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Andressa Christine Oliveira da Silva

**Prosody, semantic parallelism and pragmatic context in the processing of
gapping sentences**

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gapping sentences**

Doctoral thesis submitted to the Graduate Program in Linguistics of the Federal University of Juiz de Fora as a partial requirement for obtaining the degree of Doctor in Linguistics. Concentration area: Linguistics.

Advisor: Prof. Dr. Aline Alves Fonseca

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RESUMO

Esta tese investigou o processamento linguístico de sentenças com elipse lacunar (*gapping*) no Português Brasileiro (PB) e no Inglês Americano (IE). Esse tipo de elipse é um processo sintático opcional que consiste em elidir o verbo principal – e outros constituintes, quando possível – da segunda oração de uma estrutura coordenada (SAG, 1980; CARLSON, 2002). Nesta pesquisa, exploramos no PB sentenças *gapping* com ambiguidade estrutural temporária do DP que inicia a segunda oração, como em (1) *Alice assou bolos para suas amigas e Camila para sua prima*; e no PB e no IE, sentenças com ambiguidade global do DP que inicia a segunda oração, como em (2) *O Pedro levou a Júlia na festa e o Bruno no churrasco da empresa* (Peter took Julia to the party and Brian to the company barbecue). No exemplo (1), a ambiguidade estrutural do DP *Camila* ocorre por este não poder ser coordenado como objeto direto do verbo *assar*, o qual exige que nomes inanimados ocupem essa posição. Dessa forma, o DP *Camila* deve ser interpretado como sujeito de uma nova oração (*Camila assou bolos*) para evitar a anomalia semântica/pragmática da sentença. Por outro lado, no exemplo (2), o DP *Bruno/Brian* pode ser interpretado como o sujeito de uma nova oração (interpretação de elipse *gapping*) ou como o objeto direto do verbo (interpretação de coordenada de objetos). Evidências experimentais de trabalhos anteriores (CARLSON, 2002, 2005; HOEKS *et al.*, 2002, 2006, 2009; SILVA *et al.*, 2018) revelam que há uma preferência pela interpretação de sentenças com coordenação de objetos, devido ao viés da simplicidade estrutural, o qual está alinhado com o Princípio de Aposição Mínima (FRAZIER, 1979, 1987), e a presença de uma estrutura de tópicos complexa (HOEKS *et al.*, 2002, 2006), isto é, com dois sujeitos sintáticos na sentença. A presente tese adotou uma abordagem em Psicolinguística Experimental (LEITÃO, 2008) e conduziu experimentos dos tipos off-line e on-line com sentenças *gapping* escritas e orais. As sentenças experimentais foram manipuladas em relação aos seguintes fatores: pistas prosódicas, características semânticas entre argumentos das duas orações, contextos prévios com viés pragmático e pistas visuais. A pesquisa objetivou avaliar o papel desses diferentes fatores no processamento e na escolha da interpretação final das sentenças *gapping*. Os resultados indicam que a interpretação com elipse *gapping* é a mais preferida no PB e no IE quando as

pistas prosódicas, semânticas e pragmáticas convergem para a interpretação de sujeito do nome ambíguo da segunda oração. Portanto, concluímos que as informações linguísticas e não linguísticas são relevantes para licenciar uma análise sintática com a elipse *gapping* de sentenças coordenadas ambíguas tanto no PB quanto no IE.

Palavras-chave: Psicolinguística. Processamento de Sentenças. Elipse *Gapping*. Prosódia. Paralelismo.

