Processing and representation of unaccusative, unergative and transitive predicates

Using eye-tracking and the visual world paradigm

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ABSTRACT

Aim: This Master Thesis presents a Spanish replica of a study conducted in Dutch by Koring, Mak and Reuland (2012) using eye-tracking and the visual world paradigm. My research investigates the different processing patterns in the reactivation of the sentential subject in unaccusative, unergative and transitive sentences in Spanish. The aim of this work is to provide an answer to this question: Is the reactivation of the subject different in (i) unaccusative and unergative sentences, and (ii) unergative and transitive sentences?

Method and participants: Forty-four native speakers of Spanish participated in my study. Participants were asked to listen to recorded sentences while they saw static visual displays, showing four black-and-white line drawings positioned on each corner of a screen. In critical trials, the sentential subject was semantically related to one of the drawings in the visual display.

Results: Gaze data classified as "fixations" (stops in the eye movements) were collected, processed and analyzed. Fixations to the semantically-related drawing were interpreted as subject reactivation during the postverbal region (i.e., after verb offset). Results show a significant difference in the probability of fixations on the visual target between unergative and unaccusative sentences, and transitive and unaccusative sentences. No significant difference in subject reactivation was found between transitive and unergative sentences.

Conclusion: These results are consistent with the *Unaccusative Hypothesis*, which claims that there are two classes of intransitive predicates: unaccusatives and unergatives. Results are also consistent with the *Agent-Initial Preference Hypothesis* (Bever, 1970; *inter alia*), which claims that agent-initial sentences (like unergatives or transitives) are preferred over theme-initial ones.

Key words: *Unaccusative Hypothesis*, argument structure, sentence processing, eye-tracking, visual world paradigm

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1. INTRODUCTION

The main goal of this Master Thesis is to investigate how unaccusative, unergative and transitive predicates are processed in Spanish using eye-tracking and the visual world paradigm. In order to that, I conduct a replica of a study run in Dutch by Koring, Mak and Reuland (2012). In both studies, the patterns of reactivation of the argument are measured after verb offset.[1] These measurements are then compared across predicate types in order to discover whether and how differences in argument structure affect syntactic processing. Among the various motivations for my project, the following are to be highlighted: (i) the almost total lack of experimental work regarding processing of verbal predicates, (ii) the relevance of this question regarding the relationship between syntax and semantics, and (iii) my personal and academic motivation to conduct this kind of research.

The topic of my research comprises the processing and representation of unaccusative, unergative and transitive predicates. My work aims to make a relevant contribution to the broader topic of how meaning and structure are related in language by investigating how argument structure interacts with language processing and representation. This subject matter is associated with a number of major questions in the study of language, namely: How is meaning related to syntactic structure? Are conceptual structures of events universal? If so, is there a structured mapping between universal conceptual structures of events and their syntactic structure in predicates? What does grammatical structure reveal about the nature of perception and cognition? What are the linking hypotheses that explain cross-linguistic regularities in how conceptual events are encoded linguistically? I report these questions here not with the goal of providing a full answer - which is currently impossible, given the nature of my research - but in order to locate the relevance of my study within the fields of linguistics, psycholinguistics and cognitive science.

My research deals with the processing and representation of unaccusative, unergative and transitive predicates for two main reasons. First, because unaccusativity provides fertile ground to explore the mapping between conceptual structure and syntactic structure. Both unaccusative and unergative predicates are intransitive, yet they differ as to the thematic role of their argument. A difference in processing between unaccusative and unergative predicates, all else being equal, would provide evidence on

[1] For an explanation of reactivation, see section 3.2.

how different types of argument structure are processed. Second, the transitive predicates investigated here have an agent argument, just like unergative predicates. By comparing the processing of transitive predicates with unergatives we can investigate how agent arguments are processed, and whether there is an observable difference in the processing of agents depending on how many arguments the verb requires. By conducting this research, I believe it will be possible to contribute to a better understanding of what aspects of verb meaning and argument structure are relevant to syntax and syntactic processing.

This Master Thesis is structured in the following manner. In section 1, the topic of the study is introduced and the structure of the thesis is outlined. In section 2, I provide the historical and theoretical background surrounding the characterization of unaccusative and unergative predicates in linguistics. Additionally, I discuss relevant matters regarding conceptual structure, syntactic structure, argument structure and thematic roles. In section 3, I present and discuss previous experimental research on sentence processing with various verbal predicates to give an accurate state-of-the-art which allows me to better present my own research, results and conclusions. In section 4, I provide a detailed and thorough description of the method and design of my experiment, which is mostly a Spanish replica of the study conducted in Dutch by Koring et al. (2012). In section 5, I discuss data processing and analysis. In section 6, the obtained results are presented. In section 7, a full discussion and interpretation of the obtained results is provided. Finally, I present a conclusion of my Master Thesis in section 8.

Koring et al. (2012) measure the reactivation of the argument after verb presentation in Dutch intransitive predicates: unaccusative, unergative and a third condition they referred to as “mixed-verb” predicates. Their results show that the time course and size of argument reactivation has different patterns depending on verb type (i.e., argument structure), with unergative and “mixed-verb” subjects revealing much earlier and larger reactivation (around 300 ms after verb offset) than unaccusative arguments (around 950 ms after verb offset). I decided to test the robustness and cross-linguistic validity of these results in Spanish. To do that, I designed an experiment which was in essence like the one in Koring et al. (2012), although some changes were incorporated into the design (see section 4 for a complete account of these changes). My main research questions were:

1. Are there different patterns in the reactivation of the subject after verb offset in unaccusative and unergative predicates?
2. Does the pattern of reactivation of the subject in unergative predicates align with the pattern of reactivation of the subject in transitive predicates?

In my experiment, participants listened to sentences with unaccusative, unergative and transitive verbs while looking at a computer screen. Participants' fixation patterns were measured using eye-tracking. For each sentence, a visual display appeared on the screen, consisting in four black-and-white line drawings, each one on each corner of the screen. In test trials, the subject of the sentences was semantically-related to one of the drawings in the visual display. It was expected that sentential subjects would undergo reactivation in participants' mental representation after verb offset, which would result in an increase in fixations to the target drawing. Results show that the fixation patterns for unaccusative, unergative and transitive sentences differ significantly after verb offset: a significantly higher probability of fixations to the target drawing was found in transitive and unergative sentences compared to unaccusatives. No significant effect was found between unergative and transitive sentences. These results provide new evidence regarding the processing of unaccusative, unergative and transitive sentences, which I will evaluate in accordance with the *Unaccusative Hypothesis* (Perlmutter, 1978) and the *Agent-Initial Preference Hypothesis* (Bever, 1970; Bornkessel-Schlesewsky & Schlesewsky, 2013; among many others). This will be an attempt of determining the origin of the differences in processing between those types of predicates. However, I do not claim that my results constitute enough evidence to confirm or disconfirm either hypothesis. More research is necessary in order to further evaluate these two hypotheses and their predictions fully in the light of new findings.

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2. THEORETICAL BACKGROUND

2.1 THE UNACCUSATIVE HYPOTHESIS

Perlmutter (1978) proposed that the class of intransitive predicates is not homogeneous in his *Unaccusative Hypothesis* (henceforth UH). He observed a number of linguistic phenomena, such as the existence of impersonal passives of some intransitive clauses in Dutch (1), German (2) and Turkish (3). Crucially, Perlmutter (1978) reported that only some intransitive verbs can form impersonal passives in Dutch (1), while others cannot.

(1) *Er wordt door de kinderen op het ijs geschaatst.*
it is by the children on the ice skated
'It is skated by the children on the ice.'

(2) *Hier wurde den ganzen Abend getantz.*
here was the whole evening danced
'It was danced here all evening.'

(3) *Burada çalışılır.*
here is.worked
'Here it is worked.'

Perlmutter (1978) also observed that the subjects of some English intransitive sentences (4) bear object-like properties.[2]

(4) *Gorillas exist.*

[2] In Relational Grammar, subjects are represented as R1, while objects are represented as R2.

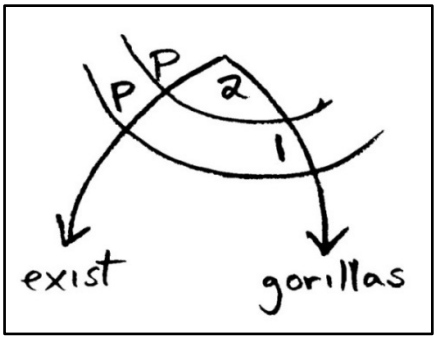

Figure 1: Stratal diagram given in Perlmutter (1978: 160) to represent the syntactic derivation of example (4). In this diagram, the subject *gorillas* is initially characterized as an object (R2), yet characterized as a subject (R1) in the final stratum.

This evidence led Perlmutter (1978) to formulate the UH, which proposes a split of intransitive predicates into two classes. On the one hand, what he named "unaccusative" clauses (5) have a single argument with object-like properties. On the other hand, what he termed "unergative" clauses (6) have a single argument with subject-like properties.

(5) *The girl fell.*

(6) *The girl ran.*

Although Perlmutter (1978) reported some syntactic phenomena, he states that the most important criteria to distinguish unaccusative and unergative clauses is the semantics of the clause. In this manner, the relevant properties that he observed in unaccusative and unergative subjects is that unaccusative subjects share semantic properties with transitive objects, while unergative subjects share semantic properties with transitive subjects.

Perlmutter (1978) did not formulate a single hypothesis, but rather provided three logical possibilities concerning the existence of unaccusatives and unergatives, which are outlined below. The first possibility is that we cannot predict which predicates are unaccusative and which ones are unergative in any given language. In this manner, the characterization of unaccusativity across languages could not be carried out in a structured manner, since its occurrence would be arbitrary. The second possibility is that there are cross-linguistic tendencies which allow us to predict which predicates are unaccusative and which ones are unergative, while allowing for a certain degree of cross-linguistic variation. The third possibility is a linking hypothesis to predict which predicates are unaccusative and which are unergative in all languages. This third

possibility is the strongest hypothesis to entertain, especially since Perlmutter (1978: 161) attempted to characterize unaccusativity and unergativity on the basis of verb meaning, assuming that this characterization is "predictable from the semantics of the clause".[3] In this manner, he argues that unaccusative verbs correspond mostly with events that are involuntary or non-active, such as predicates expressed by adjectives in English, predicates of existing and happening, non-voluntary emissions of stimuli that affect the senses, aspectual predicates, durative verbs and overall predicates in which the only participant is semantically a patient. By contrast, unergative verbs correspond with events that are volitional and/or active, manner-of-speaking verbs, verbs that correspond to animal sounds, and some involuntary bodily processes of emission.

The main semantic difference between unaccusative and unergative predicates as argued by Perlmutter (1978) lies in the thematic role borne by their subject. What is now missing is an account of why unaccusative and unergative subjects share subjecthood in languages like English, Dutch, Turkish, Spanish, Italian and many others. As it is shown in Figure 1, Perlmutter (1978) proposes that the single argument in unaccusative sentences starts the syntactic derivation as an object (R2) (4). Subsequently, and in order to satisfy the "Final 1 law" (Perlmutter & Postal, 1983), unaccusative subjects undergo *advancement* from R2 to R1 (5), which makes them identical to unergative subjects (6) in their morphology and syntactic position. The "Final 1 law" (Perlmutter & Postal, 1983) requires all sentences to have a subject (R1) in their final strata. According to it, independently of the status of the single argument in the initial stratum, the arguments in all intransitive predicates must bear subject morphology and occupy a subject syntactic position.

Burzio (1986) adapted the UH to the Government-Biding (GB) model within Generative Grammar (GG). In Burzio's (1986) proposal, the argument of an unaccusative predicate is generated as an object, internal to the VP (7), while the argument of an unergative predicate is generated as an external argument outside the VP (8).

(7) $[_{VP}$ *fell* $[_{NP}$ *the girl*$]]$

(8) $[_{NP}$ *the girl* $[_{VP}$ *ran*$]]$

[3] After Perlmutter's (1978) discovery, more evidence in support of the strongest hypothesis has been found (see section 3 for a complete discussion). Moreover, the interest of the third stance grows if we take into account that there is evidence to support the contention that verb meaning (i.e., the "conceptual structure" of events; Jackendoff, 1972) is universal (Youn et al., 2016; Artetxe, Labaka & Agirre, 2018).

The reason for the object in (7) to move to subject position has come to be known as *Burzio's Generalization*: "all and only the verbs that assign subject *θ*-role assign accusative Case" (Burzio, 1986: 189). In the case of transitive predicates, verbs assign accusative case to the object because they also assign nominative case to the subject. Therefore, unaccusative arguments must undergo syntactic movement to a position where case is assigned: the empty subject position where they receive nominative case (9). This is not so in the case of unergative arguments, which are generated as external arguments (10).

(9) $[_{NP}$ *The girl*$_i$ $[_{VP}$ *fell* $t_i]]$.

(10) $[_{NP}$ *The girl* $[_{VP}$ *ran*$]]$.

As a result of this movement, a crucial difference in the syntactic derivation of unaccusative and unergative sentences lies in the presence of a *trace* within the VP of unaccusative verbs (9), but not in unergatives (10). This claim will be of great importance when I review the previous experimental research in section 3, as a line of experiments rely on finding evidence for the predicted presence of a trace in the syntactic representation of unaccusatives.

2.2 THEMATIC ROLES

The notion of *thematic role* was critical in the development of hypotheses regarding argument structure and types of predicates. The term *thematic relation* was first introduced by Gruber (1965), although *thematic role* soon became more widely used (Jackendoff, 1972). Thematic roles correspond considerably to the *deep cases* of Case Grammar, as they refer to semantic categories (Fillmore, 1966, 1968).

