. The results of the present study suggest that other factors in addition to L1-L2 similarity may impact the establishment of morphosyntactic dependencies in an L2. There are a number of differences between Experiment 1 (noun-adjective agreement) and Experiment 3 (demonstrative-noun agreement) that might account for the pattern of results found in the present study. For example, the critical words in Experiments 1 and 3 are an adjective and a noun, respectively. Furthermore, in Experiment 1, the noun, which is the element that triggers agreement on other elements, precedes the adjective. In contrast, in Experiment 3 the noun follows the determiner. Finally, the masculine demonstrative in Experiment 3 (*este*) does not exhibit canonical gender marking, although this factor is unlikely to have affected the processing of number agreement, since it did not affect the processing of gender violations, which elicited a significant P600 that was largely similar to the P600 reported in Experiment 1, where all nouns and adjectives exhibited canonical gender marking. Future studies should investigate the extent to which these factors impact the processing of agreement in a late-acquired L2. However, it is important to keep in mind that the results for number agreement in Experiment 3 are predicted neither by the Full Transfer/Full Access Hypothesis (Schwartz & Sprouse, 1996) nor by the Interpretability Hypothesis (e.g., Tsimpli & Dimitrakopoulou, 2007), both of which predict native-like processing of number (present in the L1).

9.2.3. The Role of Structural Distance

The fifth research question, which examines the impact of structural distance on L2 morphosyntactic processing is repeated below:

Research Question 5:

Is the establishment of syntactic dependencies in a late-acquired L2 limited to local domains, as suggested by the Shallow Structure Hypothesis (Clahsen & Felser, 2006; Clahsen et al., 2010) or can adult L2 learners successfully resolve syntactic dependencies when the agreeing elements are located across phrases?

This question was addressed by comparing agreement realized within the phrase (e.g., _edificio muy seguro_ "building-MASC-SG very safe-MASC-SG") and agreement realized across the phrase (e.g., _cuento es anónimo_ "story-MASC-SG is anonymous-MASC-SG"). Recall that, under the Shallow Structure Hypothesis (Clahsen & Felser, 2006; Clahsen et al., 2010), adult L2 learners are predicted not to show sensitivity to agreement violations realized across the phrase (e.g., _cuento es anónimo_ "story-MASC-SG is anonymous-MASC-SG"), regardless of their proficiency level and of the properties of their L1 (that is, no sensitivity is predicted for either number or gender violations across the phrase).

The results of the present study show that adult L2 learners can establish agreement outside of local domains (e.g., Keating, 2010; Foote, 2011), as suggested by the fact that across-phrase violations elicited robust P600 effects for both number and gender. These results do not support the Shallow Structure Hypothesis (Clahsen & Felser, 2006; Clahsen et al., 2010), according to which, late L2 learners can only establish syntactic dependencies within local domains. Importantly, native speakers and L2 learners showed a very similar pattern of results, that is, within-phrase agreement yielded more positive waveforms than their across-phrase counterparts in both grammatical sentences and sentences with agreement violations. These results can be interpreted as evidence that structural distance impacts

agreement resolution overall, not only the repair of agreement violations. Importantly, the fact that the L2 learners were affected by the structural distance between the agreeing elements in a native-like manner provides evidence that adult L2 learners are able to posit hierarchical syntactic representations in the course of L2 processing (Wen et al., 2010), a finding that is also unpredicted by the Shallow Structure Hypothesis.

9.3. Concluding Remarks and Future Directions

The present study is one of the first to systematically investigate the native and nonnative processing of agreement dependencies at different levels of structural distance, while controlling for both linear distance and the syntactic category of the agreeing elements. The results of the study provide neurophysiological evidence suggesting that number and gender features are processed similarly in both native speakers (e.g., Nevins et al., 2007) and adult L2 learners at an advanced level of proficiency (e.g., Gillon-Dowens et al., 2010), as indicated by the presence of a P600 for both violation types in the two populations. In the learner group, results also provide evidence that the properties of the L1 influence L2 processing (as suggested by the larger P600 for number than gender violations between nouns and adjectives), but do not constrain it. Interestingly, L1 transfer did not systematically facilitate processing, as evidenced by the lack of a significant P600 for demonstrative-noun number violations, a context where both English and Spanish realize number agreement in a very similar way.

Regarding the impact of structural distance on the processing of agreement, the results of the present study also show that morphosyntactic processing in adult L2 learners is not confined to local domains, as suggested by the significant P600s for across-phrase violations. Distance, however, did impact processing in both native speakers and adult L2 learners, although the interpretation of this finding is less clear-cut. Since there was no interaction

between agreement and structural distance in any of the two groups, the more positive

waveforms for the within-phrase conditions (Experiment 1) can be interpreted in at least two

different ways. The first possibility is that, in both populations, structural distance impacts the

resolution of agreement dependencies overall, not limited to agreement violations, consistent

with the view that hierarchical structure is relevant to dependency formation even in

relatively simple structures (Bartek et al., 2011). However, a second possibility is that the

observed difference is a consequence of the differing level of predictability of the syntactic

category of the critical word in the within-phrase vs. across-phrase conditions (Experiment 1

vs. Experiment 2). Future studies should examine the extent to which structural distance

impacts the resolution of agreement in contexts that do not differ in syntactic predictability.

While the present dissertation provides empirical evidence that, at an advanced level of

proficiency, adult L2 learners' brain responses to morphosyntactic properties of the L2 are

qualitatively similar to those of native speakers', an interesting open question is how those

responses develop over time as a function of proficiency and, most importantly, how

proficiency interacts with structural distance and the properties of the learners' L1. The

present study is currently being extended to both low-proficiency and intermediate

English-speaking learners of Spanish in order to address these questions. Previous studies

have used ERPs to track the development of L2 grammars (e.g, Ojima et al., 2005; Rossi et

al., 2006; Bowden, 2007; Tanner et al., 2009; Morgan-Short et al., 2010). However, to my

knowledge, no previous ERP study has (1) addressed how proficiency interacts with

structural distance and L1 transfer and (2) examined learners at three different levels of

proficiency (low, intermediate, and advanced). Preliminary results, reported in Gabriele et al.

(in press), indicate that, at low levels of proficiency (n = 11), the properties of the L1 do not

seem to significantly impact L2 processing, as suggested by the fact that both number and

gender violations overall were associated with similar emerging positivities, relative to

grammatical sentences. At an intermediate level of proficiency (n = 11), however, L1 influence begins to emerge, as suggested by the fact that number violations yielded a significant P600, but the effect for gender was only marginal. Furthermore, results show that intermediate, but not low-proficiency learners were impacted by structural distance in a similar way to advanced learners and native speakers, suggesting that sensitivity to hierarchical syntactic representations emerges at an intermediate level of proficiency. Taken together, the results for all learner groups (low, intermediate, advanced) provide evidence that the ERP methodology is a promising method to investigate grammatical development in L2 learners.

Future research should also shed light on the linguistic factors, other than structural distance, that may impact L2 processing. One potential factor is morphological markedness, the notion that some morphemes are more specified or complex than others. A previous ERP study by Deutsch and Bentin (2001) provides evidence that morphological markedness does indeed modulate processing in native speakers. In Deutsch and Bentin's (2001) study, native speakers of Hebrew showed greater sensitivity (as suggested by a larger P600) to subject-verb agreement violations when the verb was marked (plural), compared to when it was unmarked (singular). Furthermore, a recent behavioral study by McCarthy (2008) provides evidence that adult L2 learners are also impacted by morphological markedness. In her study, English-speaking learners of Spanish showed greater sensitivity to some agreement errors than others, an asymmetry that McCarthy accounts for in terms of markedness. More specifically, the learners in her study were more sensitive to agreement violations that involved an underspecified noun (e.g., masculine, singular) and a marked adjective (e.g., *libro nueva* "book$_{MASC-SG}$ new$_{FEM-SG}$", "*libro nuevos* "book$_{MASC-SG}$ new$_{MASC-PL}$"), which she calls "feature clash errors", than to violations which involved a marked noun (e.g., feminine, plural) and an underspecified adjective (e.g., *caja nuevo* "box$_{FEM-SG}$ new$_{MASC-SG}$"

or *cajas nueva* "box-FEM-PL new-FEM-SG"), which she calls "underspecification mistakes". The question of whether morphological markedness modulates second language processing at the brain level remains an interesting open question which should be addressed in future studies, since it carries the potential to further our understanding of the factors that underlie the well-attested variability in adult L2 learners' morphological competence.

Finally, while the present dissertation has advanced our understanding of the mechanisms that guide L2 processing in advanced L2 learners as a group, future research should also evaluate the extent to which individual-level cognitive factors, such as working memory, impact processing at the brain level. While working memory has been shown to modulate syntactic processing at the brain level in native speakers (e.g. Vos et al., 2001), it remains an open question whether it can modulate brain sensitivity to long-distance syntactic dependencies in L2 learners. This is an important question, since syntactic dependencies often involve elements that are structurally very far apart and which the processor must store in working memory, increasing the processing burden. Using ERPs to examine individual differences in L2 processing is an approach that has recently been adopted by Bond et al. (2011), who focus on how verbal aptitude and general intelligence impact processing in adult L2 learners and how these factors interact with the properties of the learners' L1. In Bond et al.'s (2011) study, verbal aptitude was found to positively correlate with P600 amplitude for noun-adjective number violations (e.g., *_cuento es anónimos_* "story-MASC-SG is anonymous-MASC-PL") in English-speaking learners of Spanish at low-proficiency, suggesting that learners with higher verbal aptitude may be more sensitive to number agreement when it is realized in a context where the L1 does not realize agreement (at least at lower levels of proficiency). Most importantly, Bond et al.'s (2011) results show that the ERP methodology is a very innovative and promising approach for examining the role of individual differences in adult L2 acquisition and processing.

REFERENCES

Allen, M., Badecker, W., & Osterhout, L. (2003). Morphological analysis in sentence processing: an ERP study. *Language and Cognitive Processes, 18*, 405-430.

Antón-Méndez, I., Nicol, J.L., & Garrett, M.F. (2002). The relation between gender and number agreement processing. *Syntax, 5*, 1-25.

Barber, H., & Carreiras, M. (2003). Integrating gender and number information in Spanish word pairs: An ERP study. *Cortex, 39*, 465-482.

Barber, H., & Carreiras, M. (2005). Grammatical gender and number agreement in Spanish: An ERP comparison. *Journal of Cognitive Neuroscience, 17*, 137-153.

Bartek, B., Lewis, R.L., Vasishth, S., & Smith, M. (2011). In search of on-line locality effects in sentence comprehension. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 37*, 1178-1198.

Bernstein, J. (1991). DPs in French and Walloon: Evidence for parametric variation in nominal head movement. *Probus, 3*, 101-126.

Bernstein, J. (2001a). Focusing the "right" way in Romance determiner phrases. *Probus, 13*, 1-29.

Bernstein, J. (2001b). The DP Hypothesis: Identifying clausal properties in the nominal domain. In M. Baltin & C. Collins (Eds.), *The Handbook of Contemporary Syntactic Theory* (pp. 536-561). Oxford: Blackwell.

Besson, M., Kutas, M., & Van Petten, C. (1992). An event-related potential (ERP) analysis of semantic congruity and repetition effects in sentences. *Journal of Cognitive Neuroscience, 4*, 132-149.

Bock, K., & Cutting, J.C. (1992). Regulating mental energy: Performance units in language production. *Journal of Memory and Language, 31*, 99-127.

Bond, K., Gabriele, A., Fiorentino, R., Alemán Bañón, J. (2011). Individual differences and the role of the L1 in L2 processing: an ERP investigation. In J. Herschensohn & D. Tanner (Eds.), *Proceedings of the 11th Generative Approaches to Second Language Acquisition* (pp. 17-30). Cambridge, MA: Cascadilla Proceedings Project.

Bowden, H.W. (2007). Proficiency and second-language neurocognition: A study of Spanish as a first and second language. Ph.D. Dissertation, Georgetown University.