ABSTRACT

This doctoral thesis investigated the processing of Brazilian Portuguese (BP) and American English (AE) coordinated sentences with gapping ellipsis. This type of ellipsis is an optional syntactic process that consists of eliding the main verb – and other constituents, when possible – of the second clause of a coordinated structure (SAG, 1980; CARLSON, 2002). In this research, we explore BP gapping sentences with temporary structural ambiguity of the DP in the second clause, such as (1) *Alice assou bolos para suas amigas e Camila para sua prima* (Alice baked cakes for her friends and Camila for her cousin); and BP and AE sentences with subject versus object ambiguity, such as: *O Pedro levou a Júlia na festa e o Bruno no churrasco da empresa / Peter took Julia to the party and Brian to the company barbecue*. In example (1), the DP *Camila* is structurally ambiguous because it cannot be conjoined as a direct object of the verb *assar* (bake), which accepts only inanimate nouns as its direct object. Thus, the DP *Camila* should be interpreted as the subject of a new clause (*Camila baked cakes*) to avoid a semantic/pragmatic anomalous sentence. On the other hand, the DP *Bruno/Brian* can be interpreted as the subject of a new clause (gapping interpretation) or as the conjoined direct object of the verb (conjunction reduction interpretation) in example (2). Experimental evidence from previous research (CARLSON, 2002, 2005; HOEKS *et al.*, 2002, 2006, 2009; SILVA *et al.*, 2018) reveals a strong preference for conjunction reduction interpretation of coordinate sentences due to structural simplicity bias, which is aligned with the Minimal Attachment Principle (FRAZIER, 1979, 1987) and a topic complex structure (HOEKS *et al.*, 2002, 2006), that is, two subjects in the syntactic structure. This thesis took a Psycholinguistic approach (LEITÃO, 2008) conducted offline and online experiments with gapping written and oral sentences. The sentences were explored with regard to their prosodic cues, semantic parallelism between nouns in the two conjuncts, biasing pragmatic contexts and visual cues. We aimed to find out the role of these features in the processing and in determining the final interpretation of the gapping sentences. The results indicate that gapping interpretation is the most preferred in both BP and AE when both prosodic, semantic, and pragmatic cues bias subject interpretation of the ambiguous noun in the second conjunct (Bruno/Brian).

Therefore, we conclude that both linguistic and non-linguistic information is relevant to bias a gapping syntactic structure analysis in both BP and AE.

Keywords: Psycholinguistics. Sentence Processing. *Gapping*. Prosody. Parallelism.

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LIST OF ABBREVIATIONS, INITIALS AND SYMBOLS

AE	American English
BP	Brazilian Portuguese
CRC	Contrastive remnant condition
DP	determinant phrase
F0	fundamental frequency
GMH	Givenness-marking hypothesis
Hz	Hertz
ip	intermediate phrase
IPh	intonational phrase
LF	Logical Form
ms	milliseconds
NP	noun phrase
PC	Parallelism Condition
PClbex	PennController for Internet Based Experiments
PF	Phonological Form
PH	Parallelism Hypothesis
PP	prepositional phrase
PRPC	Prosodic Requirement of the Parallelism Condition
ROI	region of interest
RT	reaction time
SPL	Self-paced listening
SPMT	sentence-picture matching task
SPR	Self-paced reading
SSH	Simple Structure Hypothesis
ToBI	Tones and Break Indices
VP	verb phrase
VWP	Visual World Paradigm
UFJF	Universidade Federal de Juiz de Fora
UFRJ	Universidade Federal do Rio de Janeiro