Thematic roles comprise the different *relations* participants have in the event they take part in (Dowty, 1991). Thematic roles are "creatures of the syntax-semantics interface" (Dowty, 1991: 548) and bear a crucial role in argument structure. Among the various approaches to thematic roles, we can differentiate two main kinds: approaches that treat them as individual roles (Marantz, 1984; van Riemsdijk & Williams, 1986) and approaches that treat them as role types (Gruber, 1965; Jackendoff, 1972; Fillmore, 1968; Nishigauchi, 1984; Belletti & Rizzi, 1988; Rappaport Hovav & Levin, 1988). As

Dowty (1991) explains, treating thematic roles as individual roles means that no connection is established among the arguments that undertake similar roles across predicates. Under this view, the subject of *kill* is the "killer" and the subject of *build* is the "builder", without necessarily assuming or rejecting the need for a common thematic role that indexes them. By contrast, treating thematic roles as role types claims that all arguments can be effectively indexed under a small set of discrete thematic roles (Dowty, 1991).

Under this second conception, thematic roles are understood as discrete and primitive categories. The GB model assumes the need for a finite and short list of thematic roles, such as *agent*, *patient*, *goal*, *source* or *experiencer* (Nishigauchi, 1984; Belletti & Rizzi, 1988; Rappaport Hovav & Levin, 1988). There has been much disagreement over the inventory of possible thematic roles in attempting to provide a full list (Grimshaw, 1990). The relevance of Dowty's (1991) proposal regarding the nature of thematic roles is that it claims that thematic roles are brought into the grammar in two cluster-concepts called *proto-agent* and *proto-patient*:

> the best theory to account for thematic roles is not a traditional system of discrete roles (agent, patient, source, etc.) but a theory in which the only roles are two cluster-concepts called proto-agent and proto-patient, each characterized by a set of verbal entailments: an argument of a verb may bear either of the two proto-roles (or both) to varying degrees, according to the number of entailments of each kind the verb gives. (Dowty, 1991: 547)

In this manner, Dowty (1991) put forth a theory in which the meaning of the verbs determines argument structure by classifying the participant(s) in the event into the two proto-roles. This is done through a set of entailments that follow from verb meaning. In essence, the two cluster-concepts proto-agent and proto-patient are made up by a series of relevant properties that, if met by a given argument, contribute to the categorization of the argument into either one of the proto-roles. For example, some of the contributing properties for the agent proto-role are:

1. Having a volitional involvement in the event or state.
2. Causing an event or change of state in another participant.

3. Involving movement relative to the position of another participant.

(Dowty, 1991: 572)

By contrast, some of the contributing properties for the patient proto-role are:

1. Undergoing a change of state.
2. Being affected by another participant.
3. Being stationary relative to the movement of another participant.

(Dowty, 1991: 572).

These characterizations strongly resemble the semantic criteria provided in Perlmutter (1978) to distinguish unaccusative and unergative verbs, as both proposals are ultimately discussing the same issue: how to characterize agents and themes in sentence structure.

According to Dowty's (1991) proposal, each verb meaning generates a particular set of lexical entailments, which in turn determines what proto-role the participant(s) in the event will bear. The categorization of the argument into either one of the two proto-roles is understood as gradual, so that there are "different degrees of membership" to the two proto-roles (Dowty, 1991: 571). Moreover, his proposal contemplates the possibility that some arguments may be attributed properties from both the proto-agent and the proto-patient pool, even in a quite balanced fashion. Thus, this theory can account for the cross-linguistic variation phenomena observed by Rosen (1984). As Rosen (1984: 65-66, *apud* Dowty, 1991: 607-608) points out, to event-structure associated to verbs such as *sneeze*, *bleed*, *snore* or *blush* may follow an unaccusative or unergative pattern across languages; thus, as discussed by Rosen, *blush* is unergative in English but its translational equivalent in Italian (*arrossire*) or Spanish (*sonrojarse*) is unaccusative. If argument structure depends on the proto-role of the participant(s) of the event, and if thematic roles are non-discrete and non-primitive categories, cross-linguistic variation would be the reflection of how specific languages solve a problem of competing proto-agent and proto-patient properties for the argument(s). It should be noted that this fits in quite nicely with one of the forms of the UH proposed by Perlmutter (1978), in which a certain degree of cross-linguistic variation between unaccusative and unergative patterns was also contemplated.

In this section I have covered some basic theoretical literature to discuss the discovery and characterization of unaccusative and unergative predicates. In order to do so, a discussion on thematic roles could not but be brought forward, as the crucial semantic difference between unaccusative and unergative predicates resides in the thematic role of their argument. The nature of thematic roles and their place in linguistic theory is not a closed topic, and there have been various developments since Dowty's (1991) influential proposal (Croft, 1998; Marantz, 2013; Ramchand, 2013; Reinhart 2000, 2002; among others). Since the aim of my study is not to review current developments in the characterization of thematic roles, I conclude my review here in the following section I turn to the presentation of previous experimental research in the processing of unaccusative and unergative predicates.

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3. PREVIOUS EXPERIMENTAL RESEARCH

3.1 BEVER AND SANZ (1997) AND SUBSEQUENT STUDIES

The first experimental research to test the UH was carried out by Bever and Sanz (1997) in Spanish through a comprehension task. The experiment tested the UH together with the *Trace Facilitation Hypothesis*, relying on the GB model prediction that unaccusative sentences with preverbal subjects contain a trace in their syntactic derivation (11), while unergatives do not (12) (Sanz, Bever, & Laka, 1992; Bever & Sanz, 1997).

(11) *El apuesto crítico que visitaba el museo*$_i$ *llegó* t$_i$ *con cuidado.*
the handsome critic who visited the museum arrived with care
'The handsome critic who visited the museum arrived carefully.'

(12) *El apuesto crítico que visitaba el museo habló con cuidado.*
the handsome critic who visited the museum spoke with care
'The handsome critic who visited the museum spoke carefully.'

Traces are empty categories which have syntactic form and grammatical function, yet no phonological form; their semantic content is retrieved from an antecedent phrase in the sentence (Fodor, 1989). According to the GB model (Chomsky, 1981), a crucial difference between the syntactic derivation of unaccusative and unergative sentences is the presence and absence (respectively) of a trace within the VP. Bever and Sanz's (1997) experimental design was based on previous findings about processing of NP-traces and probe recognition tasks, which established the following relation: the salience of a probe word reflects the presence of a representation of it in the stimuli (Bever & McElree, 1988; MacDonald, 1989; Bever, Straub, Shenkman, Kim, & Carrithers, 1989; McElree & Bever, 1989). Thus, recognition speed of a probe word increases if the number of presentations of the said probe word also increases. The *Trace Facilitation Hypothesis* (Bever & Sanz, 1997) predicts exactly this: that the mental representation of an NP-trace provides an additional instance of its referent and therefore increases recognition speed. Since it is hypothesized that VPs of unaccusative sentences contain an NP-trace while the VPs of unergatives do not, the *Trace Facilitation Hypothesis* predicts that recognition of a probe word presented after the verb will be faster if it is presented in an unaccusative sentence compared to an unergative sentence.

Bever and Sanz's (1997) experiment had three types of items; the critical ones were sentences with unaccusative and unergative verbs and preverbal subjects such as (11) and (12). Crucially, the probe word in critical sentences was an adjective modifying the noun in the preverbal subject, i.e., the word *apuesto* 'handsome' in examples (11) and (12). Thirty-two native speakers of Spanish participated in Bever and Sanz's (1997) experiment. They were given two tasks: to decide if a probe word was contained in the sentence they had just read, and to answer content questions about the sentence (Bever & Sanz, 1997). For each trial, participants read a sentence on a screen in a moving-window fashion. When they had finished reading the sentence and it was no longer visible, the probe word appeared on the screen. Participants had to respond as quickly as possible whether or not the probe word had appeared in the sentence they had just read.

The results aligned in two different patterns: half of the participants showed faster probe recognition times in unaccusative sentences than in unergative sentences, while the other half of the participants showed the opposite pattern. This was accounted for on the grounds of participants using two different scanning techniques for probe recognition. Half of the participants scanned the surface structure representation of the sentence (i.e., syntactic structure) while searching for the probe word, while the other half searched the conceptual structure (Bever & Sanz, 1997). Since traces are syntactic representations that do not exist at the level of conceptual representation, the *Trace Facilitation Hypothesis* only predicts faster recognition times of the probe word in unaccusatives if the participant is scanning the syntactic structure of the sentence, not the conceptual structure (Bever & Sanz, 1997). In order to check that their results were not null results, Bever and Sanz (1997) introduced three types of items in their experiment: (a) critical items in which the probe word was an adjective modifying the preverbal subject in unaccusative and unergative sentences; (b) a heterogeneous set of sentences of varying length, which did not contain the probe word; (c) a heterogeneous set of sentences of varying length, which did contain the probe word. Sets (b) and (c) were used to categorize participants as *syntactic* scanners or *conceptual* scanners. The categorization was done according to the following relation: if a participant scans the syntactic structure in search for a probe word, there should be a strong correlation between sentence length and reaction times (Sternberg, 1969; Bever & Sanz, 1997). However, if a participant scans the conceptual structure of the sentence, there should not be a strong correlation between sentence length and reaction times (Bever & Sanz,

1997). In this manner, Bever and Sanz (1997) matched participants' performance in the critical set (a) to their performance in filler sets (b) and (c), finding that participants who were categorized as syntactic scanners in sets (b) and (c) showed faster probe recognition in unaccusatives than in unergatives, as predicted by the UH and the *Trace Facilitation Hypothesis*. By contrast, participants who were categorized as conceptual scanners in sets (b) and (c) showed faster probe recognition in unergatives.

After this seminal study, others have found experimental evidence of different processing patterns in unaccusative and unergative predicates (Burkhardt, Piñango, & Wong, 2003; Lee & Thompson, 2004; Friedmann, Taranto, Shapiro, & Swinney, 2008; McAllister, Bachrach, Waters, Michaud, & Caplan, 2009; Lee & Thompson, 2011; Koring et al., 2012; Shetreet & Friedmann, 2012; Meltzer-Asscher, Mack, Barbieri, & Thompson, 2015; Momma, Slevc, & Phillips, 2018). Although these studies use a variety of methods, all of them converge on one relevant finding: that the production or comprehension of unergative sentences is carried out faster or more easily than that of unaccusative sentences. This finding is often interpreted as a greater processing cost in unaccusative sentences, which is in turn attributed to the higher syntactic complexity (Burkhardt et al., 2003; Lee & Thompson, 2004; Friedmann et al., 2008; McAllister et al., 2009; Lee & Thompson, 2011; Shetreet & Friedmann, 2012; Meltzer-Asscher et al., 2015; Momma et al., 2018). Many of these studies also test grammatically impaired participants, especially people with agrammatism (Burkhardt et al., 2003; Lee & Thompson, 2004; McAllister et al., 2009; Lee & Thompson, 2011). In my study I tested healthy participants, so previous findings on processing of unaccusative and unergative sentences in healthy population are of special importance to my work. Below I present a review of these experimental works, which have been divided into two categories: those testing comprehension and those testing production.

COMPREHENSION STUDIES

In comprehension studies, the main finding is that unaccusative sentences reveal a delayed priming, reactivation or lexical decision response in comparison with unergative sentences.[4] For instance, Burkhardt et al. (2003) found earlier priming of the

[4] Priming techniques test whether and when an antecedent is reactivated during the processing of a sentence in comprehension (Friedmann et al., 2008). These techniques are frequently used in psycholinguistic research to investigate when in the online processing of the sentence word meanings

subject in unergative sentences than in unaccusative sentences in a cross-modal lexical decision priming task in English. In their experiment, sentences were presented auditorily while letter sequences (both real words and non-words) were continually presented on a computer screen. Participants had to decide if the letter sequence was a word or a non-word by pressing a button. They established four probe regions in which to test priming: (i) a control position before verb onset; (ii) a probe position 100 ms after verb offset; (iii) a probe position 650 ms after verb offset; and (iv) a probe position 800 ms after verb offset. In the probe regions, target words were presented on the computer screen; these were semantically related to the subject (e.g., *cheese - cheddar*). They tested a control group of fourteen healthy participants and a group of two patients with aphasia. Healthy participants revealed evidence of priming around 100 ms after verb offset in unergative sentences and around 650 ms after verb offset in unaccusative sentences. The group of aphasic patients also revealed a delayed priming for unaccusative subjects around 800 ms after verb offset.

In a similar study, Friedmann et al. (2008) also found different priming patterns in unaccusative and unergative predicates in a cross-modal lexical priming task in English. In their experiment, sentences were presented auditorily while letter sequences (both words and non-words) were presented on a computer screen for 500 ms. They tested a group of 120 healthy participants; participants had to decide if the letter sequence was a word or a non-word by pressing a button. They found priming of the subject around 750 ms after verb offset in unaccusative sentences; however, they did not report any priming effect in unergatives. From this, they conclude that the processing of unergative sentences does not include reactivation of the subject after verb offset.

Using fMRI, Shetreet and Friedmann (2012) found that unaccusative and unergative sentences have different patterns of brain activation by conducting a lexical decision task in Hebrew. In their experiment, participants listened to several blocks of sentences through headphones, performing a lexical decision task at the end of the sentences to ensure that they were paying attention to the stimuli. They tested a group of twenty-three healthy right-handed participants. Unaccusative sentences showed greater activation in the left inferior frontal gyrus (IFG) and the left posterior middle temporal gyrus (MTG) than unergative sentences. Also using fMRI, Meltzer-Asscher et al.

become activated. The idea is the following: when a word is heard or read shortly after a semantically-related word, it is accessed more easily or rapidly than when it is heard or read after an unrelated word (Friedmann et al., 2008).