Bruhn de Garavito, J., & White, L. (2002). L2 acquisition of Spanish DPs: The status of grammatical features. In A.T. Pérez-Leroux & J.M. Liceras (Eds.), *The acquisition of Spanish morphosyntax: The L1/L2 connection* (pp. 151-176). Doradrecht: Kluwer.

Carminati, M.N. (2005). Processing reflexes of the feature hierarchy (Person>Number>Gender) and implications for linguistic theory. *Lingua, 115,* 259-285.

Carstens, V. (2000). Concord in minimalist theory. *Linguistic Inquiry, 31*, 319-355.

Cinque, G. (1994). On the evidence for partial N-movement in the Romance DP. In G. Cinque, J. Koster, J.Y. Pollock, L. Rizzi, & R. Zanuttini (Eds.), *Paths towards Universal Grammar: Studies in honor of Richard S. Kayne* (pp. 85-110). Washington, DC: Georgetown University Press.

Clahsen, H., & Felser, C. (2006). Continuity and shallow structures in language processing. *Applied Psycholinguistics, 27,* 107-126.

Clahsen, H., Felser, C., Neubauer, K., Sato, M., & Silva, R. (2010). Morphological structure in native and nonnative language processing. *Language Learning, 60,* 21-43.

Coch, D., Hart, T., & Mitra, P. (2008). Three kinds of rhymes: an ERP study. *Brain and Language, 104*, 230-243.

Colé, P., & Segui, J. (1994). Grammatical incongruency and vocabulary types. *Memory and Cognition, 22*, 387-394.

Corbett, G.G. (1991). *Gender*. New York, NY: Cambridge University Press.

Coulson, S., King, J.W., & Kutas, M. (1998). Expect the unexpected: Event-related brain response to morphosyntactic violations. *Language and Cognitive Processes, 13*, 21-58.

Davis, C.J. & Perea, M. (2005). BuscaPalabras: A program for deriving orthographic and phonological neighborhood statistics and other psycholinguistic indices in Spanish. *Behavior Research Methods, 37*, 665-671.

De Vincenzi, M. (1999). Differences between the morphology of gender and number: Evidence from establishing coreferences. *Journal of Psycholinguistic Research, 28*, 537-553.

De Vincenzi, M., Job, R., Di Matteo, R., Angrilli, A., Penolazzi, B., Ciccarelli, L., & Vespignani, F. (2003). Differences in the perception and time course of syntactic and semantic violations. *Brain and Language, 85*, 280-296.

Demestre, J., Meltzer, S., García-Albea, J., & Vigil, A. (1999). Identifying the null subject: Evidence from event-related brain potentials. *Journal of Psycholinguistic Research, 28*, 293-312.

Deutsch, A. & Bentin, S. (2001). Syntactic and semantic factors in processing gender agreement in Hebrew: Evidence from ERPs and eye movements. *Journal of Memory and Language, 45*, 200-224.

Deutsch, A. (1998). Subject-predicate agreement in Hebrew: Interrelations with semantic processes. *Language and Cognitive Processes*, *13*, 575-597.

Domínguez, A., Cuetos, F., & Segui, J. (1999). The processing of grammatical gender and number in Spanish. *Journal of Psycholinguistic Research, 28*, 485-498.

Eberhard, K. (1997). The marked effect of number on subject-verb agreement. *Journal of Memory and Language, 36*, 147-164.

Eberhard, K.M., Cutting, J.C., & Bock, J.K. (2005). Making syntax of sense: Number agreement in sentence production. *Psychological Review, 112*, 531-559.

Faussart, C., Jakubowicz, C., & Costes, M. (1999). Gender and number processing in spoken French and Spanish. *Rivista di Linguistica, 11*, 75-101.

Federmeier, K.D., Kluender, R., & Kutas, M. (2002). Aligning linguistic and brain views on language comprehension. In A. Zani & A.M. Proverbio (Eds.), *The Cognitive Electrophysiology of Mind and Brain.* (pp. 143-168). San Diego, CA: Academic Press.

Fiebach, C.J., Schlesewsky, M., & Friederici, A.D. (2002). Separating syntactic memory costs and syntactic integration costs during parsing: The processing of German WH-questions. *Journal of Memory and Language, 47*, 250-272.

Foote, R. (2011). Integrated knowledge of agreement in early and late English-Spanish bilinguals. *Applied Psycholinguistics, 32*, 187-220.

Foucart, A., & Frenck-Mestre, C. (2011). Grammatical gender processing in L2: Electrophysiological evidence of the effect of L1-L2 syntactic similarity. *Bilingualism, Language and Cognition, 14*, 379-399.

Foucart, A., & Frenck-Mestre, C. (2012). Can late L2 learners acquire new grammatical features? Evidence from ERPs and eye-tracking. *Journal of Memory and Language, 66*, 226-248.

Franceschina, F. (2005). *Fossilized second language grammars: The acquisition of grammatical gender*. Amsterdam: Benjamins.

Frenck-Mestre C., Osterhout, L., McLaughlin, J., & Foucart, A. (2008). The effect of phonological realization of inflectional morphology on verbal agreement in French: Evidence from ERPs. *Acta Psychologica, 128*, 528-536.

Frenzel, S., Schlesewsky, M., & Bornkessel-Schlesewsky, I., (2011). Conflicts on language processing: A new perspective on the N400-P600 distinction. *Neuropsychologia, 49*, 574-579.

Friederici, A.D. (2002). Towards a neural basis of auditory sentence processing. *Trends in Cognitive Sciences, 6*, 78-84.

Friederici, A.D. (2004). Event-related brain potential studies in language. *Current Neurology and Neuroscience Report, 4*, 466-470.

Friederici, A.D., Hahne, A., & Saddy, D. (2002). Distinct neurophysiological patterns reflecting aspects of syntactic complexity and syntactic repair. *Journal of Psycholinguistic Research, 31*, 45-63.

Frisch, S., Kotz, S., Von Cramon, D., & Friederici, A.D. (2003). Why the P600 is not just a P300: The role of the basal ganglia. *Clinical Neurophysiology, 114*, 336-340.

Gabriele, A., Fiorentino, R., & Alemán Bañón, J., (in press). Examining second language development using event-related potentials: a cross-sectional study on the processing of gender and number agreement. *Linguistic Approaches to Bilingualism.*

Gibson, E. (1998). Linguistic complexity: Locality of syntactic dependencies. *Cognition, 68*, 1-76.

Gibson, E. (2000). Dependency locality theory: A distance-based theory of linguistic complexity. In A. Marantz, Y. Miyashita, & W. O'Neil (Eds.), *Image, language, brain: Papers from the first mind articulation project symposium* (pp. 95-126). Cambridge, MA: MIT Press.

Gillon Dowens, M., Vergara, M., Barber, H., & Carreiras, M. (2010). Morphosyntactic processing in late second-language learners. *Journal of Cognitive Neuroscience, 22*, 1870-1887.

Gillon Dowens, M., Guo, T., Guo, J., Barber, H., & Carreiras, M. (2011). Gender and number processing in Chinese learners of Spanish – Evidence from event related potentials. *Neuropsychologia, 49*, 1651-1659.

Giusti, G. (1993). *La Sintassi dei Determinanti*. Padova: Unipress.

Gouvea, A.C., Phillips, C., Kazanina, N., & Poeppel, D. (2010). The linguistic processes underlying the P600. *Language and Cognitive Processes, 25*, 140-188.

Gunter, T.C., Friederici, A.D., & Schriefers, H. (2000). Syntactic gender and semantic expectancy: ERPs reveal early autonomy and late interaction. *Journal of Cognitive Neuroscience, 12*, 556-568.

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

Hagoort, P., & Brown, C.M. (1999). Gender electrified: ERP evidence on the syntactic nature of gender processing. *Journal of Psycholinguistic Research, 28*, 715-728.

Hagoort, P., & Brown, C.M. (2000). ERP effects of listening to speech compared to reading: the P600/SPS to syntactic violations in spoken sentences and rapid serial visual presentation. *Neuropsychologia, 38*, 1531-1549.

Hagoort, P. (2003). Interplay between syntax and semantics during sentence comprehension: ERP effects of combining syntactic and semantic violations. *Journal of Cognitive Neuroscience, 15*, 883-899.

Hagoort, P., Brown, C.M., & Groothusen, J. (1993). The syntactic positive shift (SPS) as an ERP measure of syntactic processing. *Language and Cognitive Processes, 8*, 439-484.

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

Hahne, A., & Friederici, A.D. (1999). Electrophysiological evidence for two steps in syntactic analysis: Early automatic and late controlled processes. *Journal of Cognitive Neuroscience, 11*, 194-205.

Hammer, A., Jansma, B.M., Lamers, M., & Münte, T.F. (2008). Interplay of meaning, syntax and working memory during pronoun resolution investigated by ERPs. *Brain Research, 1230*, 177-191.

Handy, T.C. (2004). *Event-Related Potentials: A Methods Handbook*. Cambridge, MA: MIT Press.

Harris, J. (1991). The exponence of gender in Spanish. *Linguistic Inquiry, 22*, 27-62.

Hawkins, R., & Chan, C.Y. (1997). The partial availability of Universal Grammar in second language acquisition: The 'failed functional features hypothesis'. *Second Language Research, 13*, 187-226.

Hawkins, R., & Franceschina, F. (2004). Explaining the acquisition and non-acquisition of determiner-noun gender concord in French and Spanish. In P. Prévost & J. Paradis (Eds.), *The Acquisition of French in Different Contexts* (pp. 175-206). Amsterdam: John Benjamins.

Hawkins, R., & Liszka, S. (2004). Locating the source of defective past tense marking in advanced L2 English speakers. In R. van Hout, A. Hulk., F. Kuiken., & R. Towell (Eds.), *The interface between syntax and lexicon in second language acquisition* (pp. 21-44). Amsterdam: John Benjamins.

Hawkins, R. (2001). The theoretical significance of Universal Grammar in SLA. Second *Language Research, 17,* 345-367.

Hinojosa, J., Martín-Loeches, M., Casado, P., Muñoz, F., & Rubia, F.J. (2003). Similarities and differences between phrase structure and morphosyntactic violations in Spanish: An event-related potentials study. *Language and Cognitive Processes, 18*, 113-142.

Holcomb, P.J., & Neville, H.J. (1990). Auditory and visual semantic priming in lexical decision: A comparison using event-related brain potentials. *Language and Cognitive Processes, 5*, 281-312.

Hopp, H. (2010). Ultimate attainment in L2 inflection: Performance similarities between non-native and native speakers. *Lingua, 120,* 901-931.

Isel, F. (2007). Syntactic and referential processes in second-language learners: Event-related brain potential evidence. *Neuroreport, 18*, 1885-89.

Just, M.A., & Carpenter, P.A. (1992). A capacity theory of comprehension: Individual differences in working memory. *Psychological Review, 99,* 122-149.

Kaan, E., & Swaab, T.Y. (2003). Repair, revision, and complexity in syntactic analysis: An electrophysiological differentiation. *Journal of Cognitive Neuroscience, 15*, 98-110.

Kaan, E. (2002). Investigating the effects of distance and number interference in processing subject-verb dependencies: An ERP Study. *Journal of Psycholinguistic Research, 31*, 165-193.

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

Keating, G.D. (2009). Sensitivity to violations of gender agreement in native and nonnative Spanish: An eye-movement investigation. *Language Learning, 59,* 503-535.

Keating, G.D. (2010). The effects of linear distance and working memory on the processing of gender agreement in Spanish. In B. VanPatten & J. Jegerski (Eds.), *Research in second language processing and parsing* (pp. 113-134). Amsterdam/Philadelphia: John Benjamins.

Kessler, K. (2003). *ERP correlates of word order and morphosyntactic phenomena in adult native speakers and second language learners of English*. Ph.D. Dissertation, CUNY.