LIST OF EXPERIMENTAL CONDITIONS

Experiment 2

GAP Gapping

OBJ Objects

SEN Sentences

Experiment 3

OCNP Object Context, Neutral Parallelism

OCSP Object Context, Subject Parallelism

SCNP Subject Context, Neutral Parallelism

SCSP Subject Context, Subject Parallelism

Experiment 4

OPOP Object Prosody, Object Picture

OPSP Object Prosody, Subject Picture

SPOP Subject Prosody, Object Picture

SPSP Subject Prosody, Subject Picture

Experiment 5

GAP Subject Prosody

OBJ Object Prosody

BASE Baseline Prosody

Experiments 6 and 7

OA Object Accent

OCOA Object Context, Object Accent

OCSA Object Context, Subject Accent

SA Subject Accent

SCOA Subject Context, Object Accent

SCSA Subject Context, Subject Accent

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CHAPTER 1: Introduction

Ellipsis is a common phenomenon that abounds in natural languages. This type of construction leaves certain aspects of their syntactic structure omitted for the purpose of economy of expression (MERCHANT, 1999; van CRAENEBROECK and TEMMERMAN, 2018). Interestingly, ellipsis constructions are parsed and understood by humans despite the lack of overtly pronounced elements. In this sense, it is relevant to investigate from a psycholinguistic perspective how humans are able to process material that is not physically present in spoken and written sentences (KAAN *et al.*; 2013). Through the investigation of such sentences, it is possible to shed light into what kinds of linguistic and non-linguistic information (i.e., syntactic, lexical, prosodic, contextual) can be used during sentence processing. Taking that into account, the current doctoral thesis proposes to investigate the processing of a type of ellipsis known as gapping. The object of study of this research are mainly written and spoken Brazilian Portuguese¹ (hereafter BP) gapping sentences. Additionally, spoken American English² (hereafter AE) gapping sentences will be explored as part of a cross-language study.

Gapping constructions are constituted by parallel sentential conjuncts, the last one being elliptical. This sentence type contains a complete clause and an incomplete clause; the interpretation of the latter being derived from the complete clause in some way. Gapping is a linguistic phenomenon restricted to coordinate sentences (SAG, 1980) and its typical feature is the lack of the finite verb in the subsequent conjunct. In addition to the finite verb, further elements of the second conjunct such as the object, for instance, may be phonetically empty. The missing elements in one conjunct have obligatory phonetically overt counterparts in the same structural position in the first conjunct (FÉRY and HARTMANN, 2005). Gapping takes place to avoid redundant repetition of phonetic material that can be recovered in the first clause, and the language

¹ The examples in Brazilian Portuguese (BP) do not have interlinear glosses because the target sentences are structurally identical in English. A word-for-word translation is given in English of the original Brazilian Portuguese stimuli.

² The American English gapping sentences will be explored in a spoken cross-language study.

user needs to infer which pieces of information are missing in the structure in order to understand the message conveyed by the sentence. Thus, the interpretation of these sentences relies just as much on what is left unsaid as on what is said. What is interesting about these sentences is that language users interpret them as if the deleted element was present.

Two types of gapping sentences are of interest in this study. The first type is strongly biased by pragmatics and presents a temporary structural ambiguity. These sentences are called here the temporally ambiguous gapping sentences, that is, sentences that have to be interpreted as gapping or, otherwise, they will present semantic/pragmatic anomalies; see example (1). The counterpart of the gapping syntactic structure, known as nongapping or conjunction reduction, is also studied along with the temporally ambiguous gapping sentences. Conjunction reduction sentences present two conjoined objects within the same verb phrase (VP); see example (2). The second type of sentence is globally ambiguous, it presents a subject versus object ambiguity of the DP in its second conjunct, which can be understood as a subject or as an object; see examples (3) and (4). These sentences will be called here the potentially gapping sentences. Some instances of the sentences³ under study here appear as follows:

(1) *Alice assou bolos para suas amigas e Camila para sua prima.*

Alice baked cakes for her friends and Camila for her cousin.

(2) *Alice assou bolos para suas amigas e biscoitos para sua prima.*

Alice baked cakes for her friends and cookies for her cousin.

(3) *João visitou Maria nas férias e Sara no final de semana.*

John visited Mary on the vacation and Sara on the weekend.

(4) *João visitou o escritório nas férias e Sara no final de semana.*

John visited the office on the vacation and Sara on the weekend.

Sentence (1) presents a verb type (*assar/bake*) that has human subjects but non-human objects. Thus, *Camila* is more appropriate as a subject rather than an object. The sentence should be understood as a gapping type, the verb

³ These sentences were based on the stimuli used by Carlson (2002).

and its direct object were elided in the second conjunct (*assou bolos/ baked cakes*). The second example (2) is a conjunction reduction sentence, the DP *biscoitos (cookies)* is a conjoined object of the verb [...*assou bolos e biscoitos / ...baked cakes and cookies*]. Examples (3) and (4) present an ambiguous DP in the second conjunct, *Sara* can be interpreted as the subject of a new clause (*Sara visitou Maria no final de semana / Sara visited Mary on the weekend*) or as a conjoined object (*João visitou o escritório e João visitou Sara / John visited the office and John visited Sara*) because the verb type (*visitar/visit*) allows human nouns in subject and object structural positions.