(2015) reported different cortical activation patterns for unaccusative, unergative and transitive verbs in a lexical decision task in English. In their experiment, isolated verbs were presented visually; participants were asked to decide whether the stimuli were verbs or non-verbs. They tested a group of twenty-nine healthy participants. They found that unaccusative verbs elicited longer response times for the lexical decision task, as well as increased activation in the IFG with respect to unergatives and transitives.

Finally, using eye-tracking, Koring et al. (2012) found earlier and larger reactivation of the subject in unergative sentences (around 300 ms after verb offset) in comparison with the reactivation of the subject in unaccusative sentences (around 950 ms after verb offset).[5]

PRODUCTION STUDIES

In production studies, the main finding is that unergative sentences are produced more frequently and accurately than unaccusative ones. Lee and Thompson (2004) reported higher accuracy rates and higher number of unergative sentences than unaccusatives in an elicited production task in English. They tested a control group of five healthy participants and a group of eight agrammatic aphasic patients. In their experiment, pictures were presented on a screen, and participants were instructed to describe the picture using a complete sentence with the given verb. Their result was found both in the healthy control group and in the impaired group.

McAllister et al. (2009) found that unergative sentences were produced with significantly higher accuracy than unaccusatives in a single-word naming task, a sentence production task and a sentence-picture matching task in English. They tested a group of twelve healthy participants and a group of nine aphasic patients. In their experiment, participants performed various tasks. The first task was a picture naming task; participants were presented with pictures depicting actions and were asked to name the action depicted with one single verb. Target verbs were unaccusatives and unergatives. The second task was a sentence production task; participants were presented with pictures as well as the bare stem of the target verb. The target verb was presented visually in a written word and auditorily at the same time. Participants were instructed to use any form of the target verb in a sentence describing the picture. They

[5] See section 3.2 for a more in-depth description of Koring et al. (2012).

found that unergative sentences were produced more accurately than unaccusatives both in the unimpaired control group and in the impaired group.

Lee and Thompson (2011) reported greater production rates of unergative sentences in comparison with unaccusatives in an elicited sentence production task in English. They tested a control group of twelve healthy participants and a group of nine agrammatic aphasic patients. In their experiment, participants were presented with written cues and were asked to elicit complete sentences using the cues. For example, the cues *is floating* and *black/tube* were presented on the screen eliciting the production of *The black tube is floating*. This task was combined with eye-tracking in order to measure eye movements while reading the written cues used for the elicited sentence production task. Eye movements revealed different fixation patterns across the different words in the subject NP (noun + adjective) in unergative and unaccusative sentences. In unaccusative sentences, healthy participants fixated more on the noun than on the adjective before producing the noun; in unergative sentences, healthy participants fixated evenly on the noun and adjective before producing the noun. In unaccusative sentences, aphasic patients fixated more on the adjective than on the noun before producing the adjective; in unergative sentences, aphasic patients fixated evenly on the noun and adjective before producing the adjective. In addition, aphasic patients showed greater fixation durations to the verb than to the noun before producing the verb in unaccusative sentences, but not in unergatives.

Finally, Momma et al. (2018) found that the subject of unergative sentences requires less planning than that of unaccusative sentences in a picture-word interference production task in English. They tested a group of twenty-four healthy participants. In their experiment, participants were presented with pictures depicting actions, corresponding to unaccusative and unergative sentences. There was one distractor word in red font covering a small portion of each picture, placed on the middle of the black-and-white drawing. Distractors were: (i) a verb semantically-related to the action depicted by the drawing; (ii) a verb that was not semantically-related to the action depicted by the drawing; and (iii) a series of crosses (*xxxx*), in which case participants were told not to produce any sentence. Participants were instructed to describe the picture in sentential form using a verb in the present progressive, except when they saw xxxx as a distractor. In unergative sentences, they found semantic interference during subject articulation; in unaccusative sentences, they found semantic interference before subject onset. They conclude that verbs must be planned before unaccusative subjects

are uttered, but not before unergative subjects are uttered, a finding that is compatible with the UH.

3.2 KORING ET AL. (2012), EYE-TRACKING AND THE VISUAL WORLD PARADIGM

The experimental research conducted by Koring et al. (2012) is of crucial importance in this Master Thesis, as my research is a close replica of their original study. The methodology used by Koring et al. (2012), i.e., eye-tracking within the visual world paradigm, was of special importance when assessing the relevance and potential of their study. This is because this methodology allows us to look into the patterns and time course of argument reactivation in the processing of the whole sentence.

The visual world paradigm consists in the simultaneous presentation of auditory input and visual representations, and it is used to measure the time course of eye fixations patterns in relation to linguistic stimuli. It is based on the fact that linguistic processing causes changes in the eye fixations that participants make on visual stimuli (Cooper, 1974; Tanenhaus, Spivey-Knowlton, Eberhard, & Sedivy, 1995; Arantzeta et al., 2017).[6] As Conklin & Pellicer-Sánchez (2016) discuss, the use of eye-tracking relies on the assumption that fixations reveal the mental state of the participant. More specifically, it has been found that eye fixations are directly related to the processing of the presented linguistic input with a margin of 200 ms (Matin, Shao, & Boff, 1993). This close correlation between eye fixations and auditory linguistic input processing allows us to analyze linguistic processing in real time. The reason for using this methodology to investigate the processing of unaccusative and unergative sentences is precisely this: that it provides a reliable measure of how different elements in the linguistic stimuli become activated.

When listening to a lexical item in a sentence, the lexical representation of that item becomes active in the listener's mental representation. Previous research has found that lexical items also undergo *reactivation* at certain points during processing. As shown in section 3.1, research dealing with unaccusative and unergative sentences report reactivation of the subject at a postverbal position (Bever & Sanz, 1997; Burkhardt et al., 2003; Friedmann et al., 2008; Shetreet & Friedmann, 2012). This

[6] A fixation is a stop in the eye movements of the participant on a particular visual region, which tends to last about 330 ms in visual scenes (Conklin & Pellicer-Sánchez, 2016).

reactivation is often thought of as a "gap-filling process" (Burkhardt et al., 2003) which is expected as the result of integrating the argument and the verb in a single mental representation (Koring et al., 2012). Koring et al. (2012) measure the (expected) different patterns of argument reactivation in a postverbal position based on previous research, thus contributing to the understanding of the effect of thematic structure in syntactic processing.

In Koring et al.'s (2012) experiment, participants listened to sentences in Dutch while static visual displays were shown on a computer screen. Visual displays were composed of four black-and-white line drawings, each one on each corner of the screen. The linguistic input corresponded to unaccusative, unergative and what they referred to as "mixed-verb" sentences, all of them with preverbal subjects.[7] In test experimental items, only one of the four drawings was semantically related to the subject of the spoken sentence. Due to a priming effect, it was expected that participants would fixate on the semantically-related drawing when the subject of the sentence was active in their mental representation. Using eye-tracking, participants' eye movements were measured as they listened to the sentences. The critical data corresponded to the eye-fixations on the semantically-related drawings immediately after verb offset, since this fixation pattern is interpreted as a reactivation of the subject (Koring et al., 2012). Their results show a significant difference in the time course and size of argument reactivation across the different types of predicates (unaccusative, unergative and "mixed-verb"), with unaccusative subjects revealing reactivation around 650 ms later than unergative or "mixed-verb" subjects (Koring et al., 2012). Additionally, the duration of fixations also differed across types of predicates: fixations to the semantically-related drawing were longer in unergative and "mixed-verb" sentences than in unaccusatives. In this manner, Koring et al. (2012) found a larger reactivation effect of unergative subjects than unaccusative subjects.

[7] Koring et al. (2012) test a number of intransitive verbs which they refer to as "mixed-verbs" due to the fact that they seem to share properties with both unaccusative and unergative verbs. Crucially, they report that "mixed verbs" align with unergative verbs in the statistical analysis, with no statistically significant difference being found between the two groups of verbs. As a consequence, the so-called class of mixed verbs was excluded from my study, replacing them by transitive verbs instead.

3.3 TOWARD AN EXPLANATION FOR THE UNACCUSATIVE-UNERGATIVE DISTINCTION IN PROCESSING

Two different hypotheses can account for the greater processing cost observed in unaccusative sentences with respect to unergatives; these are not incompatible. The first possibility is the UH (Perlmutter, 1978), discussed in section 2.1. This hypothesis claims that the syntactic derivation of unaccusative predicates is longer, and therefore more complex than the syntactic derivation of unergatives. This greater syntactic complexity would be reflected in processing, making unaccusatives more costly to process than unergatives following the *Derivational Theory of Complexity* (Chomsky & Miller, 1963; Lee & Thompson, 2004). The second possibility is the *Agent-Initial Preference Hypothesis* (Bever, 1970; Bornkessel-Schlesewsky & Schlesewsky, 2013; among many others), which claims that agent-initial sentences are preferred. Since unaccusative subjects are themes, this preference could also explain the greater processing cost that has been found in unaccusative sentences with respect to unergative ones.

In this respect, the aim of my research is to obtain new evidence regarding the processing of unaccusative, unergative and transitive sentences by analyzing the results of my experiment and evaluating them in accordance with these two hypotheses: the *Unaccusative Hypothesis* and the *Agent-Initial Preference Hypothesis*. This will be an attempt of determining the origin of the differences in processing between those types of predicates. However, one must bear in mind that more research is necessary in order to confirm or disconfirm either hypothesis (see section 7 for further discussion).

Processing and representation of unaccusative, unergative and transitive predicates

4. PRESENT STUDY

Just like the original study in Koring et al. (2012), I used eye-tracking within the visual world paradigm as my methodology. I replicated their experiment in Spanish to measure the reactivation of the argument in unaccusative and unergative predicates, as well as the reactivation of the agent in transitive predicates. In my experiment, visual displays paired with spoken sentences were presented to the participants. Through a pair of headphones, participants listened to unaccusative, unergative and transitive sentences. Meanwhile, four black-and-white drawings appeared on the screen. In test trials, the subject of the sentences held a strong semantic relationship with one of the drawings on the screen (e.g., *mouse* - *cheese*). Reactivation of the critical argument was measured after verb offset, i.e., once participants knew whether the sentence was unaccusative, unergative or transitive. A detailed account of the method is given below.

4.1 PARTICIPANTS

Forty-four native speakers of Spanish participated in the experiment. Thirty-three were female and eleven were male (mean age 22.61). Their vision was normal or corrected to normal by glasses or contact lenses, and they did not suffer from dyslexia. The entire experiment lasted 20 minutes, and participants were paid 6 € each for their participation. I increased the number of participants in my study in comparison with the study in Koring et al. (2012), as they reported having thirty-seven native speakers of Dutch as participants.

4.2 STIMULI

This experiment had a 3x2 design, with the following independent variables: (i) the type of predicate, with three levels: unaccusative, unergative and transitive, and (ii) the type of experimental condition: test and control. The dependent variable was eye gaze, which in the visual world paradigm is a common dependent measure for studying the reactivation of the subject.

In the experiment, the stimuli consisted of recorded sentences paired with visual displays which were presented for the participants on a computer screen. Two lists of stimuli were created; participants whose number of participation was an odd number

were assigned List 1, whereas participants whose number of participation was an even number were assigned List 2. Both lists contained a total of 110 trials. Out of those, 60 were experimental trials and 50 were filler trials. There were two types of experimental trials: those containing test sentences and those containing control sentences. For each list, 30 of the experimental trials contained test sentences and the other 30 contained control sentences. In total, each list contained 10 unaccusative test sentences, 10 unaccusative control sentences, 10 unergative test sentences, 10 unergative control sentences, 10 transitive test sentences, 10 transitive control sentences and 50 filler sentences. The same set of filler sentences was shared by both lists. The number and type of items that each list contained is exemplified in Table 1.

	Type of predicate		
Type of experimental condition	Unaccusative	Unergative	Transitive
Test	10	10	10
Control	10	10	10

Table 1: Number and type of experimental items per list.

VIDEOS

Each video contained one recorded sentence which was heard by the participants, as well as a static display of four images, each one on each corner of the screen. Videos were presented on a 24" viewing monitor at a resolution of 1024x780 pixels, with a symmetrical black portion of the screen framing the videos.

DRAWINGS

The images in the visual displays were black-and-white line drawings, placed on a white background. The majority of the drawings were downloaded as freeware from the *International Picture Naming Project* (IPNP) website (Szekely et al., 2004), which is also the source Koring et al. (2012) used in their original study. Additionally, a small number of black-and-white drawings in the same style were taken from an adaptation of Snodgrass & Vanderwart (1980).

The drawings were placed on four positions on the screen: top left, top right, bottom left and bottom right. During the design of the visual displays, four rectangular

frames of identical measurements were placed on each position, so that all four rectangles were placed exactly at the same distance away from the center of the screen. Drawings were placed within the boundaries of the said rectangles evenly and never exceeding its lines, thus making the drawings as similar in size as possible. After the creation of all the visual displays, the guiding rectangles were deleted so that there were no boundaries between the white background and the black-and-white line drawings. During data processing, the dimensions of these four guiding rectangles were taken as the visual areas of interest to determine the position of the visual target.

The position of target drawings in experimental trials (test and control) was randomized in the following manner. All drawings selected as target drawings for the study appeared exactly four times during the experiment, each time in one of the four positions on the screen. For each list, the same target drawing appeared once in a test trial, once in a control trial, and twice either in a filler trial or in a visual display in which it was not the target drawing. During the experiment, target drawings were located on the left side of the screen in half of the experimental trials (test and control), and on the right side of the screen in the other half of the experimental trials (test and control).

