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eman ta zabal zazu

Universidad del País Vasco — Euskal Herriko Unibertsitatea

DOCTORAL DISSERTATION

AN INVESTIGATION INTO THE PROCESSING OF UNACCUSATIVITY AND PHI-FEATURES: EVIDENCE FROM NATIVE AND NON-NATIVE SPEAKERS OF BASQUE AND SPANISH

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Abstract

Verbs that take one argument form intransitive predicates, but not all intransitive predicates are alike, the Unaccusative Hypothesis (UH) claims that two main categories can be divided: unaccusatives and unergatives (Perlmutter, 1978). In the last decades, experimental evidence has shown that these two predicates are not processed alike. In this dissertation, I test the UH for the first time by means of ERPs, and I provide novel electrophysiological evidence in support of the UH in Basque and Spanish (Chapters II-V). I argue that the UH holds in Basque and Spanish, but that the differences in terms of processing costs between predicates rely on case alignment. I also study the processing of phi-features, and I show that person and number features are processed differently (Chapters II-V). Nevertheless, I fail to find traits of more salient processing of person compared to number in Spanish, and I attribute these results to the manipulations used in the materials. Lastly, I investigate the processing of early and highly proficient non-natives in order to study whether non-natives can process language like natives (Chapters III & V). I show that non-natives can process language similarly to natives, at least when grammatical structures common to both languages are compared. All in all, this dissertation provides the psycholinguistic field with further evidence to show that: (i) unaccusatives and unergatives are two distinct categories, (ii) person and number features are processed distinctly, (iii) nativelike processing is attainable as long as the grammatical properties are shared between the native and non-native language.

Acknowledgements

I must admit I have found it very hard to finish this dissertation, and the virus has not helped much. Fortunately, this path has come to an end, and for that, I am grateful to many people. In my humble opinion, feelings are best expressed in your own mother tongue, and for that reason, I will mostly continue with my acknowledgements in Basque and Spanish.

Doktoretzan zehar, Gasteizen bizi izan naiz banekielako Micaelara joatea zela egokiena lanean egoki aritzeko. Esan gabe doa, biziki eskertuta nagoela Micaelan ezagutu dudan jende zoragarri guztiari. Itxialdiarekin batera, Donostiara bueltatzea erabaki nuen eta horrek nire jardunerako oso ondorio txarrak izan dituelakoan nago. Oso garrantzitsuak izan zarete Gogo Elebiduna-ko kide guztiok. Prozesu honetan asko ikasi dut, ez dakit ikasle fina izan naizen, baina oso eskertuta nago Itziar eta Adami tesi hau aurrera eramaten emandako laguntza material, fisiko eta psikologikoarengatik. Gure taldean ezinbestekoak diren Yolanda eta Edurneri ere eskerrik beroenak eman nahi dizkizuet, gure taldeko muina zarete eta zuen lan gogorrik gabe tesi hau ez litzateke posible izango. Zorte onena hastera zoazen bide berrian Edurne, Gogo Elebiduna ez da gauza bera izango zu gabe. Eskerrik asko, halaber, hasieratik edo hasieran nirekin mahaia konpartitu zenuten Idoia, Sergio, Luis eta Itziarri. Zuek dagoeneko zuen bidea egin duzue eta onena opa dizuet etorkizunean.. Bidean zehar Marta eta Bea ezagutzeko aukera izan dut eta lankide bikainak izan zarete. Oraindik, apur bat falta zaizue tesia defendatzeko, baina ziur naiz kristoren tesiak aurkeztuko dituzuela, animorik beroenak! Este último año he trabajado desde casa y no he podido casi coincidir con Noèlia y Victoria, pero os deseo lo mejor, ¡mucho ánimo! Azkenik, taldeko beste doktoreei ere eskerrak eman nahi dizkiet, gertu sentitu zaituztet eta zuengandik asko ikasteko aukera izan dut.

EHUn asko gara tesia egiten dihardugunak, eta gauza polit zein beharrezkoa da elkarren berri izatea, elkarrengandik ikasi eta aurrera egiteko. Hizkuntzalaritzaren arloan, Hizkimilikiliklik taldearen baitan egoteko zorte ikaragarria izan dut, onenak zarete! Eta.. ez dadila haria eten! Gradua eta master bat Gasteizen egin ditudan arren, tesian zehar, lehendabizikoz, Gasteizen bizitza egin dudala esatera ausartzen naiz. Hori, topatu dudan kuadrilla zoragarriari esker izan da. Eskerrik asko, Ibane, Urreta, Diego, Iratxe, Ander, Maddalen eta Aitor. Ongi segi eta laster arte! Esperientzia honetan pisu bakarrean bizi izan naiz, lehen aldiz Gasteizen. Leire, Goretti, pisukide bikainak izan zarete! Uxue, nire egonaldia eta pandemia dela eta ez dugu asko egoteko aukerarik izan, baina eskerrik asko zuri ere. Alex, zer esango diat ba, hirekin lehen aldia izan duk norbaitekin segidan urtebetez baino gehiago bizi izan naizena, eta hik 3 urtez aguantatu behar izan nauk. Besarkada potolo bat adiskide! Azkenik, pala munduan ezagutu dudan jendeari eskerrak eman nahi nizkizueke, eta bereziki Urretxuko astapotroari, urte askotarako JR!

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Karrera garaitik harreman sakona mantendu dudan nire lagun kuttun Aitor eta Joni, eskerrik asko urte guzti hauetan hor egoteagatik. Modu batera edo bestera, itsasoan urak handi izanagatik, hainbeste debaterekin, Euskal Herria salbatuko diagu!

Birusak eta itxialdiak Donostiara ekarri ninduten, baina dena ez da txarra izan. Doktoretzako bigarren urtean nire bihotzeko emakumea ezagutzeko zortea izan nuen, eta itxialdiak batera bizitzen jartzeko aukera luzatu digu. Eskerrik asko animo guztiengatik Aran, hire laguntzarik gabe ez nikenan lortuko!

Por último, querría agradecer a mi familia por estar ahí en los momentos difíciles. Espero que consigamos darle la vuelta pronto a esta situación y podamos vernos más asiduamente como antaño. Un abrazo especial para mis abuelos, Pablo y Espe.

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List of Abbreviations

1	First person
2/you	Second person
3	Third person
A	Subject of transitive sentences
ABS	Absolutive
ACC	Accusative
AF	Agent First Hypothesis
AN	Anterior Negativity
AoA	Age of Acquisition
CPH	Critical Period Hypothesis
DAT	Dative
DET	Determiner
DOM	Differential Object Marking
DP	Determiner Phrase
eADM	Extended Argument Dependency Model
EEG	Electroencephalogram
ELAN	Early Left Anterior Negativity
ERG	Ergative
ERP	Event Related Potentials
FDH	Feature Distinctness Hypothesis
FEM	Femenine
FFFH	Failed Functional Features Hypothesis
fMRI	Functional Magnetic Resonance Imaging
FT/FA	The Full Transfer/Full Access Model
FUT	Future
IMPF	Imperfective
ISI	Interstimulus interval
L1	First language
L2	Second language
LAN	Left Anterior Negativity
LDH	Language Distance Hypothesis
LMTG	Left middle temporal gyrus
NOM	Nominative
NP	Noun Phrase

MAS	Masculine
MEG	Magnetoencephalography
MS	Milliseconds
O	Object
P	Object of transitive sentences
PL	Plural
PNDH	Person-Number Dissociation Hypothesis
RT	Reaction Times
S	Subject
S	Subject of intransitive sentences
SD	Standard Deviation
SDE	Standad Deviation Error
SG	Singular
SGJ	Speeded Grammaticality Judgement
SV agreement	Subject-Verb agreement
SPS	Syntactic Positive Shift
UH	Unaccusative Hypothesis
UTH	Unaccusative Trap Hypothesis
V	Verb

Ama, beste edozeren gainetik tesia zuri dedikatzen dizut.

Mila esker beti nigan sinesteagatik.

Beti izango zaitut gogoan.

Chapter 1

I General Introduction

1 Experimental methods used in this dissertation

In this introductory chapter, I introduce the experimental methods used in this dissertation. I seek to provide the reader with the essential knowledge to follow the literature and the experimental work to be presented and discussed. In section 1.1, I will discuss the behavioral methods *(Speeded) Acceptability Judgment*, *Self-Paced Reading* and *Lexical Decision Task* (see De Groot & Hagoort, 2017, for further information on other behavioral methods). In section 1.2, I will introduce electrophysiology focusing on Event Related Potentials, the electrophysiological method used in this dissertation.

1.1 Behavioral methods

Psycholinguistic behavioral methods study participants' responses to linguistic stimuli, and in most cases, time is recorded. Behavioral methods are the main source of experimental evidence in psycholinguistics (E. M. Fernández & Cairns, 2010). The behavioral method that I will use in this dissertation is the *(Speeded) Acceptability Judgment*, a subtype of the *Decision Task*, since I will measure the accuracy and reaction times to different types of sentences both grammatical and ungrammatical.

Acceptability judgment tasks gather participants' decisions on whether a sentence is acceptable/unacceptable. Judgment tasks are divided into two categories: non-numerical and numerical (Podesva & Sharma, 2014). In non-numerical tasks two response options are given to the participants (yes/no, acceptable/unacceptable), these responses seek to find qualitative differences between conditions. In numerical tasks, such as Likert scaling, response options are given (1-7, 7 being totally acceptable and 1 totally unacceptable); these responses are designed to provide more detailed information on the size of the difference in acceptability, not so much about the difference across conditions. Non-numerical acceptability judgment tasks often use two measurements to gather data: accuracy and reaction times.

The measurement of *accuracy* is an off-line technique; it measures comprehension of the linguistic materials read/heard, not the ongoing processing of linguistic materials. The linking hypothesis is that there is a correlation between accuracy and cognitive cost: the lower the accuracy the higher the cognitive demand (Gernsbacher, 1994). *Acceptability Judgement Tasks* are a subtype of *Decision Task* and thus, response latency, i.e. the time between stimulus and a response, is a dependent variable (Gernsbacher, 1994). Most behavioral methods rely on the same linking hypothesis: the complexity of the mental process correlates with the response latency, such that latencies increase as complexity increases (Garrod, 2006).

Probably the most common psycholinguistic measurement of latency is *Reaction Time* (Grey & Tagarelli, 2018). Reaction times measure the time needed to process and respond to a certain linguistic stimulus in milliseconds. Data are gathered while the read/heard linguistic material is processed, this is why it is considered an on-line measure. On-line tasks are of greater interest, because they enable tackling more sophisticated questions about how language processing takes place in real time (E. M. Fernández & Cairns, 2010). Experimental evidence shows that longer reaction times correlate with increased processing load and processing difficulty, hence the linking hypothesis is supported (Podesva & Sharma, 2014).

Historically, reaction times are one of the first measures used to study language processing (Grey & Tagarelli, 2018). It was first used by the doctors Johan de Jaager and Franciscus Donders in 1865 in the Netherlands (Levelt, 2013). Jaager and Donders designed an experiment to study how long it took them to hear a sound and reproduce it. Speaker A would say *ki* and speaker B would answer *ki* as soon as she/he heard the sound, and vice versa. It took Jaager a mean of 250 ms and Donders a mean of 180 ms to repeat the stimuli. They added a second condition, where instead of *ki*, the speaker could pronounce six different possible syllables beginning with “k”. Jaager and Donders were 88 ms slower than in the first condition. They concluded that the extra time required was a result of having to discriminate one sound from six possible choices and further having to plan in order to produce the right choice. Jaager and Donders designed several similar experiments to analyze how perception, discrimination and planning worked, and they argued that mental operations for language perception, discrimination and planning can be measured in time.

The most common methods that use reaction times are *Self-Paced Reading* and *Lexical Decision Task* (Podesva & Sharma, 2014). In *Self-Paced Reading* experiments, participants are presented with a successive presentation of words or phrases and they have to press a button to move on from sequence to sequence. This task measures how much time a participant spends on one word or phrase before moving to the next one. The linking hypothesis is that participants read passages at a pace that matches their internal comprehension processes, thus uncovering the comprehension processes themselves (Just & Carpenter, 1980).

In the *Lexical Decision Task,* the time it takes to discriminate between nonwords and words is measured (De Groot & Hagoort, 2017). A well-known effect with reaction times using lexical decision task is found in word recognition. The *Figure 1* below represents the results from an experiment carried out by Embick, Hackl, Schaeffer, Kelepir & Marantz (2001), where the participants had to decide whether the word they hear or read was part of their vocabulary or not. Figure 1 illustrates the relation between frequency and word recognition times, showing that the more frequent a word is (X-axis), the less time (shown by reaction times on the Y-axis) is needed for that word to be recognized.

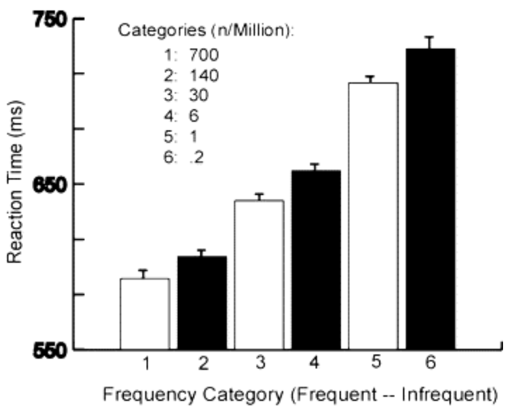

Figure 1. Reaction time by frequency category (Mean and S.E.). Taken from Embick et al. (2001), p. 346).

High frequency words are recognized faster than low-frequency/non-words (Embick et al., 2001; Whaley, 1978), as a result we infer low-frequency words/non-words require an increased search effort.

Acceptability Judgment Tasks that measure both accuracy and reaction times have also been referred to as *Speeded Grammaticality Judgement* (SGJ) in order to make them distinguishable from off-line judgment tasks (Bader & Häussler, 2010). In SGJ experiments, participants typically read sentences displayed on a screen word-by-word. After the last word is presented, participants are asked whether the sentence is acceptable or unacceptable. Then, the number of correct responses and the time needed to answer the questions in each experimental condition are analyzed. This is exactly what I am going to measure in this dissertation. The concept of “grammaticality judgment” is rather misleading, since grammar is a mental construct not accessible to conscious awareness, and it is participants’ judgments, such as acceptable/unacceptable, we can measure (Podesva & Sharma, 2014). I will add “speeded” to the name of method in order to make it distinguishable from off-line judgment tasks, but I will stick to the form “acceptability”. Therefore, I define the behavioral method used in this dissertation as *(Speeded) Acceptability Judgment*.

On the following, I will introduce some basic notions on the history of neurolinguistics and EEG, and I will present the electrophysiological method used in this dissertation, Event Related Potentials (*henceforth* ERPs).

1.2 Electrophysiology and ERPs

In this dissertation, I will also measure the brain activity generated by participants while reading sentences. Methods that look into the brain for the study of language are associated with neurolinguistics. The goal of neurolinguistics is to locate language related cognitive processes on the brain, and to explain their distribution (E. M. Fernández & Cairns, 2010). The main neurolinguistic methods are classified in two groups: methods that record the electrical and magnetic properties of neurons are termed neurophysiological (MEG, EEG), and functional imaging methods that record physiological changes associated with blood supply to the brain are termed hemodynamic (PET, fMRI), (see Ward, 2015, for more information on methods used in neurolinguistics).

Neurolinguistics is a fairly new field, since the brain has been mostly disregarded in our history and it has not been until recently that we have come to realize the importance of this field (Zimmer, 2005). Thomas Willis was, back in the late 1600s, one of the pioneering physicians who claimed that all our perceptions arise in the nervous system (Zimmer, 2005). In the late 1700s, Luigi Galvani discovered that the nervous system is made of electrical impulses, and in the late 1800s, Santiago Ramón y Cajal showed that those electrical impulses are information circuits arranged in individual cells with complicated networks. His claim was confirmed with the invention of the electron microscope in 1955, and it was corroborated that brain cells are discrete units with a tiny gap existing from cell to cell (Kemmerer, 2014).

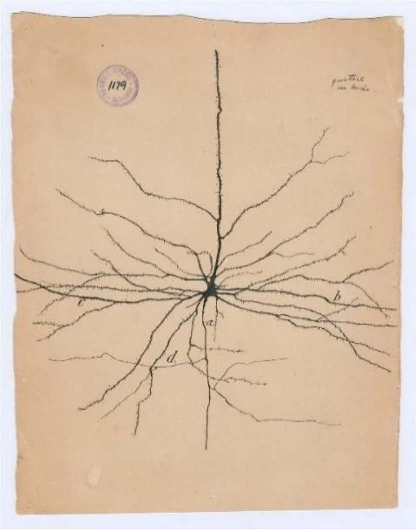

Figure 2. A pyramidal cell from the cerebral cortex by Ramón y Cajal in 1904. Picture taken from Instituto Cajal (CSIC).

The human Electroencephalography (EEG) was first implemented in 1920, when Hans Berger recorded and amplified activity of a patient with head injury by placing electrodes at the scalp. His findings were initially called into question, but the success in replicability showed the value of this technique (De Groot & Hagoort, 2017). The first EEG studies were carried out in the 30s with patients suffering from epilepsy or brain injuries, but not much was done with this method for a few years due to the Second World War. Afterwards, the EEG technique improved and it has ever since played a critical role in developing our current understanding of language processing in the brain (see Millett, 2001, for more information about the origin of EEGs). EEG measures the electricity generated in the brain by recording with electrodes placed on the scalp (De Groot & Hagoort, 2017).

Neurons are responsible for the electricity generated in the brain (see Figure 3 for an illustration). They tend to have a tree-like form, with dendrites (the roots), with an axon (the branch) covered with myelin sheaths (the bark) to provide insulation and accelerate signal propagation (Ward, 2015).

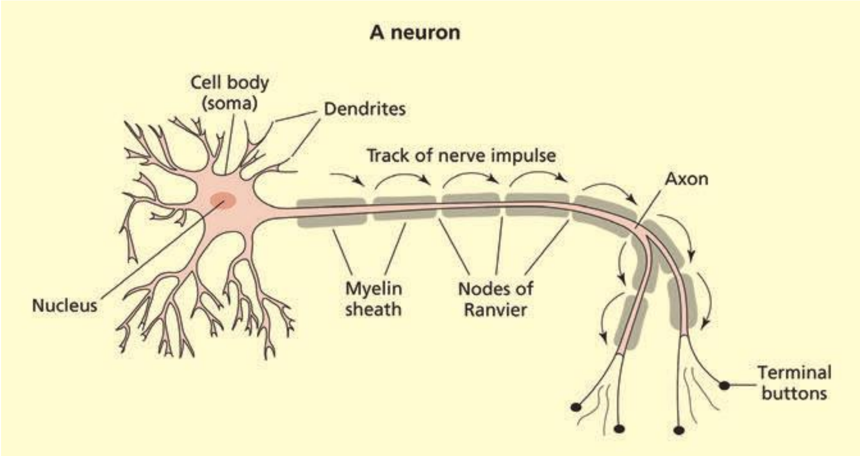

Figure 3. Basic components of a neuron. Taken from Ward (2015), p. 18.

The source of the electricity generated by neurons is twofold: action potentials and postsynaptic potentials. Action potentials are impulses fired from the beginning of the axion cell to the end of the axion, causing large voltage differences. At the end of the axon, neurotransmitters are activated. When neurotransmitters make contact with the receptors located in the membranes of postsynaptic cells, postsynaptic potentials are generated (Luck, 2005).

It is hard to measure action potentials because they only last for a millisecond, neurons activate at different times and often cancel each other's activity. In contrast, it is easier to measure postsynaptic potentials. To begin with, postsynaptic potentials last longer, somewhere between ten and one hundred milliseconds. Furthermore, postsynaptic potentials are generated within the dendrites and cells, and are not spread throughout the axon. The negativity at the tip of the dendrite and the positivity from the cell's body generate a dipole, that is, electricity. It should be noted that the dipole of a cell is so small that it is not possible to record it. However, if multiple neurons create such a dipole heading to a similar direction and in a similar time interval, it is possible to record the tension created. The electricity recorded by EEG usually comes from postsynaptic potentials. As a result, it is said that ERPs use postsynaptic potentials as their electricity source (Luck, 2005). See Figure 4 for a visual illustration of a neuron and current flow.

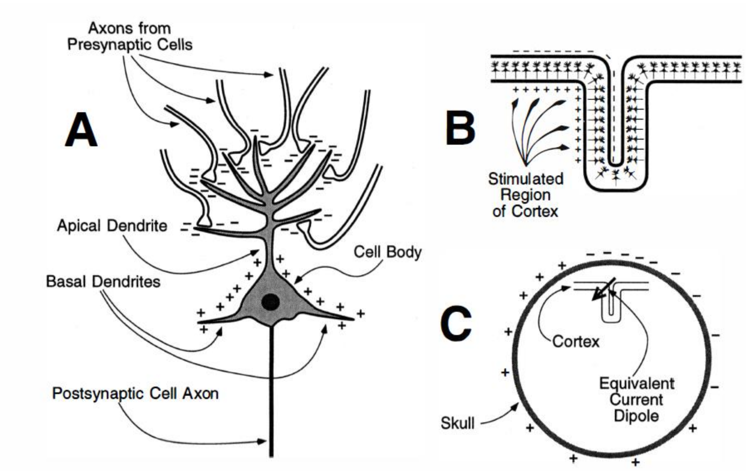

Figure 4. (A) Schematic pyramidal cell during neurotransmission. An excitatory neurotransmitter is released from the presynaptic terminals, causing positive ions to flow into the postsynaptic neuron. That activity creates a net negative extracellular voltage (-) in the area of the activated synapses and a net positive extracellular voltage (+) in other parts of the neuron, yielding a small dipole. (B) Folded sheet of cortex containing many pyramidal cells. When a region of the sheet is stimulated, the dipoles from the individual neurons summate. (C) The summated dipoles from the individual neurons can be approximated by a single equivalent current dipole, shown here as an arrow. The position and orientation of the dipole determine the distribution of positive and negative voltages recorded at the surface of the head. Taken from Luck & Girelli (1998), p. 74.

The EEG records the signals in milliseconds and after being amplified and digitalized, it takes the form of a continuous signal. Embedded within the EEG the neural responses associated with specific sensory, cognitive and motor events can be tracked (Luck, 2005). Event-related potentials are voltage fluctuations in the ongoing EEG that are time-locked to an event (Luck & Kappenman, 2011). The large background oscillations of the EEG make it impossible to the detect the evoked responses from a single trial. However, averaging across tens or hundreds of trials enables to obtain event-related potentials, that is, electrical potentials associated with specific events (Kemmerer, 2014), see Figure 5 for an illustration.

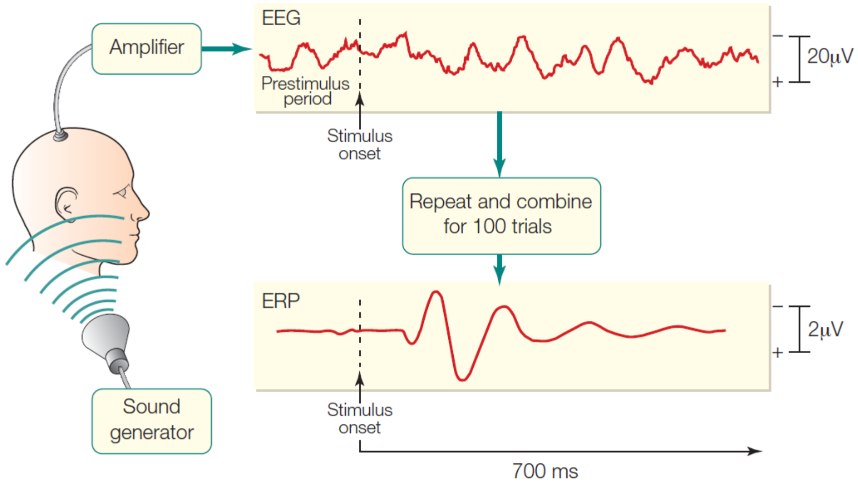

Figure 5. Recording an ERP. The relatively small electrical responses to specific events can be observed only if the EEG traces are averaged over a series of trials. Note the difference in scale between the EEG and ERP waveforms. Taken from Gazzaniga (2014), p. 149.

Waves can be positive or negative, and by convention many researches place positive polarity at the lower part of X-axis. The information provided by ERPs is considered multidimensional because differences can be found with regard to: (1) latency (when differences emerge), (2) polarity (positive and negative waveforms), (3) amplitude (how positive or negative waveforms are), and (4) topography (where activity is recorded) (Luck, 2005). ERPs do not have a high spatial resolution because the electrodes only register activity occurring at the scalp. Moreover, the electrodes are not able to determine where this activity is generated, only which point it reaches. Nevertheless, ERPs have a high temporal resolution because electrodes are able to gather brain activity online, millisecond by millisecond. Language processing occurs within milliseconds after any given stimulus is given, and that is why ERPs are an adequate tool to study language processing in real time (see Luck, 2014, for more information about the Event Related Events technique). Given the relevance of this method in my dissertation, in the next section I will describe the main ERP components in the study of language.

1.3 ERPs and language

Components are changes found in the scalp-recorded voltage across conditions. These changes refer to a specific neural or psychological process (Luck & Kappenman, 2011). The timing of a neural process can vary across trials, subjects, and experiments. As a result, ERP components will also vary across these contexts. Although a specific latency is often denoted by the name of an ERP component, e.g., P600, this latency is just approximate and related to the context in which the component was first identified. Many ERP component names also make reference to the polarity of the component. For instance, the "P" in the P600 component refers to the positive polarity of this component. Scalp distribution is often used to distinguish between components with the same polarity and similar latency. For instance, Left Anterior Negativity (LAN) refers to the scalp distribution, this way it is distinguishable from N400, another component with the same polarity and similar latency. In neurolinguistics, ELAN, LAN, N400 and P600 are the better known components (for a more detailed description of ERP components see Luck & Kappenman, 2011).

(a) Early Left Anterior Negativity (ELAN)

ELAN is a component associated with syntax and it is characterized by a negative-going wave starting at generally 125 milliseconds lasting up until 250 milliseconds in the left anterior electrodes using auditory stimuli.

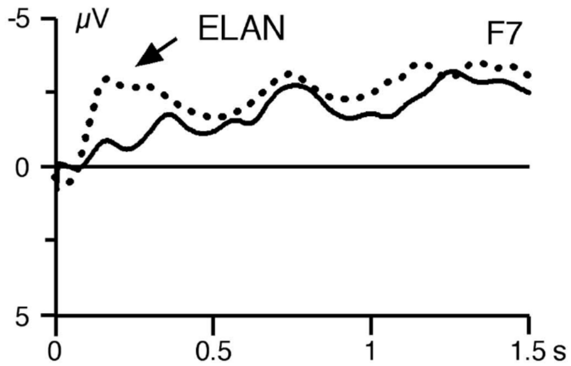

Figure 6. ELAN component, adapted from Friederici and Alter (2004), p. 272.

Friederici (2002) proposed a model in which syntactic structure is built based on grammatical categories. According to this model, ELAN usually emerges when an unexpected word category is shown, and she proposed that this component is a signature of early syntax phase building, before semantic content and relations are processed. It has also been hypothesized that ELAN is closely connected with sensory processing and that it emerges as a function of expectancy, rather than grammar violations (Bradley &

Hestvik, 2010; Dikker et al., 2009; Lau et al., 2006) (see Steinhauer & Drury, 2012, for more details).

(b) Left Anterior Negativity (LAN)

Left Anterior Negativity is a negative component that has been interpreted as an early syntactic component (Friederici, Pfeifer, eta Hahne, 1993; Weber-Fox eta Neville, 1996), which emerges within 150 and 500 milliseconds, and is located in the anterior electrodes of the left hemisphere.

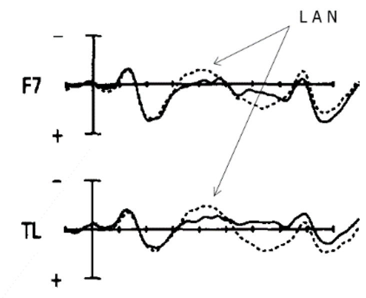

Figure 7. LAN component, adapted from Osterhout and Mobley (1995), p.745.

LAN is mainly associated syntactic and morphosyntactic processing and integration (Coulson, King, & Kutas, 1998; Friederici, Pfeifer, & Hahne, 1993). Differences in the topographic distribution of the component, such as negativity in both hemispheres, or negativity in frontal and central electrodes have been found. As a result, the existence of this component is under debate (see Molinaro, Barber, Caffarra, & Carreiras, 2015, and Tanner & Van Hell, 2014, for more information).

(c) N400

N400 is a negative component located in both hemispheres in central-parietal electrodes, popping up around 300-500 milliseconds after the stimuli is showed.

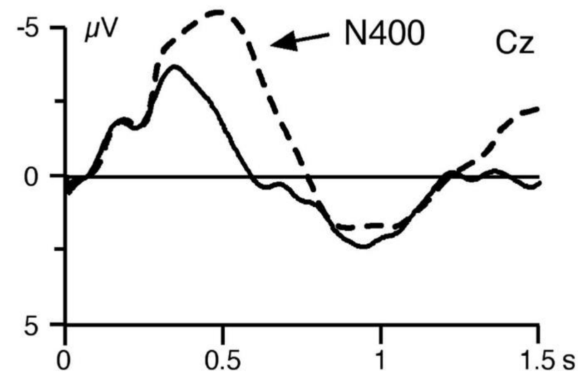

Figure 8. N400 component, adapted from Friederici and Alter (2004), p. 272.

It has been associated with semantic memory and meaning processing (Kutas & Federmeier, 2011; Kutas & Hillyard, 1980), although it is has also been observed for lexical-semantic expectations (Bornkessel-Schlesewsky & Schlesewsky, 2019) and for syntactic and thematic violations (Frisch & Schlesewsky, 2001; Martinez de la Hidalga et al., 2019; Zawiszewski et al., 2016; Zawiszewski & Friederici, 2009).

(d) P600

P600 is a positive component with a central-parietal distribution, which is generated within 500-800 milliseconds (Lee Osterhout & Mobley, 1995).

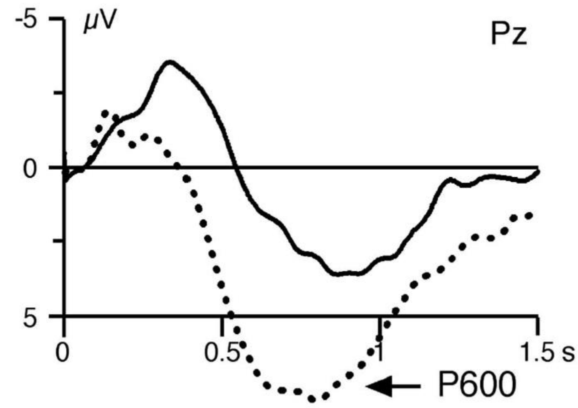

Figure 9. P600 component, adapted from Friederici & Alter (2004), p. 272.

P600 is associated with syntactic processing: syntactic reanalysis processes (Friederici, 2002), syntactic integration processes (Gouvea, Phillips, Kazanina, & Poeppel, 2010; Kaan, Harris, Gibson, & Holcomb, 2000), and filler-gaps dependencies (Phillips, Kazanina, eta Abada, 2005) *inter alia*. See Leckey and Federmeier (2019) for a review on P300, syntactic P600 and the so called semantic P600.

Behavioral and electrophysiological methods are often combined in neurolinguistics. ERPs have been often combined with reaction time data because reaction times can provide the estimated time of a processing event, while ERP data can determine whether distinct processes were used in the generation of that event. (Gonzalez-Marquez, Mittelberg, Coulson, & Spivey, 2007). As a result, behavioral and electrophysiological methods have been combined for the study of L1 processing as well as L2 processing (Díaz, Sebastián-Gallés, Erdocia, Mueller, & Laka, 2016; van Heuven & Dijkstra, 2010; Zawiszewski, Gutiérrez, Fernández, & Laka, 2011, *inter alia*). Finally, comprehension questions and acceptability judgment tasks are also frequently used in ERPs to ensure that participants read the sentences and do not lose attention (Gernsbacher, 1994; Podesva & Sharma, 2014).

In the following section, I introduce the notions of argument structure, thematic roles and intransitive predicates, and I pay special attention to the Unaccusative Hypothesis, one of the main hypotheses tested in this dissertation.

2 Intransitive predicates and the Unaccusative Hypothesis

In this dissertation, I test the Unaccusative Hypothesis (*henceforth* UH) (Perlmutter, 1978) in language processing by means of behavioral measures and ERPs. Before turning to intransitive predicates and presenting the UH, some basic notions about argument structure and thematic roles are in order. An intransitive predicate is a predicate that only takes one obligatory argument (Dixon, 1979). But, what is an argument? And a predicate? In this section I will provide some information about argument structure, thematic roles and the UH.

2.1 Argument structure

Arguments are entities that participate in events or situations. Each verb specifies the number of arguments that it takes (Hayes et al., 2013). Argument structure comprises the "labelled listing of the arguments that a lexical item can have" (Williams, 1981, p. 81), "the system of structural relations holding between heads (nuclei) and arguments linked to them in the roster of syntactic properties listed for individual items in the lexicon" (Hale and Keyser, 1998, p.1). Åfarli (2007) specifies that argument structure can be used in two related senses: "first, it can refer to the syntactic structure surrounding the verb. Second, it can refer to an inherent lexical-semantic property that the verb has, typically understood as a capacity the verb has to assign certain semantic roles, or theta roles" (p. 1). Therefore, argument structure is not only concerned with the number of arguments any given predicate takes, but also what specific type of arguments the predicate demands and how these arguments and the verb are related to each other. Predicates refer to any category that contains an argument structure, mostly used in the context of verbs (Hayes et al., 2013). Clauses involve a predicate and a number of arguments (Dixon, 2010); some predicates take only one argument (intransitives), some predicates take two arguments (transitives), and some predicates take three arguments (ditransitives). Takashima and colleagues (2020) claim that the more arguments a predicate takes, the costlier it is to process.

Grammatical relations between the verb and its arguments have been defined by constituent order and by surface morphological criteria (case marking and agreement) (Witzlack-Makarevich & Bickel, 2019). Subjects and objects have been regarded as the main syntactic functions in argument structure (Dik, 1997). Subjects have been defined in several ways (see Paul, 2010, for a discussion on subjects, grammatical relations, functions and functional categories). Objects have been regarded as internal arguments to the verb phrase, and subjects as external arguments to the verb phrase (Grimshaw, 1990), see Figure 10 below.

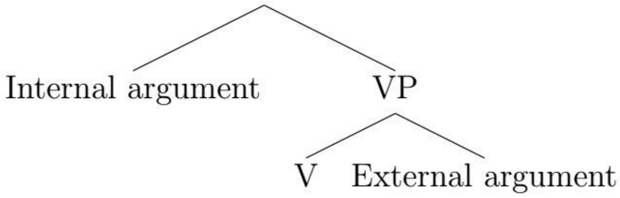

Figure 10. Syntactic epresentation of internal and external arguments.

Arguments have certain grammatical functions, and these have been associated with certain prototypical properties: subjects are generally actors (animate, definite, 1st or 2nd person), and objects are generally undergoers (inanimate, indefinite, 3rd person) (Bornkessel-Schlesewsky & Schlesewsky, 2009).

Transitive sentences contain a verb and two arguments. Bornkessel-Schlesewsky and Schlesewsky (2009) argue that the arguments in an event should be as distinct as possible from one another to ease processing. Constituent order and surface morphological marking are two of the most well-known strategies to achieve this (Witzlack-Makarevich & Bickel, 2019). Word order or constituent order represents the linear distribution of canonical sentences (a Subject, an Object and a Verb), and it is distributed in the world languages as follows: SOV (41%), SVO (35%), no predominant order (14%), VSO (7%), VOS (2%), OVS (1%), OSV (>1%) (Dryer, 2005). As mentioned above, argument structure is concerned with the number of arguments and the roles these have (Bickel & Nichols, 2009). Case alignment shows how these roles are realized in particular morphological or syntactic contexts. Three main argument types are categorized to describe case alignment: the most agent-like argument of a transitive predicate (labeled A), the most patient-like argument of a transitive predicate (labeled P), and the argument of an intransitive predicate (labeled S) (Dixon, 1979) (see example 1 below). World languages are aligned as follows: neuter (52%), nominative-accusative (standard) (24%), ergative-absolutive (17%), nominative-accusative (marked nominative) (3%), tripartite

(2%), active-inactive (2%) (Comrie, 2013). Neuter means that there is no morphological case marking, thus arguments do not differ morphologically. In nominative-accusative languages, only the object of transitive sentences (P) is marked with a distinct case, accusative (example 1a). The notions of subject and object were designed for languages bearing this case alignment, since *subject* is just a synonym for nominative, and *object* a synonym for accusative (Fillmore, 1968). In ergative-absolutive languages, only the subject of transitive sentences (A) is marked with a distinct case, ergative (example 1b). In tripartite languages, the subjects of intransitive sentences (S) receive a given case, the subjects of transitive sentences (A) another, and the objects of transitive sentences (P) another (example 1c). Last but not least, active-inactive languages assign ergative case to subjects of transitive clauses (A) and subjects of intransitive clauses (S) with agent arguments, and absolutive case to objects of transitive clauses (P) and subjects of intransitive clauses (S) with patient arguments (Danziger, 1996; Klimov, 1974) (example 1d). Active-inactive languages are also known as “semantically aligned” (Donohue & Wichmann, 2008), “split intransitive” (Merlan, 1985) and “Split-S (Dixon, 1979), and are often categorized as a subpart of ergative-absolutive case alignment (see Chapter I, Section 2.3.3 below for examples on Basque, an active-inactive language).

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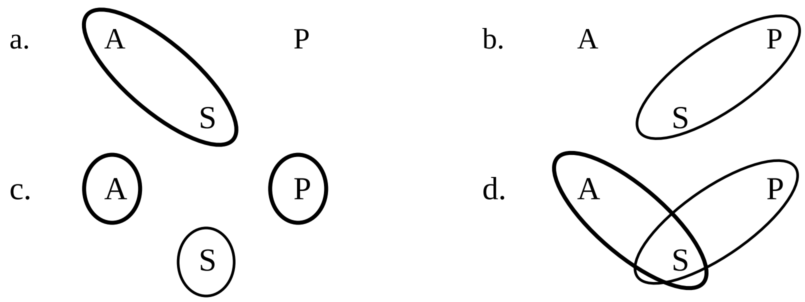

It can be observed that the notion of *subject* is unsuitable for languages with a case alignment other than nominative-accusative/neuter because subjects are not aligned with a unique case marker (Silverstein, 1976). Most case marking systems are structurally based (1a,b,c), since structural positions function as a basis for case assignment (Bobaljik, 1993; Chomsky, 1981). This means that thematic distinctions only become relevant for case in transitive predicates. Spanish is an example of (1a), as shown below:

2 a. Juan ha venido.

Juan.$_{\text{NOM}}$ has come

“Juan has come.”

b. Juan ha visto a Maria.

Juan.$_{NOM}$ has seen $_{ACC}$ Mary

"Juan has seen Mary."

The subject of (2a) and the object of (2b) are themes. Nevertheless, only the object, the most patient-like argument of transitive predicates gets an overt mark in Spanish, accusative. Only active-inactive case alignment are clearly inherent, meaning that case is assigned based on arguments' thematic roles, not on their structural position (see Levin, 1983, and Laka, 2006, for more information inherent vs. structural case).

Thematic roles are thus fundamental to understand argument structure. More precisely, thematic roles are essential when working with intransitive predicates because they are one of the defining properties of the division made by the UH. In the following subsection I will introduce the notion of *thematic roles*, focusing on agent and patient roles.

2.2 Thematic roles

Thematic roles are of great importance for this dissertation because they constitute a defining property for the distinction between two categories within intransitive predicates. Thematic roles describe and define the relations participants share in events, and are defined as "creatures of the syntax-semantics interface" by Dowty (1991), which shows that both syntax and semantics come into play when working with thematic roles. They were first introduced by Gruber (1965) as *thematic relations*, as the relations of participants whose location or movements are described by the verb. Thematic relations, later known as *thematic roles*, became largely known by Jackendoff (1972) as *thematic categories*.

Several thematic roles have been identified (Agent, Patient, Experiencer, Theme, Benefactive, etc.). Some linguists have analyzed thematic roles as discrete categories and have operated with the traditional thematic role types above mentioned (Nishigauchi 1984; Belletti & Rizzi 1988; Levin & Rappaport 1988, *inter alia*). Other linguists have classified up to a hundred different roles (Blake, 1930), but no one has really ever managed to create a unified account. Dowty (1991) explains that others saw the danger of indeterminacy, of not being able to clearly define thematic roles, and treated thematic roles as individual roles, i.e. the subject of hit "the hitter role", the subject of take, "the taker role", etc. (Marantz, 1984; Van Riemsdijk & Williams, 1986). Dowty (1991) defends that thematic roles are not discrete categories, but rather cluster concepts, similarly to the prototypes in (Rosch & Mervis, 1975). Dowty explains that:

discrete feature decomposition has its proper place in describing syntax, morphology, and phonology, because these domains are aspects of the 'coding system' of language at various levels and therefore in principle discrete. But semantic distinctions like these entailments ultimately derive from distinctions in kinds of events found 'out there' in the real world: they are natural (physical) classifications of events, and/or those classifications that are significant to human life.

(Dowty 1991: 575)

According to Dowty (1991), it is enough to consider two role types in order to describe argument selection efficiently: PROTO-AGENTS and PROTO-PATIENTS. Dowty offers some preliminary though not definitive entailments for each proto-role, shown below:

3 Contributing properties for the Agent Proto-Role:

a. volitional involvement in the event or state

b. sentience (and/or perception)

c. causing an event or change of state in another participant

d. movement (relative to the position of another participant)

(e. exists independently of the event named by the verb)

4 Contributing properties for the Patient Proto-Role:

a. undergoes change of state

b. incremental theme

c. causally affected by another participant

d. stationary relative to movement of another participant

(e. does not exist independently of the event, or not at all)

(Dowty 1991: 572)

The author defends that proto-roles are involved in argument selection for transitive sentences in the following way: "the predicate that entails the greatest number of Proto-Agent properties will be lexicalized as the subject of the predicate; the argument having the greatest number of Proto-Patient entailments will be lexicalized as the direct object" (p. 576). Verbs can have one of these entailments, some or all of them. For instance, verbs such as "kill" have all the entailments in (27) for the subject, and all the entailments in (28) for the object, whereas verbs such as "see" only have the entailment of sentience/perception for the subject.

However, not all linguists that have studied thematic roles have followed the proto-role hypothesis. In fact, dozens of hypotheses have been proposed in the last years, and recently Newmeyer (2010) reckoned that "there is no construct as murky in ANY subdivision of linguistic theory as that of 'thematic role'" (p. 689). There is still no specific definition of what thematic roles are. For some researchers thematic roles are universal components of core knowledge, abstract role categories with a universal bias to be distinguished from each other (Carey, 2009; Strickland, 2016) and cross-culturally universal (Fillmore, 1968). Experimental evidence suggests that Agent and Patient roles are indeed universal components of core knowledge, whereas things get blurry with other thematic roles (Rissman & Majid, 2019).

2.2.1 Agent and Patient

The distinction between agent and patient roles is of great relevance for linguistic event-encoding and, more precisely for this dissertation, for a categorical distinction inside intransitive sentences (see Section 2.3, for more information on the Unaccusative Hypothesis). In this subsection I present the literature on Agent and Patient roles and I present evidence in support of idea that Agent and Patient roles are rooted in cognition, and can be categorized as conceptual primitives, common to all languages (see Wierzbicka, 1996, for more information about conceptual primitives).

Since the moment babies are born, newborns show some preferences. Some of these preferences are related to agent/patient properties. For instance, a few studies have found that newborns display a preference toward face-like patterns compared to other patterns (Goren et al., 1975; M. H. Johnson et al., 1991; Kleiner, 1987; Maurer & Young, 1983; Valenza et al., 1996). Newborns are also sensitive to sound and movement, for instance, they are attracted to moving objects rather to stationary objects (Fantz, 1967; Haith, 1983). By 6 months of age, infants can recognize causality in direct launching events (Bélanger & Desrochers, 2001; Leslie, 1984), can interpret grasping actions as goal-directed (Daum & Gredebäck, 2011; Woodward, 1998), and expect a causal agent as the source of motion of an inert object (Saxe et al., 2007). Similarly, preverbal infants can identify causal-effect relations (Leslie & Keeble 1987 with 6-month-olds; Saxe, Tenenbaum & Carey 2005 with 8-month-olds; Muentener & Carey 2010 with 10 month-olds). Meltzoff, Waismeyer & Gopnik (2012) conclude that "observational causal learning may be a fundamental learning mechanism that enables infants to abstract the causal structure of the world so swiftly and accurately" (p. 1227). Several studies have shown that 2-year-olds display sensitivity to Agent and Patient categories with novel sentences such as *the duck is daxing the bunny* with transitive sentences (Arunachalam & Waxman, 2010; Naigles, 1990; Noble et al., 2011), and are also sensitive to Agent-Patient categories when producing sentences to describe actions involving animate and inanimate entities (Angiolillo & Goldin-Meadow, 1982). Even children who are not getting a linguistic system from their care givers display a sensitivity towards agents and patients (Goldin-Meadow, 2003; Goldin-Meadow & Mylander, 1998; Rissman & Goldin-Meadow, 2017).

Interestingly, some studies show that when acquiring agent and patient thematic roles, the relation between the agent acting upon the patient and vice versa is essential, and if agents are shown on their own (intransitives), children do not recognize them as agents (Arunachalam & Waxman, 2010; Naigles, 1990; Noble et al., 2011). Noble et al. (2011) report that:

… children as young as 2;3 were able to associate transitive argument structure with causal events and could use transitive argument structure to assign agent and patient roles correctly. However, second, children were unable to associate the structure of conjoined agent intransitives with noncausal events until 3;4. (p. 975)

Therefore, it seems that children develop agent and patient theme roles in transitive configurations and later apply these roles to intransitive configurations. Following the studies above presented, it can be concluded that agent and patient thematic roles are rooted in cognition and are part of core knowledge, meaning there is a universal bias to distinguish agents and patients (Rissman & Majid, 2019). These studies show that agents and patients are cognitively different, but also that agents are cognitively more salient than patients.

2.2.2 Agent First (AF) Hypothesis

In the previous subsection, I discussed the differences between the Agents and Patients and this distinction has consequences for processing as it has been claimed that agents are preferred over patients. This is known as Agent First Hypothesis, presented below in Section 2.3. Most evidence in support of the AF comes from the Subject First Hypothesis and thus, I first present what has been said about this hypothesis. As mentioned above, subjects are prototypically the most agent-like argument and objects the most patient-like one. Several studies have analyzed argument preferences in transitive contexts, and have found that sentence initial ambiguous DPs are processed as a subject rather than as an object (De Vincenzi, 1991; Frazier, 1987; Schriefers et al., 1995). This preference for subjects has been argued to be a “minimal effort” mechanism applied by the parser (Bever, 1970; Crocker, 1994; Frazier & d’Arcais, 1989; Gibson, 1998, 2000). Following this “minimal effort” strategy, the Subject First/Preference Hypothesis, also known as Subject Processing Advantage (SPA), has been put forth, and it is claimed that subjects are preferred over objects (Bader & Meng, 1999; Bornkessel & Schlesewsky, 2006; De Vincenzi, 1991; Ferreira, 2003; Schlesewsky et al., 2000). All of the cited studies above have been carried out with nominative-accusative SVO languages. Demiral, Schlesewsky & Bornkessel-Schlesewsky (2008) analyzed subjects and objects to in Turkish, a nominative-accusative SOV language which allows initial (unmarked) objects. They conducted an ERP study and found increased processing difficulties (P600) for initial ambiguous arguments that later turned out to disambiguate for object reading. They concluded that there is a universal tendency to interpret the first argument encountered as the subject of the clause, even in languages where there is no obvious structural motivation for such strategy. Subjects and object have also been compared in a couple of ergative languages (Bornkessel-Schlesewsky et al., 2008; Clemens et al., 2015) (see Longenbaugh and Polinsky, 2017, for a discussion). Bornkessel-Schlesewsky et al. (2008) modified the hypothesis and claimed that when encountering an ambiguous argument, the language comprehension system universally prefers an [S, A] reading over and [P] reading. The truth is that only subjects of transitive predicates [A] have been compared to objects of transitive predicates [P], hence, agents have been compared to themes. In consequence, these studies have found evidence in support of agents being more salient that patients. This difference in saliency is relevant for the current dissertation because intransitive predicates differ with respect to their thematic roles, as will be presented below in Section 2.3.

The Agent First Hypothesis (AF), also known as the Agent Advantage, has not ever been framed explicitly as a hypothesis. Evidence suggests that the agent is more prominent than the patient thematic role with regards to cognition (Cohn & Paczynski, 2013; Ferreira, 2003; Segalowitz, 1982). Cohn et al., (2017) claim that neurobiological mechanisms favor the detection of agents over other thematic roles, usually compared to patients. Bornkessel & Schlesewsky (2006) presented a phase-based neurocognitive model of online comprehension, the extended Argument Dependency Model (eADM). The eADM seeks to account for cross-linguistic unity and diversity in the processing of core constituents. This model posits prominence relations and defends that upon encountering an ambiguous first argument, the actor role will be assigned based on prominence information. See Figure 11 for an illustration.