King, J.W., & Kutas, M. (1995). Who did what and when? Using word- and clause-level ERPs to monitor working memory usage in reading. *Journal of Cognitive Neuroscience, 7*, 376-395.

Kluender, R., & Kutas, M. (1993). Bridging the gap: Evidence from ERPs on the processing of unbounded dependencies. *Journal of Cognitive Neuroscience, 5*, 196-214.

Kolk, H.H.J., Chwilla, D.J., Van Herten, M., & Oor, P.J.W. (2003). Structure and limited capacity in verbal working memory: A study with event-related potentials. *Brain and Language, 85*, 1-36.

Kotz, S.A. (2009). A critical review of ERP and fMRI evidence on L2 syntactic processing. *Brain and Language*, *109*, 68-74.

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

Kutas, M., & Hillyard, S.A. (1983). Event-related brain potentials to grammatical errors and semantic anomalies. *Memory & Cognition, 11*, 539-550.

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

Kutas, M., Van Petten, C.K., & Kluender, R. (2006). Psycholinguistics electrified II (1994-2005). In M. Traxler & M.A. Gernsbacher (Eds.), *Handbook of Psycholinguistics* (pp. 659-724). New York, NY: Elsevier.

Lau, E., Phillips, C., & Poeppel, D. (2008). A cortical network for semantics: (de)constructing the N400. *Nature, 9*, 920-933.

Lau, E., Stroud, C., Plesch, S., & Phillips, C. (2006). The role of structural prediction in rapid syntactic analysis. *Brain Language, 98*, 74-88.

Lewis, R.L., Vasishth, S., & Van Dyke, J. (2006). Computational principles of working memory in sentence comprehension. *Trends in Cognitive Science, 10,* 447-454.

Lukatela, G., Kostic, A., Todorovic, D., Carello, C., & Turvey, M.T. (1987). Type and number of violations and the grammatical congruency effect in lexical decision. *Psychological Research, 49*, 37-43.

Mancini, S., Molinaro, N., Rizzi, L., & Carreiras, M. (2011). A person is not a number: discourse involvement in subject-verb agreement computation. *Brain Research, 1410*, 64-76.

Marinis, T., Roberts, L., Felser, C., & Clahsen, H. (2005). Gaps in second language sentence processing. *Studies in Second Language Acquisition, 27*, 53-78.

Martín-Loeches, M., Nigbur, R., Casado, P., Hohlfeld, A., & Sommer, W. (2006). Semantics prevalence over syntax during sentence processing: A brain potential study of noun-adjective agreement in Spanish. *Brain Research, 1093*, 178-189.

McCarthy, C. (2008). Morphological variability in the comprehension of agreement: An argument for representation over computation. *Second Language Research, 24,* 459-486.

McDonald, J. (2006). Beyond the critical period: Processing-based explanations for poor grammaticality judgment performance by late second language learners. *Journal of Memory and Language, 55*, 381-401.

McLaughlin, J., Tanner, D., Pitkänen, I., Frenck-Mestre, C., Inoue, K., Valentine, G., & Osterhout, L. (2010). Brain potentials reveal discrete stages of L2 grammatical learning. *Language Learning, 60, Supplement 2,* 123-150.

McPherson, W.B., Ackerman, P.T., Holcomb, P.J., & Dykman, R.A. (1998). Event-related brain potentials elicited during phonological processing differentiate subgroups of reading disabled adolescents. *Brain and Language, 62*, 163-185.

Molinaro, N., Barber, H.A., & Carreiras, M. (2011a). Grammatical agreement processing in reading: ERP findings and future directions. *Cortex, 97*, 908-930

Molinaro, N., Kim, A., Vespignani, F., & Job, R. (2008a). Anaphoric agreement violation: An ERP analysis of its interpretation. *Cognition, 106*, 963-973.

Molinaro, N., Vespignani, F., & Job, R. (2008b). A deeper reanalysis of a superficial feature: An ERP study on agreement violations. *Brain Research, 1228*, 161-176.

Molinaro, N., Vespignani, F., Zamparelli, R., & Job, R. (2011b). Why brother and sister are not just siblings: Repair processes in agreement computation. *Journal of Memory and Language, 64*, 211-232.

Montrul, S., Foote, R., & Perpiñán, S. (2008). Gender agreement in adult second language learners and Spanish heritage speakers: the effects of age and context of acquisition. *Language Learning, 58,* 503-553.

Morgan-Short, K., Sanz, C., Steinhauer, K., & Ullman, M. (2010). Second language learning of gender agreement in explicit and implicit training conditions: An event-related potential study. *Language Learning, 60*, 154-193.

Morris, J., & Holcomb, P.J. (2005). Event-related potentials to violations of inflectional verb morphology in English. *Cognitive Brain Research, 25*, 963-981.

Mueller, J.L. (2005). Electrophysiological correlates of second language processing. *Second Language Research, 2,* 152-174.

Münte, T.F., Szentkuti, A., Wieringa, B.M., Matzke, M., & Johannes, S. (1997). Human brain potentials to reading syntactic errors in sentences of different complexity. *Neuroscience Letters, 235*, 105-108.

Myles, F. (1995). Interaction between linguistic theory and language processing in SLA. *Second Language Research, 11,* 235-266.

Neville, H.J., Nicol, J., Barss, A., Forster, K., & Garrett, M. (1991). Syntactically based sentence processing classes: Evidence from event-related potentials. *Journal of Cognitive Neuroscience, 3,*155-170.

Nevins, A., Dillon, B., Malhotra, S., & Phillips, C. (2007). The role of feature-number and feature-type in processing Hindi verb agreement violations. *Brain Research, 1164*, 81-94.

Ojima, S., Nakata, H., & Kakigi, R. (2005). An ERP study of second language learning after childhood: Effects of proficiency. *Journal of Cognitive Neuroscience, 17*, 1212-1228.

Oldfield, R.C. (1971). The assessment and analysis of handedness: the Edinburgh inventory. *Neuropsychologia, 9*, 97-113.

O'Rourke, P.L., & Van Petten, C. (2011). Morphological agreement at a distance: Dissociation between early and late components of the event-related brain potential. *Brain Research, 1392*, 62-79.

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

Osterhout, L., & Hagoort, P. (1999). A superficial resemblance does not necessarily mean you are part of the family: Counterarguments to Coulson, King and Kutas (1998) in the P600/SPS-P300 debate. *Language and Cognitive Processes, 14*, 1-14.

Osterhout, L., & Mobley, L. A. (1995). Event-related brain potentials elicited by failure to agree. *Journal of Memory and Language, 34*, 739-773.

Osterhout, L., McLaughlin, J., Pitkänen, I., Frenck-Mestre, C., & Molinaro, N. (2006). Novice learners, longitudinal designs, and event-related potentials: A means for exploring the neurocognition of second language processing. *Language Learning, 56*, 199-230.

Osterhout, L., Poliakov, A., Inoue, K., McLaughlin, J., Valentine, G., Pitkänen, I., Frenck-Mestre, C., & Herschensohn, J. (2008). Second-language learning and changes in the brain. *Journal of Neurolinguistics, 21*, 509-521.

Pearlmutter, N.J. (2000). Linear versus hierarchical agreement feature processing in comprehension. *Journal of Psycholinguistic Research*, *29*, 89-98.

Phillips, C., Kazanina, N., Abada, S.H. (2005). ERP effects of the processing of syntactic long-distance dependencies. *Cognitive Brain Research, 22*, 407-428.

Picallo, M.C. (1991). Nominals and nominalizations in Catalan. *Probus, 3*, 279-316.

Picallo, M.C., (2008). Gender and number in Romance. *Lingue e Linguaggio, 7*, 47-66.

Ritter, E. (1991). Two functional categories in noun phrases: Evidence from Modern Hebrew. In S.D. Rothstein (Ed.), *Syntax and semantics 25*: *Perspectives on phrase structure: Heads and licensing* (pp. 37-62). New York, NY: Academic Press.

Ritter, E. (1993). Where is gender? *Linguistic Inquiry, 24*, 795-803.

Roca, F. (1996). *La determinación y la modificación nominal en español*. Ph.D. Dissertation, Universidad Autónoma de Barcelona.

Rossi, S., Gugler, M.F., Hahne, A., & Friederici, A.D. (2005). When word category information encounters morphosyntax: An ERP study. *Neuroscience Letters, 384*, 228-233.

Rossi, S., Gugler, M.F., Friederici, A.D., & Hahne, A. (2006). The impact of proficiency on syntactic second-language processing of German and Italian: Evidence from event-related potentials. *Journal of Cognitive Neuroscience, 18*, 2030-2048.

Rugg, M.D. (1985). The effects of semantic priming and word repetition on event-related potentials. *Psychophysiology, 22,* 642-647.

Sabourin, L., & Stowe, L. (2008). Second language processing: When are first and second languages processed similarly? *Second Language Research, 23,* 397-430.

Sabourin, L. (2003). *Grammatical gender and second language processing: An ERP study*. Ph.D. Dissertation, Groningen.

Saporta, S. (1965). Ordered rules, dialect differences, and historical processes. *Language, 41*, 218-224.

Schmitt B., Lamers M., & Münte T.F. (2002). Electrophysiological estimates of biological and syntactic gender violation during pronoun processing. *Cognitive Brain Research, 14*, 333-346.

Schwartz, B.D., & Sprouse, R. (1996). L2 cognitive states and the Full Transfer/Full Access model. *Second Language Research, 12,* 40-72.

Silva-Pereyra, J.F., & Carreiras, M. (2007). An ERP study of agreement features in Spanish. *Brain Research, 1185*, 201-211.

Steinhauer, K., White, E.J., & Drury, J. (2009). Temporal dynamics of late second language acquisition: evidence from event-related brain potentials. *Second Language Research*, *25*, 13-41.

Tagliaferri, B. (2005). *Paradigm*. Perception Research Systems, Inc. www.perceptionresearchsystems.com

Tanner, D., Osterhout, L., & Herschensohn, J. (2009). Snapshots of grammaticalization: Differential electrophysiological responses to grammatical anomalies with increasing L2 exposure. In J. Chandlee, M. Franchini, S. Lord, & G.M. Rheiner (Eds.), *Proceedings of the 33rd Boston University Conference on Language Development* (pp. 528-539). Somerville, MA: Cascadilla Press.

Tokowicz, N., & MacWhinney, B. (2005). Implicit and explicit measures of sensitivity to violations in second language grammar: An event-related potential investigation. *Studies in Second Language Acquisition, 27*, 173-204.

Tolentino, L.C., Tokowicz, N. (2011). Across languages, space, and time: A review of the role of cross-language similarity in L2 (morpho)syntactic processing as revealed by fMRI and ERP. *Studies in Second Language Acquisition, 33,* 91-125.

Tsimpli, I., & Dimitrakopoulou, M. (2007). The interpretability hypothesis: evidence from wh-interrogatives in second language acquisition. *Second Language Research, 23,* 215-242.

Ullman, M.T. (2001). The neural basis of lexicon and grammar in first and second language: the Declarative/Procedural Model. *Bilingualism: Language and Cognition, 4*, 105-22.

Valois, Daniel (1991). *The internal syntax of DP*. Ph.D. dissertation, University of California, Los Angeles.

Van Hell, J. (2010). Event-related brain potentials and second language learning: Syntactic processing in late L2 learners at different L2 proficiency levels. *Second Language Research, 26,* 43-74.

Van Petten, C. (1993). A comparison of lexical and sentence-level context effects and their temporal parameters. *Language and Cognitive Processes, 8*, 485-532.

Van Petten, C., & Kutas, M. (1990). Interactions between sentence context and word frequency in event-related brain potentials. *Memory & Cognition, 18*, 380-393.

Vos, S.H., Gunter, T.C., Herman, H., Kolk, H.J., & Mulder, G. (2001). Working memory constraints on syntactic processing: An electrophysiological investigation. *Psychophysiology, 38*, 41-63.