Experimental evidence from prior studies (CARLSON, 2002, 2005; HOEKS *et al.*, 2009) reveals that language users have a strong preference for object interpretation of ambiguous DPs in coordinated sentences such as (3) and (4). The preference for object interpretation can be motivated by structural simplicity preference (CARLSON, 2002), which implies that language users tend to choose the structure with fewest syntactic nodes compatible with the input. Gapping sentences have more syntactic nodes than the conjoined reduction sentences. The locality preference (HARRIS & CARLSON, 2016) also favors the choice for object interpretation rather than subject interpretation for gapping sentences because it is easier to contrast the ambiguous noun of the second clause with the nearest constituent in the preceding clause, which would be the object of the first clause. Another explanation for subject interpretation dispreference is the complex topic-structure of the gapping sentences. According to Hoeks *et al.* (2002), the *topic* of a sentence is the thing the utterance provides information, which is usually the syntactic subject of the sentence. The authors argue that language users usually prefer to have only one topic rather than two in an utterance. The gapping sentences have two subject topics in their structure. On the other hand, studies have shown that the manipulation of grammatical and extra-grammatical features can influence the interpretation of potentially gapping structures. The parallelism of features shared between the ambiguous noun and one of the arguments in the first clause (the subject or the object) could help disambiguate the sentence towards a subject or an object interpretation. The work of Carlson (2002), for instance, revealed significant effects of parallelism of semantic features (definiteness,

animacy, form, number, gender etc) and prosodic parallelism (type, location and F0 range of pitch accents⁴). To address the question of complex topic-structure, Hoeks *et al.* (2009) presented potentially gapping sentences preceded by pragmatic context questions (e.g., “What did João and Sara do?”) that helped preparing language users for encountering a potentially gapping sentence with two subjects (John [*Topic 1*] visited Mary on the vacation and Sara [*Topic 2*] visited Mary on the weekend). In this thesis, we intend to explore the role of prosodic and semantic parallelism, and pragmatic statement contexts in order to find out if the combination of these cues can bias the interpretation of BP gapping sentences. In addition, visual information will be also manipulated, it is a useful source for investigating language processing since “what we look at reveals a great deal about what is going on in our minds” (BERENDS *et al.*, 2015, p. 55).

The main goal of this research is to investigate which processing strategies are involved in language processing when language users encounter these sentence types. With regard to sentence types (1) and (2), the aim is to investigate whether there are any processing differences between them during reading. These sentences will be explored in a written questionnaire and in a self-paced reading task. The potentially gapping sentences (3) and (4) will be explored in written and spoken studies. We will manipulate pragmatic contexts, semantic cues, prosodic cues and biasing pictures in order to explore whether language users rely on linguistic information and non-linguistic information to choose the final interpretation for these ambiguous sentences. These sentences will be studied in a reading eye-tracking experiment, an eye-tracking experiment with visual world paradigm, an auditory questionnaire and a sentence-picture matching task.

The specific objectives of the research are as follows: (i) to verify if there are any processing differences between temporally ambiguous gapping and conjunction reduction sentences; (ii) to find out what is the default interpretation for ambiguous DPs in potentially gapping sentences in written and spoken studies; (iii) to manipulate prosodic features (pitch accents and F0 range) and

⁴ The pitch accents are associated with the most stressed syllable of a word (GUSENHOVEN & JACOBS, 2011).

semantic features (animacy, definiteness, gender) of DPs in the two clauses of the potentially gapping sentences in BP; (iv) to investigate if a previous pragmatic context is able to bias the interpretation of potentially gapping sentences in written and spoken studies; (v) to develop a cross-linguistic spoken study in BP and AE comparing how the native speakers of two different languages interpret globally ambiguous structures that are similar in both languages. Although these structures present key similarities, the reliability on prosodic cues might differ across these languages. By comparing sentence processing in these two languages, insights into universal aspects of spoken language processing and how language-specific features alter this process might be achieved.