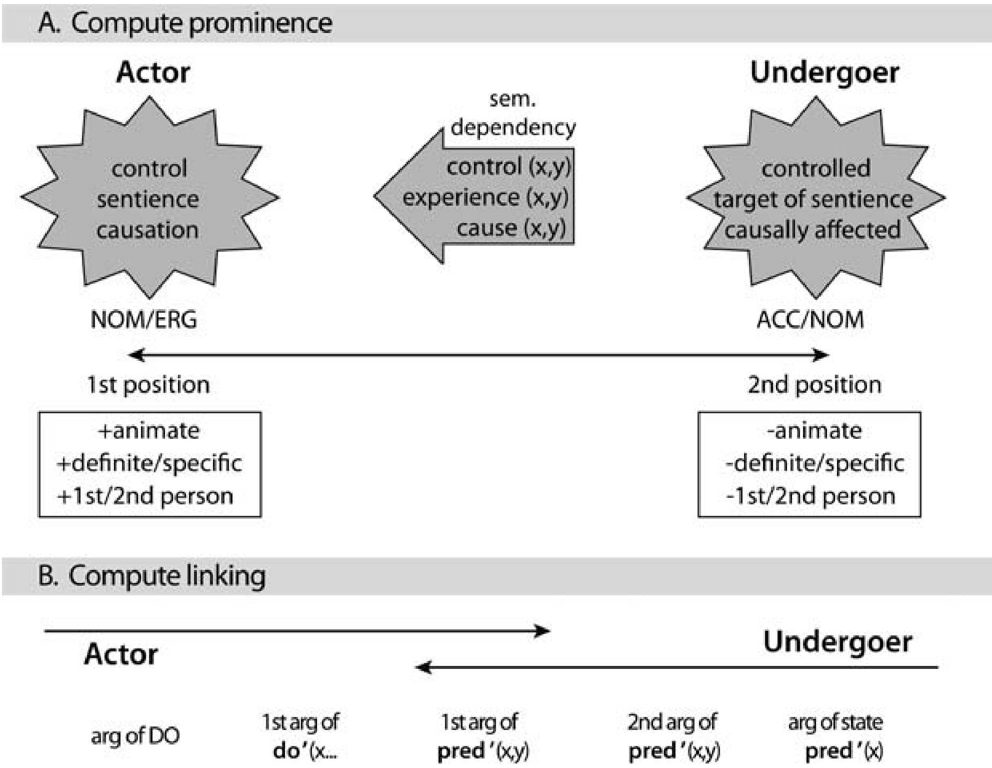

Figure 11. An illustration of the representational assumptions about the generalized roles actor and undergoer within the eADM. Taken from (Bornkessel-Schlesewsky & Schlesewsky, 2009).

Here, I present studies that provide evidence in support of the AF theory. Several studies have shown that children learn first to detect the agent than the patient (Arunachalam & Waxman, 2010; Gertner et al., 2006; Y. T. Huang et al., 2013; Naigles, 1990; Noble et al., 2011; Slobin & Bever, 1982). Abbot-Smith et al. (2017) showed that children incrementally link the first noun of a sentence with that of an agent role. Goldin-Meadow (2003) builds on this and adds that “the fact that young children often interpret sentences like “babies are pushed by dogs” to mean the babies are the *pushers* (not the *pushees*) suggests that, for these children, the first word is an agent, not a subject” (p. 10). Abbot-Smith et al. (2017) showed that two and three-year-old children use an incremental first-NP-as-agent bias to process active transitive and passive sentences, whereas four-year-old children can already distinguish between active and passive sentences:

… the 25-month-olds did not distinguish active from passive sentences in the forced choice pointing task. In contrast, the 41-month-old children did reanalyze their initial first-NP-as-agent bias to the extent that they clearly distinguished between active and passive sentences both in the eye-tracking data and in the pointing task. (p. 1)

For these children, the agent must precede the patient, and it is not until later on that they can process passive sentences where the patient precedes the agent. Studies with both children and adults have shown that agents are recognized faster than patients in visual paradigms such as pictures or short films (Robertson & Suci, 1980; Segalowitz, 1982). Webb, Knott & MacAskill (2010) found that observers’ eye movements follow a characteristic sequence, specifically, moving from the fixation point to the agent (typically to the agent’s head) and then to the target.

Canonical transitive sentences are regarded as those containing an agent argument, a patient argument and a verb. Regarding these sentences, agents are the first element in the sentence in 89% of languages, and agents precede patients in 97% of languages of the world (Dryer, 2005; Kemmerer, 2012). This is even the case with deaf children who have not learnt a sign language (Goldin-Meadow, 2003; Goldin-Meadow & Feldman, 1977). Cohn & Paczynski (2013) claim that agents provide more information about event structure than patients, which facilitates event processing. Other studies have shown that speakers of different languages display similar order preferences (actor-patient-act) in spontaneously generated gestures (Goldin-Meadow et al., 2008), and also when ordering pictures of scenes (Gershkoff-Stowe & Goldin-Meadow, 2002).

Agency is linked with animacy (Bates & McWhinney, 1982). Agents are prototypically animate, and patients are prototypically inanimate. This is also illustrated in Figure 11 presented above. When processing strict word order languages like English, electrophysiological differences can already be found on the subject when comparing animate and inanimate subjects (Bourguignon et al., 2012). Bourguignon et al. (2012) found an increased negativity in inanimate subjects compared to animate ones, showing that animate arguments, prototypically agents, are the predicted subject choice. New, Cosmides & Tooby (2007) propose the Animate Monitoring Hypothesis, and show that there is a general animate monitoring bias, whereby participants are faster and more accurate at detecting changes in animals compared to inanimate objects, even vehicles. It is further argued that their findings can only be accounted for by "implicating mechanisms that evolved to direct attention differentially to objects by virtue of their membership in ancestrally important categories, regardless of their current utility" (p. 16598).

Assigning roles is rapid and automatic, but there are cues which facilitate or make this assignment more difficult. Glanemann et al. (2016) showed that participants assign agent roles faster to global event properties such as posture/orientation compared to local event properties such as the category of instrument objects. Similarly, Cohn, Paczynski & Kutas (2017) showed that agency prediction happens very early in time, as agentive preparatory postures facilitated sentence processing.

In conclusion, there is ample evidence which shows that agent and patient roles are two primitive roles, and that agents are preferred over patients. Going back to the beginnings of thematic roles, Dowty (1991) primarily studied bivalent predicates with proto-agents and proto-patient arguments, focusing on argument selection in transitive predicates, but what about intransitive predicates? Intransitive predicates have been and are often still considered as a sole category (S) in typology, but in theoretical linguistics differences between some intransitives and other intransitives were already observed by the late 1960s (see Pullum 1988 for a full review).

2.3 The Unaccusative Hypothesis

Now that I have presented what arguments and thematic roles are, I will move on to present the Unaccusative Hypothesis (UH). Perlmutter (1978) proposed that there are two types of intransitive predicates using Relational Grammar framework. According to this syntactic framework, subjects have an initial 1 relation and objects an initial 2 relation. The UH claims that there are two types of intransitive predicates: intransitive clauses with an initial 2 relation but no initial 1 relation, and intransitive clauses with an initial 1 relation but no initial 2 relation. The former are called unaccusative predicates and have patient-like arguments; the latter are called unergative predicates and have agent-like arguments. The Final 1 Law (Perlmutter & Postal, 1983) claims that “every basic clause contains a final-stratum 1-arc, and thus that every basic clause involves some nominal as final 1” (p. 100). This law forces arguments of unaccusative predicates to advance from initial 2 to final 1. The UH, therefore, also claims that an extra step is required in the syntactic derivation of unaccusative predicates compared to that of unergatives: the argument of an unaccusative predicate has to advance from initial 2 to final 1, whereas the argument of an unergative predicate is generated in initial 1 and remains in final 1. This advancement is shown in 6 (taken from Perlmutter, 1978, p. 160), where the argument *gorillas* in (b) is generated in initial 2 and has final 1. This advancement is what Perlmutter (1978) defines as unaccusative.

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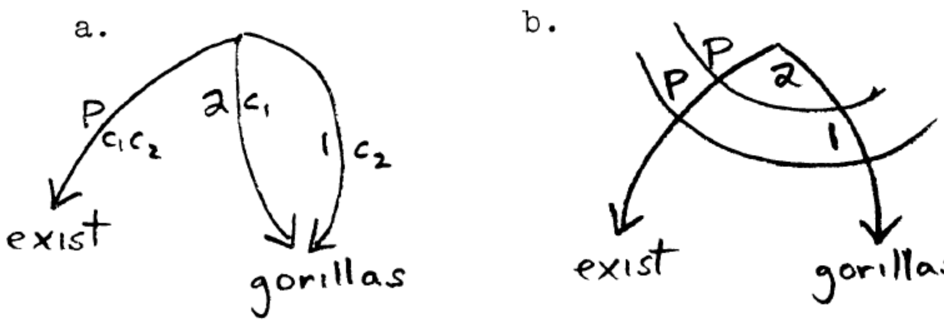
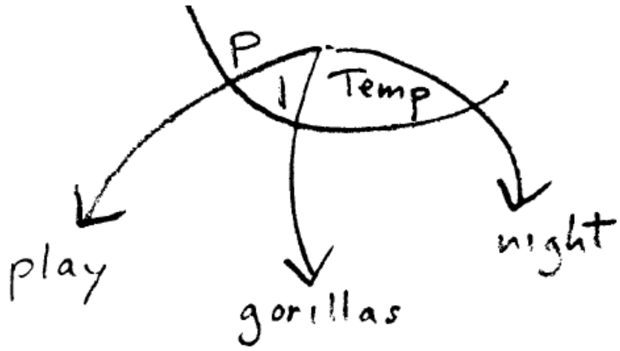


Passives are distinct from unaccusatives in that the argument in initial second position advances into an existing final first position, whereas in the case of unaccusatives, the argument in initial second position advances into a non-existing final first position. On the other hand, *gorillas* in 7 (taken from Perlmutter, 1978, p. 161) is generated in initial 1 and no advancement is required in this case, this is called unergative.

6



Burzio (1986) reframed the Unaccusative Hypothesis put forth by Perlmutter (1978) in Government and Binding theory terms by claiming that there are two intransitive predicates: unaccusatives, which Burzio (1986) "refers to as *ergative*, whose surface structure subject is a D-structure direct object" (p. 71), and unergatives, which Burzio refers to as intransitives, whose surface structure subject is a D-structure subject.

Perlmutter (1978) attributes separate semantic features to unergative and unaccusative predicates. He argues that "the class of initial unergative clauses seems to correspond closely to the traditional notion of active" (p. 162), and usually make reference to: volitional acts, including manner-of-speaking verbs and sounds made by animals, and certain involuntary bodily processes; whereas the class of unaccusative predicates makes reference to: predicates expressed by adjectives, semantically patient initial nuclear terms, non-voluntary emission of stimuli that refers to senses, existing and happening, aspectual and durative predicates. These two classes are very similar to the properties of proto-agent and proto-patients that Dowty (1991) later on proposes, presented in Section 2.2 (see also Sorace 2000). Dowty (1991) himself addresses intransitive predicates and adds that "the intransitive predicates argued to be unaccusative on syntactic grounds usually turned out to entail relatively patient-like meanings for their arguments (e.g. *arrive, die. fall),* while those argued to be syntactically unergative were usually agentive in meaning *(smile, walk, talk,* etc.)" (p. 605). The distinction of unaccusative and unergative predicates based on semantic accounts was also defended by some scholars (Van Valin, 1990; Zaenen, 1993). Working at the syntactic-semantic interface, Levin & Rappaport (1995) concluded that unaccusativity is semantically determined and syntactically represented. In this dissertation, the UH will be tested following Perlmutter's (1978) claim based on syntactic grounds, bu semantic features, such as prototypicality will also be taken into account.

The UH has been experimentally tested by means of several methods. Bever & Sanz (1997) were the first to experimentally test the UH; they conducted a reaction time study in Spanish to explore whether the trace left by the argument of unaccusative verbs in the complement of V position, argued to be an anaphor (Chomsky, 1981), would prime semantically related nouns as overt anaphors do. They identified two types of experimental subjects: *sequence-sensitive* participants, who showed a positive correlation between sentence length and response time; and *sequence-insensitive* participants, who showed a negative correlation between sentence length and response time. On the one hand, they found that *sequence-sensitive* participants, who scanned the linguistic sequence to find a probe word, recognized it faster in preverbal position in unaccusatives than in unergative constructions. On the other hand, they found that *sequence-insensitive* participants showed shorter probe recognition times with unergatives than with unaccusatives in subject preverbal position, and they linked this result with the possibility that unaccusatives may be conceptually more complex than unergatives. They concluded that their data from *sequence-insensitive* participants "confirm the hypothesis that there is a trace in the comprehended representation of a Spanish unaccusative sentence with a preverbal subject" (p. 85), thus supporting the UH.

Since this pioneering study, a number of studies have tested this hypothesis experimentally; in the last decades the UH has been tested in healthy adults, both in sentence production (Kim 2006; Lee & Thompson 2011; Momma, Slevc & Phillips 2018) and in sentence comprehension (Friedmann, Taranto, Shapiro & Swinney, 2008; Koring et al., 2012; Meltzer-Asscher et al., 2015; Shetreet et al., 2009; Thompson et al., 2007; Zeyrek & Acarturk, 2014), and in sentence production studies on agrammatic aphasia (J. Lee & Thompson, 2011; M. Lee & Thompson, 2004; McAllister et al., 2009; Thompson, 2003).

Friedmann et al. (2008) conducted a cross-modal lexical priming experiment in English to study whether subject NPs reactivate after the verb in unaccusative and unergative sentences. Visual targets were designed at three probe position in each sentence, aurally presented, and participants were instructed to respond to a visual lexical decision whenever a word/non-word was shown on the screen. They found that priming occurred right after the verb for unaccusative and unergative verbs, but the reactivation at Probe Position 3 was only found for unaccusative verbs. Zeyrek & Acarturk (2014) ran an eye-tracking experiment to study the cognitive processing of intransitive predicates. Participants had to read intransitive sentences while their eye movements were recorded. The gaze regression analysis grouped intransitive verbs in two clusters with regard to the number of regressions, revealing an unergative/unaccusative split in intransitive verbs in Turkish. Koring, Mak and Reuland (2012), ran an eye-tracking study using the visual world paradigm to investigate whether it is possible to measure the online (re)activation of an argument and whether differences arise among different types of intransitive verbs. Participants listened to sentences while they were presented with images consisting of four objects, one closely related to the argument of the verb. They found that the argument of the verb is always reactivated, but subjects were reactivated in different time intervals in Dutch unaccusative and unergative verbs (see Huang & Snedeker, 2020, for contrasting results). Finally, Meltzer-Asscher et al. (2015) in English and Shetreet et al. (2009) in Hebrew, looked at the neurological reality of the distinction between unergative and unaccusative verbs by means of fMRI, and both studies found distinct activations for unaccusatives and unergative verbs.

Unaccusative Hypothesis has not been tested by means of ERPs so far and one of the objectives of the present dissertation aims to fill this gap. All the studies presented above found differences between unaccusative and unergative predicates, thus supporting the first claim of the UH, which advocates for a categorical distinction within intransitive predicates. Evidence for the UH has come from nominative-accusative languages. In this dissertation I test the UH with another nominative-accusative language, Spanish, and also with an ergative-absolutive language, Basque.

The UH also claims that unaccusative predicates undergo an extra derivational step compared to unergative predicates. Syntactic additional movements are associated with costlier processing (see Fanselow et al., 2002, for more information). Experimental evidence for the second claim of the UH should therefore translate in traits of costlier processing for unaccusative predicates compared to unergative predicates. Evidence has been found with healthy speakers using modal lexical decision tasks, noncumulative moving-window tasks, eye-tracking and fMRI, as well as with agrammatic speakers (Bastiaanse & van Zonneveld, 2005; Dekydtspotter & Seo, 2017; Friedmann et al., 2008; Koring et al., 2012; Meltzer-Asscher et al., 2015, *inter alia*).

2.3.1 The UH and non-native speakers

The UH has also been tested with non-native speakers. Non-native speakers have proven to be able to distinguish between unaccusative and unergative verbs (Oshita, 2004; Rutherford, 1989; Zobl, 1989). Several studies have additionally reported that low-mid level language learners have more difficulties learning unaccusative predicates than unergative predicates (Montrul, 2005; Oshita, 2001; Yuan, 1999; *inter alia*). Oshita (2001) proposes the Unaccusative Trap Hypothesis (UTH), which claims that L2 learners assume at first that all intransitive predicates are unergatives. As they attain proficiency, they notice that unaccusatives function differently and start making mistakes, and at higher levels of proficiency they perform native-like.

The L2 acquisition of intransitive predicates has also been studied in Spanish. In Spanish, similarly to other romance languages, subjects of unaccusative verbs often appear post-verbally (see Mendikoetxea, 1999, for more information on unaccusative/unergatives in Spanish). This tendency for subjects of unaccusative verbs to appear post-verbally has been linked with subjects of unaccusatives being base generated as direct objects (Burzio, 1986), and it has received evidence from production studies (Hertel, 2003; Lozano, 2003, 2006). On the following, I present studies that have studied unaccusative and unergative predicates in Spanish learners.

Hertel (2003) studied how English speaking L2 learners of Spanish produced unaccusative and unergative sentences in a contextualized production task. They found that beginners produced SV orders for all structures, as in their native language. Mid-learners showed an increase in the production of VS order but the data was indeterminate and variable. Advanced learners showed a sensitivity towards unaccusativity and discourse factors, but their results were still distinguishable from native productions.

Similarly, Montrul (2005) tested the UTH by asking Spanish speakers and English speaking L2 low-intermediate, intermediate and advanced speakers to judge the acceptability of sentences with preverbal subjects, postverbal subjects, absolutive constructions, bare plurals and passives in Spanish. The author found that low-intermediate speakers judged unaccusatives and unergatives similarly, whereas differences were found in all the other groups. Intermediate speakers distinguished between unaccusatives and unergatives, but incorrectly accepted passives. Finally, advanced speakers behaved similarly to natives and showed a preference for unaccusatives in sentences containing postverbal subjects and bare plurals. She concluded that these results support the UTH, but only to a certain extent, because low-intermediate speakers' results did not show any sign of treating all intransitive predicates as unergatives.

Lozano (2006) studied how Greek/English speaking advanced L2 learners of Spanish processed intransitive sentences. The results showed that, on the one hand, Greek/English learners of Spanish prefer VS to SV for unaccusatives and SV to VS for unergatives, as found with native speakers, thus showing that L2 speakers can treat the SV/VS alternation categorically. On the other hand, L2 speakers overgeneralized the VS order in unaccusatives, pragmatically odd in unfocused contexts, thus diverging from natives' results.

2.3.2 The UH and case alignment

Here I discuss the relevance of case alignment in relation to the UH. Case marking may not be a very useful strategy to differentiate unaccusative and unergative predicates cross-linguistically because: (i) languages with neuter case marking do not show any morphological case marking anyway, (ii) nominative-accusative languages display the same case marker for external arguments (NOM), and (iii) ergative-absolutive languages display the same case marker for external arguments (ABS). Only active languages (iv) distinguish arguments of unaccusative and unergative predicates with case. This does not mean, however, that unaccusative and unergative predicates, or the underlying thematic roles are the same in the first three language groups.

Experimental evidence in support of the second claim of the UH which posits an additional derivational step for unaccusatives has come from two typologically similar languages, English and Dutch, both nominative-accusative. So far, the UH has only been experimentally tested in nominative-accusative languages. All external arguments (the most-agent-like argument of transitive predicates and the only argument of unaccusative and unergative predicates) have nominative case in these languages. Speakers have no explicit knowledge about the thematic role of the first argument based on case marking. External arguments receive nominative case, usually unmarked or default, whereas the most-patient-like argument of transitive predicates receives accusative case, usually marked. In nominative-accusative languages, transitivity triggers case assignment, thus case is assigned structurally. Agents are always marked with nominative case, whereas patients will be marked depending on their status, with nominative when being external arguments (subjects), and with accusative (or other cases such as dative) when being internal arguments (objects) (Burzio, 1986).

The UH also gathers support from processing accounts. The psycholinguistic literature suggests that processing is incremental (Kamide, Scheepers & Altmann 2003; Knoeferle et al. 2005; Bornkessel & Schlesewsky 2006, *inter alia*), and by the time an argument is presented, the hearer starts building a possible structure. The Agent First hypothesis claims that: (i) there is a universal tendency for agents to precede patients, and (ii) if an argument is thematically ambiguous, an agent prediction will be made (see Section 2.2.2 for more information on the Agent First Theory). Many other cues such as word order, pro-drop, animacy, definiteness, etc. will have an impact on the prediction and will ease the processing cost of thematic uncertainty. Agent First theory thus predicts that in nominative-accusative languages, when encountering an argument with nominative case, an agent prediction will be generated. Therefore, this prediction will be borne out for transitive and unergative predicates, but not for unaccusatives. For unaccusatives the predicate will be unpredicted and will probably trigger the reanalysis of the sentence so far, thus making the processing of unaccusative predicates costlier.

For SVO languages, this extra processing cost for unaccusatives may be enlarged by word order constrains. In SVO languages, agents usually precede the verb, whereas patients are placed after the verb, with the exception of unaccusative and passive predicates. Agent First theory and word order both predict that the first argument of a sentence will be the agent. As a result, the preference for agent-like arguments will be bigger, and the processing of preverbal patient-like arguments will be costlier. Momma, Slevc & Phillips (2018) show that for English, participants start producing the agent argument while still planning the verb, whereas for unaccusatives they plan the verb before starting to produce the patient argument. Several studies have found that people with agrammatic aphasia show difficulties to produce and comprehend unaccusative predicates (Bastiaanse, 2005; Kegl, 1995; Lee & Thompson, 2004; Lee & Thomson, 2011; McAllister et al, 2009; Thomson, 2003). All in all, not only the UH, but also the Agent First theory predicts extra costs in unaccusative predicates compared to unergative predicates in nominative-accusative languages.

The UH has not been experimentally tested in any ergative or active language yet. In ergative languages, similarly to nominative languages, case has been often analyzed structurally and has assumed to undergo longer derivations for unaccusatives compared to unergatives (Fernández, 1997; Laka, 1993b; Ortiz de Urbina, 1989). I will follow Laka's (2000, 2006b) view which advocates for a one to one mapping of thematic roles and case assignment, and thus, does not claim that unaccusative predicates do not undergo a more complex derivation compared to unergative predicates because, if any, agentive subjects should involve a more complex derivation in order to get ergative case. Transitivity is prototypically characterized as a predicate with two arguments with a cause-effect relationship (Langacker, 2014). In ergative languages, case is sensitive primarily to the transitivity properties of clauses (Givón, 1985), this means that case assignment is structural in ergative languages. In ergative languages, a number of agent-patient transitive predicates that do not have a direct effect on the patient do not take ergative case (Tsunoda, 1985). The ergative marker is the morphologically marked element and absolutive means morphological default or null case, contrary to nominative-accusative languages, where the accusative is morphologically marked and nominative usually unmarked (Handschuh, 2014). All this does not mean that agent preference does not apply in these languages, but it may be that the agent preference is not as strong as in neuter/nominative languages.

In active-inactive languages case is not signaled according to the transitivity/intransitivity of the action, but according to arguments' activity-inactivity (Klimov, 1974). If an argument is agent, it will take active case, and otherwise it won't. Moreover, similarly to ergative-absolutive languages, in active-inactive languages the absolutive/inactive argument would be the unmarked one, that is, the argument of unaccusative predicates. For De Hoop & Narasimhan (2005) only marked arguments (accusative, ergative) bear case, whereas unmarked arguments (nominative, absolutive) do not, thus suggesting an extra morphological weight for unergatives, typically associated with more processing costs. This is precisely what Erdocia et al. (2009) found in Basque for ergative arguments (marked) compared to absolutive arguments (unmarked): participants read absolutive arguments faster than ergative subjects.

All in all, agent-patient role relationships constitute the core strategy for case marking, either inherently or structurally. Here, I have discussed that the claim of the UH which advocates for a more complex derivation for unaccusatives may only hold for nominative-accusative languages. In the present dissertation, I will try to disentangle where the second claim of the UH also holds for active-inactive languages. On the following, I present some notes on the main grammatical properties of Basque and Spanish, the two languages studied throughout the dissertation.

2.4 Case, agreement morphology and intransitives in Basque and Spanish

First, I present a few notions on the case, agreement morphology and intransitives in Basque, one of the two languages tested in this dissertation is Basque. Basque is an agglutinating SOV language isolate, which has rich multipersonal agreement, as the verb obligatorily agrees with the subject, direct object and the indirect object (De Rijk, 2008)(8):

7 Zu-k ni-ri liburu-ak eman di-zki-da-zu.
you-ERG me-DAT book-DET.PL given have-PL.ABS-1SG.ABL-2SG.ERG
'You have given me (the) books.'

Basque is often classified as an ergative language (De Rijk, 2008; Euskaltzaindia, 1991; Hualde & Ortiz de Urbina, 2003). However, it has also been classified as an active-inactive language (Alcazar, 2006; Aldai, 2009; Holmer, 1999). Basque differs from ergative languages such as Warlpiri, Burushaski or West Greenlandic (see Baker & Bobaljik 2017; Laka 2006b; 2017; Levin 1983), where ergativity is a signal of transitivity[1]. In active languages arguments are distributed as follows: agent arguments (the most agent-like argument of transitive predicates and unergatives) on the one hand, and patient arguments (the least agent-like argument of transitive predicates and unaccusatives) on the other (Primus, 1999).

[1] It has also been argued there to be dialectal differences regarding ergativity in Basque. Western varieties seem to have an active-inactive pattern similarly to Georgian and Native American languages, whereas Eastern varieties resemble *bona-fide* ergative languages (Aldai, 2008, 2009; Berro & Etxepare, 2017).

Levin (1983) was the first to discuss that unaccusatives and unergatives are morphologically distinct in Basque: unaccusatives have absolutive (zero) marked subjects and select auxiliary *be*, while unergatives have ergative[2] marked subjects and select auxiliary *have*. Therefore, Basque agentive arguments carry ergative case, both in transitives (8a) and in unergatives (8b), and theme arguments carry absolutive case, both in unaccusatives (8c) and in transitive (8a) sentences, as expected in active languages.

8 a. Zu-k lagun-a ikusi du-zu.
you-ERG friend-DET.SG seen have-2SG.ERG
'You have seen the friends.'

b. Zu-k mendian eskiatu du-zu.
you-ERG mountain.the.in skied have-2SG.ERG
'You have skied in the mountain.'

c. Zu etxera joan z-ara.
you.ABS home.to gone 2SG.ABS-be
'You have gone home.'

Within unergative predicates, two types have been identified in Basque (Berro, 2010, 2015; Etxepare, 2003). Berro (2015) classifies unergatives as morphologically simplex (8b, 9a) and complex (9b). Simplex unergatives consists of a lexical verb, similarly to unaccusatives. Complex unergatives consist of a bare noun and a light predicate "egin" (do), and cannot take a further DP direct object (see Berro, 2010, for more information on unergative predicates in Basque). As a result, many linguists consider that complex unergatives are transitive in nature and undergo some kind of incorporation (Bobaljik, 1993; Kenneth Hale & Keyser, 1993; Laka, 1993b, 2006b; Uribe-Etxebarria, 1989).

9 a. Klara-k **dantza-tzen** du.
Klara-ERG dance-IMPF have.3SG.ERG

b. Klara-k **dantza egi-ten** du.
Klara- ERG dance do-IMPF have.3SG.ERG
'Clare dances.'

[2] Although I have classified Basque as an active-inactive language, I will stick to ergative (active) and absolutive (inactive) terms for the sake of convenience (Aldai, 2008; Oyharçabal, 1992).

Accounts of case assignment in Basque differ: some authors argue that case in Basque is assigned structurally, and therefore, the sole argument of an unaccusative verb undergoes movement to subject position to receive case (Fernández, 1997; Ortiz de Urbina, 1989; Preminger, 2012; Rezac et al., 2014), others argue that case is inherent, that is, case morphology reflects theta roles (Laka 2006a; b; Laka 2017; Levin 1983). This second hypothesis argues that there is no need to postulate syntactic movement to receive case for unaccusative sentences in this language. This entails no extra derivational step for the sole argument of unaccusative predicates, and thus no extra cost is expected when processing unaccusative sentences as compared to unergative sentences (Laka, 2000). In the present dissertation, I will follow the second view, and assume that in Basque case assignment correlates with theta relations.

The second language studied in this dissertation is Spanish, a nominative-accusative language with SVO word order and subject-verb agreement. In Spanish, subjects receive nominative case, this means that the subject of transitive, unergative and unaccusative predicates gets nominative case, see example (10) below.

10 a. Juan ha llegado. (unaccusative)

Juan. $_{NOM}$ has arrived

"Juan has arrived."

b. Juan ha llorado. (unergative)

Juan.$_{NOM}$ has cried

"Juan has cried."

c. Juan ha visto a María / el mar. (transitive)

Juan. $_{NOM}$ has seen $_{ACC}$ María / the. $_{NOM}$ see

"Juan has seen María / the sea."

Case is assumed to be structural in Spanish (Bosque & Gutiérrez-Rexach, 2009; Zagona, 2002). As such, arguments of unaccusative predicates need to undergo an extra derivation in order to advance into subject position, whereas arguments of unergative predicates are already generated in subject position, just as claimed by the UH. In Spanish, as previously mentioned in Section 2.3.1, contrary to subjects of unergative verbs, subjects of unaccusative verbs often appear post-verbally, similarly to other romance languages (see Mendikoetxea, 1999, for more information on unaccusative/unergatives in Spanish). Finally, not all arguments of transitive predicates with the most patient-like properties are marked with accusative case, only human/animate/definite are marked. This phenomenon is known as Differential Object Marking (DOM), illustrated in (10c) (see Leonetti, 2004, for more information on DOM).

3 The study of non-native speakers

In this dissertation, I do not only study native speakers, but also non-native speakers. For that reason, in this first section of the introduction I present the literature concerning non-native speakers. Language processing has mostly been studied with native speakers, but there has also been a considerable interest to investigate how non-natives process language, as there has been a huge increase in the number of bilinguals (Doughty & Long, 2005). Studying non-natives is fundamental to understand language because it offers a broader picture of how is language acquired and processed in different settings. Learning a second language is not a simple process, it requires putting together several pieces of a heterogeneous jigsaw (phonology, morpho-syntax, semantics, etc.), as well as multiple factors such as level of education, degree of language proficiency, age of onset of bilingualism or frequency of use. All these factors make the study of non-natives enriching, but it is important to take these factors into account, because these factors can create phantom-like effects, and result in very low replicability (Kroll & De Groot, 2009). Here, I first do a review of the literature by presenting the most well-known models and hypotheses that have been proposed for L2 acquisition and processing. Second, I expand on native/non-native differences due to language distance effects and I will provide the ERP literature on the topic.

For some decades, it was believed that children learn language by parroting what their parents say (Bloomfield, 1933). This idea changed after the emergence of generativism (Chomsky, 1959, 1965, 1981), and children's utterances were no longer seen as a repetition, but truly creative (Meisel, 2011). Lenneberg (1967) put forth the Critical Period Hypothesis (CPH), which claims there ae genetically determined processes of maturation for language, which cease after the age of 12 or 13, after puberty. Evidence for the CPH was invoked from age-related limits on recovery from brain injuries, and “wild child” cases (Curtiss, 1977; Lane, 1976). Further evidence supporting the CPH comes from congenitally deaf individuals (Mayberry & Kluender, 2018). Some congenitally deaf infants are deprived of early language input due to a lack of access to a sign language. Compared to native signers, late signers show measurable language related deficits, such as difficulties with complex morphological and grammatical constructions and with acquiring an oral language as a L2 for reading, and less sensitivity to grammatical errors (Emmorey et al., 1995; Mayberry, 2007; Mayberry & Eichen, 1991) (see Hartshorne et al., 2018, and Meisel et al., 2013, for recent evidence in support of the CPH). The critical period is not just a human phenomenon, it has also been observed for other animals such as sparrows, geese, dogs, mice and silver foxes (Lord, 2013; Lorenz, 1965; Makinodan et al., 2012; Nottebohm, 1969; Trut, 1999).

The CPH has also been claimed to apply for second language acquisition (Johnson & Newport, 1989). For first language acquisition, except for language impaired people, all of us manage to get native-like competence by the time we go through puberty. For second language acquisition, nevertheless, except for a few learners who show a near native-like competence, most learners show traits of their first language when speaking a second language, if the second language is learnt after puberty (Birdsong, 1999). Evidence shows that children are better than adults at language learning. Newport (1988, 1990) addressed this issue and put forth the Less is More hypothesis, claiming that the limitations of infants’ information processing abilities provide with the basis on which successful language acquisition takes place, whereas adult’s more advance processing abilities would have the opposite effect. Chrysikou et al. (2011) and Thompson-Schill et al. (2009) further suggest that children’s limitations in cognitive control, such as reduced executive functioning, confer early learning advantages. Elman et al. (1996) suggested that the brain is plastic and it becomes shaped as networks become committed to particular configurations. Language would not be but another example of the networks that are constructed during the development of the brain. Each language creates their own neural networks, and as a result of the loss of plasticity, it becomes hard to adjust to networks configured for other languages. So far, evidence has shown that AoA is a decisive factor for native/non-native language research, consistent with maturational constraints for language learning.

Another question in the study of non-native speakers is whether the same brain mechanisms are used for native and non-native language acquisition and processing. Some scholars defend that the same fundamental processes control both infants' first language learning and adults' foreign language learning (Dulay et al., 1982; MacWhinney, 2005; Schwartz & Sprouse, 1996). The Full Transfer/Full Access (FT/FA) model claims that the initial state of L2 acquisition is the final state of L1 acquisition (Full Transfer), and that the mistakes made with incoming inputs at the initial stage will be solved by subsequent restructuring, from the always available UG (Full Access) (Schwartz & Sprouse, 1994, 1996). Schwartz & Sprouse (1996) defend that in terms of cognitive architecture the FT/FA is the conceptually simple and most elegant view of transfer, since no further explanations are required for L2 acquisition.

The Competition Model claims that in language processing the system selects between various options or cues on the basis of their relative cue strength (Bates & McWhinney, 1982; MacWhinney, 1987). MacWhinney (2005) extended the model and put forth The Unified Competition Model. He discusses that L1 and L2 learning may seem very different at first, but a shared core of learning mechanisms will be observed if looked more closely. MacWhinney (2005) accepts that there may be some strategic processes unique to L2, and that some processes of L1 learning may be weakened for L2 learning. The Unified Competition Model defends that the basic architecture of monolinguals, bilinguals and language learners is similar enough to maintain a single account for all three groups. Moreover, the massive transfer from L1 to L2 learning makes it impossible for a model of L2 learning that does not take into account the structure of L1.

Others claim that child language development and adult foreign language learning are in fact fundamentally different (Bley-Vroman, 1989). For instance, Krashen (1994) used *acquisition* when working with L1 learning, whereas he would speak of *learning* when working with L2 learning. Bley-Vroman (1989) posited that children use Universal Grammar and domain-specific procedures to develop language. For adults, the function of the innate domain-specific acquisition system would be filled by their native language and by a general abstract problem-solving system. As a result, Universal Grammar and domain-specific procedures would no longer be available for adults and native language knowledge plus general problem-solving systems would be employed for foreign language learning. Johnson & Newport (1989) introduced a distinction within the CPH:

the Exercise Hypothesis and *the Maturational State Hypothesis*. The former claims that language, if not acquired in early childhood will be lost; the latter claims that any kind of language acquisition taking place outside the critical period will have observable effects. A final advocator of maturational constraints, Weber-Fox & Neville (1996) analyzed 61 Chinese native speakers who had learnt English thought different periods (1-3, 4-6, 7-10, 11-13), and found that even at the very early onset accuracy in judging grammar and their associated ERP responses were affected by the delay in second language structure. They also found that semantic anomalies were only altered in participants who had been exposed to English after puberty. Weber-Fox & Neville (1996) concluded that maturational changes constrain the development of our neural networks relevant for language, and that subnetworks specialized for processing different aspects of language display different maturational periods.

Another general model for language processing, The Declarative/Procedural Model, claims that lexicon relies on declarative memory and grammar on procedural memory (Ullman, 2001a). For L2 processing, Ullman (2001b) posits that “linguistic forms whose grammatical computation depends upon procedural memory in L1 are posited to be largely dependent upon declarative/lexical memory in L2” (p. 105). In ERPs, specific predictions are made about the components to be expected while manipulating lexical memory (N400) vs. syntax (P600). Manipulations regarding lexical memory are instantiated by the N400 component in both L1 and L2 speakers, evidencing declarative memory, whereas manipulations of aspects of grammar typically produce a P600 for natives, but a N400 component for non-natives, showing that non-natives depend largely upon procedural memory. However, the model also contemplates the idea that learning in procedural memory can improve with practice, as Schacter & Tulving (1994) and Squire et al. (1993) show, and predicts that the more frequently L2 is used, the higher language’s relative dependence on procedural memory for grammatical computations will be. The shift from declarative to procedural memory is expected to be a function of age of exposure: the later learners get exposed to L2, the more they will rely on declarative memory. Similarly, Lee Osterhout et al. (2006) show that an initially N400-like response evoked by morphosyntactic violation is replaced by a P600 with increasing proficiency. The claim that initial language learning is word-based and later becomes rule-based is supported by several studies (Balaguer et al., 2007; Citron et al., 2011; Friederici et al., 2013; Mueller et al., 2009). Therefore, the Declarative/Procedural Model takes not only AoA, but also proficiency as a crucial factor for a native-like competence.

A long-lasting debate is whether L2 learners can acquire native-like competence (Birdsong, 2004; Morgan-Short et al., 2012; Schachter, 1990; Sorace, 2003; White & Genesee, 1996). Some factors, such as proficiency, age of acquisition (AoA) and similarity have shown to have significant effects on the processing of some linguistic areas (Kotz, 2009), e.g. ERP findings consistently show that phonology and syntax are extremely sensitive to proficiency and AoA, whereas vocabulary is less sensitive and even early learners can generate native-like responses to semantic violations (McLaughlin et al., 2004; Ojima et al., 2005; Rüschemeyer et al., 2005; Sebastian-Gallés et al., 2006; Ullman, 2001b; Vandenberghe et al., 2019; Wartenburger et al., 2003). Most work on this debate has looked at syntax (see Caffarra et al., 2015, and Steinhauer, 2014, for a ERP revision on syntactic L2 processing). Steinhauer (2014) groups three main approaches for the relationship between native and non-native language processing: The Difference Hypothesis, The Similarity Hypothesis, and The Convergence Hypothesis.

The Difference Hypothesis mainly takes the position of the Critical Period Hypothesis (Lenneberg, 1967) and the Fundamental Difference Hypothesis (Bley-Vroman, 1989), and argues that once maturational constraints during childhood or puberty have resulted in loss of brain plasticity needed for L1 acquisition, late learners have to allocate other brain systems for their L2. As a result, differences between L1 and L2 are fundamental and irreversible, and distinct brain activations are predicted as a function of AoA. Abrahamsson & Hyltenstam (2009) claim that nativelikeness can only be attained, if attained at all, if acquisition happens in childhood, potentially before age 8, but never by adult learners. Advocators of the idea that only shared syntactic rules can be acquired and processed in a native-like fashion are a little bit more restrictive. They defend that maturational constraints only affect certain non-shared features, but as such, they also fall into this approach.

The Convergence Hypothesis argues that L2 learners initially differ from native speakers and then converge on native-like neurocognitive processing mechanisms with increasing practice and language proficiency (Foucart & Frenck-Mestre, 2012; Green, 2003; Steinhauer et al., 2009). Regarding ERP components, some authors, such as Kotz (2009), McLaughlin et al. (2010) and Steinhauer et al. (2009) among others, posit that L2 development undergoes a transition as proficiency is attained: no effects or a N400 reflecting a non-native like approach to morpho-syntactic phenomena at low levels of proficiency, and a smaller and typically delayed P600 once the brain starts to process non-native morpho-syntactic rules procedurally (Lee Osterhout et al., 2006; Rossi et al., 2006). Steinhauer et al. (2009) argues that the differences on components obtained as a function of proficiency support The Convergence Hypothesis.

Finally, the Similarity Hypothesis posits that the same mechanisms used in L1 are recruited for L2 processing (A. Hernandez et al., 2005; Schwartz & Sprouse, 1996), but assumes that L1 and L2 can have different trajectories, such as language attrition (Pallier et al., 2003). High proficient L2 speakers tend to display native-like behavioral responses. However, behavioral measures may not suffice to explore whether there are neural processing differences between L1 and L2 or not (Mueller et al., 2005; Sanz & Grey, 2015; Wartenburger et al., 2003).

The Convergence Hypothesis assumes that native-like proficiency can be attained with a high degree of proficiency. Evidence for The Similarity and Convergence Hypotheses is usually found in experiments where the grammatical structures used as materials exist in the two languages under study, and thus are equivalent in both L1 and L2, since no differences between L1 and L2 are usually found (Hahne, 2001; Hahne & Friederici, 2001; Kotz et al., 2008; Mueller et al., 2005; Rossi et al., 2006). Nevertheless, differences in L1 vs. L2 have been found in studies where non-natives are tested with syntactic stimuli not-existent in their L1. These differences have sometimes been attributed to AoA, following The Difference Hypothesis (Mueller et al., 2005; Pakulak & Neville, 2011; Rossi et al., 2006; Weber-Fox & Neville, 1996), whereas in other studies with early and high proficient L2 speakers, differences have been attributed to language distance effects, also supporting The Difference Hypothesis.

3.1 Language distance effects

Both behavioral and electrophysiological measures have shown that syntactic similarities between the L1 and L2 can determine whether native-like processing is attainable or not (Chen et al., 2007; Díaz et al., 2016; Jeong, Sugiura, Sassa, Haji, et al., 2007; Jeong, Sugiura, Sassa, Yokoyama, et al., 2007; Ojima et al., 2005; Roberts & Liszka, 2013; Zawiszewski et al., 2011; Zawiszewski & Laka, 2020; *inter alia*). Most ERP studies that have analyzed language distance effects have found effects on second language processing, thus supporting The Difference Hypothesis (Franceschina, 2005a; Sabourin & Haverkort, 2003; Zawiszewski et al., 2011; Zawiszewski & Laka, 2020, *i.a.*), see Sabourin's (2003) dissertation for a thorough study on grammatical gender and second language processing by means of ERPs.

Several accounts defend that only shared rules are available for all language learners. (see Tolentino & Tokowicz, 2011, for a review). The Shared Syntax account, claims that similarly to the lexicon, rules that are the same in the two languages are represented once, therefore not only the lexicon but also shared-syntactic structures are processed native-like (Hartsuiker et al., 2004). Evidence for the Shared Syntax account comes for syntactic priming studies, which have found priming effects for structures that have surface linguistic similarity (Bock et al., 1992; Bock & Loebell, 1990; Pickering et al., 2002). Pickering & Ferreira (2008) discuss that shared representations of languages that bilinguals speak seem to have an advantage of economy and aids for well-stablished L1 structures to be used for L2 performance. Tokowicz & MacWhinney (2005) showed that English speakers enrolled in the first four semesters of Spanish were already sensitive to violations that are formed similarly in the L1 and L2, whereas they did not display sensitivity for structures not found in their L1, such as gender agreement. The Failed Functional Features Hypothesis (FFFH), suggests that divergences from native-speaker representations are an effect of the inaccessibility of features of functional categories in second language acquisition (Hawkins & Chan, 1997). More specifically, Franceschina (2005) proposes the Strong Failed Functional Features Hypothesis (Strong FFFH), which claims that “Parameterized functional features (PFFs) cannot be acquired after childhood unless they are instantiated in the L1” (Franceschina, 2005. p. 21). Similarly, Sabourin & Haverkort (2003) and Sabourin & Stowe (2008) follow Ullman's (2001b) Declarative/Procedural Model and conclude that only in the case of similar grammatical phenomena between L1 and L2 can procedural memory be used by advance adult L2 speakers, and even then with a quantitative difference compared to natives.

Zawiszewski et al. (2011) hypothesize that native/non-native processing differences obtain if a syntactic parameter of the non-native grammar diverges from the native grammar. Building on this hypothesis, Zawiszewski & Laka (2020) put for the Language Distance Hypothesis (LDH), which claims that no differences are expected for processing traits of L2 that are present in L1, whereas even at an early age of acquisition and high proficiency in L2, native vs. non-native difference will arise in the processing grammatical properties of L2 not present in L1. Behavioral evidence for the LDH has also been found in Stepanov et al. (2020). Language distance effects between L1 and L2 alphabets and between orthographical transparency and opacity have also elicited differences between native and non-native processing (Brice et al., 2019; S. Y. Kim et al., 2016; Koda, 1989; Sun-Alperin & Wang, 2011).

3.1.1 ERPs and language distance effects

On the following, ERP studies that have compared the processing of typologically divergent languages are presented. First studies working with any languages are considered; then studies that worked with Basque L1 and Spanish L2, and then, studies that worked with Spanish L1 and English/Catalan L2 will be presented.

Chen et al (2007) were the first to study processing of L2 syntax taking typological differences into account using ERPs. Their paradigm contained subject-verb agreement violation, and they analyzed subject-verb agreement in L1/L2 (L1 Chinese) speakers of English (AoA = 12), typologically distant languages: English with subject-verb agreement, and Chinese lacking subject-verb agreement. They found no differences between L1 and L2 speakers regarding behavioral measures, but different ERP components emerged when processing English subject-verb agreement by highly proficient L1 Chinese speakers compared to native speakers of English: native speakers elicited a N400-P600 pattern, whereas L2 speakers only elicited a P600 pattern. Chen et al (2007) concluded that language-specific experiences with the native language shape the neural structure of processing a non-native language.

Foucart & Frenck-Mestre (2011) examined the effect of proficiency and similarity between L1 and L2 processing grammatical gender. They analyzed and compared advanced learners of French (AoA = 9.3) and native speakers of French with manipulations of agreement rules similar and dissimilar in their L1 and L2. They found that advanced learners of French performed native-like when the structures were similar between L1 and L2 (P600), but advance learners did not yield the same components when processing gender agreement that differed from their L1 (P600 vs N400).

Xue et al. (2013) studied Chinese learners of English (AoA = 9.3) to understand how learners grammaticalize different English syntactic rules. The authors used singular and plural NP morphology, similar in English and Chinese, subject-verb agreement, different between English and Chinese, and auxiliary omission, a structure unique to English. A P600 was found for the similar and unique conditions, whereas a N400 emerged for the different condition. They concluded that Chinese learners can easily accommodate an already existing structure into their English grammar, and can also learn new structures, but have greater difficulties for an existing but differing structure.

Basque speakers are an adequate language community for the study of language distance effects because most Basque speakers know French or Spanish, a head-initial nominative-accusative language (Spanish/French) as well as a head-final active-inactive language (Basque). Furthermore, there are areas where Basque is mostly spoken and other areas where Basque is mostly absent. This situation gives the opportunity to study both L1 Basque L2 Spanish/French and L1 Spanish/French and L2 Basque groups, which makes it ideal for the study of native and non-native language processing. Nevertheless, it must be noted that Basque speakers live in a diglossic society, where either Spanish/French are legally imposed, and as a result there are no monolingual Basque speakers.

Concerning the literature on L2 processing in Basque, the language studied in Chapters II and III, Zawiszewski et al. (2011) investigated convergent and divergent syntactic parameters in L1 and early and highly proficient L2 speakers of Basque (AoA = 3.1): (i) the head parameter, (ii) argument alignment (ergative/accusative), and (iii) verb agreement. The authors predicted that "native/non-native processing differences obtain if a syntactic parameter of the non-native grammar diverges from the native grammar. Otherwise, non-native processing will approximate native processing as levels of proficiency increase" (Zawiszewski et al., 2011, p. 1). They found that L2 speakers processed differently only the divergent syntactic structures (head parameter and argument alignment), whereas no differences were found in the processing of verb agreement. Regarding the head-parameter condition, differences were found in the 300-500 ms time window: native speakers generated a left parietal negativity and non-native speakers a frontally distributed negativity. Besides, non-natives also showed a persistent negative deflection broadly distributed also within the 500–600 ms time window, not present in native speakers. With regard to the ergative condition, negativity was found in both groups, but P600 was only found in the native group. According to the authors, their findings support the idea that language distance plays an important role in non-native language processing.

In another study, Díaz et al. (2016) examined subject agreement, object agreement and ergative case violations with early bilinguals (AoA 3-4 years) and late mid-level (B2) learners (AoA 24 years) of Basque. Concerning agreement violations, they found that early bilinguals approximated native processing to a greater extent than late learners with intermediate proficiency, although proficient, early bilinguals also obtained a reduced P600 for object agreement. Nevertheless, both L2 groups revealed a delayed and broad N400 different to the P600 found for natives. Díaz et al. (2016) concluded that L2 syntactic processing mirrors native-like processing for early and high proficient L2 speakers when the syntactic property is common to both the L1 and L2. Nevertheless, syntactic traits that are not present in the L1 do not approximate native-like processing, despite early AoA and high proficiency.

Similarly, Erdocia et al. (2014) analyzed canonical and non-canonical sentence word order processing with L1 and early and high proficient L2 speakers of Basque (AoA = 3). Basque has SOV word order and Spanish SVO, and canonical SOV and non-canonical OSV word orders were tested in Basque. ERP results showed that natives and non-natives responded differently to canonical and non-canonical sentences: the L2 group elicited a P600 component absent for L1 when comparing S and O at sentence's second position. They concluded that despite high proficiency, the neural resources recruited by non-natives are different from those employed by native speakers.