SENTENCES

Audios consisted of spoken sentences recorded in a soundproof booth by a female native speaker of Spanish at a normal speaking rate. All sentences (test, control and fillers) contained an argument and a verb, as well as additional material that was added to make the sentences longer. I provide a full list of the sentences in Appendix A.

The relationship between these recorded sentences and the drawings in the visual displays is as follows: in test sentences, the subject was semantically related to one of the drawings in its corresponding visual display (e.g., *mouse* - *cheese*), as shown in Figure 2 and its corresponding sentence (13).

(13) *La señora dijo que el ratón negro, peludo y grande cayó ese día por las escaleras del edificio.*
'The woman said that the big, hairy, black mouse fell that day
down the stairs of the building.'

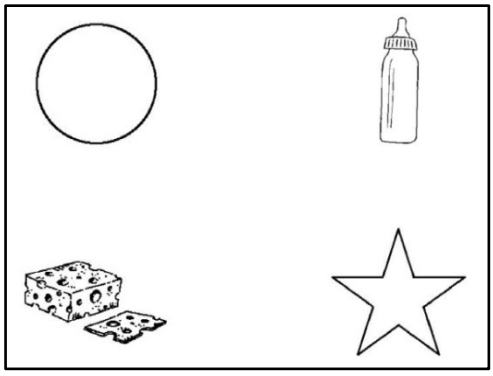

Figure 2: Example of a visual display that is paired with a test sentence (13). Target drawing is *cheese*, related to the subject *ratón* 'mouse'.

In control sentences, the subject was not semantically related to any of the drawings in its corresponding visual display (e.g., *chimpanzee - cheese*), as shown in Figure 3 and its corresponding sentence (14).

(14) *La señora dijo que el chimpancé negro, peludo y grande cayó ese día por las escaleras del edificio.*
'The woman said that the big, hairy, black chimpanzee fell that day down the stairs of the building.'

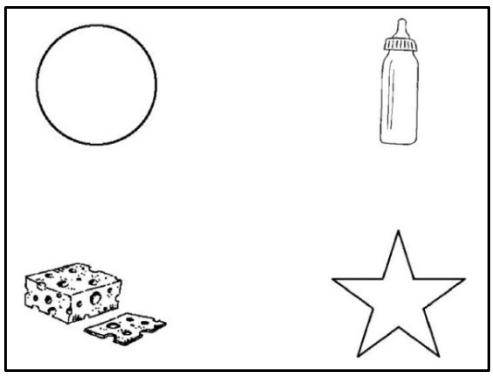

Figure 3: Example of a visual display that is paired with a control sentence (14). Target drawing is *cheese*, which is not related to the subject *chimpancé* 'chimpanzee'.

In filler sentences, the subject directly matches one of the drawings in the display (e.g., *elephant - elephant*), as shown in Figure 4 and its corresponding sentence (15).

(15) *Su novia le preguntó: ¿Qué tipo de comida está comiendo el elefante del circo ambulante?*
'His/her girlfriend asked him: What type of food is the elephant from the traveling circus eating?'

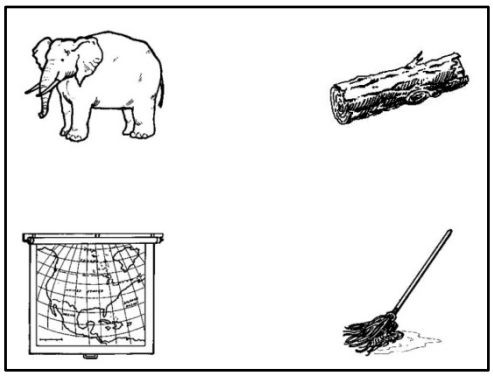

Figure 4: Example of a visual display that is paired with a filler sentence (15). The subject is *elephant*, which is directly matched to one of the drawings in the display.

Finally, I made sure that none of the words in experimental sentences (except the subject noun in test trials) were semantically related to any of the drawings in their corresponding visual displays.

The relationship between test and control sentences is that they make pairs, as illustrated in Figures 2 and 3 and sentences (13) and (14), respectively. In my experiment, there were 60 experimental pairs for a total of 120 experimental sentences; 60 were test sentences and the other 60 were control sentences. In each experimental pair of test and control sentences, both sentences shared exactly the same visual display but differed in their subject. Test sentences had a subject semantically related to one drawing, unlike their corresponding control sentences, where the subject was not related to any drawing in the visual display. Once the recorded sentences and the visual displays were paired, the resulting videos were distributed evenly among the two lists so that each list only contained the same display once, either with the test sentence or with the control sentence. As a result, participants heard either the test or the control version of the same experimental pair, but never both.

Koring et al. (2012) argue that the increase in looks to the target drawing in test trials is caused by the reactivation of the sentential subject in the mental representation of the participants. To claim this, they created the test and control sentence pairs in the

aforementioned fashion, so that fixations on the target drawing in control trials created a baseline for the looks to the visual target. Their results revealed a significantly higher percentage of fixations to the visual target in test trials versus control trials, thus ensuring that the fixations on the target drawing in test trials were due to the presence of a sentential subject that was semantically-related to the visual target. This higher percentage of looks to the target drawing in test trials is interpreted as reactivation of the subject of the sentence (Koring et al., 2012).

4.3 SENTENCE REGIONS

In experimental trials, both test and control sentences shared a specific order and structure. I delimited a total of four regions in the case of unaccusative and unergative sentences, and a total of five regions in the case of transitive sentences. Transitive sentences incorporated an additional region at the end of the sentence with respect to unaccusative and unergative sentences, in which the object was included. Since both unaccusative and unergative sentences only have one argument, they both lacked this region. The different regions in experimental sentences are exemplified in Table 2.

Regions in experimental sentences				
Intro	NP	V	PostV	(Obj)

Table 2: Regions (in this order) in all experimental sentences (unaccusative, unergative and transitive, both in the test and control condition).

I will now discuss each region in detail.

INTRO

All experimental sentences began with a framing sentence (*Intro*) like *[Alguien] dijo que...* '[Someone] said that…' This framing sentence had variations in the experimental trials: the subject of the main clause was carried out either by common Spanish names such as *María* or *Pedro*, or by frequently used NPs such as *la niña* 'the girl', *el padre* 'the father', *la directora* 'the principal', etc.

NP

After the framing sentence, there came the subject (*NP*) of the embedded clause. This argument consisted of an NP including a definite article, a noun and a PP or AdjP that modified the noun (in that order): e.g., *el ratón negro, peludo y grande* 'the big, hairy, black mouse.' I provide a full account on the selection of subjects in section 4.5. The length of the PP or AdjP that carried out noun modification was between 7-9 syllables (between 1 and 6 words, mean words 4.17). Koring et al. (2012) used PP and AdvP modification of the noun, and the length of this section was between 7-13 syllables (between 5 and 10 words, mean words 6.4). I sought to reduce the variation between their minimum length (7 syllables) and maximum length (13 syllables) for the PP or AdjP of intervening material (with its maximum length almost doubling its minimum length). Therefore, I decided to reduce the range of possible lengths of this region to 7-9 syllables, in order to keep experimental sentences more uniform. This intervening material was included between subject and verb onset in order to ensure that activation would decay from the first encounter of the subject (NP) until verb onset.

V

Next, the verb (*V*) was presented. As advanced before, there were three types of verbs in this study: unaccusative verbs, unergative verbs and transitive verbs. All verbs appeared in the past simple tense, or *pretérito perfecto simple*. Only unaccusative verbs which could be used without the preceding *se* morpheme were selected for the experiment. I provide a full account of experimental verbs in section 4.4.

POSTV

Next, intervening material was included after verb offset (*PostV*) in the form of an Adjunct, with a length of 13-15 syllables (between 5 and 10 words, mean words 7.35). This was done in order to make linguistic stimuli last more than 750 ms after verb offset, so that reactivation of the argument after verb offset could be measured and also so that I could distinguish a reactivation effect from an end-of-sentence effect (Koring et al., 2012). It is important to note that the PostV material in Koring et al. (2012) included additional subordinate clauses, while in my experiment this was not the case. I only included additional material that did not contain additional subordinate clauses, so

that there were only two verbs in each sentence: that of the framing sentence (Intro), which was always *dijo* 'said', and the experimental verb (V).

OBJ

Finally, in the case of transitive sentences an extra region (*Obj*) was included after PostV offset. In unaccusative and unergative sentences, PostV offset coincides with sentence ending. In transitive sentences, Obj offset coincides with sentence ending. The length and structure of the PostV section was kept uniform in unaccusative, unergative and transitive sentences, with the only difference being that in transitive sentences more material (Obj) came after this section, whereas in unaccusative and unergative sentences no material came after PostV offset.

The rigid structure and order in experimental sentences (13, 14) (test and control) was not shared by filler sentences (15). Whereas all experimental sentences (test and control) were declarative sentences, filler sentences included a variety of declarative, negative and interrogative sentences. Their structure, unlike experimental sentences, was not fixed, but rather allowed for variation. Similarly, the order of constituents was not fixed either. This was done in order to make it difficult for participants to anticipate the order of constituents and structure of the sentences while listening to them.

4.4 SELECTION OF VERBS

Verbs were matched in frequency using the freely available EsPal corpus for Spanish word properties (Duchon, Perea, Sebastián-Gallés, Martí, & Carreiras, 2012). All selected verbs had a frequency value between 3.311966 and 4.800250. In the corpus, the current minimum value for this frequency value is 0.301030, the current maximum value is 7.340494, and the current average value is 1,332151. For the experiment, 10 unaccusative, 10 unergative and 10 transitive verbs were selected; each verb was used twice the experiment. Unaccusative verbs were taken from the set of experimental verbs in Bever and Sanz (1997) and/or Koring et al. (2012) (in which case the appropriate Spanish translation was selected): *aparecer* 'appear', *caer* 'fall', *crecer* 'grow', *desaparecer* 'disappear', *llegar* 'arrive', *morir* 'die', *despertar* 'wake up', *nacer* 'be

born', *pasar* 'go by', *salir* 'go out'. Unergative verbs were taken from the set of experimental verbs in Bever & Sanz (1997) and/or Koring et al. (2012) (in which case the appropriate Spanish translation was selected): *caminar* 'walk', *correr* 'run', *hablar* 'speak', *pasear* 'stroll', *andar* 'walk', *bailar* 'dance', *girar* 'turn', *gritar* 'shout', *nadar* 'swim', *saltar* 'jump'. Transitive verbs were *arreglar* 'fix', *comer* 'eat', *contar* 'tell, count', *limpiar* 'clean', *llamar* 'call', *llevar* 'carry, wear', *matar* 'kill', *preparar* 'prepare ', *tocar* 'touch, play', *traer* 'bring'. I provide a complete list of the selected verbs together with the test arguments, target drawings and control arguments that they were paired with in Appendix B.

4.5 Selection of subjects and drawings

Sentential subjects were paired with black-and-white drawings based on the (relative) strength of their semantic relationship. This was done by means of a series of four norming studies, which are discussed in section 4.6.

Regarding animacy, it is worth noting that all the target drawings used in the visual displays depicted inanimate objects, whereas all the experimental subjects (test and control) were animate. Filler sentences had both animate and inanimate subjects, as well as both animate and inanimate target drawings. This was a change I incorporated with respect to the study in Koring et al. (2012), since they used both animate and inanimate subjects in test and control sentences. They reported using animate and inanimate subjects with unaccusative verbs, whereas unergative verbs were only paired with animate subjects (Koring et al., 2012). I incorporated this control of animacy in experimental trials in order to rule out that any effect found in my results were due to animacy.

4.6 Norming studies

Just as Koring et al. (2012) did in their original study, I conducted a norming study prior to running the experiment in order to check that experimental subjects, verbs and target drawings had been chosen and paired appropriately. Because Koring et al. (2012) were measuring reactivation of the subject after verb offset, they had to run the following

tests. First, they had to make sure that the test pairs of arguments and drawings shared a strong semantic relationship. Second, they had to verify that none of the other words in the sentences had a strong semantic relationship with each other. Especially, they wanted to make sure that the control pairs of arguments and drawings shared a weak semantic relationship, and that all verbs shared a weak semantic relationship with all arguments and drawings (test and control). I carried out the same verifications by means of four norming studies to ascertain that Spanish native speakers would respond to the strength of semantic relationships in the way I anticipated in the pre-selected materials.

I needed to verify the following: (i) that test arguments were indeed strongly related to the inanimate objects depicted by the chosen target drawings (e.g., *mouse* - *cheese*); (ii) that control arguments were not strongly related to the inanimate objects depicted by the chosen target drawings (e.g., *chimpanzee* - *cheese*); and (iii) that neither test nor control arguments were semantically related to their corresponding experimental verbs (e.g., *mouse* - *fall* and *chimpanzee* - *fall*). To do this, I divided the pre-selected pairs of test argument - inanimate object, control argument - inanimate object, test argument - verb, and control argument - verb into four groups, one for each norming study. The reason for this is as follows. The verifications I needed to run were not balanced in number: only 34 pairs were expected to be marked as having a strong semantic relationship, while 154 pairs were expected to receive a weak relationship rating. I did not want participants to be affected by this imbalance; more specifically, I did not wish to have participants try to compensate for the imbalance by modulating their ratings based on how many pairs received one rating or the other. As a consequence, I included distractor pairs so as to have a balanced number of pairs which I anticipated would have a strong relationship, a weak relationship, and a neutral relationship. Because this made the study quite long, I decided to divide it into four parts which could be conducted individually in a shorter period of time.