Wassenaar, M., Brown, C.M., & Hagoort, P. (2004). ERP-effects of subject-verb agreement violations in patients with Broca's aphasia. *Journal of Cognitive Neuroscience*, *16*, 553-576.

Weber-Fox, C.M. & Neville, H. (1996). Maturational constraints on functional specializations for language processing: ERP and behavioral evidence in bilingual speakers. *Journal of Cognitive Neuroscience, 8,* 231-256.

Wen, Z., Miyao, M., Takeda, A., Chu, W., & Schwartz, B.D. (2010). Proficiency effects and distance effects in non-native processing of English number agreement. In K. Franchini,

K. Iserman, & L. Keil (Eds.), *Proceedings of the 34th Boston University Conference on Language Development* (pp. 445-456). Somerville, MA: Cascadilla Press.

White, L. (1990). Another look at the logical problem of foreign language learning: a reply to Bley-Vroman. *Linguistic Analysis, 20*, 50-63.

White, L., Valenzuela, E., Koslowska-Macgregor, M., & Leung, Y-K.I. (2004). Gender and number agreement in nonnative Spanish. *Applied Psycholinguistics, 25*, 105-133.

Wicha, N.Y., Moreno, E.M., & Kutas, M. (2004). Anticipating words and their gender: An event-related brain potential study of semantic integration, gender expectancy and gender agreement in Spanish sentence reading. *Journal of Cognitive Neuroscience*, *16*, 1272-1288.

Multiple Choice Test

Each of the following sentences contains a blank indicating that a word or phrase has been omitted. Select the choice that best completes the sentence.

1. Al oír del accidente de su buen amigo, Paco se puso _____.

    a. alegre   b. fatigado   c. hambriento   d. desconsolado

2. No puedo comprarlo porque me_____.

    a. falta   b. dan   c. presta   d. regalan

3. Tuvo que guardar cama por estar _____.

    a. enfermo   b. vestido   c. ocupado   d. parado

4. Aquí está tu café, Juanito. No te quemes, que está muy _____.

    a. dulce   b. amargo   c. agrio   d. caliente

5. Al romper los anteojos, Juan se asustó porque no podía _____ sin ellos.

    a. discurrir   b. oír   c. ver   d. entender

6. ¡Pobrecita! Está resfriada y no puede _____.

    a. salir de casa   b. recibir cartas   c. respirar con pena   d. leer las noticias

7. Era una noche oscura sin _____.

    a. estrellas   b. camas   c. lágrimas   d. nubes

8. Cuando don Carlos salió de su casa, saludó a un amigo suyo: -Buenos días,____.

    a. ¿Qué va?   b. ¿Cómo es?   c. ¿Quién es?   d. ¿Qué tal?

9. ¡Qué ruido había con los gritos de los niños y el _____ de los perros!

    a. olor   b. sueño   c. hambre   d. ladrar

10. Para saber la hora, don Juan miró el _____.

    a. calendario   b. bolsillo   c. estante   d. despertador

11. Yo, que comprendo poco de mecánica, sé que el auto no puede funcionar sin _____.

a. permiso   b. comer   c. aceite   d. bocina

12. Nos dijo mamá que era hora de comer y por eso _____.

a. fuimos a nadar   b. tomamos asiento   c. comenzamos a fumar
d. nos acostamos pronto

13. ¡Cuidado con ese cuchillo o vas a _____ el dedo!

a. cortarte   b. torcerte   c. comerte   d. quemarte

14. Tuvo tanto miedo de caerse que se negó a _____ con nosotros.

a. almorzar   b. charlar   c. cantar   d. patinar

15. Abrió la ventana y miró: en efecto, grandes lenguas de _____ salían llameando de las casas.

a. zorros   b. serpientes   c. cuero   d. fuego

16. Compró ejemplares de todos los diarios pero en vano. No halló _____.

a. los diez centavos   b. el periódico perdido   c. la noticia que deseaba
d. los ejemplos

17. Por varias semanas acudieron colegas del difunto profesor a _____ el   dolor   de   la viuda.

a. aliviar   b. dulcificar   c. embromar   d. estorbar

18. Sus amigos pudieron haberlo salvado pero lo dejaron _____.

a. ganar   b. parecer   c. perecer   d. acabar

19. Al salir de la misa me sentía tan caritativo que no pude menos que _____ a un pobre mendigo que había allí sentado.

a. pegarle   b. darle una limosna   c. echar una mirada   d. maldecir

20. Al lado de la Plaza de Armas había dos limosneros pidiendo _____.

a. pedazos   b. paz   c. monedas   d. escopetas

21. Siempre maltratado por los niños, el perro no podía acostumbrarse a _____ de   sus nuevos amos.

a. las caricias   b. los engaños   c. las locuras   d. los golpes

22. ¿Dónde estará mi cartera? La dejé aquí mismo hace poco y parece que el necio de mi hermano ha vuelto a _____.

a. dejármela   b. deshacérmela   c. escondérmela   d. acabármela

23. Permaneció un gran rato abstraído, los ojos clavados en el fogón y el pensamiento __
_____.

a. en el bolsillo   b. en el fuego   c. lleno de alboroto   d. Dios sabe dónde

24. En vez de dirigir el tráfico estabas charlando, así que tú mismo _____ del choque.

a. sabes la gravedad   b. eres testigo   c. tuviste la culpa
d. conociste a las víctimas

25. Posee esta tierra un clima tan propio para la agricultura como para _____.

a. la construcción de trampas   b. el fomento de motines   c. el costo de vida
d. la cría de reses

26. Aficionado leal de obras teatrales, Juan se entristeció al saber _____ del   gran actor.

a. del fallecimiento   b. del éxito   c. de la buena suerte   d. de la alabanza

27. Se reunieron a menudo para efectuar un tratado pero no pudieron _____.

a. desavenirse   b. echarlo a un lado   c. rechazarlo   d. llevarlo a cabo

28. Se negaron a embarcarse porque tenían miedo de _____.

a. los peces   b. los naufragios   c. los faros   d. las playas

29. La mujer no aprobó el cambio de domicilio pues no le gustaba _____.

a. el callejeo   b. el puente   c. esa estación   d. aquel barrio

30. Era el único que tenía algo que comer pero se negó a _____.

a. hojearlo   b. ponérselo   c. conservarlo   d. repartirlo

Cloze Test

In the following text, some of the words have been replaced by blanks numbered 1 through 20. First, read the complete text in order to understand it. Then reread it and choose the correct word to fill each blank from the answer sheet. Mark your answers by circling your choice on the answer sheet, not by filling in the blanks in the text.

El sueño de Joan Miró

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

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

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

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

Cloze Test Answer Sheet

1. a. cumplido b. completado c. terminado

2. a. inició b. iniciara c. iniciaba

3. a. encargar b. pedir c. mandar

4. a. hubiera servido b. haya servido c. sirviera

5. a. superar b. enfrentarse c. acabar

6. a. por b. en c. con

7. a. voluntad b. poder c. favor

8. a. al b. en c. a

9. a. habría b. había c. hubo

10. a. que b. el que c. lo que

11. a. pretendido b. tratado c. intentado

12. a. disminuido b. escaso c. restringido

13. a. darán b. enseñarán c. dirán

14. a. sobre b. en c. para

15. a. ya b. así c. para

16. a. será b. sea c. es

17. a. casos b. aspectos c. niveles

18. a. a b. de c. para

19. a. total b. pleno c. entero

20. a. siguiente b. próxima c. pasada

Answer Key: Multiple Choice Test

1. d	11. c	21. a
2. a	12. b	22. c
3. a	13. a	23. d
4. d	14. d	24. c
5. c	15. d	25. d
6. a	16. c	26. a
7. a	17. a	27. d
8. d	18. c	28. b
9. d	19. b	29. d
10. d	20. c	30. d

Answer Key: Cloze Test

1. a	8. c	15. b
2. b	9. b	16. b
3. a	10. c	17. c
4. c	11. b	18. a
5. a	12. c	19. b
6. c	13. b	20. b
7. b	14. a	

Total points possible: 50

Advanced	40 to 50
Intermediate	30 to 49
Low	0 to 29

Appendix 2: Stimuli in Experiment 1 (Within-phrase agreement)

1. El Índico es un <u>océano</u> muy <u>profundo/*profundos/*profunda</u> y el Pacífico también.
2. El Antártico es un <u>océano</u> muy <u>frío/*fríos/*fría</u> y el Ártico también.
3. La pimienta es una <u>especia</u> muy <u>usada/*usadas/*usado</u> y la páprika también.
4. La canela es una <u>especia</u> muy <u>exótica/*exóticas/*exótico</u> y la cayena también.
5. El bocadillo es un <u>aperitivo</u> muy <u>alimenticio/ *alimenticios/*alimenticia</u> y el gazpacho también.
6. El queso es un <u>aperitivo</u> muy <u>graso/*grasos/*grasa</u> y el chorizo también.
7. La lechuga es una <u>verdura</u> muy <u>insípida/*insípidas/*insípido</u> y la escarola también.
8. La espinaca es una <u>verdura</u> muy <u>sana/*sanas/*sano</u> y la cebolla también.
9. El cementerio es un <u>recinto</u> muy <u>sombrío/ *sombríos/ *sombría</u> y el mausoleo también.
10. El monasterio es un <u>recinto</u> muy <u>*silencioso/ *silenciosos/ *silenciosa</u> y el asilo también.
11. La hamburguesa es una <u>comida</u> muy <u>nutritiva/*nutritivas/*nutritivo</u> y la salchicha también.
12. La pizza es una <u>comida</u> muy <u>apetitosa/*apetitosas/*apetitoso</u> y la tortilla también.
13. El rojo es un <u>tono</u> muy <u>intenso/ *intensos/*intensa</u> y el negro también.
14. El amarillo es un <u>tono</u> muy <u>luminoso/*luminosos/*luminosa</u> y el blanco también.
15. La esmeralda es una <u>piedra</u> muy <u>valiosa/*valiosas/*valioso</u> y la aguamarina también.
16. La turquesa es una <u>piedra</u> muy <u>hermosa/*hermosas/*hermoso</u> y la amatista también.
17. El pescado es un <u>alimento</u> muy <u>nutritivo/*nutritivos/*nutritiva</u> y el marisco también.
18. El pepino es un <u>alimento</u> muy <u>insípido/*insípidos/*insípida</u> y el espárrago también.
19. La cerveza es una <u>bebida</u> muy <u>amarga/*amargas/*amargo</u> y la tónica también.
20. La sangría es una <u>bebida</u> muy <u>fresca/*frescas/*fresco</u> y la limonada también.
21. El termómetro es un <u>invento</u> muy <u>práctico/*prácticos/*práctica</u> y el barómetro también.
22. El microscopio es un <u>invento</u> muy <u>caro/*caros/*cara</u> y el telescopio también.
23. La selva es una <u>zona</u> muy <u>exótica/*exóticas/*exótico</u> y la playa también.
24. La costa es una <u>zona</u> muy <u>húmeda/*húmedas/*húmedo</u> y la jungla también.
25. El baloncesto es un <u>juego</u> muy <u>entretenido/*entretenidos/*entretenida</u> y el taekwondo también.
26. El polo es un <u>juego</u> muy <u>aburrido/*aburridos/*aburrida</u> y el dominó también.
27. La seda es una <u>tela</u> muy <u>fina/*finas/*fino</u> y la alpaca también.
28. La lana es una <u>tela</u> muy <u>cálida/*cálidas/*cálido</u> y la angora también.
29. El santuario es un <u>templo</u> muy <u>silencioso/*silenciosos/*silenciosa</u> y el convento también.
30. El Vaticano es un <u>templo</u> muy <u>simbólico/*simbólicos/*simbólica</u> y el Elíseo también.
31. La camiseta es una <u>prenda</u> muy <u>cómoda/*cómodas/*cómodo</u> y la camisa también.
32. La chaqueta es una <u>prenda</u> muy <u>usada/*usadas/*usado</u> y la bufanda también.
33. El aeropuerto es un <u>sitio</u> muy <u>ruidoso/*ruidosos/*ruidosa</u> y el puerto también.
34. El reformatorio es un <u>sitio</u> muy <u>peligroso/*peligrosos/*peligrosa</u> y el presidio también.
35. La menta es una <u>hierba</u> muy <u>aromática/*aromáticas/*aromático</u> y la albahaca también.
36. La camomila es una <u>hierba</u> muy <u>curativa/*curativas/*curativo</u> y la melisa también.
37. El helicóptero es un <u>medio</u> muy <u>seguro/*seguros/*segura</u> y el aeroplano también.
38. El metro es un <u>medio</u> muy <u>barato/*baratos/*barata</u> y el barco también.
39. La manzana es una <u>fruta</u> muy <u>jugosa/*jugosas/*jugoso</u> y la papaya también.
40. La frambuesa es una <u>fruta</u> muy <u>ácida/*ácidas/*ácido</u> y la lima también.
41. El vaso es un <u>utensilio</u> muy <u>barato/*baratos/*barata</u> y el cuenco también.
42. El cuchillo es un <u>utensilio</u> muy <u>afilado/*afilados/*afilada</u> y el martillo también.
43. La física es una <u>ciencia</u> muy <u>precisa/*precisas/*preciso</u> y la química también.
44. La psicología es una <u>ciencia</u> muy <u>compleja/*complejas/*complejo</u> y la lingüística también.