Finally, Zawiszewski & Laka (2020) compared L1 vs. L2 processing of ergative, accusative, dative and allative cases in Basque (AoA = 3.25) and Spanish. They propose the Language Distance Hypothesis (LDH), which predicts that even at early AoA and high proficiency, L1 vs. L2 differences will emerge in the processing of grammatical property if the property is absent in L1, whereas no differences will emerge if the property is shared in L1 and L2. They found that only cases which differed in their L2 showed electrophysiological differences. Thus, their results supported the LDH, and concluded that L1 vs. L2 differences emerge in traits where their native and non-native languages differ, whereas a similar pattern in obtained when traits are present in both L1 and L2.

Concerning the literature on the processing of non-natives in Spanish, the language studied in Chapters IV & V, studies have analyzed and compared L1 Spanish L2 English/Catalan bilinguals. Balaguer et al. (2005) studied the processing of regular and irregular verbs in Spanish and Catalan. They found that for regular verbs, non-natives behaved native-like and produced the same electrophysiological signatures. But for irregular verbs, non-native speakers generated reduced effects. The authors concluded that the similarity between languages may help for similar structures, but it may interfere for dissimilar structures.

Regarding Spanish-English bilinguals, Dowens et al. (2010) analyzed gender and number with highly proficient L2 speakers (AoA > 20) who had long exposure to L2 environment (at least 12 years). 22 L1 speakers of English were tested in their L2, Spanish, and morphosyntactic features present (number) or absent (gender) in their L1 were considered. Gender and number violations were designed at the beginning and at the middle of the sentence. Regarding the violations located at the beginning, both native and non-native groups elicited an early negativity followed by a P600. But for the violations located at the middle, where the dependency is longer, only native speakers generated an early negativity apart from the P600 for both features, and L2 speakers only generated negativity for number violations. Furthermore, differences between the amplitude and onset of the P600 in gender and number violations were observed for L2 speakers, yielding stronger effects for number violations. The authors concluded that highly proficient L2 speakers can generate native-like electrophysiological correlates, but that L2 effects can also be observed for higher working memory demands.

Alemán Bañón et al. (2014) examined advanced learners of Spanish (AoA = 11-22) whose native language was English, and compared them to native speakers of Spanish. They studied number feature, an agreement pattern present in English, and gender feature, not present in English. They also studied noun-adjective agreement in Spanish, an agreement phenomenon not instantiated in English. They found that non-native speakers generated a P600 for agreement violations, similar to native speakers. The authors concluded that learners are sensitive to hierarchical structure, and argued that their results are in line with Full Transfer Hypothesis (Schwartz & Sprouse, 1996), presented above.

Similarly, Pérez et al. (2015) studied high proficient late bilinguals of Spanish (AoA > 20), and compared their neural mechanisms to those of native speakers of Spanish. A brain complex network analysis approach was used to analyze the properties of the functional networks extracted from the EEG. Lower degree of parallel information was observed for L2 speakers compared to L1 speakers when processing sentences containing gender mismatches. The authors concluded that when processing a morphological mismatch not present in their L1, L2 speakers configure their neural pattern differently to L1 speakers.

The literature shows, so far, that differences between native and non-native speakers often obtain when typologically distant grammatical properties are compared, showing that divergent grammatical structures are the hardest for L2 speakers to process native-like, if possible, at all. These data support The Difference Hypothesis and the LDH. We know that proficient non-native speakers perform native-like with most language features. We do not know, however, whether the differences found in the studies described above are due to an impossibility to acquire certain linguistic features absent in their native language, or whether the differences are due to a lack of proficiency for these features as a result of other factors, such as lower frequency of use.

Most of the literature on L2 processing and acquisition has not controlled for both AoA and proficiency. Most studies have worked with either, late learners or mid-advanced learners. The situation in the Basque Country differs significantly from the prototypical bilinguals that have been studied in the literature. In the Basque Country, most infants are bilingual before the age of 3. Some receive Basque at home and acquire Spanish on the streets, television, newspapers, the radio or several other settings. Others, the majority of infants at the moment, receive Spanish at home and acquire Basque at school. This situation translates in very early and highly proficient bilinguals, ideal to study whether native-like competence can be attained, since age of acquisition and proficiency are controlled for. A last condition which is the hardest to control for is frequency of use, since most people tent to primarily use a language or another. In some studies, bilinguals who left their country and got immersed in another linguistic community have been investigated (Montrul, 2008; Schmid, 2013; Tsimpli et al., 2004), but this is not the case in most studies with bilinguals. Some linguists argue that early childhood bilingualism or multilingualism is typically unbalanced, with one of the languages stronger than the others (Fillmore, 1991; Lightbown & Spada, 2013; Pulvermüller & Schumann, 1994; Schlyter, 1993, *i.a.*). This will probably be the case for most infants growing up in the

Basque Country, with either Basque or Spanish/French as their dominant language, and the other as the weaker language. Nevertheless, this does not translate in to poorer performance or different traits in terms of processing. In fact, these groups of early and highly proficient bilinguals are ideal candidates to show the opposite, that is, native-like performance and processing traits.

Finally, I present the reader with some basic notions on subject-verb agreement and phi-features, essential to understand the make-up of the experiments presented throughout the upcoming chapters.

4 Subject-Verb Agreement and Phi-features

In the experiments run in this dissertation I manipulate agreement between the subject and the verb to study the processing of intransitive predicates and phi-features. These manipulations result in grammatical and ungrammatical sentences, which I will examine and compare both behaviorally and electrophysiologically. In this section, I first describe theoretical aspects of subject-verb (SV) agreement followed by an overview of the experimental evidence using ERPs. Second, I provide a detailed description of phi-features and experimental evidence regarding their processing.

4.1 Subject-Verb agreement

Agreement refers to the covariance between two elements; the element which determines the agreement is known as the controller, and the element who is determined by agreement is known as the target (Corbett, 2006). Subject-verb agreement refers to a morphologically overt link between the subject (controller) and the verb (target), one in which one or more features of the subject (person, number, gender) are marked on the verb (Hayes et al., 2013), see Section 4.2, below for further details. Subject-verb agreement is present in approximately 50% of the world languages according to Bybee (1985), and the grammatical relation between the subject and the verb treated as the structurally highest verbal agreement in the Relational Hierarchy (subject > direct object > indirect object > other object) (Johnson, 1977). Subject-verb agreement has been vastly used in the last decades to analyze language processing by means of ERPs (see Molinaro et al., 2011, for a review on grammatical agreement processing on reading). Here, I present the most common components that have been found when studying subject verb-agreement phenomena.

The P600 has been reliably reported in almost all studies that have investigated SV agreement, and has further supported the idea that P600 is, aside from other environments, an electrophysiological signature for syntax processing or syntax repair. Some studies found a P600 for SV agreement violations with no negativity preceding the P600 (Hagoort et al., 1993, Hagoort & Brown, 2000 for Dutch; Osterhout et al., 1996 for English and Münte et al., 1997 for German, *i.a.*). Other studies have reported a P600 with an additional early negativity that has been categorized as a Left Anterior Negativity (LAN) in most cases (Kutas & Hillyard, 1983; Lee Osterhout & Mobley, 1995; Vos et al., 2001 for English; Friederici et al., 1993; Gunter et al., 2000 for German, Angrilli et al., 2002; De Vincenzi et al., 2003 for Italian; Palolahti et al., 2005 for Finnish and Hinojosa et al., 2003; Mancini et al., 2011; Silva-Pereyra & Carreiras, 2007 for Spanish, *i.a.*).

Models have been proposed for the interpretation of these components. Friederici (2002) presents a model for auditory sentence processing. This model has four phases: Phase 0, identification of phonemes takes place, Phase 1, identification of word category takes place, Phase 2, lexical-semantic (N400) and morphosyntactic processes (LAN) take place and Phase 3, different types of information (P600) are integrated. Following Friederici's (2002) auditory model and similar models, the Extended Argument Dependency Model (eADM) (Bornkessel & Schlesewsky, 2006) for instance, the anterior negativity obtained in SV agreement violations has been linked with a first syntactic pass related to morphological incongruities, and the late positivity with a second syntactic pass, related to repair processes and more complex processing.

Recently, an additional N400 preceding the P600 has also been reported in some studies working with subject-verb agreement violations (Mancini et al., 2011 for Spanish and Chow et al., 2018; Martinez de la Hidalga et al., 2019; Zawiszewski et al., 2016; Zawiszewski & Friederici, 2009 for Basque, see Chapter II, Section 1.1, for more information on these studies). In contrast to the LAN observed in other studies, the N400 obtained in the latter studies has been linked to thematic mismatches, arising as a consequence of rich morphological agreement. This last pattern (N400-P600) is of special interest for this dissertation because unlike the (LAN) + P600 pattern found for romance languages, the N400 has often been found for Basque in agreement violations, and also for Spanish.

4.2 Phi-features

The different types of agreement between the target and controller refer to agreement features (Corbett, 2006), and they are usually classified as threefold: person, number and gender, commonly known as phi-features (Chomsky, 1995). Phi-features are considered primitives of syntax (Rezac, 2010) and have been widely studied in the literature (see Mancini, 2018, for details). Features (person, gender, number) differ with regard to their distribution cross-linguistically, but they are believed to be systematically and hierarchically organized (Harley & Ritter, 2002). Greenberg (1963) presented an implicational hierarchy for these three features following their distribution across languages: Person > Number > Gender. Based on that implicational hierarchy, Noyer (1992) presented The Feature Hierarchy Hypothesis:

11 There is a universal hierarchy of morphosyntactic features. If F and G are morphosyntactic features and F is higher than G on the hierarchy, then:

> (1) if *[αFβG] is active at Morphology, then [αFβG] is Impoverished to [αF].
>
> (2) if two spell-out rules, one referring to F, the other to G and not to F, have disjoint or overlapping structural descriptions, then the rule referring to F applies first. (p. 93)

The hypothesis above refers to the competition between features for expression; higher properties will not be neutralized by lower properties, and neither will they be lost out to lower properties. This translates in an implicature, whereby languages will have person feature if any, and if number feature is also active, person feature will also be active and so on and so forth.

Linguists agree on the saliency of person over number and gender (Greenberg, 1963; Harley & Ritter, 2002). Nevertheless, there is no agreement with regard to the processing of phi-features. Some argue that the same mechanisms are used for the processing of person, gender and number phi-features (Chomsky, 1995, 2000, 2001, *inter alia*), whereas others defend different mechanisms are involved (Shlonsky, 1989; H. A.

Sigurðsson, 2004; Sigurðsson & Holmberg, 2008, *inter alia*). There is agreement in linguistics regarding the subdivision of person feature: $1^{st}/2^{nd}$ person on the one hand, and 3^{rd} person on the other. $1^{st}/2^{nd}$ person involve participants in the speech act, whereas 3^{rd} person does not. As a result, 3^{rd} person is better known as the lack of person, better reflected by number feature (Benveniste, 1966).

In the last years, phi-features have extensively been studied and compared experimentally. Here I provide a summary of the studies that have analyzed phi-features. Carminati (2005) conducted a self-paced reading in order to analyze person, number and gender features by setting subject and object antecedents that were later disambiguated, either by person, number or gender cues. She proposed the Feature Strength Hypothesis: "there is a correlation between the cognitive significance of a feature (relative to another) and its disambiguating power, that is, the more cognitively important the feature is, the better it should be at disambiguating the pronoun that carries it" (p. 265). She found that the implicational hierarchy presented by Greenberg (1963) was fulfilled in the mean reading times depending on the disambiguation cue, showing that person, gender and number have different degrees of cognitive salience. Carminati (2005) also analyzed the subdivision of person ($1^{st}/2^{nd}$vs. 3^{rd}) and found signs of distinct representations for each, and related the $1^{st}/2^{nd}$ persons' higher syntactic position to their saliency in human cognition.

Mancini et al. (2014) ran two self-paced reading experiments to analyze the processing of subject-verb agreement in Italian manipulating person and number features. Following Sigurðsson (2004) and Sigurðsson & Holmberg (2008), they analyzed person and number as features with different interpretive properties: person expresses the status of an argument regarding the participants in the speech act, whereas number makes reference to the cardinality of the subject. They found greater processing penalty for person than for number agreement violations, and concluded that there is separate access to these two features, person generating interpretation problems than number.

In another study, Acuña-Fariña et al. (2014) conducted an eye-tracking experiment to analyze number and gender features using subject-verb-adjective sentence attraction effects in Spanish. They found that number mismatches produced much stronger effects than gender mismatches, and concluded that morphologically rich languages are less inclined to be affected by semantic interference in S-V agreement processes.

Recently, Mancini et al. (2017) analyzed person and number features by means of functional magnetic resonance imaging (fMRI), and found quantitative and qualitative differences between person and number features: larger activations to person feature compared to number feature in the left middle temporal gyrus (LMTG); and a posterior-to anterior functional gradient in the LMTG, the posterior portion was sensitive to both person and number feature violations, whereas the anterior portion was sensitive only to person violations. They concluded that different language networks and feature-sensitive mechanisms and involved in the processing of person and number features.

A few studies have studied and compared the processing of phi-features by means of ERPs (Alemán-Bañón et al., 2012; Barber & Carreiras, 2005; Mancini et al., 2011a, 2011b; Silva-Pereyra & Carreiras, 2007; Zawiszewski et al., 2016; *inter alia*). Most of them have analyzed and compared gender (and number) features. First, I consider these studies, and later I describe studies which analyzed person and number features, since these are the features I have studied in this dissertation.

4.2.1 Processing gender and number features: evidence from ERPs

Barber & Carreiras (2003, 2005) compared gender and number features by manipulating article-noun and noun-adjective relations in word pairs and sentences. In word pairs, a P3 emerged, and the peak latency varied, being later for gender than number disagreement. For sentences, a P600 emerged, and the last segment of the P600 was larger for gender than for number. They argued that reanalysis or repair processes could involve more steps for gender feature, due to the fact that grammatical gender is a lexical feature and number a morphological feature.

In another study, Molinaro et al. (2008) studied the processing of gender and phonotactic violations, derived from the manipulation of a specific agreement feature based on the phonology of the word (“il” vs. “lo”). They found an early negativity and a late positivity for both types of violations, but differences were found between the negativities: phonotactic violations generated a LAN component, whereas gender violations generated a larger negativity not recognizable as either LAN or N400. They concluded that their data supports the idea that agreement processing works in parallel for different features, and differences in topographies are expected since different types of violations activate distinct neural networks.

Another study that analyzed number and gender phi-features was Alemán-Bañón et al. (2012). For that purpose, they manipulated number and gender features within (noun-adjective) relations in Spanish. They obtained a similar late positivity (P600) for both conditions and concluded that gender and number are processed similarly at the brain level. For Alemán-Bañón & Rothman (2016), more than the notion of feature type, it is markedness which plays a significant role in feature processing. They compared unmarked and marked gender (masculine vs. feminine) and number (singular vs. plural) and found that errors were detected earlier for marked features and the P600 also emerged earlier in comparison to unmarked features. They argue that the parser is sensitive to markedness asymmetries and that marked features are more salient in terms of processing.

Subsequently, Guajardo & Wicha (2014) analyzed the effect of grammatical gender and semantic violations in Spanish with post-nominal adjective manipulations (*una actitud positiva/positivo/griega/griego* "a positive.$_{\text{FEM}}$/positive.$_{\text{MAS}}$/Greek.$_{\text{FEM}}$/Greek.$_{\text{MAS}}$ actitude"). They observed an early negative component and a late positive component for both gender and semantic manipulations, although the early effect was larger for semantic incongruities, and the late effect larger for grammatical incongruities. They concluded that both gender agreement and semantic congruity affect language processing at similar time points, supporting the idea of a comprehension system whereby meaning and morphosyntax are processed in parallel.

Recently, Popov & Bastiaanse (2018) analyzed number and gender agreement in Dutch. They postulate that gender is a lexical feature which value is stored in the lexicon, whereas number is a morphological value dependent on conceptual knowledge (numerosity). They used a reading comprehension word-by-word scenario and obtained P600 components for both types of disagreement, number yielding larger effects than gender in late stages. They concluded that number has an increased repair complexity compared to gender.

Before turning to studies which have analyzed person and number features, I present the study by Nevins et al. (2007), which considered gender, person and number features, the only ERP study that has studied the three features so far. Their study contained Gender, Number, Gender & Number and Person & Number. Therefore, person was not manipulated independently. They found no differences between gender, number and gender & number, but found larger P600 for the gender & person condition. They concluded that the non-additive effect of combining agreement violations indicates that different agreement features are not checked independently, but suggested that the larger P600 for person violations is consistent with the idea that person feature has a privileged status among agreement features.

4.2.2 Processing person and number features: evidence from ERPs

The studies described above have shown that differences between gender and number feature are sometimes found, but not always. The same picture emerges for person and number features. On the one hand, Silva-Pereyra & Carreiras, (2007) compared person, number and person + number violations in Spanish, and a similar Anterior Negativity + P600 emerged for person and number, thus supporting the claim that the same mechanisms are used for the processing of phi-features. On the other hand, also in Spanish, Mancini et al. (2011a) tested the *Person-Number Dissociation Hypothesis* (PNDH), which claims that person and number features are intrinsically different, as person conveys extra-syntactic information concerning the participants in the speech act. They found a N400 + P600 pattern for person violations, and elicited a LAN + P600 pattern for number violations, thus supporting the latter view. They proposed that a N400 effect is expected when a violation which has an impact at the interface with the semantic-discourse representation of the sentence occurs (person violations); otherwise, when the violation is limited within the boundary of the morpho-syntactic representation, a LAN effect is expected (number violations).

Person and number phi-features have also been tested in other languages, and this LAN/N400 difference has not been reported elsewhere. In Basque, Zawiszewski et al. (2016) also compared person, number and person + number violations, an N400 emerged preceding the P600, but no differences were found concerning the negativity obtained. Mancini et al. (2011a) and Zawiszewski et al. (2016) did find, however, more positive waveforms for person violations compared to number violations, suggesting that person is more salient than number in terms of phi-features (see Mancini, 2018, for a more detailed description of person and number feature processing).

Finally, Alemán-Bañón & Rothman (2019) analyzed the role of markedness on feature processing. They used 1^{st} person subjects and 1^{st} vs. 3^{rd} person subject verb agreement on the one hand, and 3^{rd} person subjects and 3^{rd} vs. 1^{st} person subject verb agreement on the other. They considered 1^{st} person subjects as marked and 3^{rd} person subject as unmarked, since the subject in 1^{st} person is a participant in the speech act. They found larger effects for violations when the subject was marked, and concluded that stronger predictions are made for marked elements, yielding larger positivities compared to unmarked elements, where predictions would be weaker. The ERP literature has thus found robust differences across feature processing.

On the following, I present the main aims and outline of the dissertation, summarized chapter by chapter.

5 Aims and outline of the dissertation

Here I outline the main research questions addressed in this dissertation in each of the following four chapters (Chapters II to V). The main goals of this dissertation are (i) to test the UH and FDH in Basque (Chapters II and III), and Spanish (Chapters IV and V), two typologically distant languages; and (ii) to study native-like attainability in agreement violations with early and high proficient non-native speakers of Spanish (Chapter III) and, conversely, with early and high proficient non-native speakers of Basque (Chapter V).

Chapter 2

II *Eppur non si muove*: experimental evidence for the Unaccusative Hypothesis and distinct ϕ-feature processing in Basque.

Abstract

The Unaccusative Hypothesis (UH) has been extensively studied in linguistics, but, to date, it has not been tested by means of ERPs. The present study aimed to experimentally test the UH hypothesis in Basque and determine what the electrophysiological correlates are of the processing of unergative versus unaccusative predicates; it also aimed to investigate distinctness in phi-feature processing. I generated eight conditions to compare unergative and unaccusative predicate sentence processing involving phi-feature violations in grammatical and ungrammatical sentences. Participants responded faster to sentences containing unaccusative predicates compared to unergative predicates. All conditions elicited a N400 - P600 interaction. Overall, the negativity elicited by person violations was larger than the negativity elicited by number violations in both types of predicates. Intransitives differed regarding the size of the positivity elicited by phi-feature violations: unaccusatives elicited a larger positivity for number than for person feature violations, but unergatives elicited a larger positivity for person than for number.

Research questions:

- How are intransitive predicates processed? Are unaccusative and unergative predicates processed similarly?
- How are phi-features processed? Are person and number features processed similarly?

1 Introduction

Perlmutter (1978) put forth the Unaccusative Hypothesis (UH), claiming there are two different types of intransitive predicates: unaccusatives, with a theme theta role, and unergatives, with an agent theta role (Perlmutter, 1978). According to the UH, arguments of unaccusative verbs start as objects (R2) and advance into subjects (R1) in the derivation, whereas arguments of unergative verbs start as subjects (R1). Importantly, the UH makes two claims: (i) there are two different types of argument structure involved in intransitive predicates, one has an agent as the sole argument of the verb and the other one has a theme as the sole argument of the verb (unaccusatives) and (ii) the syntactic derivation of unaccusatives involves one more step than that of unergatives, namely the promotion of the theme argument from object to subject. Burzio (1986) rephrased this second claim in the UH in the framework of Government and Binding (Chomsky, 1981) in terms of syntactic movement: the theme argument of an unaccusative verb is generated as its complement and then moves to subject position, whereas the agent argument of an unergative verb is generated as an external argument (see Chapter I, Section 2, for more information on the UH).

Bever & Sanz (1997) were the first to experimentally test the UH; they conducted a reaction time study in Spanish to explore whether the trace left by the argument of unaccusative verbs in the complement of V position, argued to be an anaphor (Chomsky, 1981), would prime semantically related nouns as overt anaphors do. Their results showed that participants who scanned the linguistic sequence to find a probe word recognized it faster in preverbal position in unaccusatives than in unergative constructions, which the authors interpreted as evidence for the UH. Since this pioneering study, many other studies have tested this hypothesis experimentally; in the last decades the UH has been tested in sentence production studies on agrammatic aphasia (J. Lee & Thompson, 2011; M. Lee & Thompson, 2004; McAllister et al., 2009; Thompson, 2003) and in healthy adults, both in sentence production (Kim 2006; J. Lee & Thompson 2011; Momma, Slevc & Phillips 2018) and in sentence comprehension. Friedmann, Taranto, Shapiro & Swinney (2008) conducted a cross-modal lexical priming experiment in English and found that subjects of unaccusatives reactivate after the verb, whereas subjects of unergatives do not. Zeyrek & Acarturk (2014) ran an eye-tracking study and the gaze regression analysis grouped intransitive verbs in two clusters with regard to the number of regressions, revealing an unergative/unaccusative split in intransitive verbs in Turkish; Koring, Mak & Reuland (2012), ran an eye-tracking study using the visual world paradigm and found that subjects were reactivated in different time intervals in Dutch unaccusative and unergative verbs; finally, Meltzer-Asscher et al.(2015) and Thompson et al. (2007) in English, and Shetreet, Friedmann & Hadar (2009) in Hebrew, using fMRI, revealed distinct activations for unaccusatives and unergatives.

These studies found differences in the representation and processing of unergative vs. unaccusative verbs, thus converging with a large body of literature in linguistics regarding this issue (Levin & Hovav 1995). However, as far as we know, there are no studies to date exploring the electrophysiological correlates of unaccusative vs. unergative sentence processing. Here we present and discuss a pioneering study testing the UH by means of Event Related Potentials (ERPs). ERPs record time-locked electroencephalographic (EEG) activity in response to sensory, cognitive or motor stimuli, which reflect the activity of postsynaptic potentials generated by a large number of similarly oriented cortical pyramidal neurons firing in synchrony (Luck, 2014). Although quite poor with regard to spatial resolution, this electrophysiological non-invasive method provides an excellent temporal resolution, as it records neuronal activity millisecond by millisecond. Thus, ERPs allow us to continuously measure brain activity and to analyze how different stimuli are represented and processed. This study seeks to uncover the electrophysiological correlates of the representation and processing of unaccusative and unergative predicates. This study is carried in Basque, an active language (see Chapter I, Section 2.3.2, for information on case and agreement morphology in Basque), and it deploys the subject verb agreement violation paradigm, frequently used in ERP studies.

Subject agreement has been widely studied cross-linguistically in the ERP literature, also in Basque. As a result, subject agreement violations afford a very suitable ground to test the UH by means of this technique. In what follows, we provide a brief review of the literature related to ERP studies on subject agreement processing as a background for our study.

1.1 Electrophysiological correlates of subject-verb agreement

Subject-Verb Agreement is among the most studied phenomena in the ERP literature on language processing (for a review see Molinaro, Barber, & Carreiras 2011). Subject-agreement violations elicit a centro-parietal positivity (P600), preceded in most cases by a Left-Anterior Negativity (LAN). The P600 component, also known as the Syntactic Positive Shift (SPS), is usually related to syntactic ungrammaticality or complexity. The

LAN component is a brain response associated to the early detection of morpho-syntactic violations (Molinaro et al. 2011; Tanner 2015 among others).

The electrophysiology of subject-verb agreement violation in Basque has been studied in transitive sentences (Chow, Nevins & Carreiras 2018; Díaz, Sebastián-Gallés et al. 2011; Zawiszewski & Friederici 2009; Zawiszewski, Santesteban & Laka 2016) and, therefore, this paradigm offers an adequate comparison for unergative and unaccusative predicates. Zawiszewski & Friederici (2009) investigated agreement in Basque by looking at subject and object-verb agreement violations. They reported a N400-P600 pattern for the first time regarding subject agreement violations, and ever since this pattern has been consistently found in subsequent studies in Basque (Chow et al., 2018; Zawiszewski et al., 2011, 2016). The N400 was originally associated with the processing of semantic incongruities and violations (Kutas & Hillyard 1980; Kutas & Hillyard 1983), and has since also been interpreted as indexing problems with thematic role assignment (Frisch & Schlesewsky, 2001).

Díaz et al. (2011) explored whether ERP components elicited by case and verb agreement are cross linguistically equivalent. They found a P600 but no negativities in subject-verb agreement violations and offered two possible explanations for the lack of N400 in subject-verb violations in contrast to Zawiszewski & Friederici (2009): (a) the feature violated in this study was number (3rd person plural vs. 3rd person singular), whereas in the study by Zawiszewski & Friederici (2009) this factor was not controlled for by the authors (the materials included the mixture of person / number and person+number manipulations); (b) the sentences in Díaz et al. (2011) were presented auditorily, whereas they were presented visually in Zawiszewski & Friederici (2009).

Zawiszewski et al. (2016) investigated whether phi-features are processed distinctly, and for that purpose they carried out a study in Basque where person, number or person + number features were violated. A N400-P600 pattern was elicited for all conditions, replicating the findings in Zawiszewski & Friederici (2009). A larger P600 emerged for person and number + person violations than for number violations, revealing different costs related to the processing of person versus number phi-features.

Chow et al. (2018) studied the effects of subject-case marking on agreement processing by comparing transitive and unaccusative sentences in Basque. A P600 emerged for violations in both transitives and unaccusatives, but a negativity emerged only for violations in sentences headed by unaccusative verbs. The authors interpret this finding as supporting the idea that the auxiliary verb in Basque cannot support more than one instance of “true” agreement and that whenever there is a 3rd person ergative agreement, this agreement is achieved via pronominal clitic doubling (Arregi & Nevins, 2012). According to the authors true agreement in Basque only occurs with 3rd person absolutive subjects (unaccusatives). As a result, they interpret that the early posterior negativity elicited in their study constitutes evidence for this claim.

2 The present study

The present study tested the Unaccusative Hypothesis by means of ERPs for the first time. It aimed to determine what the behavioural and electrophysiological correlates are of the processing of unergative versus unaccusative predicates in Basque. We do this by exploring person versus number subject agreement. A 2 x 2 x 2 design was used for the experiment. We manipulated the TYPE of the predicate (2 levels: unaccusative vs. unergative), the FEATURE (2 levels: person and number) and the GRAMMATICALITY factors (2 levels: grammatical and ungrammatical).

2.1 Hypotheses and predictions

The main goal of this study is to test whether different processing patterns of electrophysiological correlates obtain for subject agreement violations in unaccusatives and unergatives, testing person and number features separately. We are thus testing the following hypotheses in the current study:

(H1) *The Unaccusative Hypothesis* (UH). This hypothesis makes two claims. First, it claims that there are two types of intransitive predicates, unaccusatives (assigning theme theta role) and unergatives (assigning agent theta role) (Perlmutter, 1978). This first part of the UH predicts that the differences that obtain in the processing of these two types of predicates should have unergatives look more similar to transitive predicates because both contain agentive subjects and less similar to unaccusatives because they involve theme subjects.

The UH further claims that these two predicates undergo different syntactic derivations: the theme arguments of unaccusatives are first generated as objects and become subjects during the derivation, whereas the agentive argument of unergative verbs is already born as a subject. In both Perlmutter's (1978) and Burzio's (1986) rendition, the second claim of this hypothesis entails that unaccusatives involve more complex derivations than unergatives, due to the fact that arguments of unaccusative verbs have to either be promoted to subject (Perlmutter, 1978) or undergo movement and leave a trace (Burzio, 1986). Recall that, regarding the effects of this second part of the UH, there are two contrasting hypotheses regarding the Basque language: some authors claim that unaccusatives in this language also involve this extra derivational step (Ortiz de Urbina, 1989) whereas others claim that they do not (Laka 2006a; b; Levin 1983). Longer, more complex syntactic derivations correlate with greater processing costs (Erdocia et al. 2009; Matzke et al. 2002), which is signalled behaviourally by longer reading times/or reaction times and also by ERP signatures, either by larger negativities or positivities for unaccusatives as compared to unergatives.

(H2) *The Feature Distinctness Hypothesis* (FDH)[3] that we put forth here claims person and number are processed and represented differently, yielding distinct processing signatures. Molinaro, Rizzi & Carreiras (2011) propose the Person-Number Dissociation Hypothesis (PNDH), arguing that person and number features are intrinsically different, as person conveys extra-syntactic information concerning the participants in the speech act. We hypothesize that person is more salient than number in processing. The FDH predicts that different electrophysiological responses will emerge for person and number violations. Moreover, based on (Zawiszewski et al. 2016; Chow et al. 2018) we expect to find a N400 component for violations in both unergative and unaccusative predicate violations, and based on (Zawiszewski et al., 2016) we expect to find a larger P600 for person than for number violations.

2.2 Participants

Twenty-five neurologically healthy native speakers of Basque took part in the experiment: 7 males and 17 females, all of them graduate and undergraduate students at

[3] Do not confuse H2 with Carminati's (2005) Feature Strength Hypothesis, whereby a correlation is assumed between the cognitive significance of a feature and its disambiguating power.

the University of the Basque Country with a mean age of 19,8 years (SD 2.6)[4]. They were all right-handed (Edinburgh Handedness inventory: Oldfield 1971), and they were all paid (20€) for their participation. Data from one participant was excluded due to excessive eye movements and other artefacts.

2.3 Materials

The experiment was designed in standard Basque. Four lists each consisting of 416 sentences (256 experimental and 160 fillers) were created. We then created 8 conditions (see Table 1): Condition 1, unaccusative person grammatical; Condition 2, unaccusative person ungrammatical; Condition 3, unaccusative number grammatical; Condition 4, unaccusative number ungrammatical; Condition 5, unergative person grammatical; Condition 6, unergative person ungrammatical; Condition 7, unergative number grammatical and Condition 8, unergative number ungrammatical. The critical words were the auxiliary verbs, which were always preceded by the main verbs, all controlled with respect to length and frequency.

In Basque there are two types of unergatives: the ones that consist of a bare noun and a light predicate *egin* (‘do’), and the others consisting of one word. The former cannot take a further DP direct object and many linguists consider that they are transitive in nature (Bobaljik 1993; Hale & Keyser 1993; Laka 1993; 2006b) (see Chapter I, Section 2.3.3, for more information on unergative predicates). As a result, in the present study one-word unergatives were used so that the number of words would not vary in comparison to unaccusatives, given the extreme sensitivity of ERPs to the phonological size and number of the items to compare (or the full list of experimental materials, see Supplementary Materials in the appendix).

Previous ERP studies involving phi-features used different types of materials. Zawiszewski et al. (2016) used 2nd instead of 1st persons to violate person and 2nd person singular instead of plural to violate number. Mancini et al. (2011) used 3rd instead of 2nd persons to violate person, and 3rd person plural instead of singular to violate number. It is

[4] Speakers of eastern varieties were not considered for this study due the dialectal differences mentioned in Chapter I, Section 2.4.

generally agreed in linguistics that third person lacks person feature (Benveniste, 1966), and only 1st and 2nd person have person feature, as they involve participants in the speech act. If this is correct, then the person violation in Mancini et al. (2011) might not involve a person violation at all. Given this caveat, also discussed in Zawiszewski et al. (2016), we decided to use 2nd instead of 1st for person violations. We followed Mancini et al. (2011) in using 3rd singular vs. plural for number violations.

Conditions			Sentence examples
Predicate Type	Feature	Grammaticality	
Unaccusative	Person	grammatical	Zu gaur goizean bueltatu zara Bilbotik. you-ABS today morning.in returned 2SG.ABS-be Bilbao-from "You have come back from Bilbao this morning."
		ungrammatical	*Zu gaur goizean bueltatu naiz Bilbotik. you-ABS today morning.in returned 1SG.ABS-be Bilbao-from
	Number	grammatical	Hura gaur goizean bueltatu da Bilbotik. 3.SG-ABS today morning.in returned 3SG.ABS-be Bilbao-from
		ungrammatical	*Hura gaur goizean bueltatu dira Bilbotik. 3.SG-ABS today morning.in returned 3PL.ABS-be Bilbao-from
Unergative	Person	grammatical	Zuk goizean biziki sufritu duzu aurkezpenean. you-ERG morning a.lot suffered have-2SG.ERG presentation-the-at "You have suffered a lot this morning at the presentation."
		ungrammatical	*Zuk goizean biziki sufritu dut aurkezpenean. you-ERG morning a.lot suffered have-1SG.ERG presentation-the-at
	Number	grammatical	Hark goizean biziki sufritu du aurkezpenean. 3.SG-ERG morning a.lot suffered have-3SG.ERG presentation-the-at
		ungrammatical	*Hark goizean biziki sufritu dute aurkezpenean. 3.SG-ERG morning a.lot suffered have-3PL.ERG presentation-the-at

*Table 1***.** Experimental conditions with examples of experimental materials.

2.4 Procedure

Personal computers (Windows 7 operating system) and Presentation software (version 16.3) were used to present the stimuli on screen. Before the actual experiment started, participants were instructed about the EEG procedure and seated comfortably in a quiet room in front of a 24 in. monitor. The experiment was conducted in a silent room in the Experimental Linguistics Laboratory at the University of the Basque Country (UPV/EHU) in Vitoria-Gasteiz. Sentences were displayed in the middle of the screen word by word for 350 ms (ISI = 250). A fixation cross (+) indicated the beginning of each sentence trial. After each trial the words *zuzen?* ‘correct?’ or *oker?* ‘incorrect?’appeared in the screen, and participants were asked to judge the acceptability of the previously displayed sentence as either correct (left Ctrl) or incorrect (right Intro). Half of participants used the left hand for correct responses and the other half the right hand.

All 416 sentences were distributed randomly in four blocks that lasted approximately 10 min each. Participants had a short break between each block which lasted as long as they needed. Before the actual experiment, participants ran a short training session of three trials. They were asked to avoid blinking or moving when the sentences were being displayed and to make the acceptability judgment as fast and accurately as possible. The whole experiment, including electrode-cap application and removal, lasted about 1h15m.

2.5 EEG recording

The EEG was recorded from 32 active electrodes secured in an elastic cap (Acticap System, Brain Products). Electrodes were placed on standard positions according to the extended Internationals 10 – 20 system in the following sites: Fp1/Fp2, Fz, F3/F4, F7/F8, FC5/FC6, FC1/FC2, T7/T8, C3/C4, Cz, CP5/CP6, CP1/CP2, P7/P8, P3/P4, Pz, O1/02, Oz, LM, VEOG and HEOG. All recordings were referenced to right mastoid position and re-referenced off-line to the linked mastoids. Vertical and horizontal eye movements and blinks were monitored by means of two electrodes positioned beneath and to the right of the right eye. Electrode impedance was kept below 5 kOhm at all scalp and below 10 kOhm for the eye electrodes. The electrical signals were digitized online at a rate of 500 Hz by a Brain Vision amplifier system and filtered offline within a band pass of 0.1 – 35 Hz. After the EEG datawere recorded, the ocular correction procedure (Gratton et al., 1983) as well as the artifact rejection procedure were applied (offline). Trials with other artifacts were removed indicated by any voltage exceeding 150 μV and voltage steps between two sampling points exceeding 35 μV.

2.6 Data analysis

For the data analysis the following types of subject agreement violations were compared: unaccusative person violations (*zara* 'be.2SG' vs. **naiz* 'be.1SG'; conditions 1 vs. 2 in Table 1, respectively); unaccusative number violations (*da* 'be.3SG' vs. **dira* 'be.3PL'; conditions 3 vs. 4 in Table 1, respectively); unergative person violations (*duzu* 'have.2SG' vs. **dut* 'have.1SG'; conditions 5 vs. 6 in Table 1, respectively); unergative number violations (*du* 'have.3SG' vs. **dute* 'have.3PL'; conditions 7 vs. 8 in Table 1, respectively).

For the ERP measures, segments were created from 200 ms before and 1000 ms after the onset of the critical words (the auxiliary) in the sentences. The trials associated with each sentence type were averaged for each participant. The EEG 200 ms prior to the onset was also used as a baseline for all sentence type comparisons.

300-400 ms and 400-700 ms temporal windows were considered during statistical analysis in all conditions based on the literature and visual inspection of the data. After the stimuli were recorded and averaged, analyses of variance (ANOVA) were carried out in nine regions of interest that were computed out of 27 electrodes: lateral electrodes: left frontal (F7, F3, FC5), left central (T7, FP5, C3), left parietal (P7, P3, O1), right frontal (F4, F8, FC6), right central (C4, FP6, T8), and right parietal (P8, P4, O2); midline electrodes: frontal (Fp1, Fz, Fp2), central (FC1, Cz, FC2), and parietal (CP1, Pz, CP2). Repeated-measures ANOVAs were performed in all experimental manipulations and trials (correctly and incorrectly judged trials) for each window of time using five within-subjects factors: grammaticality (2 levels: grammatical, ungrammatical), type (2 levels: unaccusative, unergative), feature (2 levels: person, number), hemisphere (2 levels: left, right), and region (3 levels: frontal, central and parietal). Midline (frontal, central, and parietal) electrodes were analyzed independently. Whenever the sphericity of variance was violated (Greenhouse & Geisser, 1959) correction was applied to all the data with greater than one degree of freedom in the numerator. Finally, further statistical comparisons were conducted (split by the grammaticality condition) whenever an interaction turned out to be statistically significant. Effects for the type, feature, hemisphere or region factors are only reported when they interact with the experimental manipulation of grammaticality.

For the behavioral results, error rates and response latencies of all the trials were submitted to repeated measures ANOVAs with grammaticality (two levels: grammatical, ungrammatical), type (two levels: unaccusative, unergative) and feature (two levels: person, number) conditions as within-subject factors. Subsequent comparisons (by subject and by item) were carried out whenever a grammatical interaction was significant.

3 Results

3.1 Behavioural results

Participants were very accurate in the acceptability task, as they were native and competent speakers (mean accuracy of 92.74%, SDE = 1.35; see Table 2).

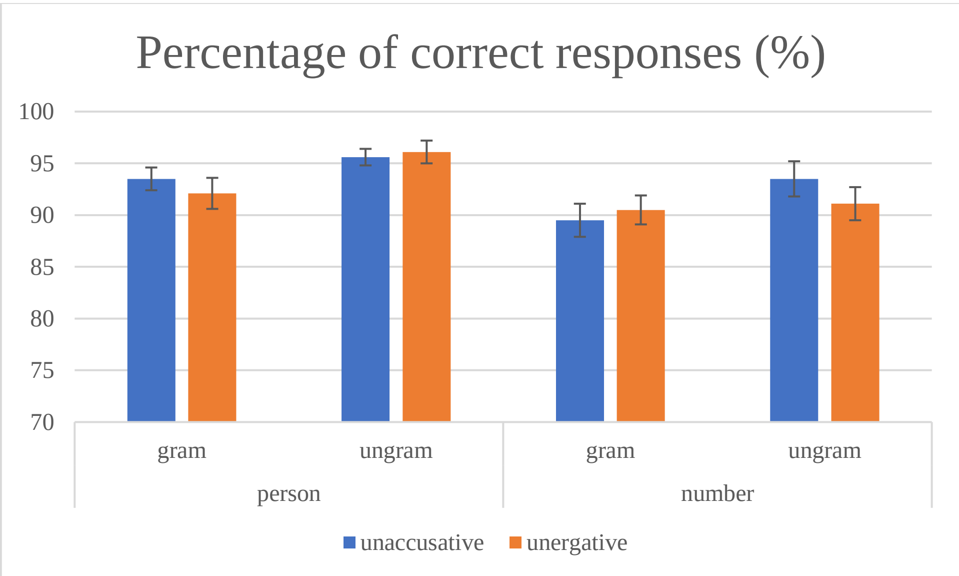


Table 2. Percentage of correct responses (%) and standard deviation error (SDE).

Regarding acceptability judgment errors, the analysis showed a significant GRAMMATICALITY effect in the analysis by item ($F1(1,23) = 3.12$, $p = .091$; $F2(1,254) = 12.25$, $p = .001$) revealing higher accuracy for the ungrammatical sentences as compared to the grammatical ones (94.08% vs. 91.38%). A FEATURE effect turned out to be statistically significant as well ($F1(1,23) = 18.17$, $p < .001$; $F2(1,254) = 16.96$,

$p < .001$). This effect showed that participants judged more accurately materials containing person feature manipulations than those with number feature manipulations (94.3% vs. 91.15%). Finally, a TYPE*GRAMMATICALITY*FEATURE interaction was marginally significant in the analysis by subject (*F1* (1,23) = 3.35, *p* = .08; *F*2(1,254) = 2.81, *p* = .095). The subsequent analysis by type factor revealed no significant differences between the experimental conditions. The analyses by grammaticality factor showed that the difference in accuracy between grammatical and ungrammatical sentences was marginally significant for unaccusatives in the person condition and non-significant in the number condition. A similar pattern emerged for unergatives: the difference between grammatical and ungrammatical sentences was significant in the person condition and non significant in the number condition (unaccusative person (*F*(1,23) = 3.93, *p* = .059); unaccusative number (*F*(1,23) = 2.33, *p* = 0.14); unergative person (*F*(1,23) = 4.54, *p* = .044); unergative number (*F*(1,23) = 0.13, *p* = .727)). The analyses by feature factor showed significant differences between person and number features when comparing unaccusative grammatical conditions (*F* (1,23) = 8.15, *p* = .009), but not when comparing the unaccusative ungrammatical conditions (*F* (1,23) = 1.98, *p* = .173), that is, the participants were more accurate when performing the task in the person feature condition than in the number feature condition. Regarding the unergatives, the analyses revealed no differences between person and number features when comparing grammatical conditions (*F*(1,23) = 1.68, *p* = .207) and a higher accuracy in person than in number when comparing ungrammatical conditions (*F*(1,23) = 11.74, *p* = .002).

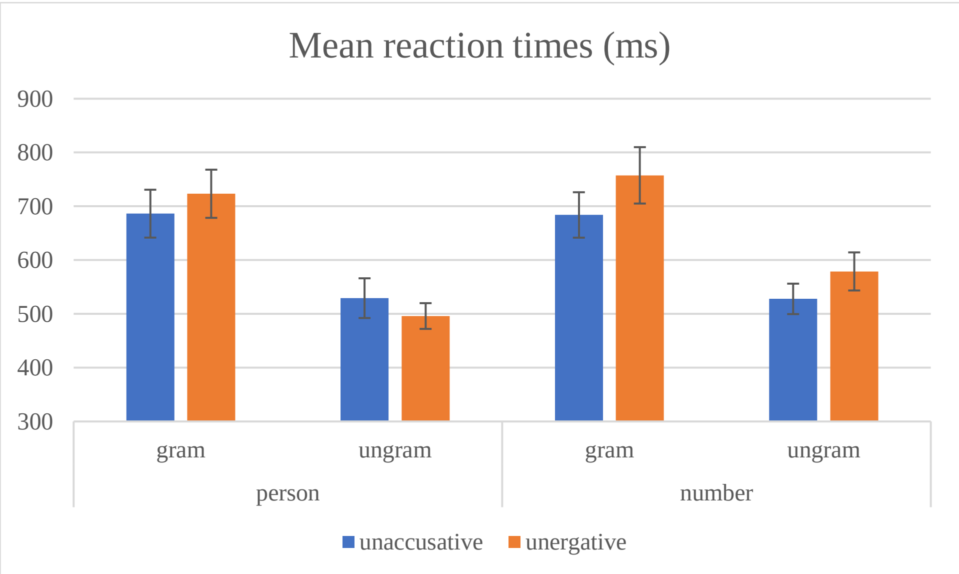


Table 3. Mean reaction times (ms) and standard deviation error (SDE).

Regarding response latencies, a significant main effects of GRAMMATICALITY (F(1,23) = 53.58, p < .001; F2(1,254) = 251.14, p < .001) showed larger response times for the grammatical conditions as compared to the ungrammatical ones (712.75 ms vs. 532.38 ms). A main effect of FEATURE ($F1$(1,23) = 4.6, p = .044; $F2$(1,254) = 2.95, p = .087) revealed shorter response times when judging the grammaticality of the sentences containing person feature manipulations in comparison to the sentences containing number feature manipulations (608.07 ms vs. 637.06 ms). A main effect of TYPE present in the by-subject analysis ($F1$(1,23) = 5.65, p = .026; $F2$(1,254) = 3.14 p = .078) showed shorter response latencies in unaccusative sentences as compared to unergatives (606.21 ms vs. 638.92 ms). A TYPE*GRAMMATICALITY interaction was marginally significant in the by subject analysis ($F1$(1,23) = 3.14, p = .09; $F2$(1,254) = 3.06, p = .082). Further comparisons (by type factor) revealed that participants were slower at processing grammatical unergative sentences (740.4 ms) in contrast to grammatical unaccusatives (685.1ms) (F(1,23) = 5.91, p = .023) while no differences between the ungrammatical unergative (537.5 ms) and ungrammatical unaccusative conditions (527.3 ms) were found (F(1,23) = 0.56, p = .463). The comparisons by grammaticality factor showed that participants were slower when responding to grammatical sentences in the unaccusative condition (685.1 ms) as compared to the ungrammatical sentences (527.3 ms) (F(1,23) = 39.1, p < .001). A similar pattern emerged when comparing the grammatical unergative condition to the ungrammatical one: participants were slower when judging the grammatical sentences (740.4 ms) in comparison to the ungrammatical ones (537.5 ms) (F(1,23) = 45.69, p < .001).

3.2 ERP results

After the baseline correction, epochs with artifacts were rejected, which resulted in the exclusion of approximately 10.8% (SD = 0.6) of the trials. Based on the previous literature and visual inspection of the data we selected an early time window (300-400 ms) and a late time window (400-700 ms) in order to capture best the effects obtained (see Figure 12 for the grand average patterns and Figure 13 for the mean voltage difference maps and Table 4 below for the summary of the statistical results).

Regarding the early time window (300-400 ms), the analysis of the lateral electrodes revealed a main GRAMMATICALITY effect ($F(1,23) = 32.9$, $p <.001$) indicating a larger negativity for the ungrammatical conditions as compared to the grammatical ones (0.91 µV vs. 2.26 µV). It also revealed a significant FEATURE effect ($F(1,23) = 4.31$, $p = .049$) indicating that person is more negative than number (1.35 µV vs. 1.82 µV). In addition, a significant FEATURE*GRAMMATICALITY interaction was found ($F(1,23) = 10.56$, $p = .004$). Further analysis (by grammaticality) showed a significantly larger negativity for the ungrammatical person condition (0.46 µV) in comparison to the grammatical one (2.24 µV) ($F(1,23) = 45.95$, $p < .001$) and a larger negativity for the ungrammatical number condition (1.37 µV) in comparison to the grammatical number condition (2.28 µV) ($F(1,23) = 10.65$, $p = .003$). The comparison by feature revealed no differences between the grammatical person (2.22 µV) and number feature (2.23 µV) conditions ($F(1,23) = 0.02$, $p = .9$), but a larger negativity for the ungrammatical person manipulations (0.46 µV) in comparison to the number manipulations (1.37 µV) ($F(1,23) = 13.73$, $p = .001$).

Regarding the midline electrodes, a main effect of GRAMMATICALITY showed that overall ungrammatical conditions (2.65 µV) displayed a larger negativity than grammatical conditions (3.64 µV) ($F(1,23) = 9.63$, $p = .005$). A FEATURE*GRAMMATICALITY interaction ($F(1,23) = 5.22$, $p = .032$) (by grammaticality factor) revealed a larger negativity for the ungrammatical person condition (2.26 µV) than for the grammatical person condition (3.62 µV) while no significant differences were found between the number conditions (3.04 µV vs. 3.66 µV) (person: $F(1,23) = 15.63$, $p = .001$; number: $F(1,23) = 2.66$, $p = .117$). In the analysis by feature factor, no differences between the person and the number conditions were observed in the grammatical conditions ($F(1,23) = 0.13$, $p = .719$) while a significant difference emerged between the ungrammatical person and number conditions, showing a larger negativity for the ungrammatical person (2.26 µV) than for the ungrammatical number (3.04 µV) ($F(1,23) = 10.93$, $p = .003$).