The four norming studies were conducted in the same fashion. They were created on the Ibex farm platform and sent to participants to be completed online. A total of fifty-five native speakers of Spanish voluntarily completed each norming study. Participants were asked to rate pairs of words based on how strongly related they were semantically, on a scale from 0-5 (0 being weakly related and 5 being strongly related). Participants had to complete a short questionnaire about personal information and linguistic profile before undertaking the norming study. Participants were told that there would be two types of pairs in the norming studies: noun - noun pairs and noun - verb

pairs. The presentation of the pairs was randomized, and each norming study took about 7 minutes to complete. For each pair, the two words were presented together in lowercase letters and separated by a dash. Below the pair of words, the 0-5 rating scale appeared. Noun - noun pairs included one animate being and an inanimate object/place/abstract concept (e.g., *mouse* - *cheese*), always in that order. Noun - verb pairs comprised one animate being and a verb/action (e.g., *mouse* - *fall*), always in that order.

Norming study 1 and norming study 2 had the same amount of pairs: 52 strongly related pairs, 48 weakly related pairs and 47 neutrally related pairs for a total of 147 pairs. Out of the strongly related pairs, 22 were noun - noun pairs and the other 30 were noun - verb pairs. Out of the weakly related pairs, 18 were noun - noun pairs and the other 20 were noun - verb pairs. All of the neutrally related pairs were noun - noun pairs.

Norming study 3 had 51 strongly related pairs, 46 weakly related pairs and 47 neutrally related pairs for a total of 144 pairs. Out of the strongly related pairs, 21 were noun - noun pairs and the other 30 were noun - verb pairs. Out of the weakly related pairs, 16 were noun - noun pairs and the other 20 were noun - verb pairs. All of the neutrally related pairs were noun - noun pairs.

Norming study 4 had 50 strongly related pairs, 46 weakly related pairs and 47 neutrally related pairs for a total of 143 pairs. Out of the strongly related pairs, 20 were noun - noun pairs and the other 30 were noun - verb pairs. Out of the weakly related pairs, 16 were noun - noun pairs and the other 20 were noun - verb pairs. All of the neutrally related pairs were noun - noun pairs.

To gather the results of the norming studies, I calculated the mean rating for each pre-selected pair, and discarded the distractor pairs. Just as Koring et al. (2012) did, all strongly-related pairs that received a mean rating of 4 or higher were selected, and all weakly-related pairs that received a mean rating of 2 or lower were also selected. I provide the mean ratings of the selected pairs which were used in my experiment in Appendix C.[8]

[8] The mean ratings reported in Appendix C were rounded-up to the two first digits after the period.

4.7 PROCEDURE

In a soundproof both, participants were seated comfortably on a chair with their eyes about 60 cm from the viewing monitor, and they were instructed to put on a pair of headphones to begin the experiment. Eye movements were measured by a Tobii X 120 sampling at 120 Hz. Each session started out with a calibration procedure with nine fixation points. Participants were instructed that they would hear some recorded sentences through the headphones while visual displays were showing. Participants were given the task of listening to the sentences very carefully. They were not, however, given any specific task regarding their looks at the visual displays, since they were told that they could look at whatever image(s) they wanted. On the screen, a centrally-located fixation cross appeared for 0.6 second between trials; participants were asked to fixate on this cross to reduce noise in the data. For each trial, there was 1 second of silence before the onset of the sentence; in this time, the display of four images was presented in silence. Then, the sentence played while the visual display remained on the screen. After the end of the sentence, there were another 2 seconds of silence before the display disappeared and the fixation cross appeared, after which another trial began. Stimuli presentation was automatic: once participants pressed the space bar to begin, the experiment ran without pause until the end. Stimuli presentation was randomized by TobiiStudio, and the entire experiment lasted 20 minutes.

5. DATA

5.1 DATA PROCESSING

A unified matrix was generated attending to the gaze fixation into the screen, presentation of each auditory stimuli and the location of the target visual stimuli into the screen. Only experimental (test and control) stimuli were selected, and filler stimuli were discarded. Data classified as "saccades" or "not classified" were eliminated from the dataset. Only data classified as "fixations" into the target visual stimuli were processed.

The auditory stimuli were segmented into 5 Regions Of Interest (ROI), coinciding with the regions discussed in section 4.3. ROI 1 corresponded to the Intro or framing sentence: *[Alguien] dijo que…* '[Someone] said that…' ROI 2 corresponded to the NP or sentential subject; this region comprised a definite article, a noun and a PP or AdjP that modified the noun: *el ratón negro, peludo y grande* 'the big, hairy, black mouse'. ROI 3 corresponded to the experimental verb (V). ROI 4 corresponded to the PostV, which comprised an Adjunct. Finally, ROI 5 corresponded to the sentential object (Obj) in the case of transitive sentences.

The eye-tracker was used with a sampling rate of 120 Hz. Therefore, gaze fixation was tracked every 8 ms. Data were processed so as to be able to know if participants were looking at the visual target in ROI 4 (PostV) in each sample line (i.e., every 8 ms). I assigned a binary treatment to the data points: sample lines in which participants were fixating on the visual target were assigned 1, while sample lines in which participants were not fixating on the visual target were assigned 0.

5.2 DATA ANALYSIS

For data analysis, I used the Generalized Linear Mixed Model (henceforth GLMM). In GLMM, the estimates have to be interpreted with respect to the logit scale (i.e., the log of the odds of observing a fixation on the visual target). A positive estimate on this scale indicates that (an increasing value of) the predictor has a positive effect on the probability of observing a fixation towards the visual target. Similarly, a negative estimate indicates a negative effect on the probability of observing a correct answer.

In my model, fixation data is the dependent variable. As advanced before, fixation data is binary: 1 indicates a fixation on the visual target, and 0 indicates a fixation outside the visual target. The final model contained two-way interactions for Predicate (with three levels: unaccusative, unergative and transitive) and Trial (with two levels: test and control) as fixed effects; stimuli and participants variables were random effects. Least square means (henceforth LSMeans) were calculated and pairwise comparisons were carried out with a Tukey correction. Effects are considered significant at the p <0.05 level. The analysis was conducted using R Statistic software (R Core Team, v.3.6.0.) using the lme4 package (Bates, Mächler, Bolker, & Walker, 2015).

6. RESULTS

Two comparisons across the fixed effects were extracted from the GLMM in order to answer my research questions. My two research questions were: (i) whether there is a difference in the reactivation pattern of the subject in unaccusative and unergative sentences, and (ii) whether there is a difference in the reactivation pattern of the subject in unergative and transitive sentences. To answer these questions, I first had to verify that any increase in the probability of fixations to the visual target in test trials was due to the reactivation of the sentential subject.

In the first comparison, I compared the probability of fixating into the visual target in test and control trials. This comparison was conducted separately across all three predicate conditions (unaccusative, unergative and transitive). Results show that participants fixate on the visual target with a significantly higher probability in test trials than in control trials, and this is consistent across all three predicate conditions (unaccusative: β = -0.973; *SE* = 0.134; *p* = <.0001; unergative: β = -1.295; *SE* = 0.147; *p* = <.0001; transitive: β = -1.466; *SE* = 0.115; *p* = <.0001).

In the second comparison, I compared the probability of fixating into the visual target across predicate conditions (i.e., unaccusative, unergative and transitive sentences) in both test and control trials. In the test trials, results show that participants fixate on the visual target with a significantly higher probability in transitive than in unaccusative sentences (β = 0.6412; *SE* = 0.134; *p* = <.0001), and in unergative than in unaccusative sentences (β = 0.4950; *SE* = 0.149; *p* = 0.0026). No significant effect was found in the transitive and unergative comparison (β = 0.1462; *SE* = 0.141; *p* = 0.5547). In the control trials, no significant effect was found across any of the conditions: transitive and unaccusative (β = 0.1481; *SE* = 0.121; *p* = 0.4390), transitive and unergative (β = -0.0245; *SE* = 0.116; *p* = 0.9755), and unaccusative and unergative (β = -0.1727; *SE* = 0.139; *p* = 0.4266). I provide a graphic representation of these results in Figure 5.

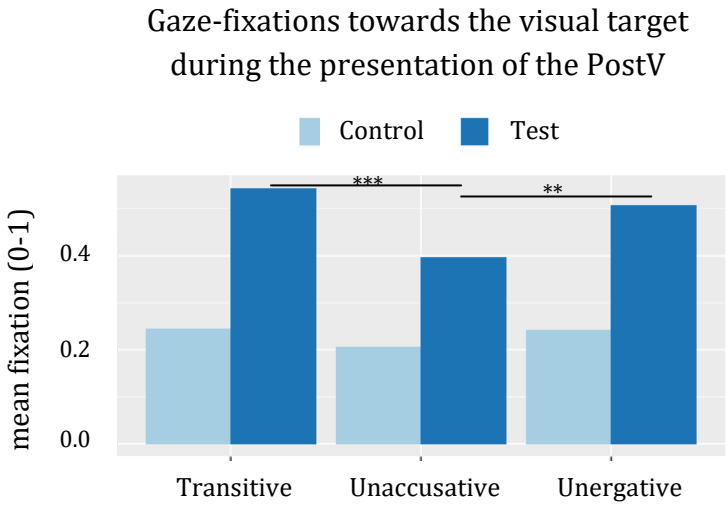

Figure 5: Mean of gaze-fixations to the visual target in unaccusative, unergative and transitive sentences in the test and control experimental trials during ROI 4 (PostV).

7. DISCUSSION

The main goal of the present study is to investigate how sentential subjects of unaccusative, unergative and transitive predicates are processed in Spanish using eye-tracking and the visual world paradigm. I now discuss my results to provide an answer to my two research questions. Additionally, I also discuss my results in relation to previous research findings, reviewed in section 3.1, and in relation with the two hypotheses that could account for the said findings, discussed in section 3.3. These are my main research questions:

1. Are there different patterns in the reactivation of the subject after verb offset in unaccusative and unergative predicates?
2. Does the pattern of reactivation of the subject in unergative predicates align with the pattern of reactivation of the subject in transitive predicates?

Regarding the first question, my results reveal a statistically significant difference in the pattern of subject reactivation in unaccusative and unergative predicates, as the subject reactivation effect had a significantly higher probability in unergative sentences than in unaccusatives. Regarding the second question, my results reveal that there was no statistically significant difference in the pattern of subject reactivation in unergative and transitive predicates. Thus, my findings show that subject reactivation in unaccusative sentences follows one pattern, having a smaller reactivation effect, while subject reactivation in unergative and transitive sentences follows another pattern, having a larger reactivation effect. This higher probability of fixating on the visual target in transitive and unergative sentences than in unaccusative sentences in test trials can be interpreted as subject reactivation because the comparison across predicates and trials (test and control) shows that participants fixate on the visual target with a significantly higher probability in test than in control trials. In other words, control trials create a baseline for fixations, as fixations in control trials do not correspond with a reactivation effect. The size of the subject reactivation effect corresponds with the mean of fixations to the visual target in test trials. My results indicate that participants fixated more on the visual target related to the subject in the case of unergative and transitive sentences as compared to unaccusatives. In other words: the subject reactivation effect was larger in unergative and transitive sentences than in unaccusatives.

How the amount of fixations is interpreted is of crucial importance at this point. The basic assumption in the visual world paradigm is that the processing of auditory linguistic stimuli promotes fixations on visual representations. Thus, fixations are associated to attention or preference processes towards the visual stimuli. My results show that the visual targets in unergative and transitive sentences received more fixations than those in unaccusative sentences; in other words, fixation patterns revealed that more attention or preference was shown to the visual targets in unergative and transitive sentences as compared to unaccusative sentences. I now turn to compare and discuss my findings with those of previous experimental research.

Koring et al. (2012), the study I replicate here, found a larger reactivation effect for sentential subjects of unergative sentences as compared to unaccusatives. This main finding was replicated in my results. It is worth noting that Koring et al. (2012) did not control for animacy in their experiment, since unergative subjects were always animate and unaccusative subjects were sometimes animate and sometimes inanimate. In my study, all subjects were animate so that animacy could not affect the differences found. My findings reveal that the larger reactivation of unergative and transitive subjects is not due to an animacy effect; rather, since all subjects were animate, the only possible cause of the different fixation patterns is the thematic role they bear, that is, the argument structure of the verb.

Koring et al. (2012) also measured the time course of subject reactivation, finding that unergative subjects are reactivated earlier (around 300 ms after verb offset) than unaccusative ones (around 950 ms after verb offset). Because of time limitations and the overall complexity of the analysis, I did not carry out the growth curve analysis (Mirman, Dixon, & Magnuson, 2008) as Koring et al. (2012) did in their study. However, I intend to do so in future research, as this analysis will allow me to investigate the time course of subject reactivation.

Concerning other previous experimental studies, the main finding across methodologies and analyses is that the processing (production or comprehension) of unergative sentences is carried out faster and with greater accuracy than that of unaccusative sentences. In line with the *Unaccusative Hypothesis* (Perlmutter, 1978), this finding is often interpreted as a greater processing cost in unaccusative sentences attributed to their greater syntactic complexity (Bever & Sanz, 1997; Burkhardt et al., 2003; Lee & Thompson, 2004; Friedmann et al., 2008; McAllister et al., 2009; Lee &

Thompson, 2011; Shetreet & Friedmann, 2012; Meltzer-Asscher et al., 2015; Momma et al., 2018).

In comprehension studies, the main finding is that the subjects of unaccusative sentences reveal a delayed priming or reactivation (measured by means of a lexical decision task) in comparison with subjects of unergative sentences. Recall that Bever and Sanz (1997) found two sharply divergent patterns of results: participants classified as syntactic scanners showed faster probe recognition for the subject of unaccusative sentences, while participants classified as conceptual scanners showed faster probe recognition for the subject of unergative sentences. Subsequent studies (Burkhardt et al., 2003; Lee & Thompson, 2004; Friedmann et al., 2008; Lee & Thompson, 2011) did not find evidence for two types of "scanners" among participants, i.e., that some pay attention to syntactic structure and others to conceptual structure, as argued by Bever and Sanz (1997).