45. El exorcismo es un rito muy serio/*serios/*seria y el entierro también.
46. El matrimonio es un rito muy festivo/*festivos/*festiva y el bautismo también.
47. La plata es una joya muy hermosa/*hermosas/*hermoso y la malaquita también.
48. La perla es una joya muy cara/*caras/*caro y la turmalina también.
49. El vídeo es un aparato muy práctico/*prácticos/*práctica y el teléfono también.
50. El frigorífico es un aparato muy espacioso/*espaciosos/*espaciosa y el horno también.
51. La peseta es una moneda muy prestigiosa/*prestigiosas/*prestigioso y la lira también.
52. La libra es una moneda muy valiosa/*valiosas/*valioso y la rupia también.
53. El cerebro es un órgano muy complejo/*complejos/*compleja y el cerebelo también.
54. El estómago es un órgano muy delicado/*delicados/*delicada y el hígado también.
55. La ensalada es una cena muy fresca/*frescas/*fresco y la pasta también.
56. La sopa es una cena muy ligera/*ligeras/*ligero y la patata también.
57. El odio es un sentimiento muy doloroso/*dolorosos/*dolorosa y el enojo también.
58. El orgullo es un sentimiento muy primitivo/*primitivos/*primitiva y el deseo también.
59. La paella es una receta muy elaborada/*elaboradas/*elaborado y la empanada también.
60. La lasaña es una receta muy sencilla/*sencillas/*sencillo y la enchilada también.
61. El teatro es un espectáculo muy pedagógico/*pedagógicos/*pedagógica y el circo también.
62. El boxeo es un espectáculo muy agresivo/*agresivos/*agresiva y el sumo también.
63. La malaria es una epidemia muy dañina/*dañinas/*dañino y la bilharzia también.
64. La difteria es una epidemia muy destructiva/*destructivas/*destructivo y la viruela también.
65. El atletismo es un pasatiempo muy monótono/*monótonos/*monótona y el remo también.
66. El ciclismo es un pasatiempo muy divertido/*divertidos/*divertida y el senderismo también.
67. La prehistoria es una época muy misteriosa/*misteriosas/*misterioso y la Reconquista también.
68. La infancia es una época muy formativa/*formativas/*formativo y la adolescencia también.
69. El parmesano es un producto muy graso/*grasos/*grasa y el tocino también.
70. El cacao es un producto muy amargo/*amargos/*amarga y el comino también.
71. La Provenza es una provincia muy florida/*floridas/*florido y la Toscana también.
72. La Borgoña es una provincia muy bonita/*bonitas/*bonito y la Guyana también.
73. El violonchelo es un instrumento muy sobrio/*sobrios/*sobria y el chelo también.
74. El piano es un instrumento muy romántico/*románticos/*romántica y el clavicordio también.
75. La lavanda es una planta muy curativa/*curativas/*curativo y la valeriana también.
76. La vainilla es una planta muy aromática/*aromáticas/*aromático y la bergamota también.
77. El castillo es un edificio muy sólido/*sólidos/*sólida y el palacio también.
78. El banco es un edificio muy seguro/*seguros/*segura y el juzgado también.
79. La mayonesa es una salsa muy sabrosa/*sabrosas/*sabroso y la vinagreta también.
80. La boloñesa es una salsa muy apetitosa/*apetitosas/*apetitoso y la carbonara también.
81. El mercado es un espacio muy festivo/*festivos/*festiva y el casino también.
82. El centro es un espacio muy ruidoso/*ruidosos/*ruidosa y el ayuntamiento también.
83. La tiranía es una política muy autoritaria/*autoritarias/*autoritario y la oligarquía también.
84. La monarquía es una política muy simbólica/*simbólicas/*simbólico y la república también.
85. El zumo es un desayuno muy sano/*sanos/*sana y el panecillo también.

86. El huevo es un <u>desayuno</u> muy <u>alimenticio</u>/*alimenticios/*alimenticia y el pomelo también.
87. La danza es una <u>disciplina</u> muy <u>expresiva</u>/*expresivas/*expresivo y la ópera también.
88. La gimnasia es una <u>disciplina</u> muy <u>complicada</u>/*complicadas/*complicado y la hípica también.
89. El asesinato es un <u>delito</u> muy <u>serio</u>/*serios/*seria y el robo también.
90. El secuestro es un <u>delito</u> muy <u>violento</u>/*violentos/*violenta y el incesto también.
91. La lavadora es una <u>máquina</u> muy <u>cómoda</u>/*cómodas/*cómodo y la secadora también.
92. La impresora es una <u>máquina</u> muy <u>buena</u>/*buenas/*bueno y la fotocopiadora también.
93. El impresionismo es un <u>movimiento</u> muy <u>moderno</u>/*modernos/*moderna y el surrealismo también.
94. El cubismo es un <u>movimiento</u> muy <u>alternativo</u>/*alternativos/*alternativa y el futurismo también.
95. La pintura es una <u>técnica</u> muy <u>complicada</u>/*complicadas/*complicado y la cerámica también.
96. La escultura es una <u>técnica</u> muy <u>precisa</u>/*precisas/*preciso y la fotografía también.
97. El turismo es un <u>negocio</u> muy <u>nuevo</u>/*nuevos/*nueva y el ciberespacio también.
98. El comercio es un <u>negocio</u> muy <u>beneficioso</u>/*beneficiosos/*beneficiosa y el petróleo también.
99. La anemia es una <u>patología</u> muy <u>dañina</u>/*dañinas/*dañino y la leucemia también.
100. La neumonía es una <u>patología</u> muy <u>dolorosa</u>/*dolorosas/*doloroso y la epilepsia también.
101. El Nilo es un <u>río</u> muy <u>largo</u>/*largos/*larga y el Congo también.
102. El Orinoco es un <u>río</u> muy <u>profundo</u>/*profundos/*profunda y el Duero también.
103. La cinematografía es una <u>industria</u> muy <u>nueva</u>/*nuevas/*nuevo y la telefonía también.
104. La minería es una <u>industria</u> muy <u>rica</u>/*ricas/*rico y la metalurgia también.
105. El bolso es un <u>accesorio</u> muy <u>femenino</u>/*femeninos/*femenina y el abanico también.
106. El sombrero es un <u>accesorio</u> muy <u>clásico</u>/*clásicos/*clásica y el pañuelo también.
107. La heroína es una <u>droga</u> muy <u>destructiva</u>/*destructivas/*destructivo y la cocaína también.
108. La nicotina es una <u>droga</u> muy <u>adictiva</u>/*adictivas/*adictivo y la codeína también.
109. El miedo es un <u>instinto</u> muy <u>humano</u>/*humanos/*humana y el apetito también.
110. El sexo es un <u>instinto</u> muy <u>primitivo</u>/*primitivos/*primitiva y el pánico también.
111. La sacarina es una <u>sustancia</u> muy <u>ligera</u>/*ligeras/*ligero y la fructosa también.
112. La morfina es una <u>sustancia</u> muy <u>adictiva</u>/*adictivas/*adictivo y la cafeína también.
113. El cilantro es un <u>condimento</u> muy <u>digestivo</u>/*digestivos/*digestiva y el orégano también.
114. El ajo es un <u>condimento</u> muy <u>sabroso</u>/*sabrosos/*sabrosa y el romero también.
115. La biología es una <u>asignatura</u> muy <u>aburrida</u>/*aburridas/*aburrido y la sociología también.
116. La geografía es una <u>asignatura</u> muy <u>monótona</u>/*monótonas/*monótono y la teología también.
117. El antibiótico es un <u>medicamento</u> muy <u>bueno</u>/*buenos/*buena y el antidepresivo también.
118. El antiácido es un <u>medicamento</u> muy <u>agresivo</u>/*agresivos/*agresiva y el antihistamínico también.
119. La fábula es una <u>literatura</u> muy <u>elaborada</u>/*elaboradas/*elaborado y la poesía también.
120. La novela es una <u>literatura</u> muy <u>creativa</u>/*creativas/*creativo y la sátira también.

Appendix 3: Stimuli in Experiment 2 (Across-phrase Agreement)

1. El <u>Mediterráneo</u> es <u>cálido/*cálidos/*cálida</u> y el Adriático también.
2. El <u>Mediterráneo</u> es <u>tranquilo/*tranquilos/*tranquila</u> y el Caspio también.
3. La <u>Tierra</u> es <u>redonda/*redondas/*redondo</u> y la Luna también.
4. La <u>Tierra</u> es <u>gigantesca/*gigantescas/*gigantesco</u> y la atmósfera también.
5. El <u>colegio</u> es <u>gratuito/*gratuitos/*gratuita</u> y el instituto también.
6. El <u>colegio</u> es <u>antiguo/*antiguos/*antigua</u> y el liceo también.
7. La <u>isla</u> es <u>preciosa/*preciosas/*precioso</u> y la bahía también.
8. La <u>isla</u> es <u>rocosa/*rocosas/*rocoso</u> y la península también.
9. El <u>Coliseo</u> es <u>emblemático/*emblemáticos/*emblemática</u> y el Foro también.
10. El <u>Coliseo</u> es <u>famoso/*famosos/*famosa</u> y el Capitolio también.
11. La <u>naranja</u> es <u>jugosa/*jugosas/*jugoso</u> y la pera también.
12. La <u>naranja</u> es <u>redonda/*redondas/*redondo</u> y la sandía también.
13. El <u>Atlántico</u> es <u>gigantesco/*gigantescos/*gigantesca</u> y el Egeo también.
14. El <u>Atlántico</u> es <u>frío/*fríos/*fría</u> y el Báltico también.
15. La <u>falda</u> es <u>femenina/*femeninas/femenino</u> y la blusa también.
16. La <u>falda</u> es <u>azulada/*azuladas/*azulado</u> y la corbata también.
17. El <u>faro</u> es <u>grandioso/*grandiosos/*grandiosa</u> y el obelisco también.
18. El <u>faro</u> es <u>sólido*sólidos/*sólida</u> y el campanario también.
19. La <u>casa</u> es <u>minúscula/*minúsculas/*minúsculo</u> y la cochera también.
20. La <u>casa</u> es <u>sombría/*sombrías/*sombrío</u> y la bodega también.
21. El <u>arroyo</u> es <u>hondo/*hondos/*honda</u> y el charco también.
22. El <u>arroyo</u> es <u>largo/*largos/*larga</u> y el meandro también.
23. La <u>cocina</u> es <u>amplia/*amplias/*amplio</u> y la entrada también.
24. La <u>cocina</u> es <u>luminosa/*luminosas/*luminoso</u> y la terraza también.
25. El <u>otoño</u> es <u>oscuro/*oscuros/*oscura</u> y el invierno también.
26. El <u>otoño</u> es <u>húmedo/*húmedos/*húmeda</u> y el verano también.
27. La <u>mesa</u> es <u>pesada/*pesadas/*pesado</u> y la silla también.
28. La <u>mesa</u> es <u>inmensa/*inmensas/*inmenso</u> y la cama también.
29. El <u>baño</u> es <u>amplio/*amplios/*amplia</u> y el pasillo también.
30. El <u>baño</u> es <u>rosado/*rosados/*rosada</u> y el dormitorio también.
31. La <u>montaña</u> es <u>grandiosa/*grandiosas/*grandioso</u> y la colina también.
32. La <u>montaña</u> es <u>rocosa/*rocosas/*rocoso</u> y la sierra también.
33. El <u>abrigo</u> es <u>clásico/*clásicos/*clásica</u> y el chaleco también.
34. El <u>abrigo</u> es <u>caluroso/*calurosos/*calurosa</u> y el gorro también.
35. La <u>biblioteca</u> es <u>gratuita/*gratuitas/*gratuito</u> y la sauna también.
36. La <u>biblioteca</u> es <u>formativa/*formativas/*formativo</u> y la escuela también.
37. El <u>terremoto</u> es <u>peligroso/*peligrosos/*peligrosa</u> y el tornado también.
38. El <u>terremoto</u> es <u>catastrófico/*catastróficos/*catastrófica</u> y el maremoto también.
39. La <u>fresa</u> es <u>ácida/*ácidas/*ácido</u> y la piña también.
40. La <u>fresa</u> es <u>digestiva/*digestivas/*digestivo</u> y la zanahoria también.
41. El <u>libro</u> es <u>didáctico/*didácticos/*didáctica</u> y el periódico también.
42. El <u>libro</u> es <u>anónimo/*anónimos/*anónima</u> y el artículo también.
43. La <u>guitarra</u> es <u>melodiosa/*melodiosas/*melodioso</u> y la flauta también.
44. La <u>guitarra</u> es <u>bonita/*bonitas/*bonito</u> y la armónica también.
45. El <u>laboratorio</u> es <u>conocido/*conocidos/*conocida</u> y el departamento también.
46. El <u>laboratorio</u> es <u>privado/*privados/*privada</u> y el archivo también.
47. La <u>película</u> es <u>romántica/*románticas/*romántico</u> y la leyenda también.
48. La <u>película</u> es <u>patética/*patéticas/*patético</u> y la crítica también.