Regarding the late time window (400-700 ms), *t*he analysis of the lateral electrodes showed a main effect of GRAMMATICALITY ($F(1,23) = 47.26$, $p < .001$, that is, overall the ungrammatical sentences elicited a larger positivity than the grammatical ones (2.59 µV vs. 0.18 µV). Also, a TYPE*GRAMMATICALITY*REGION interaction was statistically significant ($F(2,46) = 6.34$, p = .012). The analysis of this interaction by grammaticality factor revealed a larger positivity for the ungrammatical unaccusative condition than for the grammatical unaccusative condition and for the ungrammatical unergative condition than for the grammatical unergative condition over the frontal, central and parietal regions (unaccusative frontal: $F(1,23) = 11.65$, $p = .002$; unaccusative central: $F(1,23) = 53.97$, $p < .001$; unaccusative parietal: $F(1,23) = 52.64$, $p < .001$; unergative frontal: $F(1,23) = 19.09$, $p < .001$; unergative central: $F(1,23) = 38.37$, $p < .001$; unergative parietal: $F(1,23) = 22.11$, $p < .001$). The analysis of this interaction by type factor showed unaccusative grammatical conditions were marginally more positive than unergatives only over the frontal electrodes (frontal: $F(1,23) = 3.37$, $p = .079$). The positivity found over the centro-parietal regions was marginally larger in the ungrammatical unaccusative condition as compared to the ungrammatical unergative condition (central: $F(1,23) = 3.12$, $p = .091$; parietal: $F(1,23) = 3.84$, $p = .062$).

Regarding the midline electrodes, main effects of GRAMMATICALITY ($F(1,23) = 62.47$, $p < .001$) was found, indicating a larger positivity for the ungrammatical sentences (4.98 µV) as compared to the grammatical ones (1.11 µV). In addition, a significant TYPE*FEATURE*GRAMMATICALITY interaction was found ($F(1,23) = 5.3$, $p = .031$). The analysis by grammaticality factor showed that the positivity elicited by the ungrammatical sentences was significantly larger than that yielded by the grammatical sentences in both unaccusative and unergative predicates and for both person and number features (unaccusative person: $F(1,23) = 34.45$, $p < .001$; unaccusative number: $F(1,23) = 49.51$, $p < .001$; unergative person: $F(1,23) = 62.92$, $p < .001$; unergative number: $F(1,23) = 22.38$, $p < .001$). The analysis by type factor revealed that the positivity elicited by the ungrammatical number was larger in the unaccusative predicates than in the unergative ones ($F(1,23) = 6.99$, $p = .015$). Concurrently, the analysis by feature factor showed a marginally significant difference between person and number features in the grammatical unaccusative condition ($F(1,23) = 3.37$, p = .079) with a larger positivity for person than for number. Also, a significant difference between the person and number features in the ungrammatical unergative predicates was found indicating a larger positivity for the ungrammatical person than for the ungrammatical number feature ($F(1,23) = 7.04$, $p = .014$).

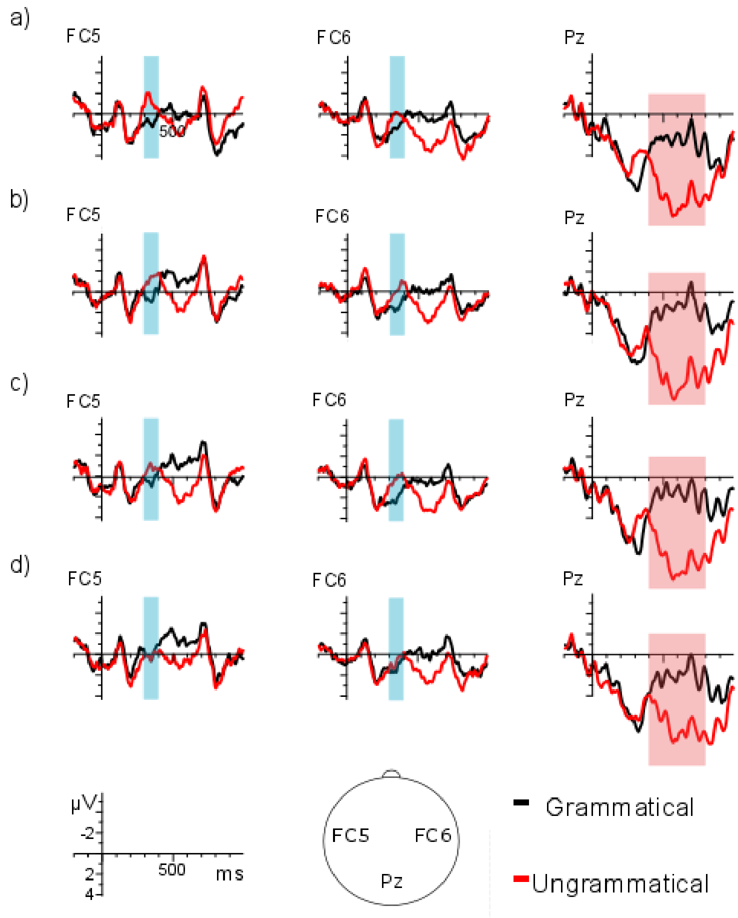


Figure 12. (a) person feature unaccusative predicate condition; (b) number feature unaccusative predicate condition; (c) person feature unergative predicate condition; (d) number feature unergative predicate condition.

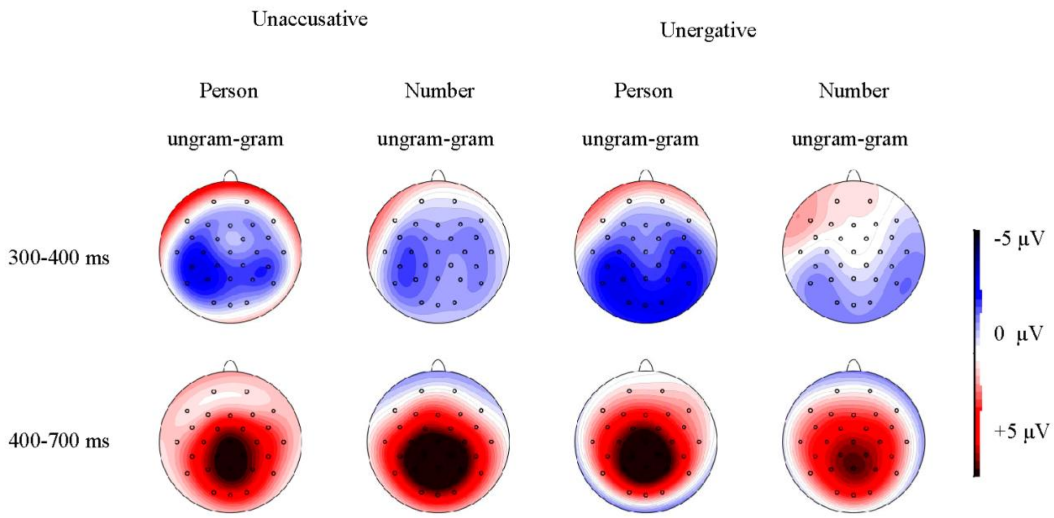


*Figure 13***.** Mean voltage difference maps (grammatical minus ungrammatical).

3.3 Summary of the results

Behavioural results show that participants were more accurate and responded faster to ungrammatical sentences than to grammatical ones. They were also more accurate and responded faster to sentences containing person feature manipulations than to sentences containing number feature manipulations. With regard to predicate types, participants responded faster to unaccusative sentences than unergative ones, and the difference in accuracy between grammatical and ungrammatical sentences was marginally significantly larger in the number condition than in the person conditions for unaccusatives and significantly larger in the person condition than in the number condition for unergatives.

Regarding ERP responses (see Table 3), all violations elicited a posterior negativity around 300-400 ms. Although the negativity does not have the classic centro-parietal distribution of the N400 (Kutas & Hillyard, 1980), we label it as such following (Mancini et al. 2011; Zawiszewski & Friederici 2009; Zawiszewski et al. 2011; 2016). In all violations, this negativity was followed by a posterior positivity, which we interpreted as a classic P600.

The ERP results showed that the N400 elicited by person violations is overall larger than the one for number violations. Regarding predicate type, ungrammatical unaccusatives elicited a significantly larger P600 over the centro-parietal regions than ungrammatical unergatives. Furthermore, unaccusatives showed a significantly larger P600 in number violations than unergative number violations. Additionally, unergatives revealed a larger P600 for person violations than for number violations.

		300-400 ms		400-700 ms	
		Lateral	Midline	Lateral	Midline
	df	F	F	F	F
GRAM	1,23	*****32.9**	****9.63**	*****47.26**	*****62.47**
TYPE	1,23	.64	.473	1.71	3.03
FEAT	1,23	***4.31**	.278	1.74	2.89
TYPE*GRAM	1,23	.64	1.66	.57	.5
FEAT*GRAM	1,23	***10.56**	***5.22**	.24	.7
TYPE*FEAT*GRAM	1,23	1.76	1.68	2.6	***5.3**
GRAM*HEM	1,23	.2	-	.0	-
TYPE*GRAM*HEM	1,23	3.13	-	1.57	-
FEAT*GRAM*HEM	1,23	0.83	-	.88	-
TYPE*FEAT*GRAM*HEM	1,23	.19	-	1.59	-
GRAM*REGION	2,46	****8.14**	***4.85**	*****18.77**	*****35.64**
TYPE*GRAM*REG	2,46	2.73	.3	***6.34**	1
FEAT*GRAM*REG	2,46	.84	2.08	1.08	.55
TYPE*FEAT*GRAM*REG	2,46	.13	.88	.87	2.59
GRAM*HEM*REG	2,46	***5.05**	**-**	.5	**-**
TYPE*GRAM*HEM*REG	2,46	.17	**-**	.29	-
FEAT*GRAM*HEM*REG	2,46	.22	-	.66	-
TYPE*FEAT*GRAM*HEM*REG	2,46	.17	-	.18	-

*Table 4***.** Summary of the ERP results. Main effects and interactions with grammaticality are shown. GRAM (grammaticality), TYPE (type), FEAT (feature), HEM (hemisphere) and REG (region). * p = < .05, ** p = < .01, *** p = < .001.

4 Discussion

The present study had a twofold goal: first, to determine what the processing cost and electrophysiological correlates are for unergative versus unaccusative predicates in Basque. Second, it investigated the processing of person and number phi-features in the context of these two types of predicates. Two hypotheses were tested, the Unaccusative Hypothesis (Perlmutter, 1978) and the Feature Separability Hypothesis that I put forth. The UH makes two claims: first it claims that there are two types of intransitive predicates (unaccusatives and unergatives) with different argument structure and syntactic representation, and second it claims they also have different derivations, where the argument of an unaccusative verb undergoes at least one more syntactic computation than the argument of an unergative verb to become subject in the case of Perlmutter (1978) or to receive nominative case in the case of Burzio (1986). The FDH hypothesis claims that person and number are processed and represented differently yielding distinct processing signatures.

Participants were highly accurate, as expected given they were native speakers. They were also faster, as expected, when responding to ungrammatical sentences, and performed with higher accuracy in person feature than in number feature conditions overall, replicating previous findings (Mancini et al. 2011; Zawiszewski et al. 2011; 2016).

The results reveal significant differences between unaccusatives and unergatives in Basque, both behaviourally and electrophysiologically, thus yielding a new type of evidence in support of the existence of two different types of intransitives in language: unaccusatives that carry theme arguments and unergatives that carry agent arguments. Importantly, Basque participants were faster processing unaccusatives than unergative sentences when performing an acceptability judgement task. This finding suggests that, at least in active-ergative languages like Basque, unaccusatives do not involve movement, as suggested by Levin (1983) and argued by Laka (2006a; b; 2017). Other experimental studies, like Koring et al. (2012) with Dutch, a nominative language, reported the opposite pattern where the unaccusatives took longer than unergatives to process, as a result the authors interpret as evidence that arguments of unaccusatives undergo a further step in the syntactic derivation (promotion to R1 in the case of Perlmutter 1978, working in Relational Grammar, and movement in the case of Burzio 1986, working in Generative Grammar).

Regarding the electrophysiological pattern, I found that unaccusatives and unergatives differ in their processing of phi-features: unaccusatives elicited a larger positivity for number violations than did unergatives and unergatives elicited a larger positivity for person violations than for number violations. Therefore, unaccusative and unergative predicates reveal different electrophysiological responses, specifically related to phi-features. The pattern of response obtained in unergative sentences, that is, a larger positivity for person than for number violations, is the electrophysiological signature found by previous studies analyzing phi features violations in transitive sentences (Nevins et al. 2007; Zawiszewski et al. 2016). In this sense, the ERP signature elicited by unergatives is similar to what has been reported for transitives, a finding that is convergent with the predictions made by the UH regarding the subjects of unergative and transitive sentences, which are “born subjects” and do not involve the promotion of extra movement step required of unaccusatives by the UH.

It is important to bear in mind that the UH was originally formulated based on data from nominative-accusative languages, where the case morphology of all intransitive subjects is the same, namely nominative. Hence, the promotion or movement of the “object born” unaccusative argument is a plausible mechanism to account for its case. In the case of Basque, the case morphology of unergative subjects is ergative, as in transitive subjects, whereas the case morphology of unaccusative subjects is absolutive, as in transitive objects. Levin (1983) was the first to discover this correlation between case morphology and argument structure, showing that the class of unaccusative predicates in this language correlates with absolutive-marked subjects, whereas the class of unergatives has ergative-marked subjects (see also Laka 1993 for a discussion). Since unaccusative subjects do not have the same case as other subjects, Levin speculated that there might be no syntactic movement for unaccusative subjects in Basque, but refrained from claiming it because it violated the principle in Government and Binding that case could not be determined by D-Structure representations (Chomsky, 1981). More recently, Laka (2006a; b; 2017) has shown that this correlation is strict, and has argued that case is inherent in Basque, not structural. This would entail no extra derivational step for the sole argument of unaccusative predicates, and thus no extra cost when processing unaccusative sentences as compared to unergative sentences.

A second finding regarding processing differences between unergative and unaccusative predicates concerns phi-features. Recall that unaccusatives showed a significantly larger P600 in number violations, while unergatives showed the opposite pattern, with person violations generating a larger P600 than number violations. This is a novel finding that would have not been detected had the experimental design not considered each feature separately. As it is a novel finding, I will offer a tentative interpretation, and await further replication of similar results for a better-grounded understanding. Note that unergatives show the ERP signature associated to violations in transitive sentences, which in turn reveals unergative subjects to be more similar to transitive subjects than to unaccusative subjects, as predicted by the UH. Until a corpus study is carried out in future work, I cannot discard the possibility that this differential sensitivity to the number feature displayed by unaccusatives be a frequency effect, if unaccusatives have third person subjects more frequently than unergatives. In connection to this possibility, speech act participants (speaker and addressee, the two types of arguments that involve *bona fide* person agreement) are more frequently subjects/agents than objects/themes in transitive clauses, a difference that might well carry over to unergatives versus unaccusatives.[5]

I also tested the Feature Separability Hypothesis that claims that person and number are processed and represented differently, yielding distinct processing signatures. Based on previous research (Chow et al. 2018; Zawiszewski et al. 2016) I expected a similar N400 component to be elicited by both person and number violations in both unaccusative and unergative predicates. I also expected to find a larger P600 for violations involving person than for number violations in the late time window (Zawiszewski et al. 2016). Regarding the first expectations, both person and number violations elicited a N400 in both types of predicates, as expected. However, the N400 was larger for person violations than for number violations. This difference can be due to the materials used in each study. Zawiszewski et al. (2016) employed second-person as a baseline for person and number manipulations, while here I used second-person for person manipulations and third-person for number. Hence given the high sensitivity of the methodology used in the current experiment (ERPs), I think that this difference might have led to a different electrophysiological output as the contrast between the person and the number features was already detected at early stages of processing (300 - 400 ms) indicating that person feature is more salient than number feature.

As concerns the late time-window (400 – 700 ms), the second expectations were met in that a P600 component was elicited by all violations, as commonly found in the literature on language processing (for a review see Molinaro et al. 2011). Interestingly, the positivity was larger for the ungrammatical person than for the ungrammatical number features in unergative predicates only, replicating the pattern in transitive predicates reported in Zawiszewski et al. (2016).

Altogether, both behavioural and electrophysiological results show that person and number features are processed differently, as indicated by the modulations of both N400 and P600 components.

5 Summary of the findings

This study shows differences in processing cost regarding unaccusative and unergative predicates and phi-features lending further support both to the UH and to the FDH. This study provides behavioural and electrophysiological evidence in support of the Unaccusative Hypothesis and the Feature Separability Hypothesis.

Regarding the UH, I found that behaviorally participants were faster processing sentences with unaccusative verbs than sentences with unergative verb. Electrophysiologically, sentences with unaccusative verbs generated a larger positivity than sentences with unergative verbs. These results provide evidence for the first claim in the UH, namely, that unergatives and unaccusatives involve different thematic/structural representations. Interestingly though, it does not provide evidence for the second claim in the UH that unaccusatives involve longer derivations than unergatives, which predicts higher processing costs for unaccusatives than for unergatives. I found the opposite pattern, with unaccusatives being less costly than unergatives. This finding provides support for linguistic analyses that argue that case in Basque is a direct reflection of theta-role (Laka

2006a; b; Levin 1983) and does not support the hypothesis that case is structural in this language (Ortiz de Urbina, 1989).

Regarding the FDH, I found that I found that behaviorally participants were more accurate and faster processing sentences with with person feature manipulations than sentences with number feature. Electrophysiologically, sentences with person feature manipulations generated a larger negativity than sentences with number feature. These results support the FDH, and show that person is more salient in terms of processing compared to number feature.

Electrophysiological results also show an interaction involving predicate type and phi-features: number violations in the unaccusative condition elicited a larger P600 than number violations in the unergative condition and the positivity was larger for person than for number features in the unergative condition. This finding can be interpreted as a function of prototypicality: unergatives involve agent arguments, highest in animacy and very frequently human where the person feature is most salient, while unaccusatives involve theme arguments, lowest in the animacy scale, with less saliency for the person feature.

Chapter 3

III Intransitive sentences and early and proficient non-native speakers of Basque

Abstract

In the third chapter of this dissertation, I investigated how early and highly proficient non-native speakers of Basque process intransitive predicates and phi-features, and compared their results to native speakers of Basque, previously examined in Chapter II. More precisely, I studied the processing correlates of unaccusative versus unergative sentences, and person and number phi-features by early and highly proficient non-native speakers of Basque whose native language was Spanish. I used behavioral measures (accuracy and reaction times) as well as Event Related Potentials (ERPs). Results revealed that non-native speakers were more accurate with person feature than with number feature, and reacted faster to unaccusative predicates than to unergative predicates. They generated a larger positivity for violations of unaccusative predicates in comparison to the unergative predicates, similarly to natives. The comparison of native and non-native speakers presented in this chapter yielded similar effects. This suggests that non-natives can attain native-like responses and processing of intransitive predicates and phi-features. This chapter is structured as follows: First, I will introduce the chapter, then I will present the study, next I will present the results and a comparison with those of natives, and finally I will provide a discussion.

Research questions:

-How do non-natives process unaccusative and unergative predicates, do they process them like natives or differently?

-How do non-natives process person and number features, do they process them like natives or differently?

1 Introduction

Can non-native speakers attain nativelike competence in all aspects of grammar? Do native and non-native speakers use the same mechanisms for language processing? These and similar questions have raised an important discussion in the last decades about the mechanisms and processes underlying native versus non-native language processing and acquisition (see Chapter I, Section 3, for a more detailed discussion on the topic). Lenneberg (1967) claimed there are maturational constraints that make native-like acquisition of languages after a critical period impossible. According to Lenneberg (1967), native-like acquisition of languages will not be an option after a few years of age. Following the claim of a critical period for language, Krashen (1994) makes a distinction between acquiring a first language and learning other languages. Dulay et al. (1982), MacWhinney (2005), Schwartz & Sprouse (1996) and others argue that the same mechanisms are used for first and second language processing and acquisition. Research carried out throughout the last decades has allowed to identify key factors to take into account when studying non-native language processing, namely proficiency, age of acquisition (AoA), similarity between L1 and L2 and active use of the language (Brice et al., 2019; Hartshorne et al., 2018).

Not all aspects of language are equally easy to acquire. In second language acquisition syntax is reported to be harder to acquire than other aspects of language (Kotz, 2009; Ojima et al., 2005; Vandenberghe et al., 2019; Weber-Fox & Neville, 1996). It has also been shown that AoA and the level of proficiency play a big role in attaining native-like performance (Wartenburger et al., 2003). Several studies revealed that proficient speakers perform like natives (Hernandez et al., 2007; Kotz et al., 2008; Rossi et al., 2006), whereas other studies found differences between native and non-native speakers when studying syntactic phenomena (Díaz et al., 2016; Erdocia et al., 2014; Foucart & Frenck-Mestre, 2012; Weber-Fox & Neville, 1996; Zawiszewski et al., 2011; Zawiszewski & Laka, 2020). Díaz et al. (2016) and Zawiszewski et al. (2011) analyzed the processing of case, and Erdocia et al. (2014) analyzed the processing of word order with native and non-native speakers of Basque, whose L1 is Spanish and does not shared neither case alignment nor word order. They found differences between native and non-native speakers in the processing of case and word order violations and argued that besides AoA and proficiency, linguistic distance between languages is a relevant factor to take into account when studying second language processing. In this dissertation, too, native and non-native speakers of languages which happen to be typologically distant are studied, that is, native speakers of Basque and non-native speakers of Basque whose native language is Spanish.

More precisely, I studied the processing of intransitive sentences by non-native speakers of Basque. The UH claims that unaccusatives and unergatives are processed differently, and hence extra processing costs are predicted for unaccusatives as a result of a more complex derivation. Previous studies with native speakers of nominative-accusative languages have shown differences between unaccusative and unergative predicates with higher processing costs for unaccusatives compared to unergatives (Bastiaanse & van Zonneveld, 2005; Dekydtspotter & Seo, 2017; Friedmann et al., 2008; Koring et al., 2012; Meltzer-Asscher et al., 2015, *inter alia*). The UH has also been tested with non-native speakers and unaccusatives have been found to be more difficult to learn than unergatives for second language learners (Montrul, 2005; Oshita, 2001; Yuan, 1999; *inter alia*). Oshita (2001) put forth the Unaccusative Trap Hypothesis (UTH), which claims that L2 learners assume at first all intransitive predicates to be unergatives. As proficiency increases, learners notice that unaccusatives function differently and start making differences between the two predicates, and at higher levels of proficiency they perform native-like (see Chapter I, Section 2.3.2, for more information on the UH and non-native speakers).

In Chapter II, I tested the UH in Basque, an active language, with native speakers of Basque. The results of the experiment indicated that unaccusatives and unergatives are processes differently, but contrary to the predictions made by the UH and previous findings, unaccusatives did not show signs of higher processing costs. In fact, I found the opposite pattern, that is, unaccusatives being less costly than unergatives, and I interpreted the differences in processing cost between unergative and unaccusative predicates as a consequence of case alignment, that is, following Levin (1983) and Laka (2006b), I argued that case and theta role are associated in Basque and that arguments of unaccusative predicates do not undergo an extra derivation in comparison to unergatives.

This raises an important question, namely how early and highly proficient non-natives whose L1 is nominative (Spanish) are going to deal with unaccusative and unergatives in their L2, an active language (Basque). Importantly, previous evidence suggests that native-like processing, among other factors, depends on the similarities between L1 and L2 of the syntactic aspects examined. In this study, I used a grammatical feature present in both languages (subject-verb agreement) to study how subject-verb agreement violations impact the processing of intransitive predicates and phi-features, hence, the agreement phenomenon used to construct manipulations does not diverge from one language to the other. Nevertheless, case alignment is different in Basque and Spanish. Here, I investigate whether non-native speakers process unergative and unaccusative predicates differently in their non-native language, and if they do so, whether they do it like native speakers of Basque or whether there is transfer from their L1.

As explained in Chapter I, Section 3, the main hypotheses that have been postulated for non-native language acquisition and processing can be summarized in four main groups: The Difference Hypothesis, The Similarity Hypothesis, The Convergence Hypothesis (Steinhauer, 2014), and the Language Distance Hypothesis (Zawiszewski & Laka, 2020). On the following, I introduce the present study (hypotheses, participants, materials, procedure, EEG recording and data analysis), I describe the processing of intransitive predicates and phi-features of early and highly proficient speakers of Basque, and a I compare the results obtained here with the results of native speakers of Basque presented in Chapter II.

2 The present study

The present study aimed to examine and compare the processing of intransitive predicates and phi-features by early and highly proficient non-native speakers of Basque to native speakers, presented in Chapter II. For that purpose, I studied the behavioral and electrophysiological correlates of the processing of unergative versus unaccusative predicates in early and highly proficient non-native speakers of Basque. The same design and experimental conditions as in Chapter II were used.

2.1 Hypotheses and predictions

The main goal of this study is to test whether different processing patterns reflected by electrophysiological correlates reported previously for the L1 speakers of Basque (Chapter II) obtain for subject agreement violations in unaccusatives vs. unergatives in non-native speakers of Basque, testing person and number features separately. I consider the following three hypotheses: (1) The Difference Hypothesis, (2) The Similarity Hypothesis, (3) The Convergence Hypothesis (Steinhauer, 2014), and (4) the Language Distance Hypothesis (LDH) (see Chapter I, Section 3, for a more detailed description).

(H1) The Similarity Hypothesis: it claims that the same mechanisms used in L1 are recruited for L2 processing from a very early stage. Therefore, the same patterns should be observed for native and early and high proficient non-native speakers.

(H2) The Convergence Hypothesis: it claims that non-native speakers can acquire native-like competence as long as they learn the language early in life and obtain a high degree of proficiency. Concerning the participants in the current experiment, this hypothesis predicts that early and highly proficient non-native speakers of Basque should process intransitive predicates and phi-features similarly to native speakers.

(H3) The Difference Hypothesis: claims that there is a critical period for the acquisition of language, and once this period is over, native-like processing is not available.

(H4) The Language Distance Hypothesis: claims that no differences are expected for processing traits of L2 that are present in L1, whereas even at an early age of acquisition and high proficiency in L2, native vs. non-native difference will arise in the processing grammatical properties of L2 not present in L1.

These hypotheses make the same predictions with regard to the group of bilinguals selected for the current experiment and no differences are expected to be found: (1) no differences are generally expected, (2) no differences are expected with highly proficient non-native speakers, (3) no differences are expected if the non-native language is acquired before maturational constraints are over, (4) subject-verb agreement violations, shared in Basque and Spanish are analyzed and therefore no differences are expected.

However, previous studies in Basque have found differences between the processing of ergative case and word order with native and early and highly proficient non-native speakers (Díaz et al., 2016; Erdocia et al., 2014; Zawiszewski et al., 2011; Zawiszewski & Laka, 2020). This evidence is compatible with (H2), (H3) and (H4), but not with (H1), which is discarded given the evidence available.

LDH is compatible with The Difference Hypothesis to a certain degree, because it predicts that native-like processing is not attainable for grammatical properties absent in the native language. As I have mentioned in the introduction, subject-verb agreement is a property present in the grammars of both Basque and Spanish. As a result, I expect to find similar traits in the processing of intransitive predicates and phi-features in native and non-native speakers, contrary to the predictions made by The Difference Hypothesis. Nevertheless, it is not clear what consequences may the different underlying case alignments in Basque and Spanish have in the processing of subject-verb agreement violations for unaccusative and unergative predicates. If similar behavioral and ERP patterns are obtained for SV agreement violations, this experiment will support the LDH, along with the results obtained in previous experiments studying case alignment and word order (Díaz et al., 2016; Erdocia et al., 2014; Zawiszewski et al., 2011; Zawiszewski & Laka, 2020). Similar results between native and non-native speakers would also provide evidence in favor of (H2), but the previous experiments cited above would disfavor it. Finally, if differences are found, such as different components or lack of components, the results of this experiment would support (H3), since even early non-native speakers with grammatical properties present in their native language would not be able to attain native-like responses.

In addition, besides the hypotheses regarding native and non-native speakers, the same hypotheses tested in Chapter II: Unaccusative Hypothesis (UH) and the Feature Distinctness Hypothesis (FDH) are also tested in the current experiment and later compared with their native counterparts.

2.2 Participants

In this experiment 26 early and highly proficient non-native speakers of Basque, whose L1 was Spanish took part in the experiment (five males; mean age 20.5 years, SD = 2.67; AoA = 3.31 years, SD = 1.3). These participants were very early speakers (AoA = 3 years) because of the schooling system of the Basque Autonomous Community. Infants can get immersed in kindergartens, where Basque language is the curricular language. There are three models with regards to language. In A model, all classes are in Spanish, except for language lessons. In B model, half of the classes are in Basque and half of the classes are in Spanish. Finally, there is D model, where all classes except for language lessons are taught in Basque. All the participants in the current study went to the latter schooling system. They were all highly proficient in Basque, 21 had obtained the C1 certificate in Basque and 3 were studying a university degree in Basque, which will eventually recognize their language competence as C1, once they finish their degree. One participant had Catalan as a mother tongue, which was not discarded, because Catalan and Spanish are typologically closely related and both languages mark subject-verb agreement in a very similar way. A table is offered below to show participants' relative use of Basque throughout their life and their self-rated proficiency. It can be seen that they mostly speak Basque at school from a very early age and that they are highly proficient.

Materials, procedure, EEG recording and data analysis are the same as in Chapter II. Data of one participant were removed due to the low number of available segments after cleaning the data, and data of another one was excluded because of the contradictory answers in questionnaire about language use. All in all, data from 24 participants were analyzed in the current experiment. First, the results of non-native speakers are provided and, then a comparison between these results and the results obtained in Chapter II is carried out and discussed.

Relative use of language		
Before primary school (0–3 years)		6.54 (0.72)
Primary school (4–12 years)		
School		2.88 (1.42)
Home		6.54 (0.72)
Others		5.86 (1.08)
Secondary school (12–18 years)		
School		3.58 (1.07)
Home		6.67 (0.56)
Others		5.92 (0.93)
At time of testing		
University/work		4.5 (1.69)
Home		6.63 (0.58)
Others		5.46 (1.02)
Self-rated proficiency	Basque	Spanish
Speaking	5.92 (0.58)	6.88 (0.34)
Comprehension	6.42 (0.5)	6.92 (0.28)
Reading	6.46 (0.51)	6.83 (0.38)
Writing	6 (0.59)	6.67 (0.48)

Table 5. The following seven-point scale was applied for measuring the relative use of language: 1=I speak only Basque, 2=I speak mostly Basque, 3=I speak Basque 75% of the time, 4=I speak Basque and Spanish with similar frequency, 5=I speak Spanish 75% of the time, 6=I speak mostly Spanish, 7=only Spanish. Proficiency level was determined by using the following four-point scale: 7=native-like proficiency,6=full proficiency, 5=working proficiency, 4=limited proficiency. SDs values are in parentheses.

3 Results

3.1 Behavioral results

Participants were very accurate in the acceptability task (mean accuracy of 91.84%, SDE = 1.3), which shows that they were highly proficient in Basque (see *Table 6* below).

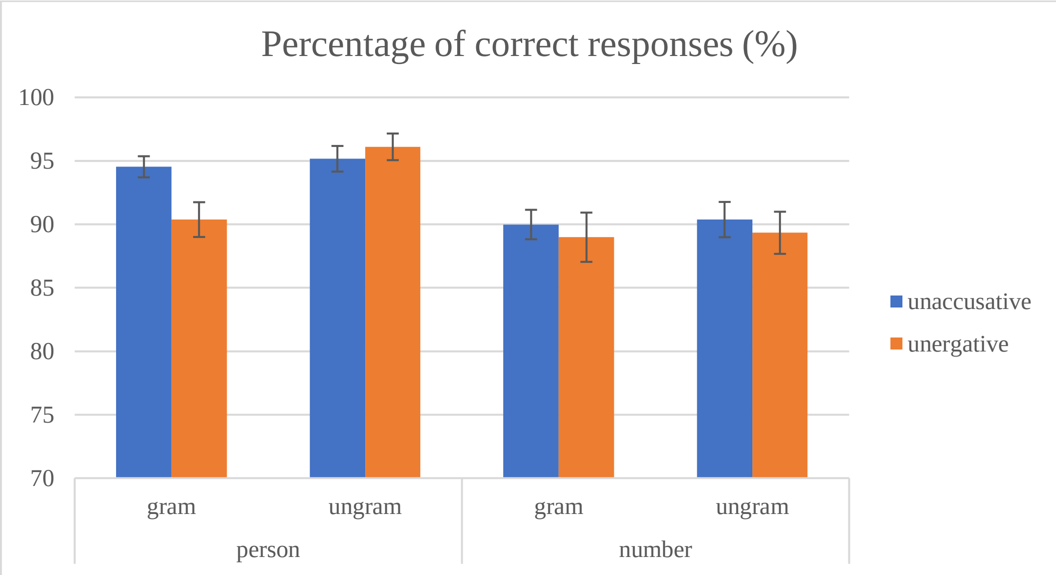


Table 6. Percentage of correct responses (%) and standard deviation error (SDE) of non-native speakers of Basque.

Regarding acceptability judgment errors, the analysis showed a marginally significant GRAMMATICALITY effect in the analysis by item (*F1*(1,23) = 1.8, *p* =.193; *F2*(1,253) = 3.03, *p* = .083) revealing higher accuracy for the ungrammatical sentences as compared to the grammatical ones (92.74% vs. 90.95%). The analysis of accuracy also revealed a main FEATURE effect (*F1*(1,23) = 23.4, *p* <.001; *F2*(1,253) = 24.62, *p* < .001) indicating that participants were more accurate with conditions containing person feature (94.04%) compared to conditions containing number feature (89.65%).

The GRAMMATICALITY*FEATURE interaction turned out to be statistically significant as well (*F1*(1,23) = 5.34, *p* =.03; *F2*(1,253) = 3.22, *p* = .074). The analyses by grammaticality factor showed that participants were significantly less accurate with grammatical person (92.45%) than with ungrammatical person (95.63%) (*F1*(1,23) = 5.97, *p* =.023; *F2*(1,253) = 7.63, *p* = .006), whereas there were no differences between grammatical number (89.46%) and ungrammatical number (89.85%) (*F1*(1,23) = 0.06, *p*

= .81; *F2*(1,253) = .01, *p* = 913). The analyses by feature factor showed that participants were more accurate with grammatical person (92.45%) than with grammatical number (89.46%) (*F1*(1,23) = 6.31, *p* = .02; *F2*(1,253) = 5.74, *p* = .017), and they were significantly more accurate with ungrammatical person (95.63%) than with ungrammatical number (89.85%) (*F1*(1,23) = 35.2, *p* < .001; *F2*(1,253) = 23.56, *p* < .001).

Finally, a triple TYPE*GRAMMATICALITY*FEATURE was significant in the analysis by subject (*F1*(1,23) = 8.09, *p* =.009; *F2*(1,253) = 2.77, *p* = .097). The analyses by grammaticality factor showed that in unaccusatives grammatical person condition (94.54%) did not differ from ungrammatical person condition (95.16%) (*F*(1,23) = 0.19, *p* =.667), and neither did grammatical and ungrammatical number (89.98% vs. 90.37%) (*F*(1,23) = 0.07, *p* = .788). In the unergative conditions participants were significantly more accurate with sentences containing ungrammatical person (96.1%) than with grammatical person (90.37%) (*F*(1,23) = 13.32, *p* = .001), but no differences were found between grammatical (88.93%) and ungrammatical number (89.32%) (*F*(1,23) = 0.03, *p* = .861). The analyses by type factor revealed participants were more accurate with sentences containing grammatical person feature in unaccusatives (94.54%) than in unergatives (90.37%) (*F*(1,23) = 12.38, *p* = .002), whereas no differences were found between sentences containing ungrammatical person feature in unaccusatives (95.16%) and in unergatives (96.1%) (*F*(1,23) = 0.66, *p* = .423). With regard to number feature, no differences were found between grammatical unaccusative (89.98%) and (88.93%) unergative predicates, and neither between ungrammatical unaccusative (90.37%) and unergative (89.33%) predicates. Finally, the analyses by feature factor showed that participants were significantly more accurate with grammatical unaccusative sentences containing person feature (94.54%) than with number feature (89.98%) (*F*(1,23) = 15.89, *p* = .001), and similarly ungrammatical unaccusative sentences containing person feature (95.16%) were judged more accurately than number feature (90.37%) (*F*(1,23) = 13.65, *p* = .001). Regarding unergative predicates, no differences were found between grammatical sentences containing person and number feature (*F*(1,23) = 0.74, *p* = .397), but ungrammatical sentences containing person feature (96.1%) were judged significantly more accurately than ungrammatical sentences containing number feature (89.33%) (*F*(1,23) = 29.67, *p* < .001).

Regarding response times (see *Table 7* below), the analyses revealed a main TYPE effect ($F1(1,23) = 16.41$, $p = .001$; $F2(1,253) = 4.21$, $p = .041$) indicating participants reacted faster to unaccusative predicates (668.37ms) than to unergative predicates (707.25ms). A main GRAMMATICALITY effect ($F1(1,23) = 71.51$, $p < .001$; $F2(1,253) = 207.2$, $p < .001$) revealed that participants were significantly faster reacting to ungrammatical sentences (597.93 ms) compared to their grammatical counterparts (777.68 ms). A FEATURE effect ($F1(1,23) = 11.16$, $p = .003$; $F2(1,253) = 9.61$, $p = .002$) revealed that participants were significantly faster responding to sentences containing person feature (665.47 ms) than number feature (710.15 ms).

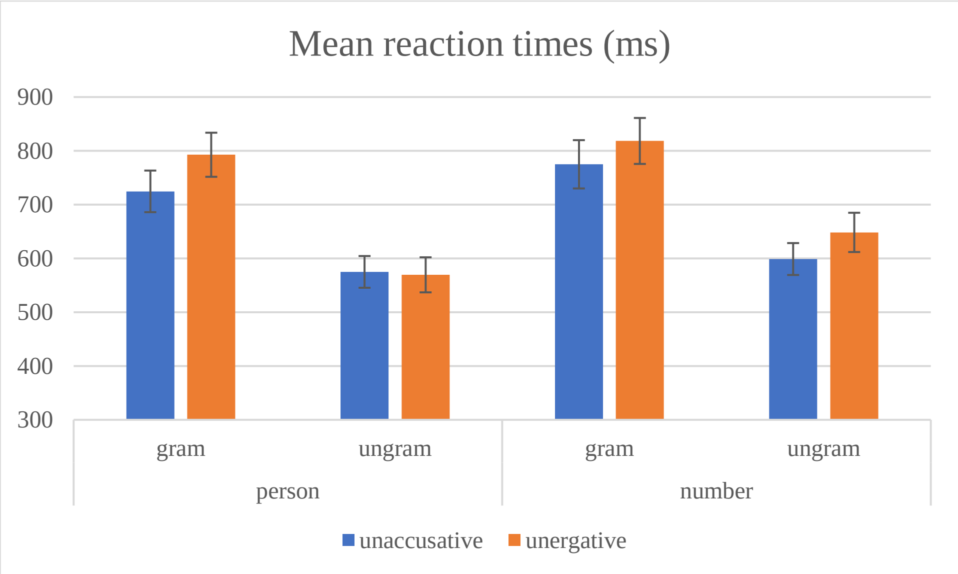


Table 7. Mean reaction times (ms) and standard deviation error (SDE) of non-native speakers of Basque.

3.2 ERP results

After the baseline correction, epochs with artifacts were rejected, which resulted in the exclusion of approximately 6.91% (SD = 2.43) of the trials. Similarly to the procedure reported in Chapter II, 300-400 ms time window was selected for an early time window and a 400-700 ms time window was chosen as a late time window.

Regarding the early time window (300-400 ms), the analysis of the lateral electrodes revealed a main GRAMMATICALITY effect ($F(1,23) = 18.92$, $p < .001$) indicating a larger negativity for the ungrammatical conditions as compared to the grammatical ones (1.08 μV vs. 2 μV).

Regarding the midline electrodes, a main effect of GRAMMATICALITY showed that overall ungrammatical conditions (2.04 μV) displayed a larger negativity than grammatical conditions (2.93 μV) (F(1,23) = 11.13, p = .003). A significant TYPE*GRAMMATICALITY interaction was found (F(1,23) = 4.9, p =.037). Further analysis (by grammaticality) showed no significant differences between ungrammatical (2.36 μV) and grammatical unaccusatives (2.79 μV) (F(1,23) = 2.25, p = .147) but a larger negativity for the ungrammatical unergative condition (1.73 μV) in comparison to the grammatical unergative condition (3.07 μV) (F(1,23) = 12.67, p = .002) was found. The comparison by type revealed no differences between the grammatical unaccusative (2.79 μV) and unergative (3.07 μV) conditions (F(1,23) = 0.76, p = .394), and neither between ungrammatical unaccusative (2.36 μV) and unergative (1.73 μV) conditions (F(1,23) = 1.66, p = .211).

The analysis of the lateral electrodes in the late time window (400-700 ms) revealed a main GRAMMATICALITY effect (F(1,23) = 60.25, p <.001) indicating a larger positivity for the ungrammatical conditions as compared to the grammatical ones (2.08 μV vs. -0.03 μV). In addition, a significant main effect of FEATURE emerged (F(1,23) = 13.47, p = .001), indicating that overall person feature generated a larger positivity as compared to number feature (1.44 μV vs. 0.61 μV).

A significant TYPE*GRAMMATICALITY interaction was found (F(1,23) = 9.34, p =.006). Further analysis (by grammaticality) showed a significantly larger positivity for the ungrammatical unaccusative condition (2.32 μV) in comparison to the grammatical one (-0.18 μV) (F(1,23) = 64.23, p < .001) and a larger positivity for the ungrammatical unergative condition (1.83 μV) in comparison to the grammatical unergative condition (0.12 μV) (F(1,23) = 35.3, p < .001). The comparison by type revealed no differences between the grammatical unaccusative (-0.18 μV) and unergative (0.12 μV) conditions (F(1,23) = 1.21, p = .282) and no differences emerged for ungrammatical unaccusative manipulations (2.32 μV) in comparison to the unergative manipulations (1.83 μV) (F(1,23) = 2.28, p = .145).

Regarding the midline electrodes, a main effect of GRAMMATICALITY showed that overall ungrammatical conditions (3.59 μV) displayed a larger positivity than grammatical conditions (0.63 μV) (F(1,23) = 59.63, p < .001). In addition, a significant FEATURE effect emerged (F(1,23) = 20.94, p < .001), indicating that overall person feature generated a larger positivity as compared to number feature (2.78 μV vs. 1.44 μV).

A significant TYPE*GRAMMATICALITY interaction was found ($F(1,23) = 13.45$, $p = .001$). Further analysis (by grammaticality) showed a significantly larger positivity for the ungrammatical unaccusative condition (4.03 μV) in comparison to the grammatical one (0.36 μV) ($F(1,23) = 56.96$, $p < .001$) and a larger positivity for the ungrammatical unergative condition (3.14 μV) in comparison to the grammatical number condition (0.9 μV) ($F(1,23) = 37{,}99$, $p < .001$). The comparison by type revealed no differences between grammatical unergatives (0.9 μV) and unaccusatives (0.36 μV) ($F(1,23) = 3.02$, $p = .096$), but a slightly larger positivity emerged for ungrammatical unaccusative manipulations (4.03 μV) in comparison to the unergative manipulations (3.14 μV) ($F(1,23) = 3.91$, $p = .06$). See Figure 14 for the grand average patterns, Figure 15 for the mean voltage difference maps, and Table 8 for the summary of the results.

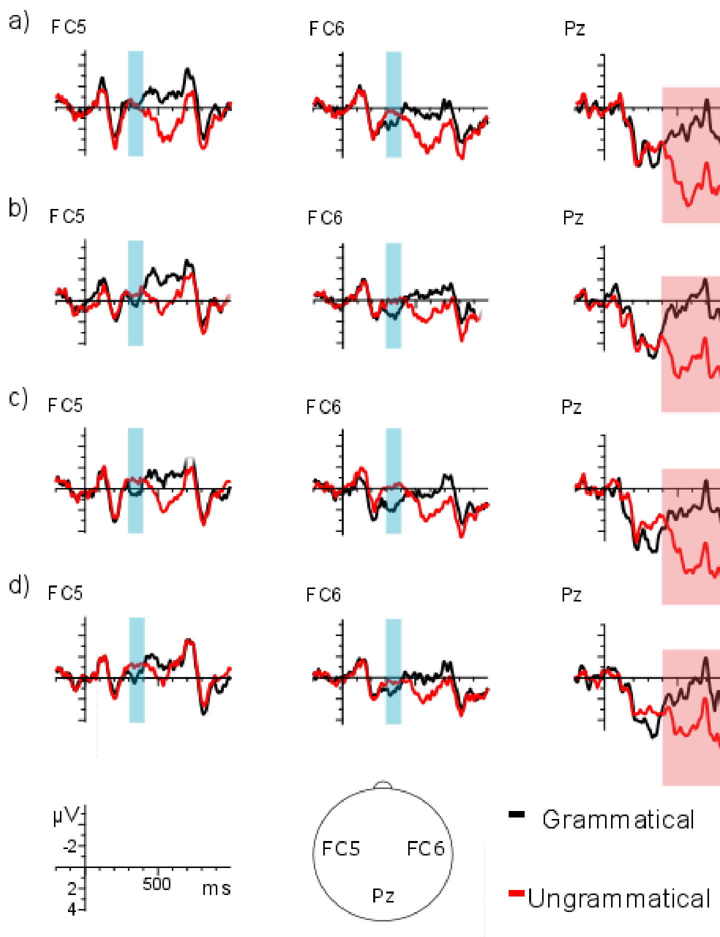


Figure 14. (a) person feature unaccusative predicate condition; (b) number feature unaccusative predicate condition; (c) person feature unergative predicate condition; (d) number feature unergative predicate condition.

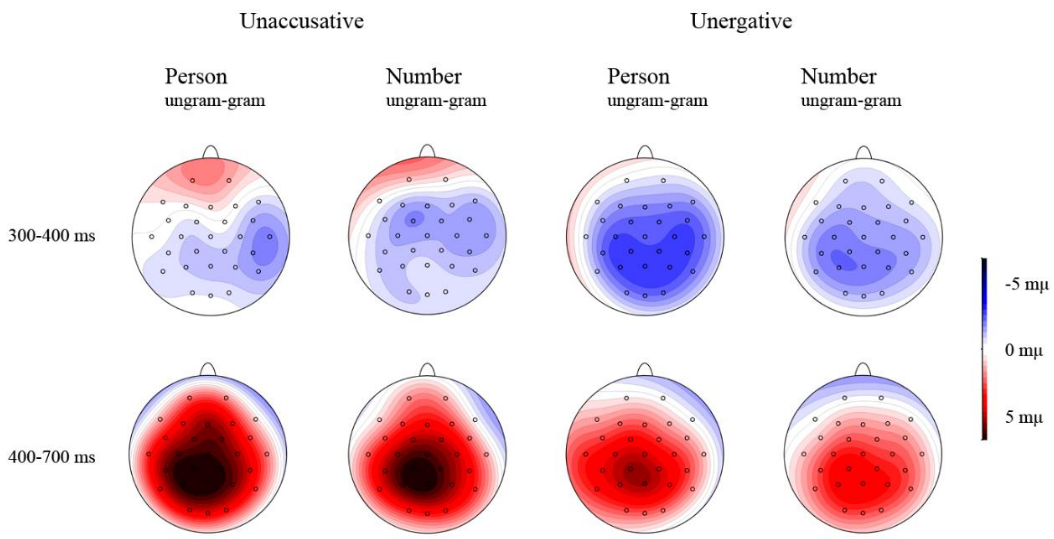


Figure 15. Mean voltage difference maps (grammatical minus ungrammatical)

		300-400 ms		400-700 ms	
		Lateral	Midline	Lateral	Midline
	df	F	F	F	F
GRAM	1,23	*****18.92**	****11.13**	*****60.25**	*****59.63**
TYPE	1,23	.19	.25	.11	.27
FEAT	1,23	.01	1.26	****13.47**	*****20.94**
TYPE*GRAM	1,23	2.67	***4.9**	****9.34**	****13.49**
FEAT*GRAM	1,23	.2	.09	.88	.48
TYPE*FEAT*GRAM	1,23	.83	.36	.21	2.04
GRAM*HEM	1,23	2.26	-	3.7	-
TYPE*GRAM*HEM	1,23	0.56	-	.01	-
FEAT*GRAM*HEM	1,23	^*3.2*	-	2.97	-
TYPE*FEAT*GRAM*HEM	1,23	.14	-	1.35	-
GRAM*REGION	2,46	3.29	*****14.42**	*****24.98**	*****56.36**
TYPE*GRAM*REG	2,46	.49	1.31	.49	.66
FEAT*GRAM*REG	2,46	.3	.99	.69	.29
TYPE*FEAT*GRAM*REG	2,46	.43	1.2	.71	.21
GRAM*HEM*REG	2,46	.7	-	1.45	-
TYPE*GRAM*HEM*REG	2,46	.38	-	.02	-
FEAT*GRAM*HEM*REG	2,46	.33	-	.05	-
TYPE*FEAT*GRAM*HEM*REG	2,46	.14	-	1.13	-

Table 8. Summary of the ERP results. Main effects and interactions with grammaticality are shown. GRAM (grammaticality), TYPE (type), FEAT (feature), HEM (hemisphere) and REG (region). ^ p = < .1, * p = < .05, ** p = < .01, *** p = < .001.

3.3 Summary of the results

Overall, non-native speakers of Basque were highly accurate in their responses. They were more accurate with sentences containing person feature than with number feature. Regarding reaction times, participants responded faster to questions related to unaccusative predicates (668.37 ms) than to unergative predicates (707.25 ms).

ERP results did not reveal major effects for non-natives in the 300-400 ms time window. Nevertheless, in the 400-700 ms time window, non-native speakers revealed a larger positivity for agreement violations in the case of unaccusative predicates as compared to agreement violations in unergative predicates.