In cross-modal lexical decision priming tasks (Burkhardt et al., 2003; Friedmann et al., 2008) results also revealed a different pattern in the time course of the reactivation of the subject in unaccusative and unergative predicates. Since I have not yet explored the time course of reactivation in my results, I cannot for the time being discuss those results in comparison to mine, although I intend to do so once I conduct the growth curve analysis with my data. Two fMRI studies (Shetreet & Friedmann, 2012; Meltzer-Asscher et al., 2015) found that unaccusative sentences or verbs in isolation reveal greater activation than unergatives in the left interior frontal gyrus (IFG), and that unaccusative verbs elicited longer response times for the lexical decision task, also revealing larger processing costs for unaccusatives as compared to unergatives.

In production studies, the main finding is that unergative sentences are produced more frequently and accurately than unaccusative ones (Lee & Thompson, 2004; McAllister et al., 2009). If longer fixation times indicate not an extra processing cost but greater attention preference, then my results are compatible with the finding that unergative sentences are less costly to process than unaccusatives.

I will now discuss my findings according to the two hypotheses at hand. First, the *Unaccusative Hypothesis* claims that there exist two different types of intransitive predicates, unaccusatives and unergatives, and that the syntactic derivation of unaccusatives is longer because unaccusative subjects are born as objects and become subjects during the syntactic derivation of the sentence (Perlmutter, 1978; Burzio,

1986). All the findings in the experimental literature reviewed here are consistent with the differentiation of unaccusative and unergative predicates in sentence processing, both in comprehension and production. Most previous findings are also compatible with the predicted larger processing cost of unaccusative sentences, although, as we shall see, this is not the only way to account for the findings. Recall that Koring et al. (2012) found larger reactivation measures for the subject in unergative sentences as well as a delayed and smaller reactivation of the subject in unaccusative sentences. They argued that a larger activation in unaccusatives would be consistent with the UH, since this hypothesis claims that unaccusatives have higher syntactic complexity than unergatives, if larger activation is interpreted as reflecting larger processing costs. However, both their and my results are not consistent with this prediction, since it was found that unergative and transitive subjects receive larger or more fixations than unaccusatives. In this respect, it is of crucial importance to investigate whether measurements such as the duration of subject reactivation are correlated to syntactic complexity or rather to cognitive saliency, as it would be the case if the larger fixation pattern of agentive subjects (unergatives and transitives) were related to the *Agent-Initial Preference Hypothesis*, as I have suggested earlier.

Let us now consider what the amount of eye-fixations indicates. On the one hand, a higher amount of fixations could be interpreted as greater processing cost (Conklin & Pellicer-Sánchez, 2016). On the other hand, this measure could also reveal greater attention or preference, which could in turn indicate easier or preferred processing. If more fixations reveal greater attention or preference to the visual target, my findings are compatible with the *Agent-Initial Preference Hypothesis* (Bever, 1970; Bornkessel-Schlesewsky & Schlesewsky, 2013; among many others). This hypothesis claims that agent-initial sentences are preferred. Unergative and transitive sentences with preverbal subjects (i.e., the ones in my study) are consistent with this preference, since they are agent initial. However, unaccusative sentences with preverbal subjects are not consistent with this preference, because they are theme initial. One possible explanation of Koring et al.'s (2012) findings as well as mine is that the larger reactivation found in agent subjects than in theme subjects is due to agents being preferred, triggering greater attention to the semantically-related drawing and resulting in longer fixations. Longer fixations to the agent were interpreted as revealing an agent-initial preference in Basque (Yetano, Duñabeitia, & Laka, 2011). More research is necessary in order to confirm or disconfirm this interpretation of my findings.

8. CONCLUSION

The aim of this Master Thesis is to present a replica in Spanish of a study that was previously conducted in Dutch by Koring et al. (2012) using eye-tracking and the visual world paradigm. My research deals with whether there are different patterns of subject reactivation in unaccusative, unergative and transitive sentences. More specifically, my two research questions are: (i) Is the pattern of subject reactivation different in unaccusative and unergative sentences? (ii) Is the pattern of subject reactivation different in unergative and transitive sentences? Gathering fixation data from an eye-tracking experiment testing forty-four native speakers of Spanish, I was able to collect new evidence for the differences between the previously mentioned predicates. On the one hand, a significantly larger subject reactivation was found in unergative and transitive sentences than in unaccusative sentences. On the other hand, no significant effect was found in the fixation patterns between unergative and transitive sentences. These results are interpreted as consistent with (a part of) the *Unaccusative Hypothesis*, which claims that there are two classes of intransitive predicates: unaccusatives and unergatives. My results constitute favorable evidence of the unaccusative and unergative distinction in sentence processing. Results are also consistent with the *Agent-Initial Preference Hypothesis* (Bever, 1970; *inter alia*), which claims that agent-initial sentences (like unergatives or transitives) are preferred over theme-initial ones. However, further research is needed in order to attain more knowledge regarding the differences in processing between unaccusative, unergative and transitive sentences. More specifically, I intend on conducting future research on this line to investigate the time course of subject reactivation patterns in unaccusative, unergative and transitive sentences in Spanish and thus further contribute new evidence on this topic.

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APPENDIX A

A.1 LIST 1

1.1 María dijo que el pájaro de color marrón clarito murió totalmente en silencio la noche de Año Nuevo.

2.1 Elena dijo que la florista con camisa y sombrero apareció después del último programa de la tarde.

3.1 La señora dijo que el ratón negro, peludo y grande cayó ese día por las escaleras del edificio.

4.1 El hombre dijo que el hámster blanco de la vecina cayó por la ventana del salón esa mañana.

5.1 La chica dijo que el músico vestido con traje y corbata llegó rápidamente al lago del parque natural.

6.1 La mujer dijo que el chimpancé gris con la barriga rosa nació sobre las tres y cuarto de la madrugada.

7.1 El inspector dijo que el pescador de la aldea de al lado murió en su propia casa durante las vacaciones.

8.1 Juan dijo que el matemático de barba larga y rizada salió de la casa con un gran saco de patatas.

9.1 El chico dijo que el arquero de gran fama y renombre pasó rápidamente por delante de la tienda.

10.1 El caballero dijo que el informático de cejas muy pobladas despertó de su largo y profundo sueño al instante.

11.1 El médico dijo que el preso sentado en el banco del parque creció mucho en los últimos años de su adolescencia.

12.1 La profesora dijo que el presentador vestido con una bata apareció de la nada en medio del recibidor de la casa.

13.1 El niño dijo que la costurera alta, delgada y esbelta desapareció aquella mañana de otoño entre la bruma.

14.1 El amigo dijo que el chico de ojos azul verdoso llegó al puerto esa mañana con una amplia sonrisa.

15.1 La mujer dijo que el piloto pelirrojo y con pecas despertó en una casa vacía después de muchos días.

16.1 María dijo que la marmota más ruidosa de todas desapareció misteriosamente una tarde de invierno.

17.1 El hombre dijo que el carpintero más conocido de la ciudad nació exactamente el mismo día que su esposa.

18.1 Juan dijo que la frutera joven y vivaracha salió de la tienda de electrónica bastante rápido.

19.1 Pedro dijo que el canario de mirada inteligente pasó rápidamente por detrás de la ventana.

20.1 El padre dijo que el lince pequeño y asustadizo creció mucho durante su estancia en aquella casa.

21.1 María dijo que el psicólogo vestido con ropa de calle bailó toda la noche en una discoteca de la ciudad.

22.1 La niña dijo que el marinero con muchos tatuajes caminó un buen rato por los pasillos del edificio.

23.1 El paciente dijo que la empresaria de pelo corto y moreno corrió por el paseo de la playa durante horas.

24.1 La reportera dijo que el anciano de grandes ojos azules gritó toda la noche por el jardín de su casa.

25.1 El pasajero dijo que el pintor con camisa y corbata azul habló con poca claridad por la megafonía.

26.1 Su amigo dijo que la gallina de color blanco y marrón corrió por la parcela dando vueltas en círculos.

27.1 El vecino dijo que el periodista de anciana edad y pelo blanco anduvo por toda la casa con preocupación y miedo.

28.1 El presidente dijo que la oculista de pelo negro y rizado paseó por toda la oficina con los brazos en jarras.

29.1 El niño dijo que la jirafa de color amarillo nadó en el riachuelo durante un cuarto de hora.

30.1 El cazador dijo que el conejo de orejas grandes y peludas giró sobre sí mismo en una milésima de segundo.

31.1 María dijo que el bebé rubio, regordete y alegre bailó por la tienda con una sonrisa de oreja a oreja.

32.1 La niña dijo que el perro pequeñito y miedoso caminó perdido durante todo el día y toda la noche.

33.1 Su amigo dijo que el cachorro más pequeño de la tienda saltó rápidamente por encima de la mesa.

34.1 El vecino dijo que el leñador con tatuajes en los brazos gritó como loco por los caminos montaña abajo.

35.1 El paciente dijo que el taxista muy callado y tímido habló ese día con muchísima seguridad.

36.1 La reportera dijo que el bombero con la nariz torcida giró lentamente y con mucho miedo sobre sí mismo.

37.1 El niño dijo que el pianista pelirrojo americano anduvo por las calles de la ciudad feliz y tranquilo.

38.1 El presidente dijo que el escritor latinoamericano nadó con fuertes brazadas río arriba y contracorriente.

39.1 La periodista dijo que el entrenador muy experimentado paseó nervioso por la habitación una y otra vez.

40.1 El pasajero dijo que la reina de pelo rizado y canoso saltó del helicóptero con la ayuda de los agentes.

41.1 El cliente dijo que el cartero de pelo negro y tupido comió rápidamente y con muchísimo entusiasmo un helado de chocolate.

42.1 La directora dijo que el logopeda de camisa de cuadros tocó con mucha calma y una habilidad sorprendente una canción al piano.

43.1 La madre dijo que la peluquera de grandes ojos verdes contó cuidadosamente y de manera muy pausada el número de asistentes.

44.1 El padre dijo que la gimnasta alta, morena y esbelta limpió afanosamente durante toda la tarde.

45.1 La reportera dijo que la cantante más bajita de todas llamó muchísimas veces esa mañana de otoño a su madre.

46.1 El narrador dijo que el viajero de barba larga y blanca mató de manera efectiva y con sus propias manos una serpiente.

47.1 La profesora dijo que el electricista más conocido de la ciudad llevó rápida y cuidadosamente en su sombrero las joyas robadas.

48.1 El inspector dijo que la policía simpática y alegre comió al lado de las escaleras relucientes un sándwich de queso.

49.1 El reportero dijo que el sacerdote más joven de todo el grupo tocó con sus propias manos y sin una pizca de miedo el veneno.

50.1 El inspector dijo que la rehén retenida en la embajada trajo dentro de su bolso de cuentas azules y negras una pistola.

51.1 El cliente dijo que la limpiadora con cara larga y triste preparó muy adecuadamente esa misma mañana la ruta de la excursión.

52.1 La directora dijo que el paciente de grandes ojos vivarachos arregló con paciencia, alegría y mucha tranquilidad aquel ordenador.

53.1 La madre dijo que el bebé de pelo muy oscuro arregló muy lentamente y con sus pequeños deditos la pistola.

54.1 El padre dijo que el doctor cansado y magullado limpió de forma concienzuda y hasta la perfección su pulsera de la suerte.

55.1 La reportera dijo que el párroco jovencito y sin experiencia llamó con voz temblorosa por la megafonía a su superior.

56.1 El narrador dijo que el estudiante de brazos delgaduchos preparó en su horno pirolítico de última generación un bacalao riquísimo.

57.1 La profesora dijo que el explorador más atrevido del grupo mató con muchísimo esfuerzo y ya casi sin aliento al oso.

58.1 El inspector dijo que el asesino de pelo extraño y puntiagudo llevó durante todo el transcurso de la película un sombrero en la cabeza.

59.1 El reportero dijo que el barbero vestido con camisa azul trajo con las manos y los brazos llenos a rebosar todos los juguetes.