49. El <u>lago</u> es <u>oscuro/*oscuros/*oscura</u> y el pozo también.
50. El <u>lago</u> es <u>hondo/*hondos/*honda</u> y el pantano también.
51. La <u>cortina</u> es <u>fina/*finas/*fino</u> y la moqueta también.
52. La <u>cortina</u> es <u>decorativa/*decorativas/*decorativo</u> y la alfombra también.
53. El <u>espejo</u> es <u>delicado/*delicados/*delicada</u> y el florero también.
54. El <u>espejo</u> es <u>precioso/*preciosos/*preciosa</u> y el mosaico también.
55. La <u>cafetera</u> es <u>metálica/*metálicas/*metálico</u> y la tetera también.
56. La <u>cafetera</u> es <u>vieja/*viejas/*viejo</u> y la tostadora también.
57. El <u>disco</u> es <u>alternativo/*alternativos/*alternativa</u> y el concierto también.
58. El <u>disco</u> es <u>conocido/*conocidos/*conocida</u> y el grupo también.
59. La <u>maleta</u> es <u>pesada/*pesadas/*pesado</u> y la cartera también.
60. La <u>maleta</u> es <u>espaciosa/*espaciosas/*espacioso</u> y la caja también.
61. El <u>diccionario</u> es <u>pedagógico/*pedagógicos/*pedagógica</u> y el tesauro también.
62. El <u>diccionario</u> es <u>didáctico/*didácticos/*didáctica</u> y el glosario también.
63. La <u>ventana</u> es <u>amarilla/*amarillas/*amarillo</u> y la escalera también.
64. La <u>ventana</u> es <u>metálica/*metálicas/*metálico</u> y la puerta también.
65. El <u>gramófono</u> es <u>viejo/*viejos/*vieja</u> y el cronómetro también.
66. El <u>gramófono</u> es <u>automático/*automáticos/*automática</u> y el estéreo también.
67. La <u>corona</u> es <u>dorada/*doradas/*dorado</u> y la cadena también.
68. La <u>corona</u> es <u>auténtica/*auténticas/*auténtico</u> y la sortija también.
69. El <u>cuadro</u> es <u>auténtico/*auténticos/*auténtica</u> y el grabado también.
70. El <u>cuadro</u> es <u>expresivo/*expresivos/*expresiva</u> y el retrato también.
71. La <u>academia</u> es <u>prestigiosa/*prestigiosas/*prestigioso</u> y la galería también.
72. La <u>academia</u> es <u>pública/*públicas/*público</u> y la guardería también.
73. El <u>narciso</u> es <u>rosado/*rosados/*rosada</u> y el gladiolo también.
74. El <u>narciso</u> es <u>decorativo/*decorativos/*decorativa</u> y el lirio también.
75. La <u>pastelería</u> es <u>famosa/*famosas/*famoso</u> y la bombonería también.
76. La <u>pastelería</u> es <u>minúscula/*minúsculas/*minúsculo</u> y la panadería también.
77. El <u>cuento</u> es <u>creativo/*creativos/*creativa</u> y el relato también.
78. El <u>cuento</u> es <u>anónimo/*anónimos/*anónima</u> y el manuscrito también.
79. La <u>conferencia</u> es <u>privada/*privadas/*privado</u> y la fiesta también.
80. La <u>conferencia</u> es <u>corta/*cortas/*corto</u> y la entrevista también.
81. El <u>tango</u> es <u>erótico/*eróticos/*erótica</u> y el flamenco también.
82. El <u>tango</u> es <u>rápido/*rápidos/*rápida</u> y el mambo también.
83. La <u>iglesia</u> es <u>misteriosa/*misteriosas/*misterioso</u> y la cripta también.
84. La <u>iglesia</u> es <u>emblemática/*emblemática/*emblemática</u> y la abadía también.
85. El <u>trópico</u> es <u>caluroso/*calurosos/*calurosa</u> y el desierto también.
86. El <u>trópico</u> es <u>florido/*floridos/*florida</u> y el prado también.
87. La <u>espada</u> es <u>afilada/*afiladas/*afilado</u> y la flecha también.
88. La <u>espada</u> es <u>dorada/*doradas/*dorado</u> y la lanza también.
89. El <u>contrato</u> es <u>justo/*justos/*justa</u> y el pago también.
90. El <u>contrato</u> es <u>estricto/*estrictos/*estricta</u> y el reglamento también.
91. La <u>sentencia</u> es <u>justa/*justas/*justo</u> y la condena también.
92. La <u>sentencia</u> es <u>estricta/*estrictas/*estricto</u> y la pena también.
93. El <u>motociclismo</u> es <u>entretenido/*entretenidos/*entretenida</u> y el judo también.
94. El <u>motociclismo</u> es <u>divertido/*divertidos/*divertida</u> y el automovilismo también.
95. La <u>cámara</u> es <u>automática/*automáticas/*automático</u> y la calculadora también.
96. La <u>cámara</u> es <u>moderna/*modernas/*moderno</u> y la agenda también.
97. El <u>vestido</u> es <u>sobrio/*sobrios/*sobria</u> y el velo también.
98. El <u>vestido</u> es <u>azulado/*azulados/*azulada</u> y el manto también.

99. La <u>samba</u> es <u>erótica/*eróticas/*erótico</u> y la lambada también.
100.   La <u>samba</u> es <u>melodiosa/*melodiosas/*melodioso</u> y la rumba también.
101.   El <u>empleo</u> es <u>patético/*patéticos/*patética</u> y el sueldo también.
102.   El <u>empleo</u> es <u>intenso/*intensos/*intensa</u> y el horario también.
103.   La <u>batalla</u> es <u>violenta/*violentas/*violento</u> y la lucha también.
104.   La <u>batalla</u> es <u>catastrófica/*catastróficas/*catastrófico</u> y la guerra también.
105.   El <u>plátano</u> es <u>beneficioso/*beneficiosos/*beneficiosa</u> y el coco también.
106.   El <u>plátano</u> es <u>amarillo/*amarillos/*amarilla</u> y el mango también.
107.   La <u>huella</u> es <u>humana/*humanas/*humano</u> y la reliquia también.
108.   La <u>huella</u> es <u>antigua/*antiguas/*antiguo</u> y la calavera también.
109.   El <u>submarino</u> es <u>rápido/*rápidos/*rápida</u> y el hidroplano también.
110.   El <u>submarino</u> es <u>inmenso/*inmensos/*inmensa</u> y el pesquero también.
111.   La <u>boda</u> es <u>sencilla/*sencillas/*sencilla</u> y la ceremonia también.
112.   La <u>boda</u> es <u>tranquila/*tranquilas/*tranquilo</u> y la gala también.
113.   El <u>camino</u> es <u>corto/*cortos/*corta</u> y el atajo también.
114.   El <u>camino</u> es <u>feo/*feos/*fea</u> y el pueblo también.
115.   La <u>plaza</u> es <u>pública/*públicas/*público</u> y la avenida también.
116.   La <u>plaza</u> es <u>fea/*feas/*feo</u> y la basílica también.
117.   El <u>gobierno</u> es <u>autoritario/*autoritarios/*autoritaria</u> y el ejército también.
118.   El <u>gobierno</u> es <u>poderoso/*poderosos/*poderosa</u> y el parlamento también.
119.   La <u>aristocracia</u> es <u>poderosa/*poderosas/*poderoso</u> y la burguesía también.
120.   La <u>aristocracia</u> es <u>rica/*ricas/*rico</u> y la realeza también.

Appendix 4: Stimuli in Experiment 3 (Demonstrative-noun Agreement)