4 Native and non-native comparison

In order to better understand the similarities and differences between the non-natives and the native speakers tested in Chapter II, we performed an additional analysis comparing both groups directly.

4.1 Behavioral results

Regarding accuracy (see Table 9 below), no GROUP interactions emerged, suggesting that both native and non-natives behaved similarly. A main effect of TYPE emerged ($F1(1,46) = 2.85$, $p = .098$; $F2(1,252) = 4.18$, $p = .041$) indicating that overall, both native and non-native participants were more accurate with conditions containing unaccusative predicates (92.76%) compared to unergative predicates (91.82%). The analysis of accuracy revealed a marginally significant main GRAMMATICALITY effect ($F1(1,46) = 4.89$, $p = .032$; $F2(1,252) = 13.49$, $p < .001$) revealing that overall both native and non-native participants were more accurate with conditions containing ungrammatical sentences (93.41%) compared to grammatical sentences(91.16%).The analysis of accuracy also revealed a main FEATURE effect ($F(1,46) = 41.51$, $p <.001$; $F2(1,252) = 41.5$, $p < .001$) suggesting that both natives and non-natives were more accurate with conditions containing person feature (94.17%) compared to conditions containing number feature (90.4%).

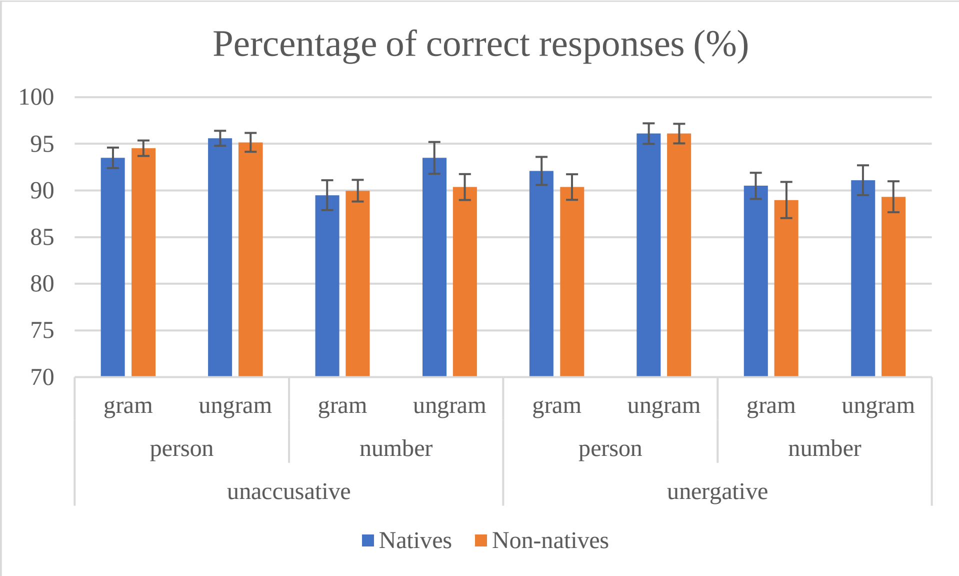


Table 9. Percentage of correct responses (%) and standard deviation error (SDE).

A GRAMMATICALITY*FEATURE interaction turned out to be marginally significant in the by subject analysis (*F1*(1,23) = 3.82, *p* =.057; *F2*(1,252) = 2.4, *p* = .118). The analyses by grammaticality factor showed that participants were significantly less accurate with grammatical person (92.61%) than with ungrammatical person (95.73%) (*F*(1,46) = 11.57, *p* =.001), whereas there were no differences between grammatical number (89.72%) and ungrammatical number (91.08%). (*F*(1,46) = 1.18, *p* = .283). The analyses by feature factor showed that participants were more accurate with grammatical person (92.61%) than with grammatical number (89.72%) (*F*(1,46) = 16.23, *p* < .001), and they were significantly more accurate with ungrammatical person (95.73%) than with ungrammatical number (91.08%) (*F*(1,46) = 37.67, *p* < .001).

Finally, a triple TYPE*GRAMMATICALITY*FEATURE interaction turned out to be significant (*F1*(1,46) = 9.28, *p* =.004; *F2*(1,252) = 5.72, *p* = .017). The analyses by grammaticality factor showed that participants were accurate when performing the task with grammatical and ungrammatical unaccusatives containing person feature (94.01% vs. 95.36%) (*F*(1,46) = 2.32, *p* =.134), and similarly with unaccusatives containing number feature (89.72% vs. 91.93%) (*F*(1,46) = 2.14, *p* = .15). In the unergative conditions participants were significantly more accurate with sentences containing ungrammatical person (96.1%) than with grammatical person (91.21%) (*F*(1,46) = 15.93, *p* < .001), but no differences were found between grammatical (89.72%) and ungrammatical number (90.24%) (*F*(1,46) = 0.13, *p* = .716). The analyses by type factor revealed that participants were more accurate with sentences containing grammatical person feature in unaccusatives (94.01%) than in unergatives (91.21%) ($F(1, 46) = 9.41$, $p = .004$), whereas no differences were found between sentences containing ungrammatical person feature in unaccusatives (95.36%) and in unergatives (96.1%) ($F(1,46) = 1.11$, $p = .296$). With regard to number feature, no differences were found between grammatical unaccusative (89.72%) and (89.72%) unergative predicates ($F(1,46) < 0.01$, $p = 1$), and neither between ungrammatical unaccusatives (91.93 %) in contrast to ungrammatical unergative (90.24%) predicates ($F(1,46) = 2.16$, $p = .148$). Finally, the analyses by feature factor showed that participants were significantly more accurate with grammatical unaccusative sentences containing person feature (94.01%) than with number feature (89.72%) ($F(1,46) = 22.79$, $p < .001$), and similarly ungrammatical unaccusative sentences containing person feature (95.36%) were judged more accurately than number feature (91.93%) ($F(1,46) = 12.01$, $p = .001$). Regarding unergative predicates, no differences were found between grammatical sentences containing person (91.21%) and number feature (89.72%) ($F(1,46) = 2.18$, $p = .147$), but ungrammatical sentences containing person feature (96.1%) were judged significantly more accurately than sentences containing number feature (90.24 %) ($F(1,46) = 37.89$, $p < .001$).

The analysis of response times (see Table 10 below) revealed a main TYPE effect ($F1(1,46) = 18.21$, $p < .001$; $F2(1,254) = 7.68$, $p < .006$) indicating that participants reacted faster to unaccusative predicates (637.29 ms) than to unergative predicates (673.08 ms). A main GRAMMATICALITY effect ($F1(1,46) = 122.46$, $p < .001$; $F2(1,252) = 453.86$, $p < .001$) revealed that participants were significantly faster reading ungrammatical sentences (565.16 ms) compared to their grammatical counterparts (745.22 ms). A FEATURE effect ($F1(1,46) = 15.48$, $p < .001$; $F2(1,254) = 11.22$, $p = .001$) revealed that participants were significantly faster reading sentences containing person feature (636.77 ms) than number feature (673.61 ms).

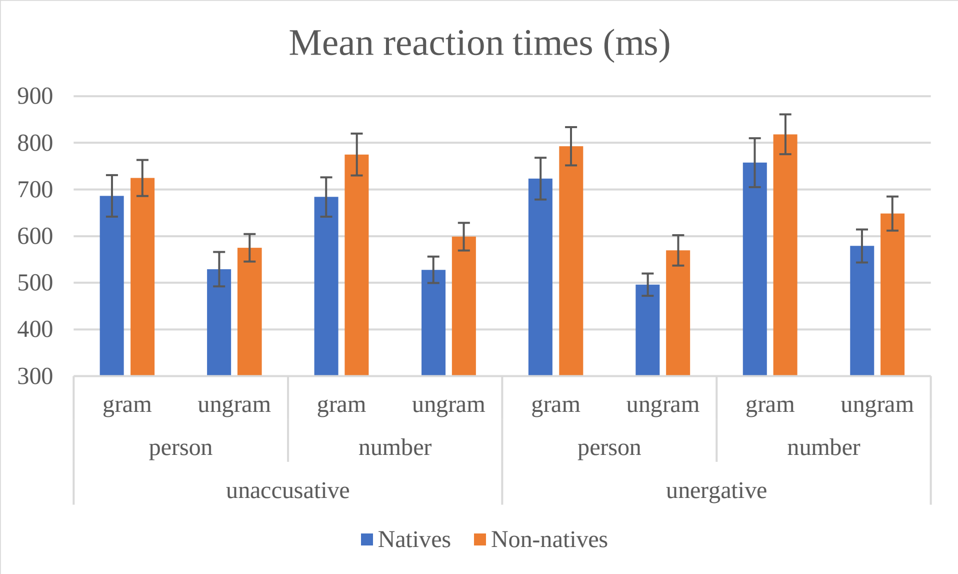


Table 10. Mean reaction times (ms) and standard deviation error (SDE).

A significant TYPE*GRAMMATICALITY interaction emerged (*F1*(1,46) = 5.04, *p* = .03; *F2*(1,252) = 4.3, *p* = .039). The analyses by grammaticality factor showed that participants reacted faster to ungrammatical unaccusatives (557.11 ms) than to grammatical unaccusative (717.47 ms) predicates (*F1*(1,46) = 88.49, *p* < .001; *F2*(1,252) = 190.11, *p* < .001), and similarly participants responded faster to ungrammatical unergatives (573.21 ms) compared to their grammatical counterparts (772.96 ms) (*F1*(1,46) = 105.37, *p* < .001; *F2*(1,252) = 274.53, *p* < .001). The analyses by type factor revealed significant differences between grammatical unaccusative and unergative predicates (*F1*(1,46) = 16.78, *p*< .001; *F2*(1,252) = 0.02, *p* = .004), indicating that participants reacted faster to grammatical unaccusatives (717.47 ms) than to grammatical unergatives (772.96 ms), but no differences were found between ungrammatical unaccusatives (557.11 ms) and ungrammatical unergative predicates (573.21 ms) (*F1*(1,46) = 2.45, *p* =.124; *F2*(1,252) = 0.77, *p* = .3.25).

Finally, a triple TYPE*GRAMMATICALITY*FEATURE interaction turned marginally significant in the by subject analysis (*F*(1,46) = 3.25, *p* =.078; *F2*(1,252) = 3.62, *p* = .058). The analyses by grammaticality factor showed that the unaccusative ungrammatical person condition (550.82 ms) was read faster than the grammatical person condition (705.5 ms) (*F*(1,46) = 60.54, *p* < .001), and similarly for number (563.4 ms vs. 729.44 ms) (*F*(1,46) = 54.99, *p* < .001). In the unergative conditions participants were significantly faster with sentences containing ungrammatical person (532.75) than with grammatical person (757.99ms) ($F(1,46) = 109.43$, $p < .001$), and similarly they were faster with ungrammatical number (613.67 ms) than with grammatical number (787.93 ms) ($F(1,46) = 59.2$, $p < .001$). The analyses by type factor revealed participants were faster with sentences containing grammatical person feature in unaccusatives (705.5 ms) than in unergatives (757.99 ms) ($F(1,46) = 8.4$, $p = .006$), whereas no differences emerged between ungrammatical person feature in unaccusatives (550.82 ms) and unergatives (532.75 ms) ($F(1,46) = 1.23$, $p = .273$). With regard to number feature, participants responded faster to grammatical sentences in unaccusatives (729.44 ms) than in unergatives (787.93 ms) ($F(1,46) = 10.73$, $p = .002$), and similarly participants reacted faster to ungrammatical unaccusative (563.4ms) than to ungrammatical unergatives (613.67 ms) ($F(1,46) = 10.45$, $p = .002$). Finally, the analyses by feature factor showed that participants reacted similarly to grammatical unaccusative sentences containing person feature (705.76 ms) and number feature (729.35) ($F(1,46) = 1.62$, $p = .21$), and similarly there were no differences between ungrammatical unaccusative sentences containing person feature (550.81 ms) and number feature (561.63 ms) ($F(1,46) = 0.75$, $p = .391$). Regarding unergative predicates, no differences were found between grammatical sentences containing person (758.07 ms) and number feature (787.54 ms) ($F(1,46) = 2.62$, $p = .113$), but ungrammatical sentences containing person feature (533.36 ms) were judged significantly faster than sentences containing number feature (612.96 ms) ($F(1,46) = 25.48$, $p < .001$).

Overall, no differences between groups were observed in the behavioral measures.

4.2 ERP results

Regarding the early time window (300-400 ms), the analysis of the lateral electrodes revealed a main GRAMMATICALITY effect ($F(1,46) = 51.43$, $p <.001$) indicating a larger negativity for the ungrammatical conditions as compared to the grammatical ones (1 μV vs. 2.13 μV).

A significant FEATURE*GRAMMATICALITY interaction was found as well ($F(1,46) = 4.5$, $p =.039$). Further analysis (by grammaticality) showed a significantly larger negativity for the ungrammatical person condition (0.75 μV) in comparison to the grammatical one (2.15 μV) ($F(1,46) = 42.5$, $p < .001$) and a larger negativity for the ungrammatical number condition (1.24 μV) in comparison to the grammatical number condition (2.11 μV) (F(1,46) = 20.38, p < .001). The comparison by feature revealed no differences between the grammatical person (2.15 μV) and number feature (2.11 μV) conditions (F(1,47) = 0.04, p = .841), but it revealed a larger negativity for the ungrammatical person manipulations (0.75 μV) in comparison to the number manipulations (1.24 μV) (F(1,46) = 6.51, p = .014).

Regarding the midline electrodes, a main effect of GRAMMATICALITY showed that overall ungrammatical conditions (2.35 μV) displayed a larger negativity than grammatical conditions (3.29 μV) (F(1,46) = 20.43, p > .001).

A significant TYPE*GRAM*GROUP interaction (F(1,46) = 6.4, p = .015) showed (by grammaticality factor) that natives revealed a larger negativity for the ungrammatical unaccusative condition (2.46 μV) than for the grammatical unaccusative condition (3.66 μV) (F(1,46) = 13.5, p = .001) and also a larger negativity for the ungrammatical unergative condition (2.84 μV) than for the grammatical unergative condition (3.62 μV) (F(1,46) = 4.48, p = .040), whereas non-natives only elicit a larger negativity for the ungrammatical unergative condition (1.7 μV) compared to the grammatical unergative condition (3.07 μV) (unaccusative: F(1,46) = 1.76, p = .191; unergative: F(1,46) = 13.36, p = .001). In the analysis by type factor, no differences were found between grammatical unaccusative and unergative conditions neither in natives (F(1,46) = 0.2, p = .889) nor in non-natives (F(1,46) = 0.71, p = .405), and similarly no differences were found between ungrammatical unaccusative and unergative conditions neither in natives (F(1,46) = 0.95, p = .334) nor in non-natives (F(1,46) = 2.67, p = .109). The T-test showed that the negativity elicited in non-natives was marginally larger than in natives for the unergative ungrammatical condition (1.7 μV vs. 2.84 μV) (F(1,46) = 0.45 , p = .09).

Regarding the 400-700 ms time window, the analysis of the lateral electrodes revealed a main GRAMMATICALITY effect (F(1,46) = 103.8, p < .001) indicating a larger positivity for the ungrammatical conditions as compared to the grammatical ones (2.33 μV vs. 0.08 μV). A significant main effect of FEATURE also emerged (F(1,46) = 13.14, p = .001), indicating that overall person feature generated a larger positivity as compared to number feature (1.48 μV vs. 0.93 μV).

A significant TYPE*GRAMMATICALITY interaction was found (F(1,46) = 6.1, p =.017). Further analysis (by grammaticality) showed a significantly larger positivity for the ungrammatical unaccusative condition (2.54 μV) in comparison to the grammatical one (0.02 μV) (F(1,46) = 108.41, $p < .001$) and a larger positivity for the ungrammatical unergative condition (2.13 μV) in comparison to the grammatical number condition (0.13 μV) (F(1,46) = 65.39, $p < .001$). The comparison by type revealed no differences between the grammatical unaccusative (0.02 μV) and unergative (0.13 μV) conditions (F(1,46) = 0.4, p = .529), but a larger positivity emerged for ungrammatical unaccusative manipulations (2.54 μV) in comparison to the ungrammatical unergative manipulations (2.13 μV) (F(1,46) = 4.52, p = .039). A significant TYPE*GRAM*REGION (F(2,46) = 5.82, p = .012) interaction also showed a larger positivity for ungrammatical conditions in comparison to grammatical conditions in unaccusatives (frontal: F(1,46) = 31.78, $p < .001$; central: F(1,46) = 127.11, $p < .001$; posterior: F(1,46) = 123.52, $p < .001$) and in unergatives (frontal: F(1,46) = 27.37, $p < .001$; central: F(1,46) = 76.9, $p < .001$; posterior: F(1,46) = 54.44, $p < .001$) in all three regions. The comparison by feature revealed no differences between grammatical conditions, but it revealed significant differences between ungrammatical unaccusative and ungrammatical unergative conditions in central (F(1,46) = 5.31, p = .026) and posterior (F(1,46) = 5.2, p = .027) electrodes were found, thus indicating that ungrammatical unaccusatives elicit a larger positivity than ungrammatical unergatives.

Regarding the midline electrodes, a main effect of FEATURE (F(1,46) = 21.85, $p < .001$) showed that overall person (3.01 μV) displayed a larger positivity than number (2.15 μV). A further main effect of GRAMMATICALITY (F(1,46) = 120.16, $p > .001$) revealed that overall ungrammatical conditions (4.28 μV) displayed a larger positivity than grammatical conditions (0.87 μV).

A FEATURE*GROUP interaction (F(1,46) = 6.88, p = .012) emerged. The analysis by feature factor revealed no differences between person and number regarding natives (F(1,46) = 2.1, p = .154), but it showed that person elicited a larger positivity than number in non-natives (2.78 μV vs. 1.44 μV) (F(1,46) = 26.63, $p < .001$). The t-test showed that there were no group differences regarding person feature (3.23 μV vs. 2.78 μV) (F(1,46) = 0.46, p = .505), but natives elicited a larger positivity than non-natives with regard to number feature (2.86 μV vs. 1.44 μV) (F(1,46) = 0.02, p = .022).

A TYPE*GRAM interaction was also found (F(1,46) = 9.19, p = .004). Further analysis by grammaticality showed that ungrammatical unaccusatives (4.64 μV) elicited a larger positivity than grammatical unaccusatives (0.8 μV) (F(1,46) = 112.21, $p > .001$), and similarly ungrammatical unergatives elicited a larger positivity (3.92 μV) than grammatical unergatives (0.94 μV) (F(1,46) = 81.51, p > .001). Analysis by type showed that there are no differences between grammatical unaccusatives (0.8 μV) and grammatical unergatives (0.94 μV) (F(1,46) = 0.36, p = .55), whereas ungrammatical unaccusatives (4.64 μV) elicited a larger positivity than ungrammatical unergatives (3.92 μV) (F(1,46) = 7.5, p = .009).

A significant TYPE*GRAM*GROUP interaction (F(1,46) = 4.02, p = .051) showed (by grammaticality factor) that both natives and non-natives revealed a larger positivity for the ungrammatical unaccusative condition than for the grammatical unaccusative condition (natives: F(1,46) = 60.29, p < .001; non-natives: F(1,46) = 50.3, p < .001) and also a larger positivity for the ungrammatical unergative condition than for the grammatical unergative condition (natives: F(1,46) = 69.71, p < .001; non-natives: F(1,46) = 25.21, p < .001). In the analysis by type factor, no differences were found between the grammatical unaccusative and unergative conditions neither in natives (F(1,46) = 0.62, p = .435) nor in non-natives (F(1,46) = 2.75, p = .104), and no differences were found between ungrammatical unaccusative and unergative conditions in natives either (F(1,46) = 2.16, p = .149). However, in non-natives ungrammatical unaccusatives elicited a larger positivity than ungrammatical unergatives (4.02 μV vs. 3.14 μV) (F(1,46) = 5.67, p = .021). The T-test revealed that natives elicit a marginally larger positivity than non-natives in the unergative ungrammatical condition (4.71 μV vs. 3.14 μV) (F(1,46) = 1.98, p = .054).

There was also a significant TYPE*FEATURE*GRAM interaction (F(2,46) = 7.22, p = .01). The analysis by grammaticality factor showed that the positivity elicited by the ungrammatical sentences was significantly larger than that yielded by the grammatical sentences in all the conditions (unaccusative person: F(1,23) = 75.1, p< .001; unaccusative number: F(1,23) = 100.22, p<.001; unergative person: F(1,23) = 93.01, p< .001; unergative number: F(1,23) = 36.42, p< .001). The analysis by type factor revealed no differences across predicate type regarding person feature (grammatical person: F(1,23) = 1.11, p< .298; ungrammatical person: F(1,23) = 0.05, p = .828). Nevertheless, regarding number feature grammatical unergatives elicited more positivity than grammatical unaccusatives (0.83 μV vs. 0.22 μV) (grammatical number: F(1,23) = 5.81, p = .02), and ungrammatical unaccusatives elicited more positivity than ungrammatical unergatives (4.24 μV vs. 3.29 μV) (*F*(1,23) = 8.36, *p* = .006). Concurrently, the analysis by feature factor showed that person elicits a larger positivity than number feature in the grammatical (1.38 μV vs. 0.22 μV) and ungrammatical (5.05 μV vs. 4.24 μV) unaccusative condition (grammatical: *F*(1,23) = 15.07, p < .001; ungrammatical: *F*(1,23) = 4.92, p = .031). Regarding unergatives, no differences were found between person and number in the grammatical condition (*F*(1,23) = 0.34, p = .563), but a significant difference was found between person and number in the ungrammatical condition, showing that both natives and non-natives generate a larger positivity when processing ungrammatical person unergatives (4.55μV) than ungrammatical number unergatives (3.3μV) (*F*(1,23) = 31.32, p < .001).

Finally, a marginally significant GRAM*REGION*GROUP interaction also emerged (*F*(2,46) = 3.19, *p* = .056). The analysis by grammaticality showed that both natives and non-natives elicited a larger positivity in ungrammatical sentences than in their grammatical counterparts in frontal electrodes (natives: *F*(1,46) = 34.78, *p* > .001; non-natives: *F*(1,46) = 25.49, *p* > .001), central electrodes (natives: *F*(1,46) = 70.04, *p* > .001; non-natives: *F*(1,46) = 39.1, *p* > .001), and posterior electrodes (natives: *F*(1,47) = 94.26, *p* > .001; non-natives: *F*(1,46) = 51.57, *p* > .001). The analysis by group showed that no differences obtain between native and non-natives' grammatical sentences in frontal electrodes (*F*(1,46) = 0.55, *p* = .284), nor central electrodes (*F*(1,46) = 0.35, *p* = .523), nor posterior electrodes (*F*(1,46) = 0.14, *p* = .484). No differences between native and non-natives obtained in ungrammatical sentences in frontal electrodes (*F*(1,46) = 0.44, *p* = .177) and in central electrodes (*F*(1,46) = 0.72, *p* = .114), but natives elicited a marginally larger positivity in posterior electrodes compared to non-natives (6.82μV vs. 4.97 μV) (*F*(1,46) = 2.19, *p* = .065).

See Figure 12 and Figure 13 in Chapter II and Figure 14 and Figure 15 above in order to compare the electrophysiological results between native and non-native speakers of Basque.

		300-400 ms		400-700 ms	
		Lateral	Midline	Lateral	Midline
	df	F	F	F	F
GROUP	1,23	.01	1.42	.81	2.36
GRAM	1,23	*****51.43**	*****20.43**	*****103.8**	*****120.61**
GRAM*GROUP	1,23	1.79	.06	.47	2.18
TYPE	1,23	.0	.0	.86	2.02
TYPE*GROUP	1,23	.62	.64	1.3	.32
FEAT	1,23	2.65	.25	****13.14**	*****21.85**
FEAT*GROUP	1,23	^*3.07*	^*3.96*	^*3.55*	***6.88**
TYPE*GRAM	1,23	.69	.84	****6.1**	****9.19**
TYPE*GRAM*GROUP	1,23	2.26	***6.4**	1.62	^*4.02*
FEAT*GRAM	1,23	***4.5**	2.21	.06	1.17
FEAT*GRAM*GROUP	1,23	1.87	.97	.96	.01
TYPE*FEAT*GRAM	1,23	2.53	1.84	2.47	***7.22**
TYPE*FEAT*GRAM*GROUP	1,23	.11	.3	1.07	.79
GRAM*HEM	1,23	.66	-	1.58	-
GRAM*HEM*GROUP	1,23	1.11	-	1.35	-
TYPE*GRAM*HEM	1,23	.83	-	.74	-
TYPE*GRAM*HEM*GROUP	1,23	^*3.41*	-	.96	-
FEAT*GRAM*HEM	1,23	.03	-	.11	-
FEAT*GRAM*HEM*GROUP	1,23	^*2.94*	-	^*3.26*	-
TYPE*FEAT*GRAM*HEM	1,23	.32	-	^*2.93*	-
TYPE*FEAT*GRAM*HEM*GROUP	1,23	.0	-	.0	-
GRAM*REGION	2,46	****10.82**	*****13.98**	*****41.46**	*****77.1**
GRAM*REGION*GROUP	2,46	3.13	.48	.34	^*3.19*
TYPE*GRAM*REG	2,46	3.03	1.28	***5.82**	.91
TYPE*GRAM*REG*GROUP	2,46	.82	.08	2.62	.83

FEAT*GRAM*REG	2,46	1.1	^*2.88*	1.62	.53
FEAT*GRAM*REG*GROUP	2,46	.14	.43	.1	.37
TYPE*FEAT*GRAM*REG	2,46	.3	2.05	1.38	2.4
TYPE*FEAT*GRAM*REG*GROUP	2,46	.22	.02	.26	1.02
GRAM*HEM*REG	2,46	***5.15**	-	.7	-
GRAM*HEM*REG*GROUP	2,46	1,84	-	.53	-
TYPE*GRAM*HEM*REG	2,46	.01	-	.19	-
TYPE*GRAM*HEM*REG*GROUP	2,46	.52	-	.15	-
FEAT*GRAM*HEM*REG	2,46	.27	-	.3	-
FEAT*GRAM*HEM*REG*GROUP	2,46	.23	-	.62	-
TYPE*FEAT*GRAM*HEM*REG	2,46	.03	-	.73	-
TYPE*FEAT*GRAM*HEM*REG*G	2,43	.28	-	.31	-

Table 11. Summary of the ERP results. Main effects and interactions with grammaticality are shown. GRAM (grammaticality), TYPE (type), FEAT (feature), HEM (hemisphere) and REG (region). ^ p = < .1, * p = < .05, ** p = < .01, *** p = < .001.

4.3 Summary of the results

Non-natives responded similarly to native speakers regarding accuracy and response times. Both groups were more accurate with unaccusative sentences than with unergative sentences, as well as with conditions containing person feature (94.17%) compared to conditions containing number feature (90.4%). Regarding reaction times, both non-natives and native participants reacted faster to unaccusative predicates than to unergative predicates, and were significantly faster reading sentences containing person feature than number feature. Overall, we found no behavioral differences between the non-native group as compared to the native group, hence, non-natives behaved native-like.

ERP results revealed that in the 300-400 ms time window, both native and non-natives generated a larger negativity for the ungrammatical person manipulations in comparison to the ungrammatical number manipulations. Non-natives generated a larger negativity for the ungrammatical sentences as compared to the grammatical ones only in the unergative condition, whereas natives showed a grammaticality effect for both types of predicates; in the group comparison the grammaticality effect was found for both types of predicates.

Within the 400-700 ms time window, both non-native and native speakers elicited a larger positivity for ungrammatical unaccusative manipulations compared to ungrammatical unergatives. However, the positivity elicited by natives was larger than the positivity elicited by non-natives in the unergative ungrammatical condition.

Also, both non-natives and natives generated a larger positivity when processing unergative sentences with person feature violations than unergatives with number feature violations. On the contrary, unaccusatives sentences containing number agreement violations elicited a larger positivity than unergatives with number feature violations. Finally, overall non-natives elicited a smaller positivity than natives with regard to number feature.

5 Discussion

This chapter aimed to analyze how early and high proficient non-native speakers of Basque process intransitive predicates and phi-features, and whether they process them similarly to natives or not. This study has shown that behaviorally non-native and speakers are indistinguishable from natives, and that electrophysiologically both groups generate similar components for SV violations (negativity followed by a P600). First, I discuss the similarities between non-natives and natives regarding the UH and FDH hypotheses, and then, I move on to the hypotheses regarding native-like attainment and the small differences between non-natives compared to natives.

Concerning the Unaccusative Hypothesis (UH), both groups together revealed differences between unaccusative and unergative predicates, as participants performed the task better and faster in sentences with unaccusative predicates than in sentences with unergative predicates and revealed different electrophysiological patterns for unaccusative and unergative predicates. Therefore, both behavioral and electrophysiological measures found evidence that unaccusative and unergative predicates are processed differently. Consequently, the results with native and non-native speakers of Basque support the idea that unaccusative and unergative predicates are processed as two distinct categories.

In the previous chapter, I found no evidence of larger processing costs for unaccusatives compared to unergatives and I concluded that case marking in Basque may rely on thematic relations, as previously suggested in the literature (Laka 2006a; b; Laka 2017; Levin 1983) and contrary to those in favor of structural case (Fernández, 1997; Ortiz de Urbina, 1989; Preminger, 2012; Rezac et al., 2014). In this chapter, the L1 of the tested participants is Spanish, a nominative-accusative language for which structural case is assumed (Bosque & Gutiérrez-Rexach, 2009; Zagona, 2002). Therefore, the argument generated as an object needs to advance into subject position in unaccusative predicates, but not in unergative predicates. This movement is responsible for the extra costs predicted in the processing unaccusative predicates compared to unergative predicates, where the argument is already generated in subject position. Furthermore, in nominative languages agents are prototypically unmarked (and bear nominative case) and patients (except for patientive subjects) are prototypically marked with accusative case, which creates a prediction for arguments with nominative case to be agents. This prediction is met in the case of unergatives, but it is not for unaccusatives, which translates in larger processing costs for the latter. I hypothesized that non-natives' L1 may have an effect on the processing of intransitive predicates in their non-native language, Basque. Similarly, I hypothesized that non-natives could show signs of larger processing costs for unaccusative predicates compared to unergative predicates, as expected in their native language. Nevertheless, results revealed that non-natives showed signs of larger processing costs for unergatives compared to unaccusatives in the two time windows analyzed. Possible transfer effects are further considered later in the discussion.

The comparison of non-native and native speakers revealed an interaction between predicate type and phi-features in the P600: a larger positivity emerged for unergative sentences with person feature violations than with unergative sentences with number feature violations; on the contrary, unaccusatives with ungrammatical number feature elicited a larger positivity than unergative predicates containing ungrammatical number feature manipulations. This pattern can be tentatively accounted by in terms of a relation between phi-features, animacy and predicate type. Animacy is a prominent cue in sentence processing, as animates tend to be agents, whereas inanimates tend to be patients (Bornkessel-Schlesewsky & Schlesewsky, 2009). Our results do not allow us to draw strong conclusions so far, but they may suggest that person feature (1st and 2nd person) is prototypically related to animate entities, and therefore to agentive arguments, whereas number feature (3rd person) is prototypically related to inanimate entities, and therefore patient arguments. This relation between predicate type and phi-features would explain why a larger positivity was obtained for person violations than for number violations in unergatives, and a larger positivity for number violations than for person violations in unaccusatives. Furthermore, the larger positivity found for person violations compared to number in unergative predicates patters with the results found in (Zawiszewski et al., 2016) for person and number violations in transitive predicates. These results support further the idea that person violations are more sensitive towards agentive arguments than towards patient arguments.

Regarding the FDH, the comparison of non-native and native speakers revealed differences in the processing of phi-features; more specifically person turned out to be more salient than number, as the sentences containing person manipulations were judged faster and more accurately than those containing number feature, and a larger negativity emerged for person violations compared to number violations. These results support the FDH, and show that person is more salient than number during verb agreement processing.

All in all, non-natives processed intransitive predicates and phi-features to a large extent like natives. Hence, these results support The Convergence Hypothesis, which advocates that native-like competence is attainable at a high level of proficiency and the Language Distance Hypothesis, which claims that grammatical phenomena can be processed in a native-like fashion as long as the grammatical phenomena studied are shared in the native and non-native language. Native vs. non-native differences have been found for non-shared syntactic phenomena in previous studies (Díaz et al., 2016; Erdocia et al., 2014; Zawiszewski et al., 2011; Zawiszewski & Laka, 2020). As a result, previous studies in Basque speak against the predictions made by The Convergence Hypothesis and speak in favor of the LDH.

In this study, non-natives were indistinguishable from natives behaviorally, but some differences emerged regarding the electrophysiological activity. In the 300-400 ms time window, non-natives only showed a N400 component in unergative predicates, whereas natives displayed a N400 component as response to SV violation in both unaccusative and unergative predicates. Within the 400-700 ms time window, although both groups generated a P600 component, natives generated a larger positivity than non-natives in the unergative ungrammatical condition. These results suggest that non-natives, in general, generate slightly smaller effects, but as the later comparisons show, these effects are comparable to those obtained by native speakers.

In the L2 literature, one relevant difference between native and non-natives is the lack of negativity (Alemán-Bañón & Rothman, 2019; Hagoort et al., 1993; Hagoort & Brown, 2000; Münte et al., 1997; L. Osterhout et al., 1996, *i.a.*), and the location of the negativity. Besides, quantitative differences in the P600 are often found in the L2 literature. In general, smaller effects are commonly found in the L2 literature and are attributed to differences in the frequency of use procedurally (Lee Osterhout et al., 2006; Rossi et al., 2006). Hahne (2001) discusses that, when tested with grammatical violations, smaller or even lack of negativity in non-native speakers may be due to a reduced degree of automaticity in the activation of processing resources. Previous cross-linguistic research has shown that in studies where speakers are tested in a typologically distant non-native language, the P600 component tends not to emerge (or it is significantly smaller) and negativity (either early or late) seems to emerge (Chen et al., 2007; Díaz et al., 2016; Foucart & Frenck-Mestre, 2011; Ojima et al., 2005; Steinhauer et al., 2009; Zawiszewski et al., 2011; Zawiszewski & Laka, 2020). In this study, the paradigm included subject-verb agreement processing, and the comparison between grammatical and ungrammatical sentences. In contrast to Chen et al. (2007), subject-verb agreement is present in both Basque and Spanish languages, thus, it is a grammatical phenomenon shared in Basque and Spanish.

When presenting the hypotheses in Section 2.1, I discussed that the LDH predicted similar results regarding native and non-native processing of subject-verb agreement, because both languages under study have it. This prediction was born out to a great extent. Nevertheless, it is worth noticing that the processing of unergative subject-verb agreement involves the processing of ergative case, a case marker not existing Spanish. I speculate that the slight enhancement of the N400 for unergatives and the decrease of the P600 for non-natives could be due to a smaller sensitivity for processing a case marking not present in their native language, compared to unaccusatives, where case is morphologically unmarked. Similarly, compared to the identical positivity obtained for agreement violations in unaccusative predicates by non-native speakers as compared to native speakers, the lack of negativity for agreement violations in unaccusative predicates in non-natives may be due to a lesser sensitivity towards fine-grained aspects of language processing. The lack of negativity has often been found in other languages in general when analyzing subject-verb agreement violations (Hagoort et al., 1993; Hagoort & Brown, 2000; Münte et al., 1997; Osterhout et al., 1996 *i.a.*). It may be the case that native Spanish speakers do not generate negativity when processing SV agreement violations of unaccusative predicates in Spanish, and this result could be a sign of transfer; or it may very well be the case that they do generate negativity in their native language but the processing of SV agreement violations is a too fine-grained aspect of grammar and they generate smaller effects in their second language. In Chapter II, I discussed that unaccusatives prototypically take a patient/inanimate/3rd person argument, compared to unergatives, which prototypically take an agent/animate/1st or 2nd person argument. The lack of negativity for non-natives is found for unaccusatives, where there is no case marking and arguments are prototypically outside the discourse. If the negativity in subject-verb agreement violations is interpreted as a response to theme violations, smaller sensitivity towards inanimate/3rd person arguments, and thus smaller negativity would be expected in comparison to animate/1st/2nd person arguments. Bear in mind that this interpretation should be taken with caution given that (1) so far intransitives have not been studied by means of ERPs, hence, there is no previous evidence and (2) our conclusions are based on null effect, that is, the fact that we don't find negativity doesn't mean that the participants don't process it. Finally, regarding phi-features, non-natives generated a smaller negativity for number than natives. In any case, the effect and tendency to generate a larger negativity for person than for number was the same for native and non-native speakers. These aspects will be further commented in Chapters IV and V, when discussing the results from Spanish.

Overall, the pattern observed among both groups of speakers is similar behaviorally and electrophysiologically: the components are qualitatively similar and similar effects and interactions are obtained. The main differences compared to natives are: (1) no effects are found in the early window for unaccusative predicates, and (2) smaller effects are found in the late window for unergative predicates, the predicate with different case morphology (ergative case). I interpret these findings as evidence for similar processing mechanisms underlying SV agreement in both languages. To conclude, this study has shown that early high proficient non-native speakers can attain native-like competence and process predicates and phi-features in Basque as native speakers.

6 Summary of the findings

In this third chapter, I studied how early and proficient non-native speakers of Basque process intransitive predicates and phi-features, and I compared the results to those of native speakers, presented in Chapter II. For that purpose, I used subject-verb agreement violations. Both Basque and Spanish have subject agreement, therefore, I compared a shared grammatical feature.

The analysis of non-native speakers of Basque and the subsequent comparison with native speakers showed that at high levels of proficiency and an early acquisition, non-native speakers can attain native like performance. Similar results were found for both groups, and they all have revealed similar different processing patterns for intransitive predicates: faster decision times and larger positivities for unaccusatives compared to unergatives, and also between phi-features: faster decision times and larger negativities for person feature compared to number feature. The same interaction between predicate and feature emerged: a larger positivity for unergative sentences with person feature violations than with unergative sentences with number feature violations, but a larger positivity for unaccusatives with ungrammatical number feature compared to unergative predicates containing ungrammatical number feature manipulations. I found larger amplitude in some components for natives compared to non-natives, but I attribute these differences to divergences in case morphology of the languages tested.

All in all, I have shown that whenever non-divergent grammatical phenomena are compared between native and high and early non-native speakers, native-like processing of the non-native language is attainable for non-native speakers, thus providing new evidence in support of the LDH hypothesis (Zawiszewski & Laka, 2020).

Chapter 4

IV *Eppur si muove*: experimental evidence for the Unaccusative Hypothesis and distinct ϕ-feature processing in Spanish.

Abstract

In this chapter, I test the processing correlates of the UH in Spanish, a nominative-accusative language, by means of ERPs. My objective is to test the cross-linguistic validity of the predictions made by the UH as well as that of the FDH. Experimental results show differences in the processing of unaccusative vs. unergative predicates and person vs. number features by Spanish speakers. Overall, larger positivity was observed for ungrammatical unergatives as compared to ungrammatical unaccusatives. The results support the UH: unaccusative and unergatives are processed differently, and unergatives show signs of easier processing. Larger negativity was elicited for subject-verb agreement violations containing number feature compared to person feature. As a result, differences were observed between phi-features, but number feature violations elicited larger negativity than person feature violations. This chapter is structured as follows: first, the study will be introduced, second, the results will be presented, and finally a discussion will be held.

Research questions

- How are unaccusative and unergative predicates processed in Spanish? Are they processed similarly or differently, and if differently, is there any sign of more complex processing for unaccusative predicates?
- How are person and number features processed in Spanish? Are they processed similarly or differently, and if differently, is there any sign of more saliency for person feature?

1 Introduction

In the late seventies, Perlmutter (1978) presented the the Unaccusative Hypothesis (UH), and for more than forty years it has been a topic for debate. According to this hypothesis, there are two categories within intransitive predicates: unergatives, with an agent argument, and unaccusatives, with a patient argument. The UH claims that the arguments of these two predicates differ with respect to the location they are generated, and hence, to their derivation. On the one hand, arguments of unaccusative predicates are claimed to be generated at object position, and later forced to undergo movement to subject position. On the other hand, arguments of unergative predicates are claimed to be generated at subject position, with no further need to move. These differences make the two arguments distinguishable. A second claim of the UH is, that as a result of the extra movement of unaccusative arguments compared to unergatives, the former should show traces of extra processing costs (see Chapter I, Section 2.3, for a more detailed description of the UH).

Previous evidence shows processing differences between unergative and unaccusative predicates (Bever & Sanz, 1997; Koring et al., 2012; Lee & Thompson, 2011; McAllister et al., 2009; Meltzer-Asscher et al., 2015; Zeyrek & Acarturk, 2014, *i.a.*), thus supporting the Unaccusative Hypothesis and placing it on the right track. Some studies have found signs of a more complex derivation for unaccusatives compared to unergatives, (Bastiaanse & van Zonneveld, 2005; Dekydtspotter & Seo, 2017; Friedmann et al., 2008; Koring et al., 2012; Meltzer-Asscher et al., 2015, *inter alia*), but others have not (Friedmann et al., 2008; C. Kim, 2006; Momma et al., 2018; Zeyrek & Acarturk, 2014, *inter alia*). It is still discussed whether there are larger processing costs for unaccusative predicates or not, and it is not still clear what these extra costs may be due to. The original claim posits that the costs are generated as a result of the extra movement to subject position in the derivation of unaccusative predicates, thus providing a syntactic account. More recent accounts suggest that there is a general agent preference, by which arguments are prototypically first processed as agents if there is no indication saying otherwise (Bornkessel-Schlesewsky & Schlesewsky, 2009) (see Chapter I, Section 2.2.2 for more information on the Agent First preference). Unergative predicates have agent subjects and, as a result, these more recent accounts also predict a preference for unergative predicates.

In Chapters II and III, I tested the UH and the FDH in Basque with native and non-native speakers for the first time by means of ERPs. The results on Basque revealed differences between unergative and unaccusative predicates, thus supporting the first claim of the UH. Nevertheless, I did not find larger processing costs for unaccusatives compared to unergatives. In fact, the results obtained suggest that unaccusatives are easier than unergatives to process in Basque, contrary to the predictions made by the UH. These results provide evidence in support of accounts which advocate for a thematic basis for case marking in Basque (Laka 2006a; b; Laka 2017; Levin 1983), and do not support accounts which claim that themes undergo movement in Basque (Fernández, 1997; Ortiz de Urbina, 1989; Preminger, 2012; Rezac et al., 2014).

In this chapter, I study intransitive predicates in Spanish, a nominative-accusative language. In nominative-accusative languages, agents carry nominative case, and themes prototypically (except for passives and unaccusatives) carry accusative case. Moreover, in SVO languages the preverbal position is prototypically the agent position, whereas the postverbal position is the theme position. Nominative case is unmarked/default, and accusative is marked. Morphological markedness/weight and prototypical agent/patient positions have been argued to be decisive for processing arguments (Alemán-Bañón & Rothman, 2016; Bornkessel & Schlesewsky, 2006; Cohn et al., 2017), which may have an impact on the processing of unaccusative and unergative predicates. Spanish is a nominative-accusative language, and as most nominative languages, the object of transitive predicates is marked, subjects are unmarked (Bosque & Gutiérrez-Rexach, 2009; Zagona, 2002) (see Chapter I, Section 2.4, for more information on Spanish). See example 10 again below for an illustration of case marking in Spanish.

12 a. Juan ha llegado. (unaccusative)
Juan.$_{NOM}$ has arrived
"Juan has arrived."

b. Juan ha llorado. (unergative)
Juan.$_{NOM}$ has cried
"Juan has cried."

c. Juan ha visto a María. (transitive)
Juan.$_{NOM}$ has seen $_{ACC}$ María
"Juan has seen María"

The example above shows that agents are always unmarked in Spanish, and that it is the patient argument of transitive predicates which is marked. According to the UH, the argument *Juan* in (12.a) is generated as an object and later moved to subject position. This is translated in higher processing costs for these arguments compared to arguments of unergative predicates, where no such extra movement is needed. This means that we should expect signs of higher processing costs for unaccusatives in the current experiment. The results obtained in Chapters II and III provided cross-linguistic evidence for the distinction between unaccusative and unergative predicates put forth by the UH. However, the differences in processing costs between unaccusative and unergative predicates seem to be dependent on morpho-syntactic factors: unergatives easier to process in nominative-accusative languages and unaccusatives easier to process in active languages. I examine these claims in the current experiment by testing the UH in Spanish.

Given the scarce evidence from experimental studies regarding the UH (Bastiaanse & van Zonneveld, 2005; Dekydtspotter & Seo, 2017; Friedmann et al., 2008; Koring et al., 2012; Meltzer-Asscher et al., 2015, *inter alia*), here I aimed to fill this gap by testing the UH by means of ERPs in Spanish, which has not been done yet and this will allow me to compare these results to those from Basque (Chapters II and III).

1.1 Subject-verb agreement and phi-features

The second hypothesis I tested in this study is the FDH. Subject-verb (SV) agreement and phi-features have been previously studied in Spanish (Alemán-Bañón et al., 2012; Alemán-Bañón & Rothman, 2019; Hinojosa et al., 2003; Mancini et al., 2011a, 2011b; Silva-Pereyra & Carreiras, 2007; see Chapter I, Section 4, for a more extended presentation on SV agreement and phi-features). In Spanish, as in all other tested languages, subject-verb agreement violations led to a robust late positivity (P600). In Alemán Bañón & Rothman (2019) no negativity emerged, but in most cases, the P600 was preceded by some kind of negativity: in Hinojosa et al. (2003) a LAN + P600 pattern emerged in verb inflection violations (*la prueba ocultada por el fiscal apareció/*apareci*); in Silva-Pereyra & Carreiras, (2007) a AN + P600 pattern emerged for person, number and person + number violations; in (Mancini et al., 2011a, 2011b) person violations elicited a N400 + P600 pattern, whereas number violations elicited a

LAN + P600 pattern. It is, thus, not very clear what these negativities mean, and what modulates their presence, location and form.

Regarding phi-features, a few studies have studied and compared the processing of person and number features by means of ERPs in Spanish (the studies presented in detail in Chapter I, Section 4.2.1). Many studies have analyzed number and gender features (Alemán-Bañón et al., 2012; Barber & Carreiras, 2003, 2005; Guajardo & Wicha, 2014; Molinaro et al., 2008, i.a.), but a few have also studied and compared the processing of person and number features in Spanish (Alemán-Bañón & Rothman, 2019; Mancini, 2018; Mancini et al., 2011a; Silva-Pereyra & Carreiras, 2007). On the one hand, as mentioned above, Silva-Pereyra & Carreiras, (2007) compared person, number and person + number violations in Spanish, and a similar Anterior Negativity + P600 emerged for person and number. On the other hand, also in Spanish, Mancini et al. (2011a) found a N400 + P600 pattern for person violations, and elicited a LAN + P600 pattern for number violations. They proposed that a N400 effect is expected when a violation which has an impact at the interface with the semantic-discourse representation of the sentence occurs (person violations); otherwise, when the violation is limited within the boundary of the morpho-syntactic representation, a LAN effect is expected (number violations). Person and number features have also been tested in other languages, and this LAN/N400 difference has not been reported elsewhere.

Zawiszewski et al. (2016) also compared person, number and person + number violations in Basque, an N400 emerged preceding the P600, but no differences were found concerning the negativity obtained. Mancini et al. (2011a) and Zawiszewski et al. (2016) did find, however, more positive waveforms for person violations compared to number violations, suggesting that person is more salient than number in terms of phi-features (see Mancini, 2018, for a more detailed description of person and number feature processing). In this experiment, I also study phi-features. To be more precise, I study person (1^{st} vs 2^{nd}) and number (3^{rd} plural vs singular) features to analyze the electrophysiological responses obtained from each feature type. All in all, in this experiment I test the UH and the FDH by means of ERPs in Spanish.

2 The present study

The main goal of this study is to investigate the electrophysiological correlates for subject agreement violations in unaccusatives and unergatives in native speakers of Spanish, testing person and number features separately.

2.1 Hypotheses and predictions

(H1) *The Unaccusative Hypothesis* (UH). The UH claims that there are two types of intransitive predicates, unaccusatives (assigning theme theta role) and unergatives (assigning agent theta role) (Perlmutter, 1978). In addition, the UH claims that these two predicates undergo different syntactic derivations: the theme arguments of unaccusatives are first generated as objects and advance to subject position during the derivation, whereas the agentive argument of unergative verbs is already generated in subject position. In both Perlmutter's (1978) and Burzio's (1986) rendition, the second claim of this hypothesis entails that unaccusatives involve more complex derivations than unergatives, as arguments of unaccusative verbs have to either be promoted to subject (Perlmutter, 1978) or undergo movement and leave a trace (Burzio, 1986). Therefore, the UH predicts to find differences between unaccusative and unergative predicate processing, and it further predicts to find signals of more processing costs for unaccusatives than for unergatives. Spanish is a nominative-accusative language that meets the canonical characteristics for which the UH was first formulated: subjects (NOM) are prototypically agents and objects (ACC) themes. Therefore, I expect to find differences between unaccusative and unergative predicates with signs of costlier processing for the former. Taking results obtained in Chapters II and III as a reference point, I expect to find the opposite pattern in Spanish: shorter reaction times and larger P600 for subject-agreement violations in unergatives compared to unaccusatives.