60.1 El vecino dijo que la modista más amable del pueblo contó ante la petición de sus amigos y colegas su historia.

A.2 LIST 2

1.2 María dijo que el cachorro de color marrón clarito murió totalmente en silencio la noche de Año Nuevo.

2.2 Elena dijo que el arquero con camisa y sombrero apareció después del último programa de la tarde.

3.2 La señora dijo que el chimpancé negro, peludo y grande cayó ese día por las escaleras del edificio.

4.2 El hombre dijo que el perro blanco de la vecina cayó por la ventana del salón esa mañana.

5.2 La chica dijo que el taxista vestido con traje y corbata llegó rápidamente al lago del parque natural.

6.2 La mujer dijo que el ratón gris con la barriga rosa nació sobre las tres y cuarto de la madrugada.

7.2 El inspector dijo que el doctor de la aldea de al lado murió en su propia casa durante las vacaciones.

8.2 Juan dijo que el leñador de barba larga y rizada salió de la casa con un gran saco de patatas.

9.2 El chico dijo que la florista de gran fama y renombre pasó rápidamente por delante de la tienda.

10.2 El caballero dijo que el sacerdote de cejas muy pobladas despertó de su largo y profundo sueño al instante.

11.2 El médico dijo que el psicólogo sentado en el banco del parque creció mucho en los últimos años de su adolescencia.

12.2 La profesora dijo que el marinero vestido con una bata apareció de la nada en medio del recibidor de la casa.

13.2 El niño dijo que la empresaria alta, delgada y esbelta desapareció aquella mañana de otoño entre la bruma.

14.2 El amigo dijo que el anciano de ojos azul verdoso llegó al puerto esa mañana con una amplia sonrisa.

15.2 La mujer dijo que el pintor pelirrojo y con pecas despertó en una casa vacía después de muchos días.

16.2 María dijo que la gallina más ruidosa de todas desapareció misteriosamente una tarde de invierno.

17.2 El hombre dijo que el periodista más conocido de la ciudad nació exactamente el mismo día que su esposa.

18.2 Juan dijo que la oculista joven y vivaracha salió de la tienda de electrónica bastante rápido.

19.2 Pedro dijo que el jirafa de mirada inteligente pasó rápidamente por detrás de la ventana.

20.2 El padre dijo que el conejo pequeño y asustadizo creció mucho durante su estancia en aquella casa.

21.2 María dijo que el preso vestido con ropa de calle bailó toda la noche en una discoteca de la ciudad.

22.2 La niña dijo que el presentador con muchos tatuajes caminó un buen rato por los pasillos del edificio.

23.2 El paciente dijo que la costurera de pelo corto y moreno corrió por el paseo de la playa durante horas.

24.2 La reportera dijo que el chico de grandes ojos azules gritó toda la noche por el jardín de su casa.

25.2 El pasajero dijo que el piloto con camisa y corbata azul habló con poca claridad por la megafonía.

26.2 Su amigo dijo que la marmota de color blanco y marrón corrió por la parcela dando vueltas en círculos.

27.2 El vecino dijo que el carpintero de anciana edad y pelo blanco anduvo por toda la casa con preocupación y miedo.

28.2 El presidente dijo que la frutera de pelo negro y rizado paseó por toda la oficina con los brazos en jarras.

29.2 El niño dijo que la canario de color amarillo nadó en el riachuelo durante un cuarto de hora.

30.2 El cazador dijo que el lince de orejas grandes y peludas giró sobre sí mismo en una milésima de segundo.

31.2 María dijo que el barbero rubio, regordete y alegre bailó por la tienda con una sonrisa de oreja a oreja.

32.2 La niña dijo que el hámster pequeñito y miedoso caminó perdido durante todo el día y toda la noche.

33.2 Su amigo dijo que el pájaro más pequeño de la tienda saltó rápidamente por encima de la mesa.

34.2 El vecino dijo que el matemático con tatuajes en los brazos gritó como loco por los caminos montaña abajo.

35.2 El paciente dijo que el músico muy callado y tímido habló ese día con muchísima seguridad.

36.2 La reportera dijo que el logopeda con la nariz torcida giró lentamente y con mucho miedo sobre sí mismo.

37.2 El niño dijo que el electricista pelirrojo americano anduvo por las calles de la ciudad feliz y tranquilo.

38.2 El presidente dijo que el viajero latinoamericano nadó con fuertes brazadas río arriba y contracorriente.

39.2 La periodista dijo que el conductor muy experimentado paseó nervioso por la habitación una y otra vez.

40.2 El pasajero dijo que la rehén de pelo rizado y canoso saltó del helicóptero con la ayuda de los agentes.

41.2 El cliente dijo que la modista de pelo negro y tupido comió rápidamente y con muchísimo entusiasmo un helado de chocolate.

42.2 La directora dijo que el bombero de camisa de cuadros tocó con mucha calma y una habilidad sorprendente una canción al piano.

43.2 La madre dijo que la policía de grandes ojos verdes contó cuidadosamente y de manera muy pausada el número de asistentes.

44.2 El padre dijo que la cantante alta, morena y esbelta limpió afanosamente durante toda la tarde.

45.2 La reportera dijo que la gimnasta más bajita de todas llamó muchísimas veces esa mañana de otoño a su madre.

46.2 El narrador dijo que el escritor de barba larga y blanca mató de manera efectiva y con sus propias manos una serpiente.

47.2 La profesora dijo que el pianista más conocido de la ciudad llevó rápida y cuidadosamente en su sombrero las joyas robadas.

48.2 El inspector dijo que la peluquera simpática y alegre comió al lado de las escaleras relucientes un sándwich de queso.

49.2 El reportero dijo que el informático más joven de todo el grupo tocó con sus propias manos y sin una pizca de miedo el veneno.

50.2 El inspector dijo que la reina retenida en la embajada trajo dentro de su bolso de cuentas azules y negras una pistola.

51.2 El cliente dijo que la directora con cara larga y triste preparó muy adecuadamente esa misma mañana la ruta de la excursión.

52.2 La directora dijo que el barrendero de grandes ojos vivarachos arregló con paciencia, alegría y mucha tranquilidad aquel ordenador.

53.2 La madre dijo que el lémur de pelo muy oscuro arregló muy lentamente y con sus pequeños deditos la pistola.

54.2 El padre dijo que el pescador cansado y magullado limpió de forma concienzuda y hasta la perfección su pulsera de la suerte.

55.2 La reportera dijo que el revisor jovencito y sin experiencia llamó con voz temblorosa por la megafonía a su superior.

56.2 El narrador dijo que el percusionista de brazos delgaduchos preparó en su horno pirolítico de última generación un bacalao riquísimo.

57.2 La profesora dijo que el atleta más atrevido del grupo mató con muchísimo esfuerzo y ya casi sin aliento al oso.

58.2 El inspector dijo que el científico de pelo extraño y puntiagudo llevó durante todo el transcurso de la película un sombrero en la cabeza.

59.2 El reportero dijo que el bebé vestido con camisa azul trajo con las manos y los brazos llenos a rebosar todos los juguetes.

60.2 El vecino dijo que el cartero más amable del pueblo contó ante la petición de sus amigos y colegas su historia.

A.3 FILLERS

61. El niño exclamó: ¡Qué gigantesca es la pecera de tu salón llena de peces de color naranja y amarillo!
62. La mujer dijo que esa misma mañana se había caído la iglesia más antigua del pueblo debido al terremoto.
63. El amigo le preguntó: ¿Está el faro de la parte exterior de la ría lo suficientemente habitable para las vacaciones de verano?
64. Su amiga dijo que la novia al final no se compró la camiseta azul de rayas rojas y blancas en el viaje a Nueva York.
65. La princesa exclamó: ¡Un payaso con la cara pintada se ha comido de un bocado el helado de ese niño!
66. Su novia le preguntó: ¿Qué tipo de comida está comiendo el elefante del circo ambulante?
67. El comentarista dijo que el hombre no saltó lo suficientemente alto durante el partido de la semifinal.
68. La cuentacuentos relató que aquella noche la bruja de gorro negro y puntiagudo voló montada en su escoba mágica por encima de la ciudad.
69. La reportera preguntó enfadada: ¿Se puede saber cómo ha entrado un murciélago en mi despacho a las doce y media del mediodía?
70. El niño dijo que la mochila se rompió sola como por arte de magia en el patio del colegio durante el recreo.
71. La madre exclamó: ¡Cuidado! Ese biberón quema muchísimo por la parte de abajo, pero no por la de arriba.
72. La niña preguntó: ¿Se ha ido ya ese abejorro tan gordo y peludo de la entrada de la casa?
73. La enfermera dijo que la tirita se empapó de la sangre del paciente moribundo al instante.
74. La profesora exclamó: ¡Qué grande era aquel globo de la fiesta de la primera comunión de Pedro!
75. La mujer confesó que la bañera no goteaba desde el lunes, sino desde la mañana del miércoles.
76. El hombre exclamó: ¡Cuidado! La bolsa de papel reciclado se está volando con esta ventolera horrible.
77. El inspector preguntó: ¿A qué ritmo crece aproximadamente la barba de un hombre adulto promedio?
78. El escritor dijo que aquella mariquita posada sobre su pluma de escribir no le molestaba en absoluto.
79. La veterinaria exclamó sorprendida: ¡Con qué facilidad y qué rápido ha abierto este pulpo la rosca de la botella de vidrio!
80. El inspector preguntó: ¿Se puede saber cuánto tiempo lleva oxidado y sucio el banco más antiguo y emblemático de la ciudad?
81. La vecina afirmó que ninguno de sus cinturones de hebilla se había caído por la ventana del patio de luces del edificio.
82. La policía dijo que la bomba localizada en el interior del banco explotará en aproximadamente veinticinco minutos.
83. María preguntó: ¿La caja de cartón llena de figuritas de decoración del salón es para mí o no?
84. La abuela le espetó: ¿No te hace mucho daño en el costado y en la espalda ese sujetador tan apretado?
85. El estudiante de arquitectura dijo que el puente construido encima del río se derrumbará por el peso excesivo y el mal estado del soporte en el terreno.
86. Una alumna preguntó: ¿A qué temperatura se derrite normalmente la mantequilla de leche de vaca?
87. La azafata dijo que un cactus de púas enormes le pinchó la mano durante su viaje por el desierto de Gobi.
88. El nativo americano preguntó: ¿Dónde se habrá metido la piragua de madera de secuoya con todas las provisiones?

89. El cuentacuentos relató que esa noche el reloj dio las doce de la noche con trece campanadas en vez de doce.
90. El cocinero preguntó: ¿En qué momento se habrá escapado de la olla el cangrejo rojo de la pinza rota?
91. La mujer afirmó que su nuevo dentista era sin duda alguna y con diferencia el mejor de toda la ciudad.
92. El hombre preguntó: ¿Entonces tu médico se fue de la consulta al momento sin decir absolutamente nada?
93. La vecina gritó: ¡Cuidado! ¡El fuego ya se ha extendido por las escaleras, y por el rellano del primer piso también!
94. El pescador exclamó: ¡Aquel pez gigantesco se resistió como un demonio atrapado en la red de pesca!
95. El niño preguntó: ¿Y entonces qué deseo le concedió al final de la película el genio de la lámpara mágica?
96. El inspector preguntó: ¿Qué objeto destruyó supuestamente el fantasma en la casa encantada de su abuela?
97. El historiador dijo que aquel rey no gobernó como un tirano, sino como un auténtico y generoso líder.
98. El padre comentó que debido a la falta de viento la cometa no se elevó del suelo casi nada aquella tarde de invierno.
99. El hombre egipcio aseguró que aquel escarabajo proveniente de las dunas de Egipto no tenía una maldición, sino poderes mágicos.
100. El ama de llaves dijo que el cortacésped del jardín se estropeó justamente en la peor época del año.
101. La madre explicó que aquella hoja de árbol no se había secado bien debido a la humedad de ese lugar.
102. El veterinario preguntó: ¿Qué come exactamente un león adulto dentro de un parque natural sin presas en libertad?
103. La niña preguntó: ¿Dónde se ha escondido la lagartija de color verde y amarillo del terrario de reptiles?
104. La chica exclamó: ¡Una llama de pelo blanco y rizado me escupió en toda la cara durante la visita al parque natural!
105. El biólogo exclamó: ¡Ese macaco se ha comido todas las galletas de chocolate de la caja recién abierta!
106. El vecino preguntó: ¿Por qué calles del pueblo se paseó aquel día el alce de casi dos metros de altura?
107. La mujer comentó que la trampa para ratones no se accionó debidamente en las instalaciones de la granja.
108. La nutricionista afirmó que una hamburguesa de vaca no es una buena elección para una comida saludable y equilibrada.
109. El padre exclamó: ¿Por qué está hecho añicos el espejo redondo del salón de la casa de los abuelos?
110. El cura preguntó: ¿Dónde se encontraba a esas horas la monja de la orden de las Carmelitas?

APPENDIX B

B.1 UNACCUSATIVE VERBS

Verb	Test argument	Target picture	Control argument
aparecer (*appear*)	arquero (*archer*)	arrow	florista (*florist*)
	marinero (*sailor*)	ship	presentador (*host*)
caer (*fall*)	perro (*dog*)	bone	hámster (*hamster*)
	ratón (*mouse*)	cheese	chimpancé (*chimpanzee*)
crecer (*grow*)	conejo (*rabbit*)	carrots	lince (*lynx*)
	preso (*inmate*)	handcuffs	psicólogo (*psychologist*)
desaparecer (*disappear*)	costurera (*seamstress*)	sewing needle	empresaria (*business woman*)
	gallina (*hen*)	egg	marmota (*groundhog*)
despertar (*wake up*)	piloto (*pilot*)	airplane	pintor (*painter*)
	sacerdote (*priest*)	cross	informático (*computer technician*)
llegar (*arrive*)	anciano (*old man*)	cane	chico (*boy*)
	músico (*musician*)	violin	taxista (*taxi driver*)
morir (*die*)	pájaro (*bird*)	nest	cachorro (*puppy*)
	pescador (*fisherman*)	fishing pole	doctor (*doctor*)
nacer (*be born*)	carpintero (*carpenter*)	wood	periodista (*journalist*)
	ratón (*mouse*)	cheese	chimpancé (*chimpanzee*)
pasar (*go by*)	arquero (*archer*)	arrow	florista (*florist*)
	canario (*canary*)	bird cage	jirafa (*giraffe*)
salir (go out)	leñador (*lumberjack*)	log	matemático (*mathematician*)
	oculista (*oculist*)	glasses	frutera (*green grocer*)