1. Francisco olvidó <u>este</u>/*estos/*esta <u>cuaderno</u> el sábado pasado.
2. Sandra alquiló <u>esta</u>/*estas/*este <u>tienda</u> la semana pasada.
3. Rodrigo utilizó <u>este</u>/*estos/*esta <u>bolígrafo</u> el sábado pasado.
4. Sara alquiló <u>esta</u>/*estas/*este <u>avioneta</u> la semana pasada.
5. Diego limpió <u>este</u>/*estos/*esta <u>lavabo</u> el sábado pasado.
6. Ana arregló <u>esta</u>/*estas/*este <u>lámpara</u> la semana pasada.
7. Mateo limpió <u>este</u>/*estos/*esta <u>apartamento</u> el sábado pasado.
8. Laura arregló <u>esta</u>/*estas/*este <u>bicicleta</u> la semana pasada.
9. Alberto ganó <u>este</u>/*estos/*esta <u>premio</u> el sábado pasado.
10. Fátima visitó <u>esta</u>/*estas/*este <u>capilla</u> la semana pasada.
11. Alejandro heredó <u>este</u>/*estos/*esta <u>piso</u> el sábado pasado.
12. Elisa encontró <u>esta</u>/*estas/*este <u>pulsera</u> la semana pasada.
13. Alfonso pintó <u>este</u>/*estos/*esta <u>cuarto</u> el sábado pasado.
14. Amelia ganó <u>esta</u>/*estas/*este <u>medalla</u> la semana pasada.
15. Adolfo encontró <u>este</u>/*estos/*esta <u>trabajo</u> el sábado pasado.
16. Susana pintó <u>esta</u>/*estas/*este <u>sala</u> la semana pasada.
17. Alfredo redactó <u>este</u>/*estos/*esta <u>discurso</u> el sábado pasado.
18. Carolina preparó <u>esta</u>/*estas/*este <u>tarta</u> la semana pasada.
19. Antonio organizó <u>este</u>/*estos/*esta <u>congreso</u> el sábado pasado.
20. Macarena planchó <u>esta</u>/*estas/*este <u>toalla</u> la semana pasada.
21. Arturo lavó <u>este</u>/*estos/*esta <u>trapo</u> el sábado pasado.
22. Diana lavó <u>esta</u>/*estas/*este <u>toalla</u> la semana pasada.
23. Sergio terminó <u>este</u>/*estos/*esta <u>dibujo</u> el sábado pasado.
24. Clara empezó <u>esta</u>/*estas/*este <u>botella</u> la semana pasada.
25. Eugenio quebró <u>este</u>/*estos/*esta <u>plato</u> el sábado pasado.
26. Sonia empezó <u>esta</u>/*estas/*este <u>caricatura</u> la semana pasada.
27. Roberto firmó <u>este</u>/*estos/*esta <u>acuerdo</u> el sábado pasado.
28. Mónica explicó <u>esta</u>/*estas/*este <u>pregunta</u> la semana pasada.
29. Pablo creó <u>este</u>/*estos/*esta <u>equipo</u> el sábado pasado.
30. Adela firmó <u>esta</u>/*estas/*este <u>carta</u> la semana pasada.
31. Ricardo redactó <u>este</u>/*estos/*esta <u>capítulo</u> el sábado pasado.
32. Alicia utilizó <u>esta</u>/*estas/*este <u>botella</u> la semana pasada.
33. Hugo explicó <u>este</u>/*estos/*esta <u>capítulo</u> el sábado pasado.
34. Andrea selló <u>esta</u>/*estas/*este <u>carta</u> la semana pasada.
35. Leonardo usó <u>este</u>/*estos/*esta <u>cuarto</u> el sábado pasado.
36. Ángela rechazó <u>esta</u>/*estas/*este <u>propuesta</u> la semana pasada.
37. Ignacio rechazó <u>este</u>/*estos/*esta <u>premio</u> el sábado pasado.
38. Aurora anunció <u>esta</u>/*estas/*este <u>propuesta</u> la semana pasada.
39. Mauricio anunció <u>este</u>/*estos/*esta <u>acuerdo</u> el sábado pasado.
40. Bárbara probó <u>esta</u>/*estas/*este <u>tarta</u> la semana pasada.
41. Jacobo acabó <u>este</u>/*estos/*esta <u>cuaderno</u> el sábado pasado.
42. Berta decoró <u>esta</u>/*estas/*este <u>tienda</u> la semana pasada.
43. Lorenzo selló <u>este</u>/*estos/*esta <u>certificado</u> el sábado pasado.
44. Camila editó <u>esta</u>/*estas/*este <u>revista</u> la semana pasada.
45. Armando editó <u>este</u>/*estos/*esta <u>certificado</u> el sábado pasado.
46. Cecilia encargó <u>esta</u>/*estas/*este <u>caricatura</u> la semana pasada.
47. Aurelio probó <u>este</u>/*estos/*esta <u>bizcocho</u> el sábado pasado.
48. Celia examinó <u>esta</u>/*estas/*este <u>avioneta</u> la semana pasada.

49. Augusto encargó este/*estos/*esta <u>bizcocho</u> el sábado pasado.
50. Claudia decoró esta/*estas/*este <u>sala</u> la semana pasada.
51. Bernardo examinó este/*estos/*esta <u>dibujo</u> el sábado pasado.
52. Cristina fundó esta/*estas/*este <u>empresa</u> la semana pasada.
53. Eduardo aceptó este/*estos/*esta <u>trabajo</u> el sábado pasado.
54. Daniela creó esta/*estas/*este <u>empresa</u> la semana pasada.
55. Emilio organizó este/*estos/*esta <u>equipo</u> el sábado pasado.
56. Elena publicó esta/*estas/*este <u>noticia</u> la semana pasada.
57. Ernesto investigó este/*estos/*esta <u>suceso</u> el sábado pasado.
58. Elvira publicó esta/*estas/*este <u>revista</u> la semana pasada.
59. Federico reveló este/*estos/*esta <u>suceso</u> el sábado pasado.
60. Estefanía reveló esta/*estas/*este <u>noticia</u> la semana pasada.
61. Fernando quebró este/*estos/*esta <u>bolígrafo</u> el sábado pasado.
62. Natalia aceptó esta/*estas/*este <u>medalla</u> la semana pasada.
63. Gregorio inauguró este/*estos/*esta <u>congreso</u> el sábado pasado.
64. Eva investigó esta/*estas/*este <u>compañía</u> la semana pasada.
65. Guillermo fundó este/*estos/*esta <u>orfanato</u> el sábado pasado.
66. Silvia realizó esta/*estas/*este <u>tarea</u> la semana pasada.
67. Gustavo llenó este/*estos/*esta <u>depósito</u> el sábado pasado.
68. Julia reparó esta/*estas/*este <u>bicicleta</u> la semana pasada.
69. Humberto ordenó este/*estos/*esta <u>armario</u> el sábado pasado.
70. Violeta cambió esta/*estas/*este <u>pulsera</u> la semana pasada.
71. Rodolfo vació este/*estos/*esta <u>armario</u> el sábado pasado.
72. Juana heredó esta/*estas/*este <u>compañía</u> la semana pasada.
73. Ramiro reparó este/*estos/*esta <u>lavabo</u> el sábado pasado.
74. Josefina ordenó esta/*estas/*este <u>oficina</u> la semana pasada.
75. Darío inauguró este/*estos/*esta <u>museo</u> el sábado pasado.
76. Lara aclaró esta/*estas/*este <u>pregunta</u> el sábado pasado.
77. Demetrio visitó este/*estos/*esta <u>museo</u> el sábado pasado.
78. Leticia mencionó esta/*estas/*este <u>oficina</u> la semana pasada.
79. Dionisio mencionó este/*estos/*esta <u>orfanato</u> el sábado pasado.
80. Lola diseñó esta/*estas/*este <u>capilla</u> la semana pasada.
81. Gonzalo quemó este/*estos/*esta <u>trapo</u> el sábado pasado.
82. Lidia quemó esta/*estas/*este <u>sábana</u> la semana pasada.
83. Patricio actualizó este/*estos/*esta <u>catálogo</u> el sábado pasado.
84. Lucía diseñó esta/*estas/*este <u>estatua</u> la semana pasada.
85. Lázaro acabó este/*estos/*esta <u>catálogo</u> el sábado pasado.
86. Lorena planchó esta/*estas/*este <u>sábana</u> la semana pasada.
87. Jerónimo actualizó este/*estos/*esta <u>cuestionario</u> el sábado pasado.
88. Úrsula compró esta/*estas/*este <u>lámpara</u> la semana pasada.
89. Mario usó este/*estos/*esta <u>cuestionario</u> el sábado pasado.
90. Marta memorizó esta/*estas/*este <u>lista</u> la semana pasada.
91. Mariano memorizó este/*estos/*esta <u>discurso</u> el sábado pasado.
92. Marina preparó esta/*estas/*este <u>lista</u> la semana pasada.
93. Rogelio enseñó este/*estos/*esta <u>apartamento</u> el sábado pasado.
94. Teresa cargó esta esta/*estas/*este <u>pistola</u> la semana pasada.
95. Marcelo enseñó este/*estos/*esta <u>piso</u> el sábado pasado.
96. Noelia cargó esta/*estas/*este <u>batería</u> la semana pasada.
97. Cesáreo vació este/*estos/*esta <u>depósito</u> el sábado pasado.
98. Nuria cambió esta/*estas/*este <u>batería</u> la semana pasada.

99. Gerardo infló <u>este</u>/*estos/*esta <u>globo</u> el sábado pasado.
100.   Margarita infló <u>esta</u>/*estas/*este <u>pelota</u> la semana pasada.
101.   Marco confiscó <u>este</u>/*estos/*esta <u>documento</u> el sábado pasado.
102.   Virginia restauró <u>esta</u>/*estas/*este <u>estatua</u> la semana pasada.
103.   Raimundo restauró <u>este</u>/*estos/*esta <u>documento</u> el sábado pasado.
104.   Verónica reventó <u>esta</u>/*estas/*este <u>pelota</u> la semana pasada.
105.   Paco aclaró <u>este</u>/*estos/*esta <u>asunto</u> el sábado pasado.
106.   Victoria compró <u>esta</u>/*estas/*este <u>carpeta</u> la semana pasada.
107.   Sancho reventó <u>este</u>/*estos/*esta <u>globo</u> el sábado pasado.
108.   Enriqueta notificó <u>esta</u>/*estas/*este <u>medida</u> la semana pasada.
109.   Isidoro notificó <u>este</u>/*estos/*esta <u>asunto</u> el sábado pasado.
110.   Olga confiscó <u>esta</u>/*estas/*este <u>pistola</u> la semana pasada.
111.   Anselmo realizó <u>este</u>/*estos/*esta <u>experimento</u> el sábado pasado.
112.   Rita olvidó <u>esta</u>/*estas/*este <u>carpeta</u> la semana pasada.
113.   Santiago revisó <u>este</u>/*estos/*esta <u>experimento</u> el sábado pasado.
114.   Frida revisó <u>esta</u>/*estas/*este <u>tarea</u> la semana pasada.
115.   Pedro cantó <u>este</u>/*estos/*esta <u>himno</u> el sábado pasado.
116.   Yolanda cantó <u>esta</u>/*estas/*este <u>balada</u> la semana pasada.
117.   Gilberto interpretó <u>este</u>/*estos/*esta <u>himno</u> el sábado pasado.
118.   Genoveva interpretó <u>esta</u>/*estas/*este <u>balada</u> la semana pasada.
119.   Bruno llenó <u>este</u>/*estos/*esta <u>plato</u> el sábado pasado
120.   Sofía terminó <u>esta</u>/*estas/*este <u>medida</u> la semana pasada.

Appendix 5: Fillers

<u>7-Word Fillers</u>

1. Francisco conoció a un piloto muy respetado.
2. Berta recibió a una escritora muy extraña.
3. Rodrigo contempló a un italiano muy moreno.
4. Sara conoció a una francesa muy alta.
5. Diego homenajeó a un piloto muy exitoso.
6. Ana homenajeó a una profesora muy respetada.
7. Rogelio saludó a un italiano muy gordo.
8. Julia abrazó a una profesora muy simpática.
9. Alberto ayudó a un soldado muy problemático.
10. Fátima escuchó a una educadora muy simpática.
11. Alejandro entrevistó a un matemático muy exitoso.
12. Violeta entrevistó a una escritora muy distinguida.
13. Leonardo castigó a un soldado muy perezoso.
14. Natalia castigó a una alumna muy estúpida.
15. Adolfo escuchó a un matemático muy distinguido.
16. Susana cuidó a una educadora muy anciana.
17. Alfredo ayudó a un pasajero muy desorientado.
18. Carolina acompañó a una chiquilla muy pequeña.
19. Antonio acompañó a un pasajero muy anciano.
20. Macarena abrazó a una alumna muy sincera.
21. Sandra saludó a una trabajadora muy maleducada.
22. Mateo cuidó a un enfermo muy problemático.
23. Laura defendió a una chiquilla muy pequeña.
24. Armando defendió a un empleado muy sincero.
25. Elisa despidió a una dependienta muy maleducada.
26. Alfonso despidió a un empleado muy perezoso.
27. Amelia echó a una dependienta muy tonta.
28. Bernardo echó a un universitario muy estúpido.
29. Diana invitó a una francesa muy neurótica.
30. Ernesto invitó a un americano muy alto.
31. Sonia hipnotizó a una trabajadora muy antipática.
32. Fernando hipnotizó a un enfermo muy neurótico.
33. Alicia sonrió a una vendedora muy morena.
34. Hugo sonrió a un viajero muy rubio.
35. Andrea miró a una extranjera muy rubia.
36. Ignacio miró a un viajero muy desorientado.
37. Aurora expulsó a una vendedora muy tonta.
38. Mauricio expulsó a un universitario muy antipático.
39. Bárbara contempló a una extranjera muy extraña.
40. Jacobo recibió a un americano muy gordo.