(H2) *The Feature Distinctness Hypothesis* (FDH) that we put forth here claims person and number are processed and represented differently, yielding distinct processing signatures. Molinaro, Rizzi & Carreiras, (2011) propose the Person-Number Dissociation Hypothesis (PNDH), arguing that person and number features are intrinsically different, as person conveys extra-syntactic information concerning the participants in the speech act. We hypothesize that person is more salient than number in processing. The FDH predicts that different electrophysiological responses will emerge for person and number violations. We predict that native speakers of Spanish should behave similarly to native speakers of Basque, and hence, we predict they will elicit a larger negativity for person compared to number violations.

2.2 Participants

27 native speakers of Spanish took part in the experiment. To create a mirror image to the experiments in Basque, we selected participants that had studied in Basque and were highly proficient in Basque: they all had the C1 in Basque. They were all right-handed (Edinburgh Handedness inventory: (Oldfield, 1971), and they were all paid for their participation.

2.3 Materials

The materials for the experiment in Spanish (see Table 12) were designed to make them as similar as possible to those used for the experiments in Basque (Chapters II and III). In the experiment in Basque, the critical word was the auxiliary, which was preceded by the main verb, as in (19.a). In Spanish, the auxiliary precedes the main verb in present perfect (19.b), and a configuration where the auxiliary follows the verb is not grammatical in this language. In order to make the Spanish materials as similar with Basque materials as possible, the critical words in this series of experiments were the verbs. Spanish is a fusional language which integrates tense, aspect, and mood in the lexical verb. Future tense takes the whole verb and adds an ending to the right (19.c). Compared to present tense (19.d), where only the root is maintained, the future offers a pattern as similar as it can get to resemble Basque word order. Consider the examples below to visualize the patterns described above.

13 a. Sufritu duzu.
suffer have.2SG$_{\text{ERG}}$

b. Has sufrido.
have.2SG$_{\text{NOM}}$ suffer
"You have suffered."

c. Sufrirás.
suffer.$_{\text{FUT}}$.2SG$_{\text{NOM}}$
"You will suffer."

d. Sufres.
suffer2SG$_{\text{NOM}}$
"You suffer."

Conditions			Sentence examples
Predicate Type	Feature	Grammaticality	
Unaccusative	Person	grammatical	Tú, lo antes posible, vendrás de visita. you, the earliest possible, come.FUT.2SG of visit "You will pay a visit as soon as possible."
		ungrammatical	* Tú, lo antes posible, vendré de visita. you, the earliest possible, come.FUT.1SG of visit
	Number	grammatical	Él/ella, lo antes posible, vendrá de visita. he/she, the earliest possible, come.FUT.3SG of visit
		ungrammatical	* Él/ella, lo antes posible, vendrán de visita. He/she, the earliest possible, come.FUT.3PL of visit
Unergative	Person	grammatical	Tú, dentro de poco, actuarás en Hollywood. you, within a little, act.FUT.2SG in Hollywood "You will shortly play in Hollywood."
		ungrammatical	* Tú, dentro de poco, actuaré en Hollywood. you, within a little, act.FUT.1SG in Hollywood
	Number	grammatical	Él/ella, dentro de poco, actuará en Hollywood. he/she, within a little, act.FUT.3SG in Hollywood
		ungrammatical	* Él/ella, dentro de poco, actuarán en Hollywood. he/she, within a little, act.FUT.3PL in Hollywood

Table 12. Sample of the materials for the 8 conditions considered in the experiment.

In this respect, the only difference compared to the previous experiments was, that for Basque only the auxiliary was the critical word ("duzu" in 13.b), whereas in the current experiment, the lexical conjugated verb was the critical word (13.c). Word order is more rigid in Spanish, and thus, words between S and V are not easily accepted. In order to create a distance between both elements, intervening material was introduced as in Basque, but in this experiment the intervening material was introduced between commas. On the other hand, Spanish uses prepositions and articles separated from nouns, and for that reason an average of 2.6 words (1, 2, or 3 words) were added after the critical word, controlled per condition. Following Martinez de la Hidalga et al.'s (2019) design, we used 2nd person for person violations, and 3rd singular vs. plural for number violations. As in the previous experiment, materials were controlled with for length and frequency.

2.4 Procedure

The procedure was the same as in Chapters II and III. Personal computers (Windows 7 operating system) and Presentation software (version 16.3) were used to present the stimuli on screen. Before the actual experiment started, participants were instructed about the EEG procedure and seated comfortably in a quiet room in front of a 24 in. monitor. The experiment was conducted in a silent room in the Experimental Linguistics Laboratory at the University of the Basque Country (UPV/EHU) in Vitoria-Gasteiz. Sentences were displayed in the middle of the screen word by word for 350 ms (ISI = 250). A fixation cross (+) indicated the beginning of each sentence trial. After each trial the words *correcto?* “correct?” or *incorrecto?* “incorrect?” appeared in the screen, and participants were asked to judge the acceptability of the previously displayed sentence as either correct (left Ctrl) or incorrect (right Intro). Half of participants used the left hand for correct responses and the other half the right hand.

All 416 sentences were distributed randomly in four blocks that lasted approximately 10 min each. Participants had a short break between each block which lasted as long as they needed. Before the actual experiment, participants ran a short training session of three trials. They were asked to avoid blinking or moving when the sentences were being displayed and to make the acceptability judgment as fast and accurately as possible. The whole experiment, including electrode-cap application and removal, lasted about 1h15m.

The same EEG recording was carried out as in previous experiments.

2.5 Data analysis

The same data analysis procedure was carried out as in Chapters II and III. After visualizing the data, different time intervals were chosen for the ERP data analysis, to better capture the effects obtained in the study: 300-500 ms and 600-900ms temporal windows were considered during statistical analysis in all conditions based on the literature and visual inspection of the data.

3 participants were removed due to the insufficient number of segments obtained when cleaning the data. Data from 24 participants were analyzed in the current experiment (ten men; mean age 20.46 years, SD = 0.59).

3 Results

3.1 Behavioral results

Regarding accuracy, participants were highly accurate and provided with the correct judgment to 93.25% of the sentences (see Table 13). A main GRAMMATICALITY effect ($F1(1,23) = 6.68$, $p = .017$; $F2(1,254) = 29.65$, $p < .001$) was found, indicating that participants were more accurate with grammatical sentences (95.25%) than with ungrammatical sentences (91.25%).

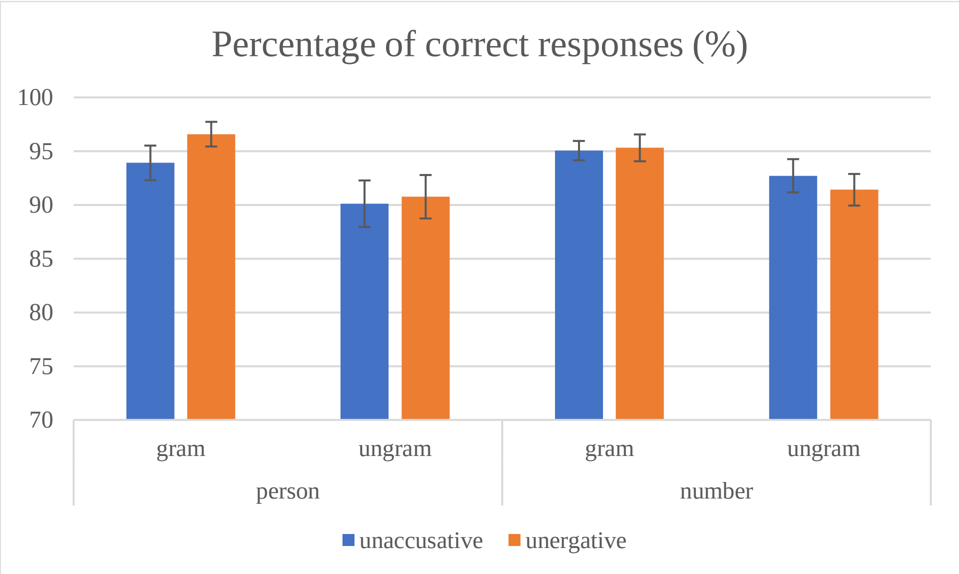


Table 13. Percentage of correct responses (%) and standard deviation error (SDE).

A marginally significant TYPE*GRAMMATICALITY interaction was found ($F1(1,23) = 4.05$, $p = .056$; $F2(1,254) = 2.9$, $p = .09$). The analysis by grammaticality factor showed that participants were marginally more accurate with grammatical unaccusatives (94.48%) compared with ungrammatical unaccusatives (91.41%) ($F(1,23) = 3.21$, $p = .086$), and participants were also more accurate with grammatical unergatives (96.01%) compared to ungrammatical unergatives (91.08%) ($F(1,23) = 10.67$, $p = .003$). The analysis by type factor showed that participants were slightly more accurate with grammatical unergatives than with (96.01%) grammatical unaccusatives (94.48%) (*F*(1,23) = 3.56, *p* =.072).

Regarding reaction times, a table with the mean reaction times for each condition and the results are presented.

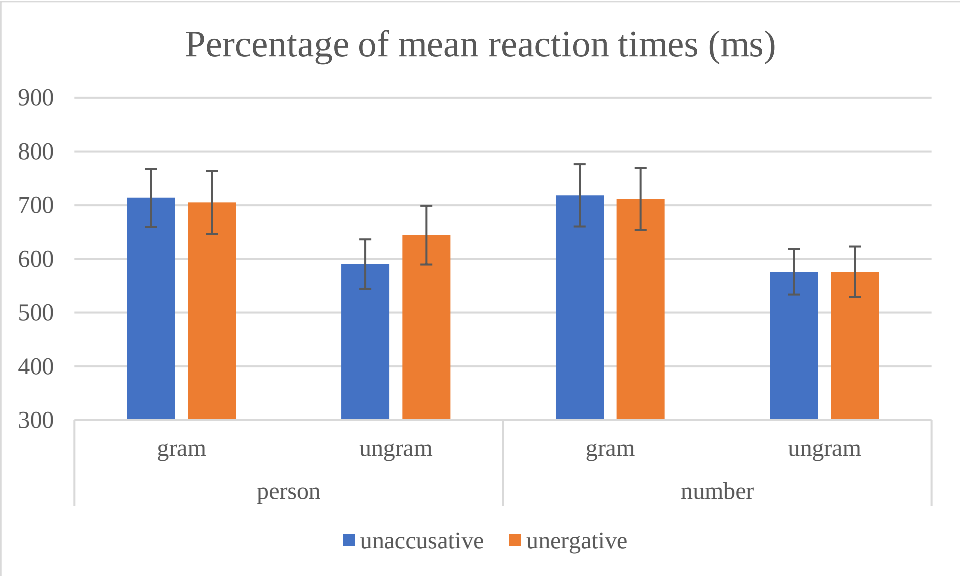


Table 14. Mean reaction times (ms) and standard deviation error (SDE).

A main GRAMMATICALITY effect (*F1*(1,23) = 28.43, *p* <.001; *F2*(1,254) = 111.89, *p* <.001) was found, indicating that participants were faster responding to ungrammatical sentences (596.72ms) than to grammatical sentences (712.09ms).

A GRAM*FEATURE effect was found in the analysis by item *(F1*(1,23) = 2.77, *p* =.11; *F2*(1,254) = 11.894, *p* <.001). The analysis by grammaticality factor showed that participants were faster with ungrammatical sentences than with grammatical sentences containing person feature (622.73 ms vs. 727.97) *(F*(1,254) = 37.9, *p* <.001), and similarly participants were faster with ungrammatical sentences than with grammatical sentences containing number feature (590.7 ms vs. 744.09 ms) *(F*(1,254) = 81.56, *p* <.001). The analysis by feature factor revealed that participants were faster with ungrammatical number than with ungrammatical person feature (590.7 ms vs. 622.73 ms) (*F*(1,254) = 3.86, *p* =.051).

3.2 ERP results

Regarding the early time window (300-500 ms) the analysis of the lateral electrodes revealed a main FEATURE effect ($F(1,23) = 9.1$, $p = .006$), indicating that number elicits a larger negativity than person (-0.35 µV vs. -0.99 µV). A marginal main GRAMMATICALITY effect also emerged ($F(1,23) = 3.3$, $p = .082$), indicating that ungrammatical sentences are slightly more negative than their grammatical counterparts (-0.81 µV vs. -0.53 µV).

A TYPE*GRAM interaction emerged ($F(1,23) = 6.41$, $p = .019$). The analysis by grammaticality factor showed that ungrammatical unaccusatives (-0.91 µV) elicit a larger negativity than grammatical unaccusatives (-0.23 µV) ($F(1,23) = 6.23$, $p = .016$), whereas grammatical and ungrammatical unergatives do not differ with regard to the negativity (-0.84 µV vs. -0.71 µV) ($F(1,23) = 0.55$, $p = .466$). The analysis by type showed that grammatical unergatives (-0.84 µV) elicit a slightly larger negativity than grammatical unaccusatives (-0.23 µV) ($F(1,23) = 3.91$, $p = .053$), whereas ungrammatical unaccusatives and unergatives do not differ (-0.91 µV vs. -0.71 µV) ($F(1,23) = 0.91$, $p = .351$).

Regarding midline electrodes, the analysis revealed a main FEATURE effect ($F(1,23) = 7.79$, $p = .01$) indicating that number elicits a larger negativity than person (-0.37 µV vs. -1.21 µV).

Regarding the late time window (600-900 ms), the analysis of the lateral electrodes revealed a main GRAMMATICALITY effect ($F(1,23) = 24.88$, $p < .001$), indicating that ungrammatical sentences elicit more positivity than their grammatical counterparts (0.86 µV vs. 2.55 µV).

A TYPE*GRAM interaction emerged ($F(1,23) = 8.42$, $p = .008$). The analysis by grammaticality factor showed that ungrammatical unaccusatives (2.32 µV) generate a larger positivity than grammatical unaccusatives (1.11 µV) ($F(1,23) = 8.11$, $p = .009$), whereas ungrammatical unergatives generate a larger positivity than grammatical unergatives (2.79 µV vs. 0.6 µV) ($F(1,23) = 43.29$, $p < .001$). The analysis by type showed that grammatical unaccusatives (1.11 µV) elicit a marginally larger positivity than grammatical unergatives (0.6 µV) ($F(1,23) = 3.11$, $p = .091$), whereas ungrammatical unergatives elicit a marginally larger positivity than ungrammatical unaccusatives (2.79 μV vs. 2.32 μV) ($F(1,23) = 3.75$, $p = .065$).

Regarding midline electrodes, the analysis revealed a main GRAMMATICALITY effect ($F(1,23) = 36.11$, $p < .001$), indicating that ungrammatical sentences elicit a larger positivity than their grammatical counterparts (1.26 μV vs. 4.17 μV).

A TYPE*GRAM interaction emerged ($F(1,23) = 7.23$, $p = .013$). The analysis by grammaticality factor showed that ungrammatical unaccusatives (3.78 μV) elicit a larger positivity than grammatical unaccusatives (1.52 μV) ($F(1,23) = 15.6$, $p = .001$), and similarly ungrammatical unergatives generated a larger positivity than grammatical unergatives (4.56 μV vs. 1.01 μV) ($F(1,23) = 49.36$, $p < .001$). The analysis by type showed that grammatical unaccusatives (1.52 μV) did not differ from grammatical unergatives (1.01 μV) ($F(1,23) = 1.73$, $p = .202$), whereas ungrammatical unergatives elicit a larger positivity than ungrammatical unaccusatives (4.56 μV vs. 3.78 μV) ($F(1,23) = 5.52$, $p = .028$).

A FEAT*GRAM*REGION interaction emerged ($F(1,23) = 3.76$, $p = .05$). The analysis by grammaticality factor showed that ungrammatical person elicited a larger positivity than grammatical person in all regions (frontal: $F(1,23) = 14.51$, $p = .001$; central: $F(1,23) = 14.54$, $p = .001$; posterior: $F(1,23) = 24.09$, $p < .001$), and similarly ungrammatical number elicits a larger positivity than grammatical number in all regions (frontal: $F(1,23) = 14.4$, $p = .001$; central: $F(1,23) = 23.06$, $p = .001$; posterior: $F(1,23) = 50.92$, $p < .001$). The analysis by feature showed that grammatical person elicited a larger positivity than grammatical number over posterior electrodes (2.71 μV vs. 1.66 μV) ($F(1,23) = 4.26$, $p = .05$).

See Figure 16 for the grand average patterns, Figure 17 for the mean voltage difference maps, and Table 15 for the summary of the results.

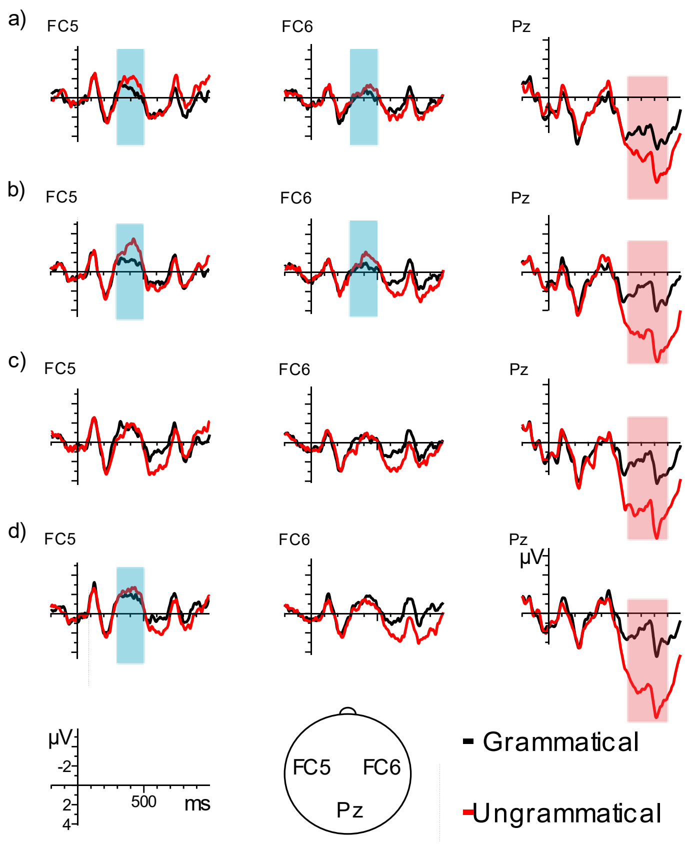


Figure 16. (a) person feature unaccusative predicate condition; (b) number feature unaccusative predicate condition; (c) person feature unergative predicate condition; (d) number feature unergative predicate condition.

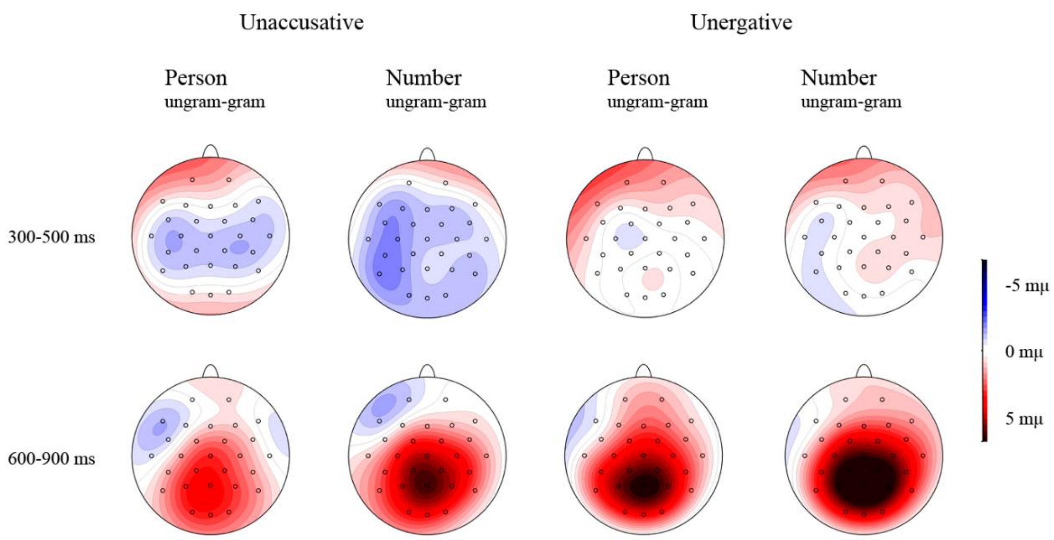


Figure 17. Mean voltage difference maps (grammatical minus ungrammatical).

		300-500 ms		600-900 ms	
		Lateral	Midline	Lateral	Midline
	df	F	F	F	F
GRAM	1,23	3.3	.02	*****24.88**	*****36.11**
TYPE	1,23	1	.14	.01	.24
FEAT	1,23	****9.1**	***7.79**	.88	.68
TYPE*GRAM	1,23	***6.41**	2.62	****8.42**	***7.23**
FEAT*GRAM	1,23	.48	.0	2.96	2.39
TYPE*FEAT*GRAM	1,23	.45	.31	.09	.17
GRAM*HEM	1,23	3.13	-	4.22	-
TYPE*GRAM*HEM	1,23	.01	-	.06	-
FEAT*GRAM*HEM	1,23	^*3.16*	-	.38	-
TYPE*FEAT*GRAM*HEM	1,23	.0	-	.53	-
GRAM*REGION	2,46	1.55	*****19.09**	*****26.64**	*****26.98**
TYPE*GRAM*REG	2,46	.33	.35	.12	1.2
FEAT*GRAM*REG	2,46	1.3	1.63	1.33	***3.76**
TYPE*FEAT*GRAM*REG	2,46	.66	.37	.23	.35
GRAM*HEM*REG	2,46	.11	**-**	****9.05**	**-**
TYPE*GRAM*HEM*REG	2,46	.06	**-**	.45	-
FEAT*GRAM*HEM*REG	2,46	.73	-	.34	-
TYPE*FEAT*GRAM*HEM*REG	2,46	.09	-	.04	-

Table 15. Summary of the ERP results. Main effects and interactions with grammaticality are shown. GRAM (grammaticality), TYPE (type), FEAT (feature), HEM (hemisphere) and REG (region). ^ p = < .1, * p = < .05, ** p = < .01, *** p = < .001.

3.3 Summary of the results

Regarding behavioral results, participants were marginally more accurate when performing the task in the grammatical unergative condition than in the grammatical unaccusative condition. They also answered acceptability questions faster to sentences containing number feature than to sentences containing person feature.

With regard to ERPs, overall participants generated a larger negativity for grammatical unergatives than for grammatical unaccusatives. Similarly, participants generated a larger positivity for ungrammatical unergatives than for ungrammatical unaccusatives. Number feature generated a larger negativity than person feature, and agreement violations in all conditions generated a late positive component (P600).

4 Discussion

The aim of this fourth chapter was to study the electrophysiological correlates of unergative and unaccusative predicates and person and number features in Spanish. First, I discuss the UH, which predicts differences across predicates, and also signs of more processing costs for unaccusative predicates. Recall that the UH also claims that unaccusative predicates need an extra operation in the derivation, since the argument created in object position needs to get to subject position. Both behavioral and electrophysiological results support the predictions made by UH: differences were found with regard to unaccusative and unergatives regarding accuracy and ERPs, both in the first time-window and the second time-window, thus supporting the first claim of the UH; participants were more accurate and generated a larger positivity with unergative predicates, hence, unergatives showed traits of less complex derivations compared to unaccusatives. This experiment, thus, together with results obtained in Chapters II and III, supports the claim that there is a distinction within the category of intransitive predicates: unaccusatives on the one hand, and unergatives on the other.

Furthermore, the differences obtained also support the claim that unaccusatives involve further derivations, which translates in more processing costs: participants were more accurate when performing the task with grammatical unergative predicates than with grammatical unaccusatives and ungrammatical unergatives yielded larger positivity than ungrammatical unaccusatives. The results from Chapter II and III and the data obtained from this experiment show a clear pattern: there is a difference between unaccusatives and unergatives. Besides, there are differences in the way unaccusatives and unergatives are processed in Basque and in Spanish. In Basque unaccusatives are easier to process than unergatives while in Spanish the opposite pattern emerged. This difference is not random as the effects go in the opposite directions. I interpret this experimental evidence as consequence of case morphology.

The present results provide evidence in support of Perlmutter's (1978) and Burzio's (1986) claim regarding unaccusatives' extra derivation costs for Spanish, a nominative-accusative language. The results of this experiment provide novel evidence in favor of the Unaccusative Hypothesis in a nominative-accusative language by means of ERPs, corroborating thus previous findings from other nominative languages (English and Dutch) and different experimental methods (Bastiaanse & van Zonneveld, 2005; Dekydtspotter & Seo, 2017; Friedmann et al., 2008; Koring et al., 2012; Meltzer-Asscher et al., 2015, *inter alia*). Hence, the present data supports the second claim of the Unaccusative Hypothesis: unaccusative predicates undergo extra derivational steps compared to unergative predicates, which translate in larger processing costs.

This extra derivation cost can also be linked with morphological markedness. In nominative-accusative languages, agents prototypically take nominative case (morphologically unmarked), whereas patients take accusative case (morphologically marked). Therefore, the prediction upon encountering a morphologically unmarked subject is for it to be an agent, either subject of a transitive or intransitive predicate. For unaccusatives, morphologically unmarked, the same prediction is made, but it is not met and this violation of the prediction may create extra processing costs. This violation of the prediction is even starker in nominative-accusative SVO languages, where themes prototypically take postverbal position. In these languages, agents prototypically take preverbal position and patients postverbal position. Hence, subjects of unaccusative predicates take an unexpected position and create extra processing costs (see Chapter I, Section 2.2 for more information about thematic roles).

On the contrary, in active-inactive languages like Basque, an extra derivation movement may not be needed for objects to get nominative case (Levin, 1983). In fact, agents may need an extra derivation in order to get ergative case. Furthermore, patients are prototypically unmarked, and agents marked. Morphological markedness translates in more processing costs for the morphologically heavier element (Alemán-Bañón & Rothman, 2016). In Basque, subjects of transitive and unergative predicates are marked, and unaccusatives unmarked, thus suggesting an easier processing for unaccusative predicates. All in all, I conclude that there is a categorical distinction between unaccusative and unergative predicates, and that differences in processing costs between unaccusative and unergative change depending on the underlying morphological case alignment.

The second aspect tested in the current experiment, namely the FDH, predicted to find differences across phi-features, and signs of larger saliency for person feature. Our results support the first claim of the Feature Distinctness Hypothesis, since differences were found between person and number features concerning reaction times and electrophysiological results. I obtained faster reaction times for sentences containing number feature violations than for sentences containing person feature violations and, overall, a larger negativity emerged for sentences with number feature compared to person feature. This pattern is unexpected, since the FDH further claims that person is more salient than number. Taking results from Chapters II and III into account, the second claim of the FDH predicted faster reaction times and larger negativities for person violations compared to number violations, but the predictions were not met. In fact, behavioral results contradicted the predictions by showing signs of larger saliency for number feature compared to person feature.

The negativities obtained in this experiment, thus, do not coincide with neither the negativities found in Chapters II and III, nor with the negatives found in previous studies where person and number where compared. Silva-Pereyra & Carreiras (2007) reported a similar AN + P600 for both person and number violations in Spanish. Mancini et al. (2011a) reported a N400+600 pattern for person violations and a LAN+P600 pattern for number violations in Spanish. Zawiszewski et al. (2016) reported N400+P600 for both kinds of violations, but the difference emerged in the late time-window, generating larger positive responses for person violations than for number violations. Previous experiments show that differences between person and number are not robustly gathered in the ERP pattern. The larger negativities obtained for number feature are a new pattern in the study of person and number feature processing, but it does not break with any previous established pattern. It is also worth noticing that the features chosen for this experiment are different from feature manipulations used in other studies. Silva-Pereyra & Carreiras (2007) used (1st singular vs. 2nd singular) for person violations and (1st singular vs. plural) for number violations. Mancini et al. (2011a) used (3rd singular vs. 2nd singular) for person violations and (3rd plural vs. singular) for number violations. Zawiszewski et al. (2016) used (2nd singular vs. 1st singular) for person violations and (2st singular vs. plural) for number violations. The results obtained in these experiments show that differences between person and number were only obtained in the early time-window when 1st/2nd and 3rd person are combined (Mancini et al., 2011a; Martinez de la Hidalga et al., 2019). This was also the case in the current experiment. In fact, this experiment and (Mancini et al., 2011a) used (3rd singular vs. plural) violations for number feature, and the results obtained resemble each other. The variability obtained in this and previous experiments show that any slight change in the materials can have important effects when working with phi-features.

One possible explanation for the negativities obtained in this experiment is that participants processed the subject of sentences containing person feature (2nd person) as vocatives, which is not an option for sentences containing number feature (3rd person). First, a possible reading of subjects as vocatives could explain the fact that participants were faster with ungrammatical sentences containing number feature compared to sentences containing person feature. Second, negativities have also been linked to prediction (Bornkessel-Schlesewsky & Schlesewsky, 2019; Kutas & Federmeier, 2011), and if vocatives were an open possibility for sentences containing person feature, then the prediction upon encountering the verb would get diminished for all sentences containing person feature. This would explain the lack of negativities for sentences containing person feature in contrast to number feature.

All in all, in this chapter I have provided novel evidence in support of the UH, by showing differences between unaccusative and unergative predicates both behaviourally and electrophysiologically. Moreover, participants were more accurate and generated larger positivities for unergative violations compared to unaccusative violations, and grammatical unaccusatives elicited larger positivity than grammatical unergatives, which indicates that unergatives involve less complex processing compared to unaccusatives in Spanish. Therefore, these results support a distinction between unaccusative and unergative predicates, with traits of more processing cost for unaccusative predicates in nominative-accusative languages. Furthermore, I have also shown differences between the processing of person and number features, although with an unexpected pattern, which I attribute to the specific manipulations used in the materials.

5 Summary of the findings

In the fourth chapter, I studied intransitive predicates and phi-features in Spanish by means of ERPs. Regarding the Unaccusative Hypothesis, I found differences between unaccusative and unergative predicates, thus supporting the UH. Furthermore, participants were more accurate and generated larger positivities for unergative violations compared to unaccusative violations, and this indicates that unergatives are less complex to process than unaccusatives in Spanish, as predicted by the UH. Following this and previous results, I attributed these differences to case alignment. For nominative-accusative languages, nominative case is prototypically assigned to agents and the extra step for theme arguments to get nominative case makes it harder to process the latter. For active-inactive languages, unaccusative predicates do not show signs of undergoing longer derivations, whereas agents show signs of more complex processing, possibly due to the extra morphological weight.

Finally, regarding the FDH, differences were found between person and number feature, but the pattern obtained contradicted the predictions, since number feature showed signs of larger saliency compared to person feature. I concluded that this pattern of results may be due to a caveat in the materials, related to the possibility for subjects of sentences containing person feature to be initially processed as vocatives. In any case, this experiment shows that differences are found between features and that more research is needed in order to understand the nature of the differences.

Chapter 5

V Intransitive sentences and early and proficient non-native speakers of Spanish

Abstract

In this chapter, I tested how early and highly proficient non-native speakers of Spanish process intransitive predicates and phi-features and whether they do it similarly to native speakers of Spanish, previously studied in Chapter IV. This experiment constitutes the mirror experiment of Chapter III, where early and highly proficient non-native speakers of Basque were tested in Basque. For that purpose, I studied the processing correlates of unaccusative versus unergative sentences, as well as person and number phi-features, using behavioural and ERPs measures. In the previous chapter, native speakers of Spanish showed differences in processing for unaccusative and unergatives, as predicted by the UH, and unergatives showed signs of easier processing as compared to unaccusatives, supporting the UH. Overall, non-natives did not show major differences in the processing of intransitive predicates and phi-features compared to natives, suggesting that non-natives can attain native-like responses and processing of intransitive predicates and phi-features. This chapter is structured as follows: after briefly introducing the present study, I will describe the experiment, discuss the results and compare them to those obtained from natives.

Research questions

Similarly to the questions raised in Chapter III, here we aim at unveiling:

-How do non-natives of Spanish process unaccusative and unergative predicates, do they process them like natives or differently?

-How do non-natives of Spanish process person and number features, do they process them like natives or differently?

1 Introduction

Chapter V addresses a general question in the study of non-native language acquisition and processing, namely, how do non-natives process their second language? Do they process it like their native tongue? Do they process it like native speakers? Many studies have addressed these questions and three main hypotheses have emerged from this research: (1) non-native speakers largely rely on the same mechanisms as the L1 to process the second language, (2) it is possible to process a second language native-like, but only with a high degree of proficiency, and (3) there exist some maturational constrains for language acquisition, which make native-like language acquisition and processing for non-early non-native speakers impossible (see Chapter I, Section 3, for details).

In Chapter III, I compared native speakers of Basque and non-native speakers of Basque whose native tongue was Spanish, and studied how non-natives process intransitive predicates and phi-features. I found that early and highly proficient non-natives process intransitive predicates and phi-features similarly to natives. The results supported the Language Distance Hypothesis (Zawiszewski et al., 2011; Zawiszewski & Laka, 2020), which claims that native-like processing is attainable as long as the grammatical phenomena compared are shared.

In this chapter, I study native speakers of Spanish and non-native speakers of Spanish whose native tongue is Basque, and I study how non-native speakers of Spanish process intransitive predicates and phi-features. The goal of this chapter is to investigate whether non-native speakers of Spanish with an early age of acquisition and at high levels of proficiency can process intransitive predicates and phi-features in Spanish similarly to natives.

In the following lines, I present a brief discussion of the literature on L2 processing in Spanish by means of ERPs to get a broad picture of the background literature (see Chapter I, Section 3, for more details on L2 processing). Dowens et al. (2010) analyzed gender and number processing in Spanish with highly proficient L2 speakers (AoA < 20) who had long exposure to L2 environment. Gender and number violations were inserted at the beginning and at the middle of the sentence (el suelo.$_{SG.MASC}$ está plano.$_{SG.MASC}$ /*plana.$_{SG.FEM}$ /*planos.$_{PL.MASC}$ "the floor is flat."). Both non-natives as well as natives elicited an early negativity followed by a P600. However, for the violations located at the middle, where the dependency is longer, native speakers generated an early negativity followed by a P600 for both features while L2 speakers only displayed negativity for number violations. The authors concluded that highly proficient L2 speakers can generate native-like electrophysiological correlates, but that L2 effects can also be observed for higher working memory demands in long dependencies.

Similarly, Alemán Bañón et al. (2014) examined high proficient non-native speakers of Spanish (AoA = 11-22) whose native language was English, and compared them to native speakers of Spanish. They studied the processing of agreement violations with number feature, an agreement pattern present in English, and gender feature, not present in English (Mateo limpió este.$_{SG.MASC}$/estos.$_{PL.MASC}$/esta.$_{SG.FEM}$ apartamento.$_{SG.MASC}$ “Mateo cleaned this apartment.”). They compared agreement within a determiner phrase and across a verb phrase to investigate whether native like processing is limited to local domains or not. They found that non-native speakers generated a P600 for all agreement violations both within and outside local dependencies and were impacted by structural distance, similar to native speakers. The authors concluded that learners can show native-like processing for novel features and are sensitive to hierarchical structure.

Finally, Pérez et al. (2015) studied the processing of gender agreement violations (el.$_{MASC}$/*la.$_{FEM}$ suelo.$_{MASC}$ está plano y bien acabado. “the floor is clean and well finished.”) by high proficient late bilinguals (AoA > 20) of Spanish, whose native language was English, and compared their brain activations to those of native speakers of Spanish by using a brain complex network analysis (EEG). Different activation patterns were observed for L2 speakers compared to L1 speakers when processing sentences containing gender mismatches. The authors concluded that when processing a morphological mismatch not present in their L1, L2 speakers configure their neural pattern differently to L1 speakers.

As far as I am aware, the processing of subject-verb agreement in Spanish non-natives has only been studied with speakers of Spanish whose native language is English. Alemán-Bañón et al. (2014) concluded that advanced non-natives process their non-native language native-like, whereas Pérez et al. (2015) concluded that non-native speakers process the non-native language different from natives. Previous evidence from intransitive predicates and phi-feature processing in Basque indicates that early and highly proficient non-native speakers can process shared grammatical phenomena similarly to natives, contrary to advocators of the Difference Hypothesis (see Chapter I, Section 3, for more details). The present study aims to complete this puzzle by providing new data on Spanish non-natives and later comparing their results to those natives, previously studied in Chapter IV.

2 The study

2.1 Hypotheses

The main goal of this study is to test whether different processing patterns reflected by electrophysiological correlates reported previously for the L1 speakers of Spanish (Chapter IV) obtain for subject agreement violations in unaccusatives vs. unergatives in non-native speakers of Spanish, testing person and number features separately. The hypotheses tested are the same as in Chapter III, repeated below:

(1) The Difference Hypothesis claims that there is some critical period for the study of language, and once this period is over, native-like processing is not available. Nevertheless, given the early AoA of the participants tested in the present study, no native vs. non-native differences are expected (Steinhauer, 2014).

(2) The Similarity Hypothesis claims that the same mechanisms used in L1 are recruited for L2 processing from a very early stage, and predicts that early and highly non-native speakers of Spanish will perform similarly to natives (Steinhauer, 2014).

(3) The Convergence Hypothesis claims that native-like processing is acquired as a function of proficiency; hence, highly proficient non-native speakers should behave and process language similarly to native speakers (Steinhauer, 2014).

(4) The Language Distance Hypothesis (LDH) claims that even at early AoA and high proficiency, L1 vs. L2 differences will emerge in the processing of grammatical property if the property is absent in L1, whereas no differences will emerge if the property is shared in L1 and L2 (Zawiszewski et al., 2011; Zawiszewski & Laka, 2020).

As mentioned in Chapter III, Section 2.1, hypotheses 1, 2 and 3 make the same predictions with regard to the group of bilinguals selected for the current experiment: no differences are expected to be found in early and highly proficient non-native speakers. In this study, subject-verb agreement is analyzed, an overt property in the grammars of both Basque and Spanish. As a result, the LDH predicts similar traits concerning the behavior and processing of intransitive predicates and phi-features in native and non-native speakers, just as in Chapter III. However, it has to be kept in mind that Basque and Spanish have different morphology, which may have an impact on the way SV is processed. Besides, the UH and the FDH are also tested in the current experiment and later compared with their native counterpart.

2.2 Participants

25 non-native speakers of Spanish, whose native language is Basque, took part in the experiment (five men; mean age 21.79 years, SD = 0.59; AoA = 5.7 years, SD = 0.39). All of them had studied in Basque, 21 had the C1 certificate in Basque and 3 were studying a university degree in Basque. They were all right-handed (Edinburgh Handedness inventory: (Oldfield, 1971), and they were all paid for their participation. A table is offered below to show participants' relative use of Basque throughout their life and their self-rated proficiency. It can be seen that they are native speakers of Basque and that they mostly use Basque in their everyday life. Nonetheless, because of the diglossic society in the Basque Country, they all have acquired Spanish from an early point and their proficiency is very high.

Relative use of language		
Before primary school (0–3 years)		6.75 (0.09)
Primary school (4–12 years)		
School		6.58 (0.13)
Home		6.63 (0.15)
Others		6.54 (0.12)
Secondary school (12–18 years)		
School		6.08 (0.18)
Home		6.63 (0.13)
Others		6 (0.16)
At time of testing		
University/work		5.58 (0.27)
Home		6.34 (0.22)
Others		5.34 (0.25)
Self-rated proficiency	Spanish	Basque
Speaking	6.04 (0.15)	6.92 (0.06)
Comprehension	6,5 (0.16)	7 (0)
Reading	6,54 (0.13)	6.92 (0.06)
Writing	5.71 (0.19)	6.75 (0,09)

Table 16. The following seven-point scale was applied for measuring the relative use of language: 1=I speak only Spanish, 2=I speak mostly Spanish, 3=I speak Spanish75% of the time, 4=I speak Basque and Spanish with similar frequency, 5=I speak Basque75% of the time, 6=I speak mostly Basque, 7= only Basque. Proficiency level was determined by using the following four-point scale: 7=native-like proficiency, 6=full proficiency, 5=working proficiency, 4=limited proficiency. SDs values are in parentheses.

2.3 Materials, procedure, EEG recording and data analysis

Materials, procedure, EEG recording and data analysis were the same as in Chapter IV. One participant was removed due to the low number of segments obtained after cleaning the data. As a result, Data from 24 participants were analyzed in the current experiment,

3 Results

3.1 Behavioral results

Regarding accuracy, participants were very accurate in the acceptability task (mean accuracy of 89.12%, SDE = 2.4), which shows that they were highly proficient in Spanish (see Table 17).

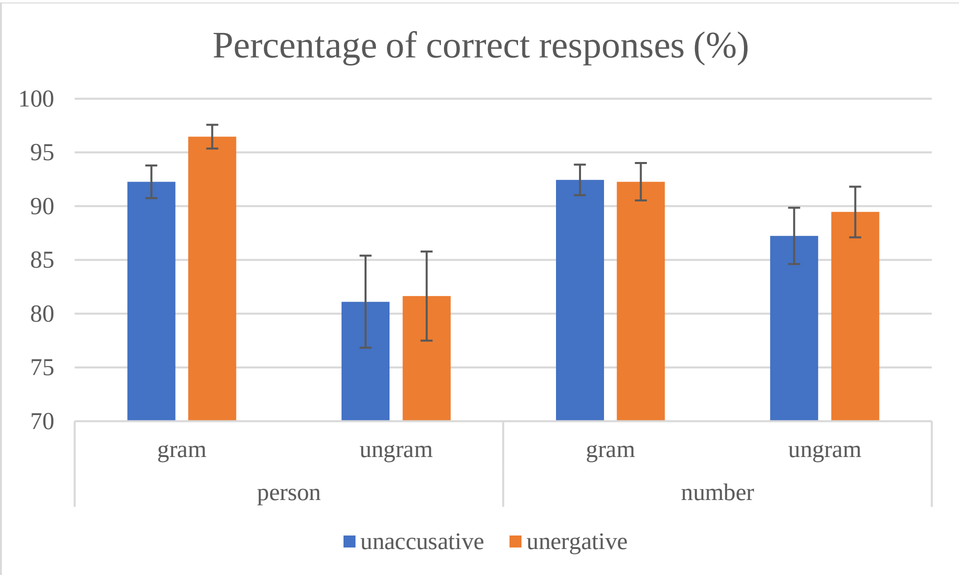


Table 17. Percentage of correct responses (%) and standard deviation error (SDE).

A main TYPE effect was found (*F1*(1,23) = 6.96, *p* =.015; *F2*(1,253) = 5.08, *p* =.025), indicating that non-native speakers were more accurate with unergative sentences (90.02%) than with unaccusative sentences (88.27%). A main GRAMMATICALITY effect (*F1*(1,23) = 10.44, *p* =.004; *F2*(1,253) = 111.71, *p* <.001) was also found, indicating that participants were more accurate with grammatical sentences (93.4%) than with ungrammatical sentences (84.89%). A final FEATURE effect was found in the analysis by item (*F1*(1,23) = 1.16, *p* =.292; *F2*(1,253) = 7.56, *p* =.006), indicating that participants were more accurate with sentences containing number feature than person feature (90.39% vs. 87.71%).

A marginal FEATURE*GRAMMATICALITY interaction was found ($F1(1,23) = 4.08$, $p = .055$; $F2(1,253) = 32.26$, $p < .001$). The analysis by grammaticality factor indicated that participants were more accurate with grammatical sentences (94.37%) than with ungrammatical sentences (81.44%) containing person feature ($F(1,23) = 9.21$, $p = .006$). Similarly, participants were slightly more accurate with grammatical sentences (92.43%) than with ungrammatical sentences (88.35%) containing number feature ($F(1,23) = 3.15$, $p = .089$). The analysis by feature factor showed participants were more accurate with grammatical sentences containing person feature (94.37%) than with grammatical sentences containing number feature (92.43%) ($F(1,23) = 6.33$, $p = .019$).

Finally, a TYPE*FEATURE*GRAMMATICALITY interaction was also found ($F1(1,23) = 5.2$, $p = .032$; $F2(1,253) = 3.63$, $p = .058$). The analysis by grammaticality factor indicated that participants were more accurate with grammatical unaccusative sentences (92.27%) than with ungrammatical unaccusative sentences (81.12%) containing person feature ($F(1,23) = 6.04$, $p = .022$). Participants were also marginally more accurate with grammatical unaccusative sentences (92.45%) than with ungrammatical unaccusative sentences (87.24%) containing number feature ($F(1,23) = 4.06$, $p = .056$). Similarly, participants were more accurate with grammatical unergative sentences (96.47%) than with ungrammatical unergative sentences (81.76%) containing person feature ($F(1,23) = 12.75$, $p = .002$). The analysis by type factor revealed that participants were more accurate with grammatical unergatives (92.27%) than with grammatical unaccusatives containing person feature (96.47%) ($F(1,23) = 17.87$, $p < .001$). The analysis by feature factor revealed that participants were more accurate with grammatical unergatives containing person feature (96.47%) than with grammatical unergatives containing number feature (92.41%) ($F(1,23) = 12.62$, $p = .002$). Participants were marginally more accurate with ungrammatical unergatives containing number feature (89.46%) than with ungrammatical unergatives containing person feature (81.76%) ($F(1,23) = 3.1$, $p = .096$).

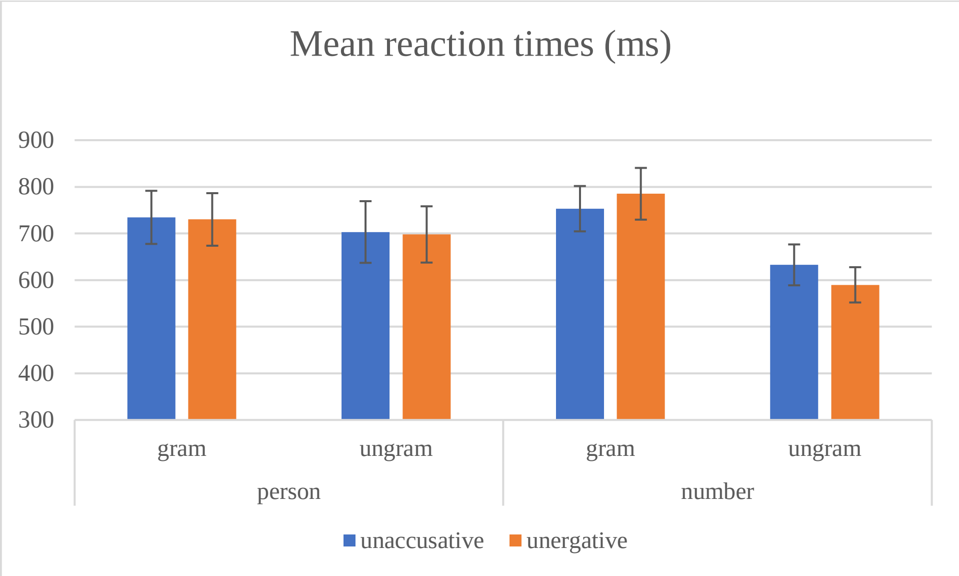


Table 18. Mean reaction times (ms) and standard deviation error (SDE).

Concerning reaction times, a main GRAMMATICALITY effect (*F1*(1,23) = 5.16, *p* =.033; *F2*(1,253) = 91.39, *p* <.001) was found, indicating that participants were faster responding to ungrammatical sentences (655.82 ms) than to grammatical sentences (750.66 ms).

A marginally significant TYPE*GRAM interaction was found in the analysis by item *F2*(1,253) = 3.43, *p* =.065). The analysis by grammaticality factor showed that participants reacted faster to ungrammatical unaccusatives than to grammatical unaccusatives 642.04 ms vs. 744.02 ms) (*F*(1,23) = 29.71, *p* <.001), and similarly participants reacted faster to ungrammatical unergatives than to grammatical unergatives (615.94 ms vs. 766.89 ms) (*F*(1,23) = 65.1, *p* <.001). The analysis by type found no differences across predicate.

A marginal FEATURE*GRAMMATICALITY interaction was found (*F1*(1,23) = 3.69, *p* =.067; *F2*(1,253) = 11.07, *p* =.001). The analysis by grammaticality factor showed that participants responded faster to sentences containing ungrammatical number (611.19 ms) than to sentences containing grammatical number (769.06 ms) (*F*(1,23) = 38.47, *p* <.001). The analysis by grammaticality factor showed that participants responded slightly faster to grammatical sentences containing person feature (732.26 ms) than to grammatical sentences containing (769.06 ms) number feature (*F1*(1,23) = 3.02, *p* =.096).

A marginally significant TYPE*GRAMMATICALITY*FEATURE interaction was also found in the analysis by subject ($F1(1,23) = 4.02$, $p = .057$). The analysis by grammaticality factor showed that participants responded faster to ungrammatical unaccusatives with number feature (632.59 ms) than to grammatical unaccusatives (753.09ms) ($F(1,23) = 27.47$, $p < .001$), and similarly participants responded faster to ungrammatical unergatives with number feature (589.76 ms) than to grammatical unergatives with number feature (785.03 ms) ($F(1,23) = 26.67$, $p < .001$). The analysis by type factor showed no differences between unaccusatives and unergatives. The analysis by feature factor revealed that non-natives responded slightly faster to grammatical unergatives containing person feature (730.01 ms) than to grammatical unergatives containing number feature (785.03ms) ($F(1,23) = 3.12$, $p = .09$), whereas they responded slightly faster to ungrammatical unergatives containing number feature (589.79ms) than to ungrammatical unergatives containing person feature (697.86ms) ($F(1,23) = 3.01$, $p = .096$).

3.2 ERP results

According to the literature and similarly to the procedure reported in Chapter IV, I selected an early time window (300-500 ms) and a late time window (600-900 ms) in order to capture best the effects obtained (see Figure 18 for mean voltage differences and table Table 19 for a summary of the results).