B.2 UNERGATIVE VERBS

Verb	Test argument	Target picture	Control argument
andar (*walk*)	carpintero (*carpenter*)	wood	periodista (*journalist*)
	electricista (*electrician*)	light bulb	pianista (*pianist*)
bailar (*dance*)	barbero (*barber*)	beard	bebé (*baby*)
	preso (*inmate*)	handcuffs	psicólogo (*psychologist*)
caminar (*walk*)	marinero (*sailor*)	ship	presentador (*host*)
	perro (*dog*)	bone	hámster (*hamster*)
correr (*run*)	costurera (*seamstress*)	sewing needle	empresaria (*business woman*)
	gallina (*hen*)	egg	marmota (*groundhog*)
girar (*turn*)	bombero (*firefighter*)	firetruck	logopeda (*speech therapist*)
	conejo (*rabbit*)	carrots	lince (*lynx*)
gritar (*shout*)	anciano (*old man*)	cane	chico (*boy*)
	leñador (*lumberjack*)	log	matemático (*mathematician*)
hablar (*speak*)	músico (*musician*)	violin	taxista (*taxi driver*)
	piloto (*pilot*)	airplane	pintor (*painter*)
nadar (*swim*)	canario (*canary*)	bird cage	jirafa (*giraffe*)
	escritor (*writer*)	typewriter	viajero (*traveler*)
pasear (*stroll*)	conductor (*driver*)	car	entrenador (*coach*)
	oculista (*oculist*)	glasses	frutera (*green grocer*)
saltar (*jump*)	pájaro (*bird*)	nest	cachorro (*puppy*)
	reina (*queen*)	crown	rehén (*hostage*)

B.3 TRANSITIVE VERBS

Verb	Test argument	Target picture	Control argument
arreglar (*fix*)	barrendero (*sweeper*)	broom	paciente (*patient*)
	bebé (*baby*)	baby bottle	lémur (*lemur*)
comer (*eat*)	cartero (*mailman*)	mailbox	modista (*dressmaker*)
	peluquera (*hairdresser*)	comb	policía (*police officer*)
contar (*tell*, *count*)	cartero (*mailman*)	mailbox	modista (*dressmaker*)
	peluquera (*hairdresser*)	comb	policía (*police officer*)
limpiar (*clean*)	cantante (*singer*)	microphone	gimnasta (*gymnast*)
	pescador (*fisherman*)	fishing pole	doctor (*doctor*)
llamar (*call*)	cantante (*singer*)	microphone	gimnasta (*gymnast*)
	párroco (*priest*)	church	revisor (*reviser*)
llevar (*carry*, *wear*)	científico (*scientist*)	microscope	asesino (*murderer*)
	electricista (*electrician*)	light bulb	pianista (*pianist*)
matar (*kill*)	escritor (*writer*)	typewriter	viajero (*traveler*)
	explorador (*explorer*)	map	atleta (*athlete*)
preparar (*prepare*)	limpiadora (*cleaner*)	mop	directora (*principal*)
	percusionista (*drummer*)	drum	estudiante (*student*)
tocar (*touch*, *play*)	bombero (*firefighter*)	fire truck	logopeda (*speech therapist*)
	sacerdote (*priest*)	cross	informático (*computer technician*)
traer (*bring*)	barbero (*barber*)	beard	baby (*bebé*)
	reina (*queen*)	crown	rehén (*hostage*)

APPENDIX C

C.1 MEAN RATING OF STRONGLY-RELATED NOUN-NOUN PAIRS

Noun 1	**Noun 2**	**Mean rating**
anciano (*old man*)	bastón (*cane*)	4,69
arquero (*archer*)	flecha (*arrow*)	4,98
barbero (*barber*)	barba (*beard*)	4,87
barrendero (*sweeper*)	escoba (*broom*)	4,87
bebé (*baby*)	biberón (*baby bottle*)	4,87
bombero (*firefighter*)	camión de bomberos (*firetruck*)	4,98
canario (*canary*)	jaula de pájaro (*bird cage*)	4,7
cantante (*singer*)	micrófono (*microphone*)	4,81
carpintero (*carpenter*)	madera (*wood*)	4,76
cartero (*mailman*)	buzón (*mailbox*)	4,92
científico (*scientist*)	microscopio (*microscope*)	4,63
conductor (*driver*)	coche (*car*)	4,85
conejo (*rabbit*)	zanahoria (*carrot*)	4,7
costurera (seamstress)	aguja de coser (*sewing needle*)	4,92
electricista (*electrician*)	bombilla (*light bulb*)	4,72
escritor (*writer*)	máquina de escribir (*typewriter*)	4,69
explorador (*explorer*)	mapa (*map*)	4,9
gallina (*hen*)	huevo (*egg*)	4,96
leñador (*lumberjack*)	tronco (*log*)	4,9
limpiadora (*cleaner*)	fregona (*mop*)	4,63
marinero (*sailor*)	barco (*ship*)	4,94
músico (*musician*)	violín (*violin*)	4,69
oculista (*oculist*)	gafas (*glasses*)	4,9
pájaro (*bird*)	nido (*nest*)	4,96
párroco (*priest*)	iglesia (*church*)	4,94
peluquera (*hairdresser*)	peine (*comb*)	4,92
percusionista (*drummer*)	tambor (*drum*)	4,81
perro (*dog*)	hueso (*bone*)	4,8
pescador (*fisherman*)	caña de pescar (*fishing pole*)	4,87
piloto (*pilot*)	avión (*airplane*)	4,96
preso (*inmate*)	esposas (*handcuffs*)	4,63
ratón (*mouse*)	queso (*cheese*)	4,72
reina (*queen*)	corona (*crown*)	4,9
sacerdote (*priest*)	cruz (*cross*)	4,74

C.2 MEAN RATING OF WEAKLY-RELATED NOUN-NOUN PAIRS

Noun 1	**Noun 2**	**Mean rating**
asesino (*murderer*)	microscopio (*microscope*)	0,67
atleta (*athlete*)	mapa (*map*)	0,67
bebé (*baby*)	barba (*beard*)	0,27
cachorro (*puppy*)	nido (*nest*)	0,72
chico (*boy*)	bastón (*cane*)	0,41
chimpancé (*chimpanzee*)	queso (*cheese*)	0,29
doctor (*doctor*)	caña de pescar (*fishing pole*)	0,32
directora (*principal*)	fregona (*mop*)	0,3
empresaria (*business woman*)	aguja de coser (*sewing needle*)	0,67
entrenador (*coach*)	coche (*car*)	0,78
estudiante (*student*)	tambor (*drum*)	0,5
florista (*florist*)	flecha (*arrow*)	0,16
frutera (*green grocer*)	gafas (*glasses*)	0,69
gimnasta (gymnast)	micrófono (*microphone*)	0,14
hámster (*hamster*)	hueso (*bone*)	0,38
informático (*computer technician*)	cruz (*cross*)	0,25
jirafa (*giraffe*)	jaula de pájaro (*bird cage*)	0,07
lémur (*lemur*)	biberón (*baby bottle*)	0,23
lince (*lynx*)	zanahoria (*carrot*)	0,34
logopeda (*speech therapist*)	camión de bomberos (*firetruck*)	0,07
marmota (*groundhog*)	huevo (*egg*)	0,25
matemático (*mathematician*)	trongo (*log*)	0,21
modista (*dressmaker*)	buzón (*mailbox*)	0,2
paciente (*patient*)	escoba (*broom*)	0,12
periodista (*journalist*)	madera (*wood*)	0,21
pianista (*pianist*)	bombilla (*light bulb*)	0,29
pintor (*painter*)	avión (*plane*)	0,34
policía (*police officer*)	peine (*comb*)	0,45
presentador (*host*)	barco (*ship*)	0,21
psicólogo (*psychologist*)	esposas (*handcuffs*)	0,3
rehén (*hostage*)	corona (*crown*)	0,12
revisor (*reviser*)	iglesia (*church*)	0,21
taxista (*taxi driver*)	violín (*violin*)	0,2
viajero (*traveler*)	máquina de escribir (*typewriter*)	0,81

C.3 MEAN RATING OF WEAKLY-RELATED NOUN-VERB PAIRS

Noun	**Verb**	**Mean rating**
anciano (*old man*)	gritar (*shout*)	1,72
	llegar (*arrive*)	1
arquero (*archer*)	aparecer (*appear*)	0,54
	pasar (*go by*)	0,4
asesino (*murderer*)	llevar (*carry, wear*)	0,69
atleta (*athlete*)	matar (*kill*)	0,09
barbero (*barber*)	bailar (*dance*)	0,27
	traer (*bring*)	0,36
barrendero (*sweeper*)	arreglar (*fix*)	1,05
bebé (*baby*)	arreglar (*fix*)	0,2
	bailar (*dance*)	0,87
	traer (*bring*)	0,58
bombero (*firefighter*)	girar (*turn*)	0,8
	tocar (*play*)	0,45
cachorro (*puppy*)	morir (*die*)	1,2
	saltar (*jump*)	1,98
canario (*canary*)	nadar (*swim*)	0,12
	pasar (*go by*)	0,23
cantante (*singer*)	limpiar (*clean*)	0,18
	llamar (*call*)	0,63
carpintero (*carpenter*)	andar (*walk*)	0,74
	nacer (*be born*)	0,63
cartero (*mailman*)	comer (*eat*)	1,05
	contar (*tell, count*)	1,6
chico (*boy*)	gritar (*shout*)	1,83
	llegar (*arrive*)	0,98
chimpancé (*chimpanzee*)	caer (*fall*)	0,87
	nacer (*be born*)	1,52
científico (*scientist*)	llevar (*carry, wear*)	0,5
conductor (*driver*)	pasear (*stroll*)	1,6
conejo (*rabbit*)	crecer (*grow*)	1,67
	girar (*turn*)	0,56
costurera (*seamstress*)	correr (*run*)	0,56
	desaparecer (*disappear*)	0,25
doctor (*doctor*)	limpiar (*clean*)	1,29
	morir (*die*)	1,43
directora (*principal*)	preparar (*prepare*)	1,83
electricista (*electrician*)	andar (*walk*)	0,7
	llevar (*carry, wear*)	0,74
empresaria (*business woman*)	correr (*run*)	0,96
	desaparecer (*disappear*)	0,47
entrenador (*coach*)	pasear (*stroll*)	1,2
escritor (*writer*)	matar (*kill*)	1,01
	nadar (*swim*)	0,34
estudiante (*student*)	preparar (*prepare*)	1,32
explorador (*explorer*)	matar (*kill*)	0,47
florista (*florist*)	aparecer (*appear*)	0,32
	pasar (*go by*)	0,29
frutera (*green grocer*)	pasear (*stroll*)	0,7
	salir (*go out*)	0,5
gallina (*hen*)	correr (*run*)	1,85
	desaparecer (*disappear*)	0,49
gimnasta (*gymnast*)	limpiar (*clean*)	0,27
	llamar (*call*)	0,4
hámster (*hamster*)	caer (*fall*)	0,69
	caminar (*walk*)	1,69
informático (*computer technician*)	despertar (*wake up*)	0,5
	tocar (*touch*)	0,9

Noun	**Verb**	**Mean rating**
jirafa (*giraffe*)	nadar (*swim*)	0,21
	pasar (*go by*)	0,49
lémur (*lemur*)	arreglar (*fix*)	0,03
leñador (*lumberjack*)	gritar (*shout*)	1,34
	salir (*go out*)	0,58
limpiadora (*cleaner*)	preparar (*prepare*)	1,5
lince (*lynx*)	crecer (*grow*)	1,76
	girar (*turn*)	0,49
logopeda (*speech therapist*)	girar (*turn*)	0,2
	tocar (*touch*)	0,43
marinero (*sailor*)	aparecer (*appear*)	0,96
	caminar (*walk*)	0,96
marmota (*groundhog*)	correr (*run*)	1,14
	desaparecer (*disappear*)	0,63
matemático (*mathematician*)	gritar (*shout*)	0,54
	salir (*go out*)	0,67
modista (*dressmaker*)	comer (*eat*)	1,18
	contar (*tell, count*)	1,2
músico (*musician*)	hablar (*speak*)	1,61
	llegar (*arrive*)	0,9
oculista (*oculist*)	pasear (*stroll*)	0,58
	salir (*go out*)	0,52
paciente (*patient*)	arreglar (*fix*)	1,34
pájaro (*bird*)	morir (*die*)	1,49
	saltar (*jump*)	1,38
párroco (*priest*)	llamar (*call*)	1,52
peluquera (*hairdresser*)	comer (*eat*)	1,1
	contar (*tell, count*)	1,43
percusionista (*drummer*)	preparar (*prepare*)	1,7
	andar (*walk*)	1,49
periodista (*journalist*)	nacer (*be born*)	0,65
perro (*dog*)	caer (*fall*)	0,61
	caminar (*walk*)	1,65
pescador (*fisherman*)	limpiar (*clean*)	2
	morir (*die*)	1,27
pianista (*pianist*)	andar (*walk*)	0,63
	llevar (*carry, wear*)	0,32
piloto (*pilot*)	despertar (*wake up*)	0,56
	hablar (*speak*)	1,78
pintor (*painter*)	despertar (*wake up*)	0,58
	hablar (*speak*)	1,05
policía (*police officer*)	comer (*eat*)	1,47
	contar (*tell, count*)	1,16
presentador (*host*)	aparecer (*appear*)	1,81
	caminar (*walk*)	1,07
preso (*inmate*)	bailar (*dance*)	0,54
	crecer (*grow*)	0,52
psicólogo (*psychologist*)	bailar (*dance*)	0,74
	crecer (*grow*)	1,74
ratón (*mouse*)	caer (*fall*)	0,43
	nacer (*be born*)	1,76
rehén (*hostage*)	saltar (*jump*)	1,1
	traer (*bring*)	0,83
reina (*queen*)	saltar (*jump*)	0,38
	traer (*bring*)	0,32
revisor (*reviser*)	Llamar (*call*)	1,87
sacerdote (*priest*)	despertar (*wake up*)	0,4
	tocar (*touch*)	1,09
taxista (*taxi driver*)	hablar (*speak*)	1,96
	llegar (*arrive*)	1,98
viajero (*traveler*)	matar (*kill*)	0,29