<u>8-Word Fillers</u>

41. Arturo fotografió a este ministro y Octavio también.
42. Clara gritó a esta secretaria y Natacha también.

43. Sergio insultó a este abogado y Lucio también.
44. Elena gritó a esta limpiadora y Paula también.
45. Eugenio escribió a este ministro y Francisco también.
46. Cecilia aconsejó a esta editora y Valentina también.
47. Roberto escogió a este candidato y Pedro también.
48. Mónica observó a esta limpiadora y Gloria también.
49. Pablo recomendó a este abogado y Laura también.
50. Adela escribió a esta editora y Gabriela también.
51. Ricardo identificó a este testigo y Alejandro también.
52. Ángela recomendó a esta pedagoga y Rosa también.
53. Lorenzo humilló a este becario y Alfredo también.
54. Camila observó a esta maestra y Regina también.
55. Aurelio identificó a este testigo y Edmundo también.
56. Cristina reconoció a esta presentadora y Marisa también.
57. Federico ofendió a este caballero y Pablo también.
58. Eva reconoció a esta artista y Luisa también.
59. Dionisio eligió a este candidato y Mateo también.
60. Silvia insultó a esta maestra y Ágata también.
61. Augusto aconsejó a este caballero y Octavio también.
62. Claudia contradijo a esta pedagoga y Ágata también.
63. Eduardo seleccionó a este ejecutivo y Lucio también.
64. Daniela fotografió a esta artista y Natacha también.
65. Emilio contradijo a este diplomático y Marcelo también.
66. Elvira telefoneó a esta investigadora y Paula también.
67. Guillermo telefoneó a este diplomático y Aurelio también.
68. Estefanía humilló a esta doctora y Valentina también.
69. Gregorio escogió a este ingeniero y Eduardo también.
70. Sofía vio a esta presentadora y Gloria también.
71. Humberto ofendió a este ejecutivo y Ernesto también.
72. Juana llamó a esta doctora y Gabriela también.
73. Ramiro contrató a este médico y Gregorio también.
74. Lara vio a esta bailarina y Rosa también.
75. Demetrio contrató a este ingeniero y Guillermo también.
76. Leticia felicitó a esta bailarina y Regina también.
77. Gonzalo eligió a este médico y Humberto también.
78. Lola felicitó a esta investigadora y Marisa también.
79. Patricio seleccionó a este becario y Gustavo también.
80. Celia llamó a esta secretaria y Luisa también.

11-Word Fillers

81. Gustavo trabajó con un arqueólogo muy aventurero durante todo el año.
82. Teresa vivió con una compañera muy generosa durante toda la primavera.
83. Rodolfo vivió con un sobrino muy sucio durante todo el año.
84. Josefina contactó con una veterinaria muy guapa durante toda la mañana.
85. Darío colaboró con un chico muy presuntuoso durante todo el año.
86. Lidia habló con una señora muy educada durante toda la mañana.
87. Lázaro colaboró con un arquitecto muy culto durante todo el simposio.
88. Lucía habló con una farmacéutica muy trabajadora durante toda la mañana.
89. Jerónimo viajó con un chico muy aventurero durante todo el año.

90. Marta viajó con una amiga muy tímida durante toda la primavera.
91. Paco discutió con un invitado muy soberbio durante todo el simposio.
92. Noelia discutió con una farmacéutica muy grosera durante toda la mañana.
93. Gerardo cooperó con un arqueólogo muy tímido durante todo el año.
94. Margarita cooperó con una enfermera muy respetuosa durante toda la primavera.
95. Marco rivalizó con un vecino muy presuntuoso durante todo el año.
96. Victoria rivalizó con una compañera muy guapa durante toda la primavera.
97. Gilberto contactó con un vecino muy gracioso durante todo el simposio.
98. Enriqueta conversó con una peluquera muy linda durante toda la mañana.
99. Santiago conversó con un invitado muy educado durante todo el simposio.
100. Yolanda trabajó con una enfermera muy atenta durante toda la semana.
101. Lorena entrenó con una niña muy trabajadora durante toda la primavera.
102. Mariano estudió con un filósofo muy excéntrico durante todo el año.
103. Úrsula entrenó con una nadadora muy competitiva durante toda la primavera.
104. Mario charló con un músico muy excéntrico durante todo el simposio.
105. Marina debatió con una señora muy atenta durante toda la mañana.
106. Marcelo debatió con un arquitecto muy respetuoso durante todo el simposio.
107. Nuria compitió con una nadadora muy grosera durante toda la mañana.
108. Cesáreo compitió con un muchacho muy soberbio durante todo el año.
109. Virginia estuvo con una niña muy graciosa durante toda la mañana.
110. Raimundo estudió con un músico muy raro durante todo el año.
111. Verónica bailó con una peluquera muy graciosa durante toda la fiesta.
112. Sancho charló con un sobrino muy cariñoso durante todo el año.
113. Frida bailó con una amiga muy linda durante toda la mañana.
114. Isidoro estuvo con un filósofo muy raro durante todo el simposio.
115. Olga convivió con una tía muy generosa durante toda la primavera.
116. Anselmo convivió con un muchacho muy sucio durante todo el año.
117. Rita dialogó con una tía muy cariñosa durante toda la mañana.
118. Pedro dialogó con un experto muy culto durante todo el simposio.
119. Genoveva consultó con una veterinaria muy antipática durante toda la mañana.
120. Bruno consultó con un experto muy competitivo durante todo el simposio.

Appendix 6: Vocabulary Task
Please, circle the correct English translation for the Spanish words below:

(1) producto
    (a) product
    (b) salary

(2) grandioso/a
    (a) powerful
    (b) grandiose

(3) certificado
    (a) certificate
    (b) copy machine

(4) técnica
    (a) terrace
    (b) technique

(5) dañino/a
    (a) bitter
    (b) harmful

(6) película
    (a) bracelet
    (b) film

(7) minúsculo/a
    (a) fine
    (b) miniscule

(8) pasatiempo
    (a) rite
    (b) pastime

(9) época
    (a) time period
    (b) measure

(10) sábana
    (a) silk
    (b) bedsheet

(11) especia
    (a) watermelon
    (b) spice

(12) privado
    (a) practical
    (b) private

(13) encargar
    (a) to show
    (b) to order

(14) juego
    (a) game
    (b) jewel

(15) beneficioso/a
    (a) beneficial
    (b) immense

(16) piedra
    (a) fabric
    (b) stone

(17) sencillo/a
    (a) safe
    (b) simple

(18) revelar
    (a) to reveal
    (b) to realize

(19) empresa
    (a) ceremony
    (b) firm

(20) revisar
    (a) to review
    (b) to reject

(21) ventana
    (a) carpet
    (b) window

(22) apetitoso/a
    (a) luminous
    (b) appetizing

(23) plaza
    (a) shortcut
    (b) square

(24) cuarto
    (a) box
    (b) room

(25) cálido/a
    (a) warm
    (b) noisy

(26) prestigioso/a
    (a) precise
    (b) prestigious

(27) ácido/a
    (a) tart
    (b) complex

(28) pregunta
    (a) question
    (b) grapefruit

(29) primitivo/a
    (a) sober/austere
    (b) primitive

(30) feo/a
    (a) fat
    (b) ugly

(31) inflar
    (a) to inflate
    (b) to inaugurate

(32) motociclismo
    (a) motorcycling
    (b) movement

(33) aromático/a
    (a) aromatic
    (b) melodic

(34) usado/a
    (a) bluish
    (b) used

(35) catálogo
    (a) questionnaire
    (b) catalogue

(36) industria
    (a) incest
    (b) industry

(37) comida
    (a) cumin
    (b) meal

(38) trapo
    (a) garment
    (b) cloth

(39) pistola
    (a) gun
    (b) panic

(40) examinar
    (a) to explain
    (b) to examine

(41) museo
    (a) museum
    (b) mosaic

(42) casa
    (a) castle
    (b) house

(43) órgano
    (a) organ
    (b) orphanage

(44) gobierno
    (a) gramophone
    (b) government

(45) acuerdo
    (a) matter/issue
    (b) agreement

(46) decorativo/a
    (a) rosy
    (b) decorative

(47) digestivo/a
    (a) distinguished
    (b) digestive

(48) práctico/a
    (a) painful
    (b) practical

(49) emblemático/a
    (a) emblematic
    (b) entertaining

(50) biblioteca
    (a) library
    (b) courthouse

(51) expresivo/a
    (a) strange
    (b) expressive

(52) verdura
    (a) vegetable
    (b) vanilla

(53) boda
    (a) wedding
    (b) baptism

(54) intenso/a
    (a) intense
    (b) insipid

(55) batalla
    (a) battle
    (b) battery

(56) compañía
    (a) convent
    (b) company

(57) montaña
    (a) mountain
    (b) mining

(58) hondo/a
    (a) dangerous
    (b) deep

(59) complicado/a
    (a) complicated
    (b) comfortable

(60) narciso
    (a) daffodil
    (b) nicotine

(61) planchar
    (a) to burst
    (b) to iron

(62) instrumento
    (a) instrument
    (b) impressionism

(63) caricatura
    (a) chronometer
    (b) caricature

(64) iglesia
    (a) lighthouse
    (b) church

(65) humano/a
    (a) affectionate
    (b) human

(66) balada
    (a) bay
    (b) ballad

(67) cocina
    (a) kitchen
    (b) cilantro

(68) autoritario/a
    (a) ample
    (b) authoritarian

(69) florido
    (a) formative
    (b) flowery

(70) hermoso/a
    (a) tasty
    (b) beautiful

(71) patología
    (a) pastime
    (b) pathology

(72) jugoso/a
    (a) juicy
    (b) sharp

(73) disciplina
    (a) desire
    (b) discipline

(74) viejo/a
    (a) somber
    (b) old

(75) himno
    (a) hymn
    (b) hydroplane

(76) sentencia
    (a) veil
    (b) verdict

(77) tarta
    (a) tie
    (b) cake

(78) valioso/a
    (a) nutritious
    (b) valuable

(79) amarillo/a
    (a) fattening
    (b) yellow

(80) toalla
    (a) towel
    (b) teapot

(81) colegio
    (a) school
    (b) chapel

(82) agresivo/a
    (a) aggressive
    (b) well-known

(83) sentimiento
    (a) feeling
    (b) fight/struggle

(84) frío/a
    (a) rocky
    (b) cold

(85) documento
    (a) document
    (b) deposit

(86) maleta
    (a) suitcase
    (b) meander

(87) nuevo/a
    (a) hot
    (b) new

(88) contrato
    (a) crown
    (b) contract

(89) pelota
    (a) perl
    (b) ball

(90) cena
    (a) dinner
    (b) curtain

(91) redondo/a
    (a) round
    (b) golden

(92) restaurar
    (a) to restore
    (b) to prepare

(93) aclarar
    (a) to clarify
    (b) to change

(94) disco
    (a) record
    (b) domino

(95) bicicleta
    (a) basilica
    (b) bicycle

(96) curativo/a
    (a) light (not heavy)
    (b) healing

(97) cargar
    (a) to charge
    (b) to create

(98) premio
    (a) port
    (b) prize

(99) público/a
    (a) pathetic
    (b) public

(100) sitio
    (a) medal
    (b) place

(101) laboratorio
    (a) laboratory
    (b) lake

(102) cámara
    (a) camera
    (b) clavichord

(103) húmedo/a
    (a) quiet
    (b) humid/damp

(104) sustancia
    (a) substance
    (b) sausage

(105) serio/a
    (a) dirty
    (b) serious

(106) nutritivo/a
    (a) nutritious
    (b) amusing

(107) aparato
    (a) appliance
    (b) appetizer

(108) aceptar
    (a) to accept
    (b) to order

(109) alimenticio/a
    (a) nutritious
    (b) sophisticated

(110) política
    (a) pole
    (b) politics