Regarding the early time window (300-500 ms), the analysis of lateral electrodes revealed a FEAT*GRAM interaction ($F(1,23) = 10.53$, $p = .004$). The analysis by grammaticality factor showed that grammatical person (-0.03 µV) elicited a larger negativity than ungrammatical person (0.53 µV) ($F(1,23) = 4.31$, $p = .049$), whereas ungrammatical number elicited a larger negativity than grammatical number (-0.01 µV vs. 0.57 µV) ($F(1,23) = 5.01$, $p = .035$). The analysis by feature showed that grammatical person (-0.02 µV) elicited a larger negativity than grammatical number (0.57 µV) ($F(1,23) = 11.06$, $p = .003$), whereas ungrammatical number elicits a larger negativity than ungrammatical person (-0.01 µV vs. 0.53 µV) ($F(1,23) = 5.44$, $p = .029$). A further FEAT*GRAM*HEM interaction emerged ($F(1,23) = 5.48$, $p = .028$). The analysis by grammaticality factor showed that grammatical person (-0.41 µV) elicits a larger negativity than ungrammatical person (0.24 µV) over the left hemisphere ($F(1,23) = 5.4$, $p = .029$), whereas ungrammatical number elicited a larger negativity than grammatical number (-0.59 µV vs. 0.17 µV) in the left hemisphere (*F*(1,23) = 6.84, *p* =.015). The analysis by feature factor showed that grammatical person elicits a larger negativity than grammatical number in the left hemisphere (-0.41 µV vs. 0.17 µV) (*F*(1,23) = 7.07, *p* =.014), and also in the right hemisphere (0.36 µV vs. 0.97 µV) (*F*(1,23) = 11.47, *p* =.003). Ungrammatical number elicits a larger negativity than ungrammatical person in the left hemisphere (-0.59 µV vs. 0.22 µV) (*F*(1,23) = 11.28, *p* =.003). Finally, a FEAT*GRAM*HEM*REG interaction emerged (*F*(1,23) = 7.08, *p* =.004).

Regarding midline electrodes, the analysis revealed a very marginal main TYPE effect (*F*(1,23) = 2.99, *p* =.097) indicating that unaccusatives generate a slightly larger negativity than unergatives (0.13 µV vs. 0.51 µV).

A FEAT*GRAM interaction emerged (*F*(1,23) = 6.75, *p* =.016). The analysis by grammaticality factor showed that grammatical person (-0.17 µV) elicited a larger negativity than ungrammatical person (0.67 µV) (*F*(1,23) = 4.04, *p* =.056), whereas grammatical and ungrammatical number do not differ (0.59 µV vs. 0.18 µV) (*F*(1,23) = 1.49, *p* =.235). The analysis by feature showed that grammatical person (-0.16 µV) elicits a larger negativity than grammatical number (0.59 µV) (*F*(1,23) = 10.59, *p* =.003), whereas ungrammatical person and number do not differ (-0.17 µV vs. 0.18 µV) (*F*(1,23) = 2.24, *p* =.148).

Regarding the late time window (600-900 ms), the analysis of the lateral electrodes revealed a main GRAMMATICALITY effect (*F*(1,23) = 14.21, *p* =.001), indicating that ungrammatical sentences elicited a larger positivity than their grammatical counterparts (1.08 µV vs. 2.18 µV).

A FEATURE*GRAM*REGION interaction emerged (*F*(1,23) = 4.69, *p* =.036). The analysis by grammaticality factor showed that ungrammatical person generates a larger positivity than grammatical person in all regions, whereas ungrammatical number generates a larger positivity than grammatical number only over central and over posterior electrodes (person frontal: *F*(1,23) = 7.36, *p* = .012; person central: *F*(1,23) = 12.93, *p* = .002; person parietal: *F*(1,23) = 11.63, *p* = .002; number frontal: *F*(1,23) = 0.31, *p* = .584; number central: *F*(1,23) = 5.47, *p* = 0.28; number parietal: *F*(1,23) = 16.09, *p* = .001). The analysis by feature factor showed that person and number did not differ in any lateral region.

Regarding midline electrodes, the analysis revealed a main GRAMMATICALITY effect ($F(1,23) = 25.14$, $p < .001$), indicating that ungrammatical sentences elicit a larger positivity than their grammatical counterparts (1.33 µV vs. 3.4 µV).

A FEATURE*GRAM*REGION interaction emerged ($F(1,23) = 5.02$, $p = .016$). The analysis by grammaticality factor showed that ungrammatical person generates a larger positivity than grammatical person in all regions, and similarly ungrammatical number generates more positivity than grammatical number marginally over frontal electrodes and significantly over central and posterior electrodes (person frontal: $F(1,23) = 18.39$, $p < .001$; person central: $F(1,23) = 18.88$, $p = .001$; person parietal: $F(1,23) = 20.72$, $p = .001$; number frontal: $F(1,23) = 3.84$, $p = .062$; number central: $F(1,23) = 14.9$, $p = .001$; number parietal: $F(1,23) = 19.55$, $p < .001$). The analysis by feature factor showed that neither grammatical person and number nor ungrammatical person and number differ in any mid region.

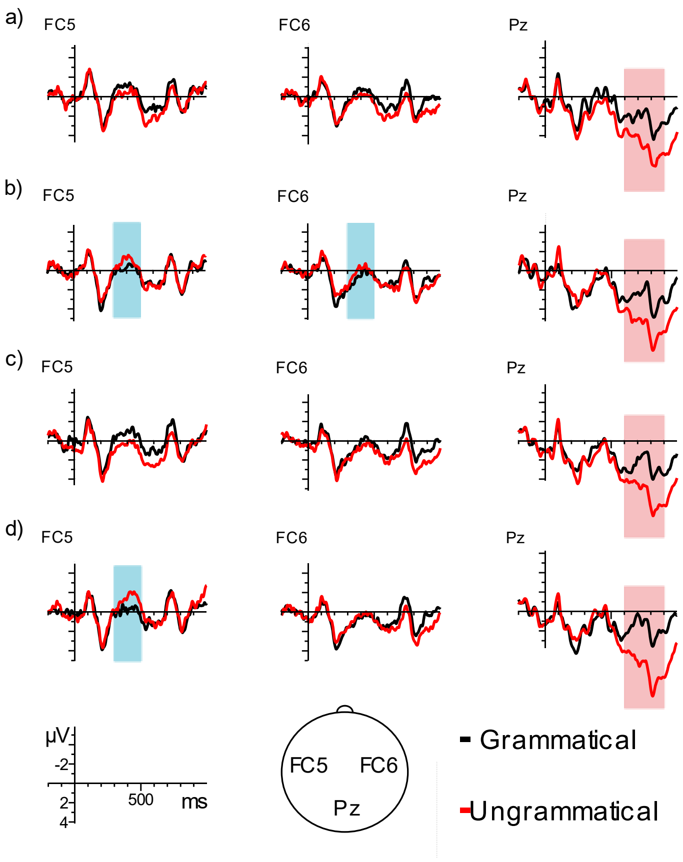


Figure 18. (a) person feature unaccusative predicate condition; (b) number feature unaccusative predicate condition; (c) person feature unergative predicate condition; (d) number feature unergative predicate condition.

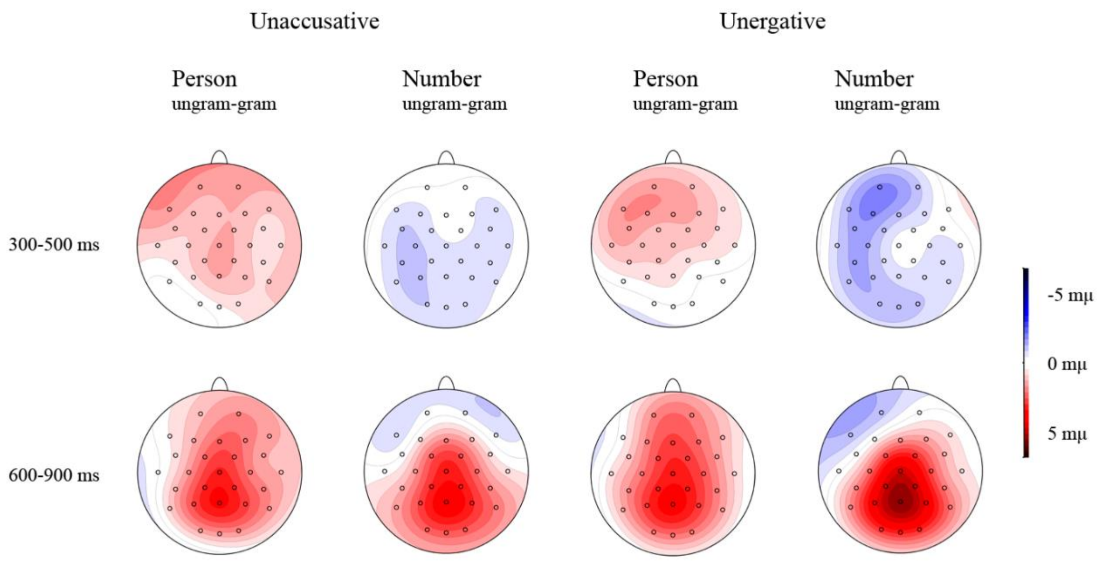


Figure 19. Mean voltage difference maps (grammatical minus ungrammatical).

		300-500 ms		600-900 ms	
		Lateral	Midline	Lateral	Midline
	df	F	F	F	F
GRAM	1,23	.01	.62	****14.21**	*****25.14**
TYPE	1,23	^*1.04*	2.99	.18	.01
FEAT	1,23	.07	.74	.0	.46
TYPE*GRAM	1,23	.14	.43	.52	.93
FEAT*GRAM	1,23	****10.53**	***6.75**	.06	.0
TYPE*FEAT*GRAM	1,23	.01	.0	.05	.19
GRAM*HEM	1,23	.44	-	3.74	-
TYPE*GRAM*HEM	1,23	.0	-	.02	-
FEAT*GRAM*HEM	1,23	***5.48**	-	.08	-
TYPE*FEAT*GRAM*HEM	1,23	2.45	-	.43	-
GRAM*REGION	2,46	2.75	.3	****10.6**	*****12.85**
TYPE*GRAM*REG	2,46	.36	.76	.23	.41
FEAT*GRAM*REG	2,46	1.48	.31	***4.69**	***5.02**
TYPE*FEAT*GRAM*REG	2,46	.32	.82	.13	.37
GRAM*HEM*REG	2,46	.49	-	1.81	-
TYPE*GRAM*HEM*REG	2,46	2.09	-	1.72	-
FEAT*GRAM*HEM*REG	2,46	****7.08**	-	.48	-
TYPE*FEAT*GRAM*HEM*REG	2,46	.26	-	.41	-

Table 19. Summary of the ERP results. Main effects and interactions with grammaticality are shown. GRAM (grammaticality), TYPE (type), FEAT (feature), HEM (hemisphere) and REG (region). ^ p = < .1, * p = < .05, ** p = < .01, *** p = < .001.

3.3 Summary of the results

Non-native speakers of Spanish were very accurate in the acceptability task. They were more accurate responding to acceptability questions in sentences containing unergative predicates than in sentences unaccusative predicates, and they were also more accurate with sentences containing number feature than person feature, although they were more accurate with grammatical person than with grammatical number. Participants reacted similarly to predicate type and feature, but they were slightly faster with grammatical sentences containing person feature than with grammatical sentences containing number feature, and slightly faster with ungrammatical unergatives containing number feature than with ungrammatical unaccusatives containing person feature.

Regarding electrophysiological results, no significant differences with regard to predicate type were found. With regard to phi-features, in the early time window (300-500 ms), non-native speakers of Spanish generated a negative component for agreement violations of unaccusative sentences with number feature, and a positive component for unergatives with person feature. Regarding grammatical sentences, person generated a larger negativity than number, whereas regarding ungrammatical sentences, number generated a larger negativity than person. In the late time-window (600-900 ms), a late positive component (P600) was found for agreement violations in all conditions, but it did not interact with either predicate type or feature.

4 Comparison of the results obtained for L1 and L2 speakers of Spanish

First behavioral results will be presented. A table is provided below to illustrate the percentage of correct responses per condition.

4.1 Behavioral results

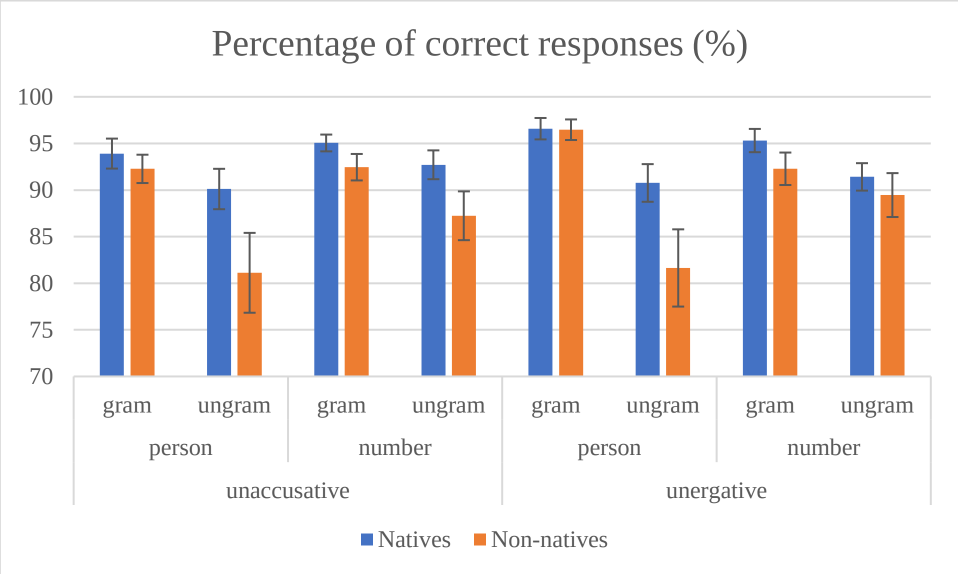


Table 20. Percentage of correct responses (%) and standard deviation error (SDE).

Regarding accuracy, a GROUP effect was found (*F1*(1,46) = 4.68, *p* =.036; *F2*(1,508) = 69.15, *p* <.001), showing that overall natives were more accurate than non-natives (93.25% vs 89.15%). A main TYPE effect was found (*F*(1,46) = 6.73, *p* =.013; *F2*(1,508) = 3.71, *p* =.055), indicating that participants were more accurate with unergative sentences (91.78%) than with unaccusative sentences (90.61%). A main GRAMMATICALITY effect (*F1*(1,48) = 16.78, *p* <.001; *F2*(1,508) = 131.6, *p* <.001) was found, indicating that participants were more accurate with grammatical sentences (94.32%) than with ungrammatical sentences (88.07%). A main FEATURE effect turned significant in the analysis by item (*F2*(1,508) = 7.88, *p* =.005), indicating that participants were more accurate with sentences containing number feature (92.02%), than with sentences containing person feature (90.37%).

A GRAMMATICALITY*GROUP interaction emerged in the analysis by item (*F1*(1,46) = 2.18, *p* =.147; *F2*(1,508) = 16.94, *p* <.001). The analysis by grammaticality factor showed that both groups were more accurate with grammatical sentences compared to ungrammatical sentences (95.25% vs. 91.18%; 93.13% vs 84.83%) (natives: *F2*(1,508) = 28.59, *p* <.001; non-natives: *F2*(1,508) = 118.96, *p* <.001). The T-test showed that natives were more accurate than non-natives both for grammatical sentences (95.25% vs.

93.13%) (*F2*(1,508) = 0.69, *p* =.002), and for ungrammatical sentences (91.18% vs 84.83%) (*F2*(1,508) = 0.33, *p* <.001).

A GRAMMATICALITY*FEATURE interaction emerged (*F1*(1,46) = 5.22, *p* =.027; *F2*(1,508) = 30.89, *p* <.001). The analysis by grammaticality factor showed that participants were more accurate with grammatical sentences (94.81%) than with ungrammatical sentences (85.94%) containing person feature (*F*(1,46) = 13.84, *p* =.001), and similarly, participants were more accurate with grammatical sentences (93.84%) than with ungrammatical sentences (90.2%) containing number feature (*F*(1,46) = 7.31, *p* =.009). The analysis by feature factor revealed that participants were slightly more accurate with ungrammatical sentences containing number feature (90.2%) than with ungrammatical sentences containing person feature (85.94%) (*F*(1,46) = 3.47, *p* =.069).

A TYPE*GRAMMATICALITY*FEATURE interaction emerged in the analysis by item (*F1*(1,46) = 3.31, *p* =.075; *F2*(1,508) = 12.28, *p* <.001). The analysis by grammaticality factor showed that participants are more accurate with grammatical unaccusative sentences (93.09%) than with ungrammatical unaccusatives containing person feature (85.61%) (*F*(1,46) = 8.46, *p* =.006). Participants were also more accurate with grammatical unaccusative sentences (93.75%) than with ungrammatical unaccusatives containing number feature (89.98%) (*F*(1,46) = 6.15, *p* =.017). Participants were more accurate with grammatical unergative sentences (96.52%) than with ungrammatical unergatives containing person feature (86.26%) (*F*(1,46) = 19.49, *p* <.001). Similarly, participants were more accurate with grammatical unergative sentences (93.93%) than with ungrammatical unergatives containing person feature (90.43%) (*F*(1,46) = 6.15, *p* =.017). The analysis by type showed that participants were more accurate with grammatical unergatives containing person feature (96.52%) than with unaccusatives containing person feature (93.09%) (*F*(1,46) = 23.1, *p* <.001). The analysis by feature revealed that participants were slightly more accurate with ungrammatical unaccusatives containing number feature (89.98%) than with ungrammatical unaccusatives containing person feature (85.61%) (*F*(1,46) = 3.28, *p* =.077). Participants were more accurate with grammatical unergatives containing person feature (96.52%) than with grammatical unergatives containing number feature (%93.75) (*F*(1,46) = 7.59, *p* =.008), whereas participants were slightly more accurate with ungrammatical unergatives containing number feature (90.43%) than with ungrammatical unergatives containing person feature (86.26%) (*F*(1,46) = 3.19, *p* =.08).

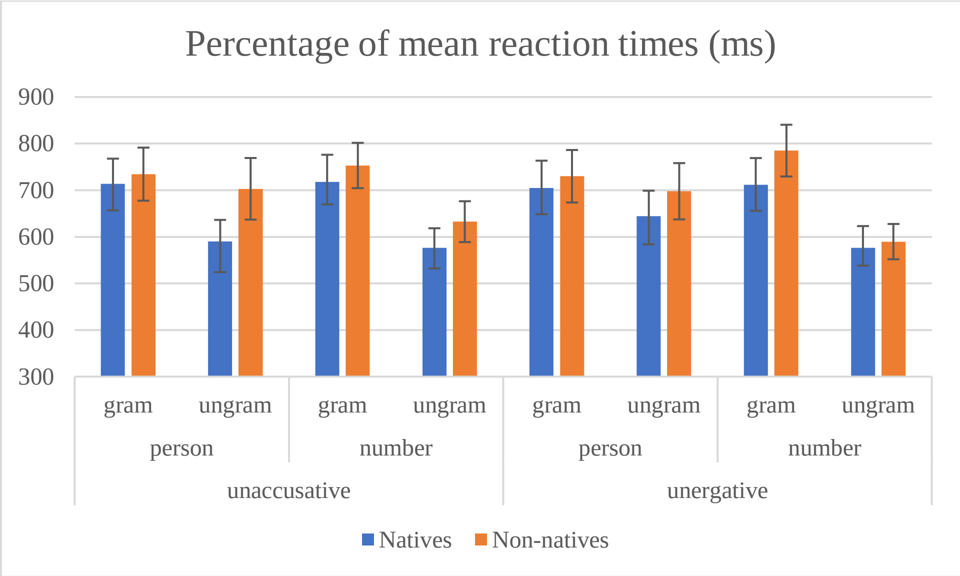


Table 21. Mean reaction times (ms) and standard deviation error (SDE).

With regard to reaction times, a main GRAMMATICALITY effect (*F1*(1,48) = 19.98, *p* <.001; *F2*(1,508) = 201.64, *p* <.001) was found, indicating that participants reacted faster to ungrammatical sentences (626.29 ms) than to grammatical sentences (731.37%). A main GROUP effect emerged in the analysis by item (*F2*(1,508) = 3.98, *p* =.047), indicating that natives reacted faster than non-natives (671.37 ms vs. 692.22 ms).

A marginally significant TYPE*GRAM*GROUP interaction emerged (*F1*(1,48) = 3.6, *p* =.064; *F2*(1,508) = 3.8, *p* =.052). The analysis by grammaticality factor found that participants reacted faster to ungrammatical unaccusatives than to grammatical unaccusatives (natives: *F*(1,46) = 16.76, *p* <.001; non-natives: *F*(1,46) = 5.49, *p* =.023). Similarly, participants reacted faster to ungrammatical unergatives than to grammatical unergatives (natives: *F*(1,46) = 6.29, *p* =.016; non-natives: *F*(1,46) = 8.48, *p* =.006). The analysis by type factor found no differences across type. The T-test found no differences between natives and non-natives.

A GRAMMATICALITY*FEATURE interaction emerged (*F1*(1,48) = 5.86, *p* =.02; *F2*(1,508) = 14.62, *p* <.001). The analysis by grammaticality factor found that participants reacted faster to ungrammatical sentences containing number feature (593.66 ms) than to grammatical sentences containing number feature (720.83 ms) (*F*(1,46) =

70.21, *p* <.001). The analysis by feature revealed that participants reacted faster to ungrammatical sentences containing number feature (593.66 ms) than to ungrammatical sentences containing person feature (658.92 ms) ($F(1,46) = 4.36$, p =.042).

A TYPE*GRAMMATICALITY*FEATURE interaction emerged ($F1(1,48) = 4.72$, p =.035; $F2(1,508) = 2.97$, p =.086). The analysis by grammaticality factor revealed that participants reacted faster to ungrammatical unaccusatives (646.75 ms) containing person feature than to grammatical unaccusatives containing person feature (724.15) ($F(1,46) = 4.26$, p =.045). They also reacted faster to ungrammatical unaccusatives containing number feature (604.34 ms) than to grammatical unaccusatives containing number feature (735.64 ms) ($F(1,46) = 44.54$, p <.001). Participant also reacted faster to ungrammatical unergatives containing number feature (582.97 ms) than to grammatical unergatives containing number feature (748.19 ms) ($F(1,46) = 54.49$, p <.001). The analysis by type factor found no differences across type. The analysis by feature factor found that participants reacted faster to ungrammatical unergatives containing number feature (671.08 ms) than to ungrammatical unergatives containing person feature (582.97 ms) ($F(1,46) = 7.23$, p =.01).

4.2 ERP results

Regarding the early time window (300-500 ms), the analysis of lateral electrodes between groups revealed a marginally significant main GROUP effect ($F(1,46) = 3.8$, p =.057) indicating that natives generate a larger negativity than non-natives (-0.67 µV vs. 0.27 µV). A main FEATURE effect also emerged ($F(1,46) = 6.53$, p =.014), indicating that number elicited a larger negative than person (-0.35 µV vs. -0.05 µV).

A FEATURE*GROUP interaction emerged ($F(1,46) = 7.84$, p =.007). Further analyses by feature factor showed that number generated a larger negativity than person in native speakers (-0.99 µV vs. -0.35 µV), whereas number and person do not differ in non-natives (0.28 µV vs. 0.25 µV) (natives: $F(1,23) = 14.33$, p <.001; non-natives: $F(1,23) = 0.03$, p =.864). The comparison between both groups showed that natives elicited a larger negativity for number feature than non-natives (-0.99 µV vs. 0.28 µV) ($F(1,23) = 3.93$, p =.016).

A TYPE*GRAM*GROUP interaction emerged ($F(1,46) = 4.59$, p =.037). The analysis by grammaticality factor showed that natives generated a larger negativity for ungrammatical unaccusatives than for grammatical unaccusatives (-0.91 µV vs. -0.23 µV) ($F(1,23) = 6.89$, p =.012), whereas non-natives did not differ with regard to grammaticality neither in unaccusatives nor in unergatives. The analysis by type factor showed that natives generated a larger negativity for grammatical unergatives than for grammatical unaccusatives (-0.84 µV vs. -0.23 µV) ($F(1,23) = 5.77$, p =.02), whereas non-natives did not differ with regard to the predicate type. Finally, the t-test showed that natives generated a larger negativity than non-natives for grammatical unergatives (-0.84 µV vs. 0.37 µV) ($F(1,23) = 3.7$, p =.025), for ungrammatical unaccusatives (-0.91 µV vs. 0.21 µV) ($F(1,23) = 1.59$, p =.047), and marginally for ungrammatical unergatives (-0.71 µV vs. 0.31 µV) ($F(1,23) = 0.73$, p =.079).

A FEATURE*GRAMMATICALITY interaction emerged ($F(1,46) = 7.81$, p =.008). The analysis by grammaticality factor showed that there are no differences between grammatical and ungrammatical person, whereas ungrammatical number generated a larger negativity than grammatical number (-0.6 µV vs. -0.11 µV) ($F(1,46) = 9.17$, p =.004). The analysis by feature factor revealed no differences between grammatical person and number, but ungrammatical number generated a larger negativity than ungrammatical person (-0.6 µV vs. 0.51 µV) ($F(1,46) = 13.43$, p =.001).

A FEATURE*GRAMMATICALITY*HEMISPHERE interaction also emerged ($F(1,46) = 7.48$, p =.009). Further analyses by grammaticality factor showed that sentences containing ungrammatical number generated a larger negativity than sentences containing grammatical number over the left hemisphere (-1,25 µV vs. -0.54 µV) ($F(1,46) = 15.14$, $p < .001$). The analysis by feature factor showed that ungrammatical number elicits a larger negativity than ungrammatical person over left and right hemisphere (-1,25 µV vs. -0.36 µV; 0.05 µV vs. 0.46 µV) (left: $F(1,23) = 18.28$, $p < .001$; right $F(1,46) = 6.21$, p =.016). Furthermore, a marginally significant FEATURE*GRAMMATICALITY*HEMISPHERE*REGION interaction also emerged ($F(1,46) = 3.23$, p =.06).

The analysis of midline electrodes showed a main FEATURE effect ($F(1,46) = 4.37$, p =.042), indicating that number elicited a larger negativity than person (-0.41 µV vs. -0.06 µV).

A FEATURE*GROUP interaction emerged ($F(1,46) = 8.26$, p =.006). Further analyses by feature factor showed that number generates a larger negativity than person in native speakers (-1.21 µV vs. -0.37 µV), whereas number and person do not differ in non-natives

(0.39 μV vs. 0.25 μV) (natives: $F(1,23) = 12.33$, $p = .001$; non-natives: $F(1,23) = 0.31$, $p = .582$). The t-test showed that natives elicit a larger negativity for number feature than non-natives (-1.21 μV vs. 0.39 μV) ($F(1,23) = 1.49$, $p = .029$).

A marginally significant FEATURE*GRAMMATICALITY interaction emerged ($F(1,46) = 3.28$, $p = .077$). The analysis by grammaticality factor showed that there are no differences between grammatical and ungrammatical person, and similarly there are no differences between grammatical and ungrammatical number. The analysis by feature factor revealed no differences between grammatical person and number, but ungrammatical number generated a larger negativity than ungrammatical person (-0.53 μV vs. 0.15 μV) ($F(1,46) = 6.9$, $p = .012$).

A GRAM*REGION*GROUP interaction emerged ($F(1,46) = 9.11$, $p < .001$). Subsequent analyses (by grammaticality or group) showed no differences between natives and non-natives.

Regarding the late time window (600-900 ms), the analysis of the lateral electrodes revealed a main GRAMMATICALITY effect ($F(1,46) = 38.96$, $p < .001$), indicating that ungrammatical sentences (2.37 μV) generates a larger positivity than grammatical ones (0.97 μV).

In addition, a TYPE*GRAMMATICALITY interaction emerged ($F(1,46) = 7.21$, $p = .01$). The analysis by grammaticality factor showed that ungrammatical unaccusatives (2.24 μV) elicit a larger positivity than grammatical unaccusatives (1.15 μV) ($F(1,46) = 18.5$, $p < .001$), and similarly ungrammatical unergatives (2.49 μV) elicit a larger positivity than grammatical unergatives (0.8 μV) ($F(1,46) = 45.94$, $p < .001$). The analysis by type factor found that grammatical unaccusatives (1.15 μV) elicited a marginally larger positivity than grammatical unergatives (0.8 μV) ($F(1,23) = 3.41$, $p = .071$).

A GRAM*REGION*GROUP interaction emerged ($F(1,46) = 3.94$, $p = .043$). Further analyses by grammaticality factor showed that regarding native speakers, ungrammatical sentences elicited a larger positivity than grammatical ones marginally over frontal regions and significantly over centro-parietal regions (frontal: $F(1,46) = 3.26$, $p = .077$; mid: $F(1,46) = 29.98$, $p < .001$; posterior: $F(1,46) = 41.73$, $p < .001$). Regarding non-native speakers, similarly, ungrammatical sentences elicited a marginally larger positivity than grammatical ones over frontal regions and significantly over central and posterior regions (frontal: $F(1,46) = 3.56$, $p = .065$; mid: $F(1,46) = 9.28$, $p = .004$; posterior: $F(1,46) = 16.48$, $p < .001$). Finally, the t-test found no differences between both groups either when comparing grammatical sentences over each region or when comparing ungrammatical sentences.

A FEATURE*GRAM*REGION interaction emerged ($F(1,46) = 4.31$, $p = .037$). Further analyses by grammaticality factor showed that sentences containing ungrammatical person generated a larger positivity than sentences containing grammatical person (frontal: $F(1,46) = 5.46$, $p = .024$; mid: $F(1,46) = 17.95$, $p < .001$; posterior: $F(1,46) = 30.55$, $p < .001$), and similarly sentences containing ungrammatical number generated a larger positivity than sentences containing grammatical number marginally over frontal electrodes and significantly over central and posterior electrodes (frontal: $F(1,46) = 2.91$, $p = .095$; mid: $F(1,46) = 30.16$, $p < .001$; posterior: $F(1,46) = 53.6$, $p < .001$). The analysis by feature factor showed that grammatical person elicits a larger positivity (1.24 µV) than grammatical number (0.79 µV) significantly over central electrodes ($F(1,23) = 4.05$, $p = .05$), and marginally over posterior electrodes (1.83 µV vs. 1.43 µV) ($F(1,23) = 3.44$, $p = .07$).

The analysis of midline electrodes showed a main GRAMMATICALITY effect ($F(1,46) = 61.24$, $p < .001$), indicating that ungrammatical sentences (1.29 µV) generates a larger positivity than grammatical ones (3.79 µV).

A TYPE*GRAMMATICALITY interaction emerged ($F(1,46) = 7.04$, $p = .011$). The analysis by grammaticality factor showed that ungrammatical unaccusatives (3.54 µV) elicit a larger positivity than grammatical unaccusatives (1.47 µV) ($F(1,46) = 34.89$, $p < .001$), and similarly ungrammatical unergatives (4.04 µV) elicit a larger positivity than grammatical unergatives (1.12 µV) ($F(1,46) = 62.8$, $p < .001$). The analysis by type factor found that ungrammatical unergatives (4.04 µV) generate a larger positivity than ungrammatical unaccusatives (3.54 µV) ($F(1,23) = 4.32$, $p = .043$).

A marginally significant GRAM*REGION*GROUP interaction emerged ($F(1,46) = 3.19$, $p = .058$). Further analyses by grammaticality factor showed that regarding native speakers, ungrammatical sentences elicited a larger positivity than grammatical ones in all regions (frontal: $F(1,46) = 25.55$, $p < .001$; mid: $F(1,46) = 30.86$, $p < .001$; posterior: $F(1,46) = 53.04$, $p < .001$). Regarding non-native speakers, similarly, ungrammatical sentences elicited a larger positivity than grammatical ones in marginally over frontal regions and significantly over central and posterior regions (frontal: $F(1,46) = 13.77$, $p < .001$; mid: $F(1,46) = 19.68$, $p < .001$; posterior: $F(1,46) = 22.7$, $p < .001$). Finally, the T-test found no differences between groups.

A FEATURE*GRAM*REGION interaction emerged ($F(1,46) = 8.66$, $p = .001$). Further analyses by grammaticality factor showed that sentences containing ungrammatical person generated a larger positivity than sentences containing grammatical person (frontal: $F(1,46) = 33.19$, $p < .001$; mid: $F(1,46) = 33.11$, $p < .001$; posterior: $F(1,46) = 44.14$, $p < .001$), and similarly sentences containing ungrammatical number generated a larger positivity than sentences containing grammatical number (frontal: $F(1,46) = 16.47$, $p < .001$; mid: $F(1,46) = 37.81$, $p < .001$; posterior: $F(1,46) = 63.14$, $p < .001$). The analysis by feature factor showed that sentences containing grammatical person (2.43 µV) elicited a slightly larger positivity than sentences grammatical number (1.83 µV) over posterior electros ($F(1,23) = 4.01$, $p = .051$).

		300-500 ms		600-900 ms	
		Lateral	Midline	Lateral	Midline
	df	F	F	F	F
GROUP	1,23	^*3.8*	2.78	.04	.38
GRAM	1,23	1.36	.29	*****38.96**	*****61.24**
GRAM*GROUP	1,23	1.1	.52	1.81	1.68
TYPE	1,23	.05	.7	.13	.15
TYPE*GROUP	1,23	1.99	2	.06	.07
FEAT	1,23	***6.53**	***4.37**	.65	.09
FEAT*GROUP	1,23	****7.84**	****8.26**	.65	1.13
TYPE*GRAM	1,23	2.74	.54	***7.21**	***7.04**
TYPE*GRAM*GROUP	1,23	***4.59**	2.66	^*3.07*	1.9
FEAT*GRAM	1,23	****7.81**	^*3.28*	1.36	1.31
FEAT*GRAM*GROUP	1,23	^*3.33*	^*2.96*	2.2	1.22
TYPE*FEAT*GRAM	1,23	.07	.09	.0	.01
TYPE*FEAT*GRAM*GROUP	1,23	.21	.12	.13	.35
GRAM*HEM	1,23	2.63	-	****7.94**	-

GRAM*HEM*GROUP	1,23	.34	-	.0	-
TYPE*GRAM*HEM	1,23	.0	-	.01	-
TYPE*GRAM*HEM*GROUP	1,23	.01	-	.08	-
FEAT*GRAM*HEM	1,23	****7.48**	-	.44	-
FEAT*GRAM*HEM*GROUP	1,23	.09	-	.11	-
TYPE*FEAT*GRAM*HEM	1,23	1.19	-	.94	-
TYPE*FEAT*GRAM*HEM*GROUP	1,23	1.19	-	.0	-
GRAM*REGION	2,46	3.65	*****10.21**	*****36.19**	*****38.83**
GRAM*REGION*GROUP	2,46	.77	*****9.59**	***3.94**	^*3.19*
TYPE*GRAM*REG	2,46	.71	.77	.26	1.57
TYPE*GRAM*REG*GROUP	2,46	.01	.25	.06	.22
FEAT*GRAM*REG	2,46	1.4	1.5	***4.31**	****8.66**
FEAT*GRAM*REG*GROUP	2,46	1.42	.15	2.05	.09
TYPE*FEAT*GRAM*REG	2,46	.83	.59	.3	.07
TYPE*FEAT*GRAM*REG*GROUP	2,46	.07	.74	.02	.66
GRAM*HEM*REG	2,46	.44	-	*****9.53**	-
GRAM*HEM*REG*GROUP	2,46	.15	-	1.47	-
TYPE*GRAM*HEM*REG	2,46	1.24	-	.25	-
TYPE*GRAM*HEM*REG*GROUP	2,46	.6	-	2.01	-
FEAT*GRAM*HEM*REG	2,46	3.23	-	.04	-
FEAT*GRAM*HEM*REG*GROUP	2,46	1.11	-	.71	-
TYPE*FEAT*GRAM*HEM*REG	2,46	.12	-	.25	-
TYPE*FEAT*GRAM*HEM*REG*G	2,43	.25	-	.27	-

Table 22. Summary of the ERP results. Main effects and interactions with grammaticality are shown. GRAM (grammaticality), TYPE (type), FEAT (feature), HEM (hemisphere) and REG (region). ^ p = < .1, * p = < .05, ** p = < .01, *** p = < .001.

4.3 Summary of the results

Regarding accuracy, non-natives were less accurate than natives, overall participants were more accurate with unergative sentences than with unaccusative sentences, and they were more accurate with sentences containing number feature than person feature. Regarding reaction times, non-natives were slower than natives, and participants reacted faster to ungrammatical sentences containing number feature than person feature.

Electrophysiological results in the early time-window (300-500 ms) revealed that both groups generated a negative component for unaccusative predicates containing number feature, and this negativity was also significant when taking number feature with unaccusative and unergative predicates together. Unergatives containing person feature generated a marginally significant positivity. Results showed that sentences containing number feature elicit a larger negativity than sentences containing person feature. Non-natives elicited a smaller negativity for grammatical number, ungrammatical number and grammatical person feature than natives.

With regard to the late time-window (600-900 ms), all conditions yielded a positive component (P600). Grammatical unaccusatives generated a slightly larger positivity than grammatical unergatives, and ungrammatical unergatives elicit a larger positivity than ungrammatical unaccusatives. Regarding feature, grammatical sentences containing person elicited more positive responses than grammatical sentences containing number over central and posterior electrodes.

5 Discussion

This chapter aimed to analyze how early and high proficient non-native speakers of Spanish process intransitive predicates and phi-features, and whether they process them similarly to natives or not. In general, similar effects and interactions were found for non-native speakers as compared to native speakers of Spanish, namely, differences in the processing of unaccusative and unergative predicates and person and number phi-features were observed for both groups. Non-natives were overall less accurate and slower than natives behaviorally, and regarding brain activity non-natives generated a smaller negativity for grammatical number, ungrammatical number and grammatical person feature than natives. The pattern is similar to that found with non-native speakers of Basque in Chapter III, indicating that the processing of phi-features is a fine-grained area where smaller components can be found in non-native speakers. In Chapter III, I concluded that the differences observed between native and non-native speakers may be due to divergent case morphology and this possibility is also considered for the results obtained in this last experiment. Here, I first discuss the similarities and differences between non-native speakers and their native counterparts and the hypotheses entertained regarding nativelikeness, and then I briefly discuss the UH and FDH.

Overall, non-native speakers of Spanish were slower and less-accurate than native speakers when reacting to the questions displayed after reading each sentence. These results contrast with the results obtained from Basque, where no differences were observable at a behavioral level. Longer reaction times and the lower accuracy may be attributed to a lesser use of the language (see Table 16). In any case, similar effects and interactions between predicate type and phi-features emerged for non-native and native speakers. Non-native speakers generated smaller negativities than natives when presented with subject-verb agreement violations. This effect was also found for non-native speakers of Basque and two possible explanations were suggested: (1) Spanish speakers do not generate negativity when processing SV agreement violations of unaccusative predicates in Spanish, and this is why no negativity is observed for SV agreement violations in Basque (transfer from L1 to L2); (2) the processing of SV agreement violations is a fine-grained aspect of grammar and non-native speakers generate smaller effects in their second language, a tendency also found in other studies with early and highly proficient bilinguals (Kotz et al., 2008; Zawiszewski & Laka, 2020, i.a.).

The results obtained in this chapter support the second explanation. Case morphology is divergent in Basque and Spanish: Spanish is a nominative-accusative language and Basque an active-inactive language. As such, the processing of divergent case morphology may account for the smaller negativities obtained for non-native speakers in Basque and Spanish. I also discussed that the negativity obtained in SV agreement violations is not very reliable, because the amplitude, latency and topography of the negativity differs significantly in most studies that have analyzed SV agreement violations. In any case, the effects and interactions obtain for both non-native and native speakers, suggesting that the processing of intransitive predicates and phi-features is similar for both groups.

The results obtained in this experiment support all four hypotheses entertained, because non-native speakers of Spanish processed intransitive predicates and phi-features similarly to native speakers. Nevertheless, if this experiment is taken in the context of previous studies, similarly to native vs. non-natives in Basque, the results are best accounted for by the Language Distance Hypothesis (LDH). The Similarity and Convergence Hypotheses both predicted these results, because they claim that either natives and non-natives process the language alike, or native-like competence can be attained as a function of proficiency. Nevertheless, differences have been found between native and highly proficient non-native speakers (Díaz et al., 2016; Erdocia et al., 2014; Zawiszewski et al., 2011; Zawiszewski & Laka, 2020). Similarly, The Difference Hypothesis claims that native-like competence is not attainable once maturational constraints have run their course. Early bilinguals took part in the studies above and this experiment, thus, these results do not support this hypothesis. Finally, the LDH claims that differences between native and non-native speakers will emerge if non-shared grammatical phenomena are tested, as in (Díaz et al., 2016; Erdocia et al., 2014; Zawiszewski et al., 2011; Zawiszewski & Laka, 2020). This study analyzed subject-verb agreement violation, a phenomenon present and not divergent in Basque and Spanish in intransitive predicates, where Basque and Spanish diverge. Overall, non-natives processed intransitive predicates and phi-features similarly to natives, as predicted by the LDH.

Regarding the UH, the comparison of both groups yielded greater accuracy for unergatives than for unaccusatives, and larger positive waveforms for ungrammatical unergatives than ungrammatical unaccusatives, thus supporting the main claims of the UH: (1) unergative and unaccusative predicates undergo different derivations, and (2) unaccusatives undergo an extra step in the derivation in Spanish. Although the results for non-natives taken individually did not show any electrophysiological difference between predicate type, when analyzed together with native speakers the pattern was found, suggesting that, non-natives also show a positive trend towards lesser costs for the processing of unergative predicates.

Concerning phi-features, the comparison of non-native and native speakers of Spanish yielded faster reaction times for sentences containing number feature than person feature, and larger negativities for number feature. I offered an explanation for these results in the discussion of the previous chapter, which I present again in the following lines. This is the first time that person (2^{nd} vs 1^{st}) and number (3^{rd} singular vs. plural) were compared using the design inside the brackets for Spanish. Previous studies comparing person and number features in Spanish found some kind of negative component for person and number violations (Mancini et al., 2011a; Silva-Pereyra & Carreiras, 2007). The results for person violations lack negativity, and even contain some positivity. This has not been reported before, and I believe the results might be accounted for by the materials used in the experiment. The sentences containing person feature had the 2nd person subjects, which participants may have considered as vocatives, not an option for sentences containing number feature, which had 3rd person subjects. In that case, sentences containing person feature would have been more acceptable compared to sentences containing number feature. The negativities obtained for number violations are similar to the negativities found in previous studies in Spanish (Mancini et al., 2011a; Silva-Pereyra & Carreiras, 2007), not so much as a N400 and more of an Anterior Negativity. In sum, these results support the first claim of the Feature Distinctness Hypothesis, indicating that person and number features are processed differently, but do not support the idea that person is more salient than number, since negativity was only observed for number violations.

All in all, this experiment showed that non-natives process intransitive predicates and phi-features differently, as natives did. Therefore, I conclude that native-like competence can be attained in early and highly proficient non-native speakers concerning non-divergent grammatical properties.

6 Summary of the findings

In this last chapter, I have studied the processing of intransitive predicates and phi-features by non-native speakers of Spanish, and I have compared their results with those of native speakers. Non-native speakers processed intransitive predicates and phi-features similarly to natives, similar effects and interactions obtained in the comparison between groups. Nevertheless, non-natives were slower, less accurate and generated smaller negativities for violations, and I speculated that differences in case morphology may be responsible for these differences. This study showed that early and highly proficient non-native speakers can process shared properties of languages similarly to natives, as predicted by the LDH (Zawiszewski & Laka, 2020).

This study provided further evidence supporting the UH: differences between unaccusative and unergative predicates were found in the late time window (600-900 ms), with traits of costlier processing for the former; evidence was found supporting the FDH: differences were found between person and number features, but contrary to expected, traits of larger saliency were found for number feature.

All in all, this study has provided evidence which shows that at high levels of proficiency and an early AoA, native-like processing is attainable as long as the properties are shared between the native and the non-native language.

Chapter 6

VI General conclusions and questions for future research

In this dissertation I investigated: (i) the processing of intransitive predicates, (ii) the processing of phi-features, and (iii) the processing of shared linguistic structures with early and highly proficient non-native speakers. For that purpose, I tested the UH and the FDH in Basque by means of ERPs in Chapter II; I examined the processing of intransitive predicates and phi-features with non-native speakers of Basque and compared their results to those of native speakers in Chapter III; I tested the UH and the FDH in Spanish by means of ERPs in Chapter IV; and I analysed the processing of intransitive predicates and phi-features with non-native speakers of Spanish and compared their results to those of native speakers in Chapter V. In conclusion, I list below the main findings of this dissertation:

1. I provided novel evidence in support of the Unaccusative Hypothesis by means of ERPs in Basque and Spanish.
2. I tested the UH in an active-inactive language for the first time and I showed that unaccusatives do not show traits of costlier processing compared to unergatives in an active-inactive language like Basque. I argued that the differences in the cost of processing intransitive predicates rely on case alignment, and that in Basque unergatives are costlier to process compared to unaccusatives due to morphological weight.
3. I showed that person and number features are processed differently, thus providing evidence in favor of the Feature Distinctness Hypothesis in Basque and Spanish. However, I only found signs of more salience for person in Basque. In fact, I found signs of more salience for number in Spanish, and I discussed that these results may be due to the manipulations used in the materials.
4. I investigated the processing of intransitive predicates and phi-features with early and highly proficient non-native speakers of Basque and Spanish, showing that native-like processing of shared structures is possible. Hence, I provided evidence in favor of the Language Distance Hypothesis.

1 Main findings

In Chapter II, I tested the UH and the FDH in Basque by means of ERPs. The UH claims that there are two types of intransitive predicates: unaccusatives with a theme subject, and unergatives, with an agent subject (Perlmutter, 1978). It also claims that unaccusatives involve more derivations compared to unergatives, because arguments of unaccusative predicates are generated in object position and need to advance into subject position, framed in GB terms (Burzio, 1986). The UH has been tested by means of several behavioural methods (Bever & Sanz, 1997; Lee & Thompson, 2011; Meltzer-Asscher et al., 2015; Shetreet et al., 2009; Zeyrek & Acarturk, 2014; *inter alia*), but it has never been tested by means of electrophysiological methods. Here, I investigated whether the processing of unaccusative and unergative predicates yield different brain activations. Second, the FDH claims that person and number features are processed differently, and that person is more salient than number. In this second chapter, I analyzed person and number features by means of ERPs to studied their brain correlates.

I found differences between unaccusative and unergative predicates in Basque, thus supporting the UH. Nevertheless, both behavioral and electrophysiological results did not show signs of more processing costs for unaccusatives compared to unergative predicates. In contrast, the results suggest the opposite pattern: unergatives seem to be harder to process than unaccusatives in Basque. The present results suggest there are two distinct intransitive predicates: unaccusatives and unergatives. However, these results do not show signs of longer derivations for unaccusatives compared to unergatives, suggesting that the second claim of the UH does not apply to active languages and that the differences in terms of processing costs depend on case alignment. I argued that the signs of more processing costs for unergatives may be due to the markedness of ergative case in Basque, as it is the argument with more morphological weight.

Regarding phi-features, differences were observed both behaviorally and electrophysilogically, thus supporting the FDH. Furthermore, participants were faster more accurate and generated a larger negativity for sentences with person than for sentences with number feature, suggesting that person is more salient than number in terms of processing.

In Chapter III, I studied non-native speakers of Basque whose native language is Spanish to investigate whether early and highly proficient non-native speakers can process similarly to natives or not. Three main hypotheses have been put forth: (i) nativelike processing is not available after a certain age due to maturational constraints, (ii) non-native languages are processed nativelike, and (iii) processing language like natives is possible in high degrees of proficiency (Steinhauer, 2014). These hypotheses do not take into account language distance, and I also considered (iv) the Language Distance Hypothesis, which claims that only grammatical properties present in the native language (L1) can be processed in a nativelike fashion in the non-native language (L2) (Zawiszewski & Laka, 2020).

I used a grammatical property present in both Basque and Spanish, subject-verb agreement. Both groups processed intransitive predicates and phi-features similarly, with a few differences. Previous studies analyzing the processing of non-shared properties of grammar, such as word-order and case, with native and non-native speakers found differences between the two groups (Díaz et al., 2016; Erdocia et al., 2014; Zawiszewski et al., 2011; Zawiszewski & Laka, 2020). Taking these studies into account, I concluded that the LDH best explains the nativelike attainability issue, supporting the claim that only shared properties of grammar can be processed in a nativelike fashion.

In Chapter IV, similarly to Chapter II, I tested the UH and the FDH by means of ERPs, but for this study I chose native speakers of Spanish, a nominative-accusative language. The results obtained fully support the predictions made by the UH: (i) differences were observed between unaccusative and unergative predicates, (ii) and unaccusatives showed signs of more processing costs compared to unergative predicates. Considering the results in Chapter II and III, I concluded that there are two distinct categories within intransitive predicates, unaccusatives and unergatives. Nevertheless, following Levin's (1983) and Laka's (2000, 2006b) approaches to case assignment in Basque, I discussed that the longer derivations causing more processing costs for unaccusative predicates compared to unergative predicates may not apply to active languages like Basque, where case assignment correlates with theta relations.

Regarding the FDH, I found differences between person and number feature, supporting the claim that different mechanisms are used to process phi-features. Nevertheless, the differences found contradicted the predictions, since number feature showed signs of larger saliency compared to person feature. I discussed that this pattern of results may result from a caveat in the materials, due to the possibility that subjects of sentences containing person feature could initially be processed as vocatives. In any case, differences were observed between person and number features, and the negativities found in this study were different in topography, amplitude, and latency compared to the negativities found in Basque, suggesting that further research is needed in order to understand the nature of these brain correlates.

In Chapter V, I studied early and highly proficient non-native speakers of Spanish whose native language is Basque, and I compared their results to those obtained with natives in Chapter IV. Non-natives were less accurate, slower at reaction times than native speakers and did not generate negativity for agreement violations in unaccusative predicates, but both groups differentiated intransitive predicates and phi-features similarly. As a result, I concluded that non-natives process intransitive predicates and phi-features similarly to natives, thus supporting the LDH, and I attributed the differences to divergent a case morphology between the languages studied.

2 Further research

This dissertation offers new evidence in support of the UH and the LDH, and puts forth the FDH. Further research is needed in order to better understand the issues discussed throughout this work. I discuss some of these issues in the following lines.

Regarding the UH, I have discussed that besides the extra derivation step arguments in unaccusative predicates undergo, the agent preference may also be responsible for a costlier processing of arguments in unaccusative predicates compared to arguments in unergative predicates. In Chapters II and III, I found no sign of more derivation steps for unaccusatives in Basque, and in fact, I found traits of more processing costs for unergatives, which I related to an extra morphological mark. On the contrary, in Chapters IV and V, I found traits of more processing costs for unaccusative predicates compared to unergative predicates in Spanish, as previously attested in other nominative-accusative languages. Further research should study how agent first preference affects the processing of intransitive predicates in languages other than nominative-accusative, where subjects are not always assigned the same case.

Besides, in Chapters III and V, I studied the processing of subject-verb agreement with early and highly proficient non-native speakers. Intransitive predicates and phi-features were similarly proccesed by non-native and native speakers, but overall non-natives generated smaller components and were behaviorally less accurate and slower in Spanish. I discussed that these differences may be related to the difference in case morphology between Basque and Spanish, but also in the active use of the non-native language, and I believe future research should pay closer attention to the factor of active use of the non-native language.

Finally, the negativities obtained in Chapters II-V varied from Basque to Spanish, in both latency and topography. I labeled the negativity obtained in Basque as N400, but I refrained from labelling the negativity obtained in Spanish as any certain component, because it was distributed neither in posterior electrodes nor left anterior electrodes. It is still not clear how these negativities are modulated by, and as a result, further research is needed to better understand the nature of early negative components.

Laburpena euskaraz

Tesi honetan argumentu egitura, tasunak eta natibo/ez-natiboen prozesamendua jorratu ditut, eta horretarako zehaztasuna, erreakzio denborak eta garunaren aktibitatea neurtu ditut. Lehenik eta behin, Perlmutter-ek (1978) Hipotesi Ezakusatiboa (HE) aurkeztu zuen, eta defendatu zuen badirela bi predikatu iragangaitz mota: alde batetik, ezakusatiboak, argumentua bakarra objektu gisa sortu eta gai rol semantikoa dutenak; eta beste alde batetik, ezergatiboak, argumentu bakarra subjektu gisa sortu eta egile rol semantikoa dutenak. Psikohizkuntzalaritzaren arloan, hainbatetan testatu da HE (Bever & Sanz, 1997; Lee & Thompson, 2011; Meltzer-Asscher et al., 2015; Shetreet et al., 2009; Zeyrek & Acarturk, 2014; besteak beste), eta kasu gehienetan ezberdintasunak topatu dira bi predikatu moten artean. ERP bidez, dena den, ez da inoiz HE testatu, eta hori lehenengo aldiz egin dut tesi honetan euskaraz eta gaztelaniaz.

Bigarrenik, phi-tasunen prozesamendua aztertu dut. Subjektu-aditz komunztaduran, hiru komunztadura bereizi izan dira; pertsona, numeroa eta generoa, eta hauek phi-tasun izenarekin ezagutzen dira (Chomsky, 1995). Tasunok ez dira berdin ageri hizkuntza guztietan, baina hierarkikoki eta sistematikoki antolatuta daudela uste da. (Harley & Ritter, 2002). Greenberg-ek (1963) inplikazio hierarkia bat aurkeztu zuen tasun horientzat hizkuntzetan duten banaketari jarraiki: Pertsona > Numeroa > Generoa. Prozesamendu arloan, tasunak prozesatzeko mekanismo berak erabiltzen diren aztertu da, eta baita hierarkia horren baliozkotasuna ere (Carminati, 2005; Mancini et al., 2011; Nevins et al., 2007; Zawiszewski et al., 2016; besteak beste). Neuk ere, ERPen bitartez, pertsona eta numero tasunak nola prozesatzen diren ikertu dut euskaraz eta gaztelaniaz, lehen aldiz 1/2. pertsonak (pertsona) eta 3. pertsona singular eta plurala (numeroa) aztergai gisa erabiliz.

Hirugarrenik eta azkenik, tesion natiboen eta ez-natiboen prozesamendua ikertu dut. Ez dago argi ez-natiboek nola prozesatzen duten hizkuntza. Hiru hipotesi nagusi landu dira (Steinhauer, 2014): (1) adinari loturiko mugak daude, eta adin batetik gora ezin da beste hizkuntzarik modu natiboan ikasi (Abrahamsson & Hyltenstam, 2009; Johnson & Newport, 1989; Newport, 1988, besteak beste); (2) gramatikala unibertsala eskuragarri dago bizitza guztian zehar eta hizkuntza berriak natiboek bezala prozesatzen dira (Dulay et al., 1982; Hernandez et al., 2005; Schwartz & Sprouse, 1996, besteak beste); (3)

hasieran ez-natiboek ez dute hizkuntza natiboek bezala prozesatzen, baina maila eta erabilerak gora egin ahala natiboek bezala prozesatzea lor daiteke (Foucart & Frenck-Mestre, 2012; Green, 2003; Steinhauer et al., 2009; besteak beste). Zawiszewski eta Laka-k (2020) lehen bien arteko konbinaketa bat eginez Hizkuntza Distantzia Hipotesia (HDH) proposatzen dute: ez natiboak gai izango dira hizkuntza natiboek bezala prozesatzeko, baina soilik bi hizkuntzek komunean dituzten ezaugarri gramatikalei dagokionean. Hemen, natiboak eta maila altuko elebidun goiztiarrak ikertu eta konparatu ditut bai euskaraz, eta baita gaztelaniaz ere. Aztertu nahi izan dut ea maila altuetan, eta jabekuntza goiztiarretan, ez-natiboak hizkuntza natiboen gisara prozesatzeko gai diren, eta horretarako, predikatu iragangaitzak eta pertsona/numero tasunak erabili ditut.

Lehenengo kapitulua sarrera kapitulua da. Bertan, orain arte aipatu ditudan eta tesian lantzen diren metodologia, terminologia eta lan bibliografikoen inguruko aurkezpena egiten dut. Jarraian, 2-5 kapituluen inguruko edukiak laburtuko ditut.

1 Kapituluen laburpena

II. kapitulua

Kapitulu honetan predikatu iragangaitzen eta tasunen prozesamendua aztertu dut euskaraz euskarazko natiboekin ERPen bitartez. Alde batetik, Hipotesi Ezakusatiboa testatu dut (ikus goian), eta aldeak topatu ditut aditz ezkusatiboak eta aditz ezergatibodun esaldien artean: aditz ezakusatibodun esaldiekin azkarragoak izan dira aditz ezergatibodun esaldiekin baino, eta aditz ezakusatibodun esaldiek positibotasun handiagoa sortu dute aditz ezergatibodun esaldiek baino. Hori horrela, nire emaitzek HEren aldeko ebidentzia ematen dute, eta predikatu ezakusatibo eta ezergatiboak ezberdinak direla erakutsi dut. Haatik, HEk ere argudiatzen du predikatu ezakusatiboetako aditzek deribazio luzeagoak dituztela, eta hortaz, konplexuagoak direla prozesatzeko. Nire emaitzek ez dute horrelakorik erakusten. Aitzitik, nire emaitzek euskaraz predikatu ezakusatiboak prozesako ezergatiboak baino errazagoak direla iradokitzen dute. Azken hau, kasu ezarketarekin lotu dut: euskara hizkuntza aktiboa da, eta nominatibo-akusatiboetan ez bezala, egileak dira pisu morfologikoa jasotzen dutenak.

Beste aldetik, pertsona eta numero tasunak aztertu ditut. Horretarako, Tasun Ezberdintasun Hipotesia (TEH) testatu dut, zeinak pertsona eta numeroa ezberdin prozesatzen diren argudiatzen baituen, eta pertsona numeroa baino nabarmenagoa baiten. Esperimentuan aurkitu dut parte hartzaileak hobeagoak eta azkarragoak direla pertsona tasunarekin numero tasunarekin baino, eta pertsona tasuna prozesatzeak negatibotasun handiagoa eragiten du numero tasunak baino. Nire emaitzek TEH sostengatzen dutela ondorioztatu dut, pertsona eta numeroa ezberdin prozesatzen dira, eta pertsona numeroa baina nabarmenagoa da prozesamenduari dagokionez.

Azkenik, emaitza elektrofisiologikoek nabarmentzeko elkarrekintza bat erakusten dute predikatu mota eta phi-tasunen artean: zenbaki urraketek baldintza ezakusatiboan P600 handiagoa eragin zuten baldintza ezergatiboan baino, eta pertsona urraketek P600 handiagoa eragin zuten baldintza ezergatiboan numero urraketek baino. Elkarrekintza hau prototipikotasunarekin lotu dut: ezergatiboek subjektu egileak dituzte, bizitasun eskaletan nabarmenen, eta sarri gizakiak, non pertsona tasuna nabarmenen baiten; kontran, ezakusatiboek gai rol tematikoa duten subjektuak dituzte, bizitasun eskaletan oso behean, eta ez pertsona tasuna bezain nabarmen.

III. kapitulua

Kapitulu honetan, maila altuko ez-natibo goiztiarrek predikatu iragangaitzak eta phi-tasunak euskaraz nola prozesatzen dituzten aztertu dut, eta gerora natiboen emaitzekin erkatu ditut. Horretarako aditz-subjektu komunztadura urraketak erabili ditut. Aditz-subjektu komunztadura euskara zein gaztelaniak dute, hortaz, bi hizkuntzek komunean duten ezaugarri bat aztertu dut.

Konparaketek erakutsi dute jabekuntza goiztiar eta maila altuarekin natiboen gisako prozesamendua posible dela. Konduktualki ez da alderik topatu: bi multzoek erabaki azkarragoak hartu dituzte ezakusatiboekin ezergatiboekin baino, eta hobeagoak zein azkarragoak izan dira pertsona tasundun esaldiekin numero tasundunekin baino. Emaitza elektrofisiologikoei dagokionez ere, antzeko elkarrekintzak topatu dira: positibotasun handiagoa ezakusatiboen kasuan, negatibotasun handiagoa pertsonaren kasuan, eta baita predikatu mota eta tasunen arteko elkarrekintza ere. Ez natiboen kasuan, ez da negatibotasunik aurkitu predikatu ezakusatiboen urraketen kasuan, eta P600 txikiagoa sortu dute ezergatiboetan natiboek baino. Ezberdintasun horiek bi hizkuntzen arteko kasu morfologia ezberdinek izan ditzaketen eraginei egotzi dakiekeela ondorioztatu dut.

Hortaz gain, aurreko kapituluan testatu ditudan hipotesiak, HE eta TDH ere aztertu ditut esperimentu honetan, emaitza berekin: (i) HEren aldeko ebidentzia lortu dut, predikatu ezakusatiboak eta ezergatiboak ezberdin prozesatu baitituzte, dena den, predikatu ezergatiboak prozesatzeko zailtasun gehiago erakutsi dute predikatu ezakusatiboekin alderatuta, HEk argudiatzen duenaren kontra; (ii) TDHren aldeko emaitzak lortu ditut, pertsona eta numero tasunak ezberdin prozesatzen direla erakutsi dut eta pertsona numeroa baino nabarmenagoa dela.

Funtsean, erakutsi dut maila altuko ez-natibo goiztiarrek beste hizkuntzan aztertzen diren ezaugarri gramatikalak ama-hizkuntzan ere badituzte, ezaugarri gramatikal horiek natiboen gisara prozesatuko dituztela. Hortaz, emaitza hauek HDHren aldeko egiten dute (Zawiszewski & Laka, 2020).

IV. kapitulua

Laugarren kapituluan, predikatu iragangaitzak eta phi-tasunak aztertu ditut gaztelaniaz gaztelaniazko natiboekin. Esperimentu honetan HE eta TEH hipotesiak testatu ditut. HEari dagokionez, ezberdintasunak topatu ditut predikatu ezakusatibo eta ezergatiboen artean. Gainera, emaitzek adierazten dute ezakusatiboak ezergatiboak baino zailagoak direla prozesatzeko. Hau dena bat dator Hek argudiatzen duenarekin: (i) bi predikatu iragangaitz daude eta aldeak topatu beharko lirateke bi hauen artean, (ii) ezakusatiboek deribazio luzeagoa dute, eta hortaz, prozesatzeko zailagoak izatea espero da. Aurreko kapituluko eta kapitulu honetako emaitzak kontuan hartuta, ondorioztatzen dut bi predikatu iragangaitzak ezberdinak direla, baina bakoitzaren prozesamendu zailtasunak hizkuntzatik hizkuntzara aldatzen direla duten kasu ezarketaren arabera. Hizkuntza nominatibo-akusatiboen kasuan, subjektuak prototipikoki egileak dira eta gai rol semantikoa duten argumentuentzat subjektu bilakatzeak prozesamendu gainkostuak eragiten ditu. Hizkuntza ergatibo-absolutibo/aktibo-ezaktiboetan, gai rol semantikoa duten argumentuek ez dute deribazio konplexuagorik eta egileak dira prozesamendu karga handiagoa erakusten dutenak, seguruenik duten karga morfologiko gehigarria medio.

Azkenik, TEHri dagokionez, ezberdintasunak topatu ditut pertsona eta numero tasunen artean, baina ez espero nuenaren kontrako bidean: numero tasuna prozesatzeko nabarmenagoa dela pertsona baino. Ondorioztatu dut emaitza horiek materialen ondorio izan daitezkeela, pertsona tasuna zuten subjektuak bokatibo gisa ere uler zitezkeelako.

Dena den, esperimentu honetan, aurrekoek bezala, ezberdintasunak topatu ditut tasun ezberdinen artean, eta emaitzek erakutsi dute ikerketa gehiago beharrezkoa dela tasunen inguruan gehiago jakiteko.

V. kapitulua

Azken kapitulu honetan predikatu iragangaitzen eta phi-tasunen prozesamendua aztertu dut gaztelaniaz gaztelaniazko maila altuko ez-natibo goiztiarrekin, eta gerora emaitzak aurreko kapituluan aztertutako natiboen emaitzekin erkatu ditut. Horretarako, hirugarren kapituluan bezala, subjektu-aditz komunztadura manipulazioak erabili ditut, hots, bi hizkuntzek komunean duten ezaugarri gramatikal bat.

Ez-natiboek predikatu iragangaitzak eta phi-tasunak natiboen antzera prozesatzen dituzte, antzeko efektu eta elkarrekintzak atera dira bi taldeen arteko konparaketetan. Dena den, natiboak azkarragoak eta zehatzagoak izan dira, eta negatibotasun handiagoa erakutsi dute urraketetan. Alde horiek, bi hizkuntzen arteko kasu morfologia ezberdinekin lotu ditut.

Hortaz gain, esperimentu honetan HE eta TEH hipotesiak ere testatu ditut, eta natiboek bezalaxe: (i) HEren aldeko ebidentzia aurkitu dut, predikatu ezakusatiboak eta ezergatiboak ezberdin prozesatzen direla erakutsi dut eta predikatu ezakusatiboetan zailtasun gehiago izan dute ezergatiboetan baino; (ii) TEHren aldeko emaitzak lortu ditut, pertsona eta numero tasunak ezberdin prozesatu baitituzte, baina emaitzek, TEHk aurreikusitakoaren kontra, numero tasuna pertsona baino nabarmenagoa dela iradoki dute.

Orohar, bi taldeek efektu eta elkarrekintza antzekoak erakutsi dituzte, eta horrek erakusten du, maila altuko ez-natibo goiztiarrak gai direla komunean dituzten ezaugarri gramatikalak natiboen antzera prozesatzeko, HDHk aurreikusi bezala (Zawiszewski & Laka, 2020).

2 Ekarpen nagusienak

Laburbilduz, honatx tesi honen ekarpen nagusiak:

1. Hipotesi Ezakusatiboa lehen aldiz testatu dut ERPak erabilita eta lehen aldiz testatu dut HE hizkuntza ez nominatibo batean. HEren aldeko ebidentzia lortu dut euskaraz zein gaztelaniaz.
2. Erakutsi dut prozesamenduaren zailtasunari dagokionez predikatu ezakusatibo eta ezergatiboen artean aurki daitezkeen aldeak kasu ezarketarekin daudela lotuta, ezakusatiboak prozesatzeko zailagoak dira hizkuntza nominatiboetan (gaztelania), eta ezergatiboak hizkuntza aktiboetan (euskara).
3. HDHren aldeko ebidentzia lortu dut euskarazko zein gaztelaniazko ez-natiboekin, erakutsi baitut maila altuko ez-natibo goiztiarrek hizkuntza natiboen antzera prozesatu dezaketela, beti ere aztertzen den ezaugarri gramatikala bi hizkuntzetan baldin badago.
4. TEHren aldeko ebidentzia lortu dut, aldeak topatu baititut pertsona eta numero tasunen artean metodo konduktual zein elektrofisiologikoetan. Bestetik, gaztelaniaz espero zenaren kontrako emaitzak topatu ditut tasunen prozesamendu banaketari dagokienez, numero tasunaren prozesamendu nabarmenagoaren emaitzak topatu baititut.

Supplementary materials to Chapters II and III

1. Zu gaur goizean bueltatu zara Bilbotik.
2. Zu nahi gabe lesionatzen zara futbolean.
3. Zu igandetan berandu jaikitzen zara normalean.
4. Zu gauean goiz oheratu zara gaurkoan.
5. Zu etzi Aizkorrira igoko zara lehenbizikoz.
6. Zu ibilian maiz irristatzen zara mendian.
7. Zu gauean erraz izutzen zara saguzarrekin.
8. Zu azterketen ostean lasaituko zara behingoz.
9. Zu eguzkiarekin batera irtengo zara kalera.
10. Zu ama bisitatzera hurbilduko zara ostegunean.
11. Zu sarritan berandu altxatzen zara ohetik.
12. Zu aurten askotan lokartu zara sofan.
13. Zu turismoaren eraginaz jabetu zara azkenean.
14. Zu kamararen atzean ezkutatzen zara beti.
15. Zu hondartzan pozik etzan zara hamakan.
16. Zu tabernan berehala oldartzen zara gauetan.
17. Zuek modako telesailean berragertu zarete bart.
18. Zuek ikastolara pozez gerturatu zarete jaietan.
19. Zuek parkean birritan irristatu zarete izotzetan.
20. Zuek futbolean azkar nekatzen zarete partiduetan.
21. Zuek azterketan gogor ahalegindu zarete hasieratik.
22. Zuek bigarren bozkaketan abstenitu zarete lehen.
23. Zuek jauntxoen kontra matxinatu zarete aspalditik.
24. Zuek hilabetean behin solastu zarete udalarekin.
25. Zuek hobe beharrez banandu zarete argi.
26. Zuek erregearen aurrean belaunikatu zarete gorteetan.
27. Zuek naturarekin batera desagertuko zarete mundutik.
28. Zuek datorren urtean elkartuko zarete berriz.
29. Zuek bizitzan poliki zahartu zarete zorionez.
30. Zuek festa gogoz zutitzen zarete egunero.

31. Zuek eguerdian uretan murgildu zarete aletekin.
32. Zuek loterian ikaragarri aberastu zarete bat-batean.
33. Hura azkenean aurten bueltatu da atzerritik.
34. Hura kiroletan maiz lesionatzen da betidanik.
35. Hura egunero zortzietan jaikitzen da neguan.
36. Hura ohartu gabe oheratu da gaur.
37. Hura bihar beldurrez igoko da bulegora.
38. Hura takoidun oinetakoekin irristatzen da gehien.
39. Hura ilunpean segituan izutzen da zaratekin.
40. Hura notak ateratzean lasaituko da ziurrenik.
41. Hura aterkia eskuan irtengo da gero.
42. Hura partidua ikustera hurbilduko da ostegunean.
43. Hura maiz oihuka altxatzen da sofatik.
44. Hura eskolan eserita lokartu da inoiz.
45. Hura tamalez beranduegi jabetu da horretaz.
46. Hura oso maiz ezkutatzen da tamalez.
47. Hura leher eginda etzan da ohean.
48. Hura zigorraren kontra oldartzen da klasean.
49. Haiek uda honetan berragertu dira hondartzan.
50. Haiek goizean pozik gerturatu dira hiriburura.
51. Haiek neguan askotan irristatu dira korrika.
52. Haiek irakasleen sermoiekin nekatzen dira egunero.
53. Haiek lasterketan biziki ahalegindu dira irabazten.
54. Haiek kamaran gutxitan abstenitu dira zorionez.
55. Haiek murrizketen kontra matxinatu dira lehen.
56. Haiek internet bidez solastu dira orokorrean.
57. Haiek arazoak medio banandu dira azkenik.
58. Haiek apaizaren aurrean belaunikatu dira elizan.
59. Haiek tabernak ixtean desagertuko dira jaietatik.
60. Haiek etorkizunean berriro elkartuko dira seguraski.
61. Haiek ikaragarri azkar zahartu dira bat-batean.
62. Haiek bost minuturo zutitzen dira eskolan.

63. Haiek linterna eskuan murgildu dira kobazuloan.
64. Haiek enpresa munduan aberastu dira elkarrekin.
65. Zu drogen mundura bueltatu naiz tamalez.
66. Zu nahi gabe lesionatzen naiz edonon.
67. Zu alarmarik gabe jaikitzen naiz egunero.
68. Zu gaueko hamabietan oheratu naiz gaur.
69. Zu uztailean izerditan igoko naiz Larrunarrira.
70. Zu urtean behin irristatzen naiz gehienez.
71. Zu edozein animaliarekin izutzen naiz oihanean.
72. Zu udararen etorrerarekin lasaituko naiz ekainean.
73. Zu Loiuko aireportura irtengo naiz arratsaldean.
74. Zu Donostiako jaietara hurbilduko naiz larunbatean.
75. Zu oso berandu altxatzen naiz igandeetan.
76. Zu liburua eskutan lokartu naiz bart.
77. Zu Sumatrako hondamendiaz jabetu naiz azkenean.
78. Zu txikitatik arazoetatik ezkutatzen naiz koldarki.
79. Zu etxeko terrazan etzan naiz goizean.
80. Zu txikiagoen kontra oldartzen naiz soilik.
81. Zuek pilotako txapelketan berragertu naiz udan.
82. Zuek Mirenen urtebetetzean gerturatu gara Iruñeara.
83. Zuek izotz jaurekian irristatu gara lehen.
84. Zuek zinemako ilaran nekatzen gara gehien.
85. Zuek dena gainditzen ahalegindu gara sutsuki.
86. Zuek eguneko erabakian abstenitu gara bigarrenez.
87. Zuek Bastillako gotorlekuan matxinatu gara irmoki.
88. Zuek gustu handiz solastu gara parkean.
89. Zuek umea bilatzeko banandu gara merkatuan.
90. Zuek lentillak bilatzeko belaunikatu gara kontzertuan.
91. Zuek dendetako apaletatik desagertuko gara denborarekin.
92. Zuek zinemen atean elkartuko gara gauean.
93. Zuek urteen poderioz zahartu gara elkarrekin.
94. Zuek sofatik kostata zutitzen gara bazkalostean.

95. Zuek oihanean barna murgildu gara lagunekin.
96. Zuek besteen kaltetan aberastu gara kontzienteki.
97. Hura gaur berandu bueltatu dira festatik.
98. Hura urtean behin lesionatzen dira gutxienez.
99. Hura alarmarekin batera jaikitzen dira normalean.
100. Hura beste nonbait oheratu dira gaurkoan.
101. Hura bihar berriz igoko dira Pagasarrira.
102. Hura orbelarekin erraz irristatzen dira udazkenean.
103. Hura erleekin segituan izutzen dira udaberrian.
104. Hura egunen batetan lasaituko dira azkenean.
105. Hura ziur laster irtengo dira kartzelatik.
106. Hura umeen bila hurbilduko dira eskolara.
107. Hura matxinoen kontra altxatzen dira maiz.
108. Hura historiako klasean lokartu dira goizean.
109. Hura nire akatsez jabetu dira aurten.
110. Hura arratsaldero aitarengandik ezkutatzen dira eskolan.
111. Hura sofan presaka etzan dira eguerdian.
112. Hura arazoen aurrean oldartzen dira beti.
113. Haiek lanean indartsu berragertu da udazkenean.
114. Haiek aita ikustera gerturatu da ospitalera.
115. Haiek eskaileretan behera irristatu da lehen.
116. Haiek izugarri aise nekatzen da igerian.
117. Haiek harresia gainditzen ahalegindu da Melillan.
118. Haiek urriko erreferendumean abstenitu da zoritxarrez.
119. Haiek injustiziaren kontra matxinatu da txikitatik.
120. Haiek telefonoz erruz solastu da azkenaldian.
121. Haiek denboraldi batez banandu da berriki.
122. Haiek elizaren aurrean belaunikatu da miresmenez.
123. Haiek egunkari ezagunenetatik desagertuko da seguruenik.
124. Haiek zeruan betiko elkartuko da azkenik.
125. Haiek bilobak heziz zahartu da baserrian.
126. Haiek dudak galdetzeko zutitzen da eskolan.

127. Haiek bizitzako esperientzian murgildu da unibertsitatean.
128. Haiek apostuei esker aberastu da nolabait.
129. Zuk galdera batean dudatu duzu azterketan.
130. Zuk bizitzan lautan emigratu duzu nahitaez.
131. Zuk lanera gutxi tardatu duzu gaur.
132. Zuk arrazoirik gabe protestatu duzu partiduan.
133. Zuk kontzerturako pozez entsaiatu duzu garajean.
134. Zuk goizean biziki sufritu duzu aurkezpenean.
135. Zuk jaunaren alde predikatu duzu elizan.
136. Zuk Formigalen birritan eskiatzen duzu urtero.
137. Zuk gauero ordubetez meditatzen duzu saloian.
138. Zuk txikitatik maiz trafikatzen duzu lagunentzat.
139. Zuk oso gazte debutatu duzu profesionaletan.
140. Zuk oporretan luze deskantsatu duzu Mallorkan.
141. Zuk neguan izotzetan patinatu duzu Kanadan.
142. Zuk segurtasun arrazoiengatik abortatu duzu klinikan.
143. Zuk epaiketan gogotik kolaboratu duzu justiziarekin.
144. Zuk autoan seguru zirkulatzen duzu betidanik.
145. Zuek enpresan kritikengatik dimititu duzue azkenean.
146. Zuek seguruenik urteetan iraungo duzue irratian.
147. Zuek arrunt zakarki erreakzionatu duzue kritikekin.
148. Zuek furgonetarekin urrutira bidaiatu duzue asteburuan.
149. Zuek xantaien aurrean etsi duzue zoritxarrez.
150. Zuek kongresuan alde bozkatu duzue inbestiduran
151. Zuek jaietan bikain funtzionatu duzue batzordean.
152. Zuek aurten lehenbizikoz kotizatu duzue lanean.
153. Zuek itsasoan aspalditik nabigatu duzue iparrorratzarekin.
154. Zuek lekuko gisa deklaratu duzue epaiketan.
155. Zuek gaztetako istorioez pentsatzen duzue maiz.
156. Zuek telebistan franko distiratu duzue kantuan.
157. Zuek itsasoan erraz flotatzen duzue udan.
158. Zuek galderaren inguruan hausnartu duzue berriki.

159. Zuek saskibaloian asko izerditu duzue entrenamenduan.
160. Zuek unibertsitatean ikaragarri flipatu duzue emaitzekin.
161. Hark gaueko jantziarekin dudatu du lehen.
162. Hark Estatu Batuetara emigratu du aurten.
163. Hark ordubete eskas tardatu du igerian.
164. Hark atzoko istiluengatik protestatu du bileran.
165. Hark Bethovenen lana entsaiatu du goizean.
166. Hark gerlan majo sufritu du bizitzan.
167. Hark homofobiaren kontra predikatu du maiz.
168. Hark txikitatik primeran eskiatzen du zorionez.
169. Hark parkean eserita meditatzen du arratsaldero.
170. Hark oraintsu gehiegi trafikatzen du tamalez.
171. Hark oso zoriontsu debutatu du Alavesekin.
172. Hark lo-kuluxk batekin deskantsatu du eguerdian.
173. Hark udaletxeko plazan patinatu du neguan.
174. Hark gurasoen eraginez abortatu du zoritxarrez.
175. Hark hainbat katerekin kolaboratu du telebistan.
176. Hark uhala jarrita zirkulatzen du beti.
177. Haiek zuen karguetatik dimititu dute birritan.
178. Haiek irakaslearen erabakiarekin flipatu dute lehen.
179. Haiek berriekin baldarki erreakzionatu dute goizean.
180. Haiek kontinente guztietara bidaiatu dute hegazkinez.
181. Haiek zuen zereginetan etsi dute azkenean.
182. Haiek erreformaren kontra bozkatu dute berriki.
183. Haiek talde bezala funtzionatu dute zorionez.
184. Haiek askoz gehiago kotizatu dute aurten.
185. Haiek ozeanoetan barna nabigatu dute itsasontziz
186. Haiek epailearen aurrean deklaratu dute lehen.
187. Haiek estatu utopikoetan pentsatzen dute maiz.
188. Haiek entrenatzaileari esker distiratu dute txapelketan.
189. Haiek ezer gabe flotatzen dute itsasoan.
190. Haiek biziki sakonki hausnartu dute erabakiaz.

191. Haiek lanean lepo izerditu dute sargoriarengatik.
192. Haiek irakaslearen erabakiarekin flipatu dute lehen.
193. Zuk erabaki aproposenaz dudatu dut oraintxe.
194. Zuk lan bila emigratu dut iparraldera.
195. Zuk goizean asko tardatu dut komunean.
196. Zuk murrizketen kontra protestatu dut manifestazioan.
197. Zuk gelditu gabe entsaiatu dut kontzerturako.
198. Zuk txikitatik majo sufritu dut eskolan.
199. Zuk Gasteizko kaleetan predikatu dut gaztetan.
200. Zuk oso ongi eskiatzen dut betidanik.
201. Zuk astean bitan meditatzen dut kiroldegian.
202. Zuk kalean halabeharrez trafikatzen dut zoritxarrez.
203. Zuk familiaren aurrean debutatu dut Beotibarren.
204. Zuk zortzi orduz deskantsatu dut bart.
205. Zuk gurpilen gainean patinatu dut soilik.
206. Zuk espero gabe abortatu dut aurten.
207. Zuk erakunde askorekin kolaboratu dut iraganean.
208. Zuk errepide nagusietatik zirkulatzen dut gehienetan.
209. Zuek hobe beharrez dimititu dugu lanetik.
210. Zuek denbora luzez iraungo dugu bizirik.
211. Zuek nahiko trakets erreakzionatu dugu berriekin.
212. Zuek oporretan sarritan bidaiatu dugu atzerrira.
213. Zuek emaitzak ikusita etsi dugu azkenik.
214. Zuek NANa eskuan bozkatu dugu eskolan.
215. Zuek tenisean ederki funtzionatu dugu elkarrekin.
216. Zuek lehen aldiz kotizatu dugu aurten.
217. Zuek Garona ibaian nabigatu dugu piraguan.
218. Zuek zuen alde deklaratu dugu epaitegian.
219. Zuek etorkizuneko bizitzan pentsatzen dugu ziurrenik.
220. Zuek eguzki izpiekin distiratu dugu arratsaldean.
221. Zuek lau bidoirekin flotatzen dugu jokuetan.
222. Zuek erabakiaren inguruan hausnartu dugu luze.

223. Zuek nahi gabe izerditu dugu soinketan.
224. Zuek Sirian gertatutakoarekin flipatu dugu telebistan.
225. Hark soldaduen leialtasunaz dudatu dute arestian.
226. Hark gerretatik ihesi emigratu dute Europara.
227. Hark denbora asko tardatu dute gosaltzen.
228. Hark betiko arrazoiengatik protestatu dute telefonoz.
229. Hark lagunekin batera entsaiatu dute lokalean.
230. Hark oso gutxi sufritu dute ebakuntzan.
231. Hark mikrofonoa eskuan predikatu dute askotan.
232. Hark makilarik gabe eskiatzen dute batzuetan.
233. Hark parkeko belardian meditatzen dute gusturen.
234. Hark Bilboko kaleetan trafikatzen dute gehien.
235. Hark lehen mailan debutatu dute ezustean.
236. Hark sofan botata deskantsatu dute eguerdian.
237. Hark mendian bera patinatu dute neguan.
238. Hark hobe beharrez abortatu dute azkenean.
239. Hark armen salmentan kolaboratu dute terroristekin.
240. Hark baimenik gabe zirkulatzen dute kamioetan.
241. Haiek soldata baxuengatik dimititu du enpresan.
242. Haiek nahi beste iraungo du lanean.
243. Haiek oso haserre erreakzionatu du berriarekin.
244. Haiek Euskal Herrian bidaiatu du aurten.
245. Haiek mehatxuen aurrean etsi du ustekabean.
246. Haiek bidaiaren alde bozkatu du eskolan.
247. Haiek lanean gaizki funtzionatu du betidanik.
248. Haiek oso gutxi kotizatu du otsailean.
249. Haiek itsasontziz Amerikan nabigatu du hilabetez.
250. Haiek zuen errugabetasuna deklaratu du epaiketan.
251. Haiek Afrikako umeengan pentsatzen du sarritan.
252. Haiek brillantina askorrekin distiratu du inauterietan.
253. Haiek surf taulan flotatzen du hondartzan.
254. Haiek arazoaren inguruan hausnartu du afarian.

255. Haiek egurra mozten izerditu du baserrian.

256. Haiek aurtengo jaiekin flipatu du positiboki.

Supplementary materials to Chapters IV and V

1. Tú, por la mañana, desembarcarás en Bilbao.
2. Tú, el próximo año, caerás en sus garras.
3. Tú, lo más seguro, vendrás a clase.
4. Tú, antes o después, desaparecerás de aquí.
5. Tú, sí o sí, morirás algún día.
6. Tú, con esa crema, rejuvenecerás en pocas semanas.
7. Tú, con los años, palidecerás poco a poco.
8. Tú, durante la adolescencia, crecerás poco a poco.
9. Tú, en un futuro, existirás en internet.
10. Tú, en alguna fiesta, sobrarás seguro.
11. Tú, en algún momento, resurgirás de las cenizas.
12. Tú, en dos minutos, embarcarás hacia Londres.
13. Tú, algún día, seguramente, subirás en ascensor.
14. Tú, con treinta años, saldrás de la cárcel.
15. Tú, en un futuro, volverás a tu país.
16. Tú, con el tiempo, reaparecerás en televisión.
17. Vosotros, de seguir recto, apareceréis en la playa.
18. Vosotros, por la tarde, bajaréis a la playa.
19. Vosotros, con dieciocho años, entraréis en la universidad.
20. Vosotros, por este camino, descenderéis sí o sí.
21. Vosotros, de seguir así, acudiréis al médico.
22. Vosotros, en cuatro años, asistiréis a vuestra graduación.
23. Vosotros, en nueve meses, regresaréis de Erasmus.
24. Vosotros, con este sistema, adelgazaréis rápidamente.
25. Vosotras, de seguir aquí, envejeceréis también aquí.
26. Vosotras, con esa dieta, engordaréis más que adelgazar.
27. Vosotras, con este sistema, viviréis mejor.
28. Vosotras, por alguna razón, faltaréis a clase.
29. Vosotras, ante la noticia, enloqueceréis en seguida.
30. Vosotras, con la edad, encogeréis poco a poco.
31. Vosotras, en tres horas, aterrizaréis en Berlín.
32. Vosotras, comiendo tan poco, mermaréis considerablemente.
33. Él, la próxima semana, desembarcará en Barcelona.
34. Él, con el tiempo, caerá en el olvido.
35. Él, cuando haya trabajo, vendrá para quedarse.
36. Él, en estas condiciones, desaparecerá muy pronto.
37. Él, según los médicos, morirá en cuatro meses.
38. Él, si se afeita, rejuvenecerá una barbaridad.
39. Él, con esta terapia, palidecerá un poco.
40. Él, lo más seguro, crecerá con sus padres.
41. Ella, según este cuento, existirá por siempre jamás.
42. Ella, en este puesto, sobrará cada vez más.

43. Ella, en un futuro, resurgirá como actriz.
44. Ella, si dios quiere, embarcará por la mañana.
45. Ella, cuando haga bueno, subirá al monte.
46. Ella, a las nueve, saldrá de casa.
47. Ella, después de comer, volverá al trabajo.
48. Ella, en esta película, reaparecerá en pantalla.
49. Ellos, cuando haya vacaciones, aparecerán por aquí.
50. Ellos, si hace bueno, bajarán a la playa.
51. Ellos, a las ocho, entrarán en clase.
52. Ellos, piraguas al hombro, descenderán por el río.
53. Ellos, aun habiendo trasnochado, acudirán a clase.
54. Ellos, aunque no quieran, asistirán al juicio.
55. Ellos, finalmente por navidad, regresarán a casa.
56. Ellos, mediante esta dieta, adelgazarán sin darse cuenta.
57. Ellas, en esa residencia, envejecerán felizmente.
58. Ellas, viendo la televisión, engordarán poco a poco.
59. Ellas, con ese trabajo, vivirán plácidamente.
60. Ellas, debido al desprendimiento, faltarán al entierro.
61. Ellas, en unas horas, enloquecerán con la noticia.
62. Ellas, en este apartamento, encogerán de frío.
63. Ellas, en tres días, aterrizarán en Loiu.
64. Ellas, con semejante presión, mermarán bastante.
65. Tú, como muy tarde, desembarcaré el martes.
66. Tú, con un empujón, caeré por el precipicio.
67. Tú, lo antes posible, vendré de visita
68. Tú, en cuanto anochezca, desapareceré en el monte.
69. Tú, con esa película, moriré de miedo.
70. Tú, en esas termas, rejuveneceré diez años.
71. Tú, con la edad, palideceré poco a poco.
72. Tú, en la universidad, creceré bastante todavía.
73. Tú, sin ninguna duda, existiré en mi memoria.
74. Tú, en su casa, sobraré bastante.
75. Tú, en el juego, resurgiré tras cada muerte.
76. Tú, cuando sea posible, embarcaré hacia Nueva York.
77. Tú, en alguna ocasión, subiré a esa colina.
78. Tú, en Santo Tomás, saldré antes del trabajo.
79. Tú, si es posible, volveré a hacer deporte.
80. Tú, en Semana Santa, reapareceré por casa.
81. Vosotros, si hace falta, apareceremos por el trabajo.
82. Vosotros, cuando haga bueno, bajaremos al pueblo.
83. Vosotros, cuando haya sitio, entraremos al bar.
84. Vosotros, con unos bastones, descenderemos más fácilmente.
85. Vosotros, si está barato, acudiremos al cine.
86. Vosotros, hacia las once, asistiremos a la inauguración.
87. Vosotros, cuando haya paz, regresaremos a nuestro país.

88. Vosotros, mediante mucho ejercicio, adelgazaremos lo acordado.
89. Vosotras, en ese asilo, envejeceremos con total tranquilidad.
90. Vosotras, con tanto turrón, engordaremos más que nunca.
91. Vosotras, en el futuro, viviremos en una villa.
92. Vosotras, debido al catarro, faltaremos unos días.
93. Vosotras, por la tarde, enloqueceremos con la noticia.
94. Vosotras, si hace frío, encogeremos como el algodón.
95. Vosotras, si algo falla, aterrizaremos en el mar.
96. Vosotras, con esa dieta, mermaremos considerablemente.
97. Él, cuando finalmente amaine, desembarcarán en el muelle.
98. Él, de seguir así, caerán en la trampa.
99. Él, cuando haga bueno, vendrán todas las semanas.
100. Él, si oscurece mucho, desaparecerán en la oscuridad.
101. Él, con semejante estrés, morirán de un infarto.
102. Él, con estas vacaciones, rejuvenecerán de manera propicia.
103. Él, en el barco, palidecerán por el movimiento.
104. Él, en esa escuela, crecerán junto con inmigrantes.
105. Ella, por siempre jamás, existirán en su recuerdo.
106. Ella, en esa discusión, sobrarán más que nadie.
107. Ella, con esa canción, resurgirán una vez más.
108. Ella, a las once, embarcarán rumbo a Lisboa.
109. Ella, por la tarde, subirán al pueblo.
110. Ella, durante el descanso, saldrán a por pan.
111. Ella, si hace malo, volverán otro día.
112. Ella, tras los anuncios, reaparecerán en escena.
113. Ellos, cuando haga frío, aparecerá a clase.
114. Ellos, cuando falte comida, bajará al pueblo.
115. Ellos, a las tres, entrará al comedor.
116. Ellos, en cuanto amanezca, descenderá con un guía.
117. Ellos, ante esta sentencia, acudirá al tribunal supremo.
118. Ellos, aunque con resignación, asistirá al acontecimiento.
119. Ellos, el martes siguiente, regresará de vacaciones.
120. Ellos, de seguir así, adelgazará muy poco.
121. Ellas, en el futuro, envejecerá en ese barrio.
122. Ellas, con comida basura, engordará muy rápidamente.
123. Ellas, dentro de poco, vivirá en un apartamento.
124. Ellas, si nieva mucho, faltará durante un tiempo.
125. Ellas, con su presencia, enloquecerá de celos.
126. Ellas, poco a poco, encogerá con la edad.
127. Ellas, hacia las dos, aterrizará en Santander.
128. Ellas, con este frío, mermará bastante físicamente.
129. Tú, de ganar mañana, gritarás de la emoción.
130. Tú, en la gala, bailarás con tu pareja.
131. Tú, en la discoteca, cantarás como loca.

132. Tú, de estudiar mucho, trabajarás como jefe.
133. Tú, en tu casa, hablarás de cualquier manera.
134. Tú, de no dormir, bostezarás a menudo.
135. Tú, de seguir fumando, respirarás con dificultad.
136. Tú, en esta cama, dormirás espléndidamente.
137. Tú, con otro trago, caminarás torcido.
138. Tú, con este chiste, llorarás de risa.
139. Tú, con la actuación, aplaudirás con entusiasmo.
140. Tú, ante la injusticia, protestarás incesantemente.
141. Tú, de no aprender, sufrirás lo indecible.
142. Tú, después del entrenamiento, descansarás tranquilamente.
143. Tú, con tanta presión, dimitirás en una semana.
144. Tú, dentro de poco, actuarás en Hollywood.
145. Vosotros, de seguir parados, emigraréis a Alemania.
146. Vosotros, con este solazo, estornudaréis unas cuantas veces.
147. Vosotros, para el concierto, ensayaréis todos los días.
148. Vosotros, de tener dinero, colaboraréis con una ONG.
149. Vosotros, por la ciudad, circularéis con precaución.
150. Vosotros, durante las vacaciones, conduciréis a muchos sitios.
151. Vosotros, la siguiente vez, reaccionaréis más amablemente.
152. Vosotros, este próximo verano, viajaréis a Mallorca.
153. Vosotras, en un futuro, votaréis sobre vuestros derechos.
154. Vosotras, para este trabajo, funcionaréis individualmente.
155. Vosotras, con este velero, navegaréis en paz.
156. Vosotras, en el juicio, declararéis a favor.
157. Vosotras, con la edad, pensaréis en tener hijos.
158. Vosotras, la próxima vez, recapacitaréis antes de hablar.
159. Vosotras, seguramente sin querer, reflexionaréis sobre el futuro.
160. Vosotras, contando algunos recuerdos, sonreiréis tiernamente.
161. Él, de ganar mañana, gritarás de la emoción.
162. Él, en la fiesta, bailará con María.
163. Él, en el concierto, cantará con mucha energía.
164. Él, durante las prácticas, trabajará en Mercedes.
165. Él, de no aprobar, hablará con tus padres.
166. Él, de dormir poco, bostezará constantemente.
167. Él, de aprobar mañana, respirará en paz.
168. Él, durante el verano, dormirá hasta tarde.
169. Ella, de tener tiempo, caminará por la playa.
170. Ella, cuando muera Juan, llorará de tristeza.
171. Ella, durante la actuación, aplaudirá si le gusta.
172. Ella, de no seguir, protestará ante el jefe.
173. Ella, en este trabajo, sufrirá de angustia.
174. Ella, con su muerte, descansará en paz.
175. Ella, en ningún caso, dimitirá sin razón alguna.

176. Ella, en tres días, actuará en el teatro.
177. Ellos, a la mínima, emigrarán a Estados Unidos.
178. Ellos, con tanta mucosidad, estornudarán sin parar.
179. Ellos, para poder triunfar, ensayarán muchas veces.
180. Ellos, en la escuela, colaborarán con otros centros.
181. Ellos, en la autopista, circularán más deprisa.
182. Ellos, por la ciudad, conducirán más despacio.
183. Ellos, de haber huelga, reaccionarán levantando piquetes.
184. Ellos, en Semana Santa, viajarán a Portugal.
185. Ellas, en la votación, votarán en contra.
186. Ellas, en este trabajo, funcionarán de maravilla.
187. Ellas, llegada la jubilación, navegarán por la costa.
188. Ellas, desde este año, declararán en hacienda.
189. Ellas, la próxima vez, pensarán en voz alta.
190. Ellas, en la reunión, recapacitarán antes de hablar.
191. Ellas, antes o después, reflexionarán sobre lo ocurrido.
192. Ellas, para la foto, sonreirán tímidamente.
193. Tú, cuando nazca Pedro, gritaré de felicidad.
194. Tú, en la romería, bailaré toda la noche.
195. Tú, en el karaoke, cantaré a todo volumen.
196. Tú, en el campamento, trabajaré con niños.
197. Tú, de seguir así, hablaré con tus padres.
198. Tú, sin un café, bostezaré constantemente.
199. Tú, en ese antro, respiraré con dificultad.
200. Tú, durante estas vacaciones, dormiré hasta tarde.
201. Tú, con marea baja, caminaré por la orilla.
202. Tú, cuando María vuelva, lloraré de alegría.
203. Tú, si lo merece, aplaudiré con ganas.
204. Tú, ante las injusticias, protestaré enérgicamente.
205. Tú, con tanta presión, sufriré bastante.
206. Tú, durante las vacaciones, descansaré de lo lindo.
207. Tú, en esta situación, dimitiré en poco tiempo.
208. Tú, mediante esta ONG, actuaré contra el cáncer.
209. Vosotros, en dos semanas, emigraremos a Australia.
210. Vosotros, con este ventilador, estornudaremos continuamente.
211. Vosotros, si es posible, ensayaremos toda la tarde.
212. Vosotros, de ninguna manera, colaboraremos con la policía.
213. Vosotros, visto lo visto, circularemos con más precaución.
214. Vosotros, en ningún caso, conduciremos borrachos.
215. Vosotros, la próxima vez, reaccionaremos con más calma.
216. Vosotros, para las olimpiadas, viajaremos a Pekín.
217. Vosotras, en la reunión, votaremos sobre la propuesta.
218. Vosotras, para este trabajo, funcionaremos en grupo.
219. Vosotras, en Puerto Rico, navegaremos en velero.
220. Vosotras, en la causa, declararemos sobre lo ocurrido.

221. Vosotras, al encontrar trabajo, pensaremos sobre el futuro.
222. Vosotras, ante tal suceso, recapacitaremos detenidamente.
223. Vosotras, en la cama, reflexionaremos sobre el tema.
224. Vosotras, en la boda, sonreiremos alegremente.
225. Él, con la inyección, gritarán de dolor.
226. Él, en la boda, bailarán románticamente.
227. Él, en el karaoke, cantarán con un micrófono.
228. Él, en el despacho, trabajarán con tranquilidad.
229. Él, en la reunión, hablarán de negocios.
230. Él, en la universidad, bostezarán de sueño.
231. Él, durante el estiramiento, respirarán profundamente varias veces.
232. Él, en el hotel, dormirán plácidamente.
233. Ella, en el monte, caminarán por el sendero.
234. Ella, en el funeral, llorarán con los familiares.
235. Ella, por la tarde, aplaudirán en el teatro.
236. Ella, en la manifestación, protestarán contra la desigualdad.
237. Ella, con la edad, sufrirán de vértigo.
238. Ella, en ese banco, descansarán un rato.
239. Ella, en esas condiciones, dimitirán sin ningún reparo.
240. Ella, en la obra, actuarán con ropa antiquísima.
241. Ellos, si nada cambia, emigrará en patera.
242. Ellos, en el trabajo, estornudará tímidamente.
243. Ellos, después de navidades, ensayará en un garaje.
244. Ellos, debido al huracán, colaborará con una ONG.
245. Ellos, en una persecución, circulará por donde sea.
246. Ellos, si es necesario, conducirá con mal tiempo.
247. Ellos, en un atraco, reaccionará ante el peligro.
248. Ellos, mochila al hombro, viajará por el mundo.
249. Ellas, por primera vez, votará a la derecha.
250. Ellas, en esas condiciones, funcionará de maravilla.
251. Ellas, de haber oleaje, navegará con miedo.
252. Ellas, en el juicio, declarará sobre el suceso.
253. Ellas, en el aniversario, pensará en su padre.
254. Ellas, con más calma, recapacitará sobre lo ocurrido.
255. Ellas, la próxima vez, reflexionará antes de volver.
256. Ellas, en la gala, sonreirá ante la cámara.

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