The current doctoral thesis was mainly inspired by Carlson (2002)⁵ and the gapping sentences used in that work were adapted and translated to BP. As far as we know, the linguistic literature in BP lacks of research on gapping structures, especially within a Psycholinguistic perspective. Prior research on gapping sentences have been done in English, Dutch, German, among other languages (CARLSON, 2002, 2005; HARTMANN, 2000; HOEKS *et al.*, 2009; WINKLER, 2005). Thus, by studying those sentences in BP, we can show effects to be valid and similar cross-linguistically. The prosodic features of BP gapping sentences have not been investigated yet and neither if language users can rely on prosodic, semantic and contextual information during sentence processing to guide their interpretation of globally ambiguous gapping sentences. Therefore, this thesis intends to manipulate the syntactic, prosodic, semantic and contextual features of gapping sentences, and test language users' reliance on each of these cues in the interpretation of these sentences. The thesis can contribute to the grammar description of ellipsis structures in BP. It is also noteworthy to point out that this research is going to carry out experiments using an accurate measure, the eye movements. Psycholinguistic studies using eye-tracking methodology are recent, dating from the 2000s onwards. Therefore, this research can also broaden psycholinguistic studies with the use of eye-tracker in Brazil.

⁵ Carlson (2002) studied gapping sentences among other ellipsis sentence types in American English.

The doctoral thesis is structured into more four chapters. Chapter 2 covers the theoretical background, with a description of ellipsis; the general features and the prosodic structure of gapping sentences; and aspects of prosody and its relation with processing and sentence processing mechanisms. Chapter 3 presents some previous studies on gapping sentences from a psycholinguistic perspective. Chapter 4 introduces the online and offline experimental paradigms used to design and conduct the experimental studies of this doctoral thesis. Chapter 5 reports the two written experiments that explored the temporally ambiguous and the globally ambiguous gapping sentences in BP. Chapter 6 introduces the two spoken experiments that investigated the globally ambiguous gapping sentences in BP, and two spoken experiments that aimed to develop a cross-language study between BP and AE. Finally, the conclusion section summarizes the main findings of the doctoral thesis and indicates possible future research directions.

CHAPTER 2: Theoretical Background

This chapter presents the definition of ellipsis and some theoretical questions involved in this phenomenon in section 2.1. After that, the object of study in this doctoral thesis, the gapping elliptical constructions, is introduced in section 2.2; their basic properties are presented. In section 2.3, aspects of prosody and the processing of ellipsis as well as the prosodic features of gapping sentences are explored. The chapter ends with section 2.4, which covers some aspects related to the linguistic processing of ellipsis in Psycholinguistics.

2.1 Ellipsis

Ellipsis is a well-known language phenomenon that consists in the omission of linguistic material from an utterance, avoiding the repetition of identical and redundant elements (HOEKS *et al.*, 2009). The omitted element from the structure is generally recoverable from the linguistic or the extralinguistic context. Therefore, the elliptical structure is thus dependent for its interpretation on being associated with something else in the utterance (WINKLER, 2006) or in a surrounding context. In other words, we can say that in elliptical constructions there is meaning (i.e., intended message) without form (i.e., what is actually pronounced). This is the reason why elliptical constructions are theoretically interesting to linguistic studies, there is a rupture in the usual mappings of form–meaning correspondence, but it is still possible to infer the meaning in ellipsis without form (MERCHANT, 2018). Despite this break in sound-meaning correspondence, speakers are able to recover the meaning of such sentences. When we study ellipses, we are usually interested in finding out how language users recover the meaning of a sentence in the absence of form.

The term ellipsis covers a number of different types of constructions, such as VP-ellipsis, sluicing, NP-ellipsis (or Nominal Ellipsis), pseudogapping, stripping (or Bare Argument Ellipsis), gapping, replatives and comparative

deletion. In the literature, the elliptical constructions have been the focus of intense theoretical interest over the past four decades (MERCHANT, 2018). As the present research is interested in investigating the gapping ellipsis specifically, the general features of the other types of elliptical constructions will not be presented, that will be done just for gapping constructions.

In what regards to the phenomenon of ellipsis, Merchant (2018) pointed out that linguists have been mostly debating about the structure of the ellipsis site, the ellipsis identity, and the licensing in ellipsis. The research in this area try to answer the following questions:

(i) **Structure:** in elliptical constructions, is there syntactic structure that is unpronounced?

(ii) **Identity:** what is the relationship between the understood material in ellipsis and its antecedent?

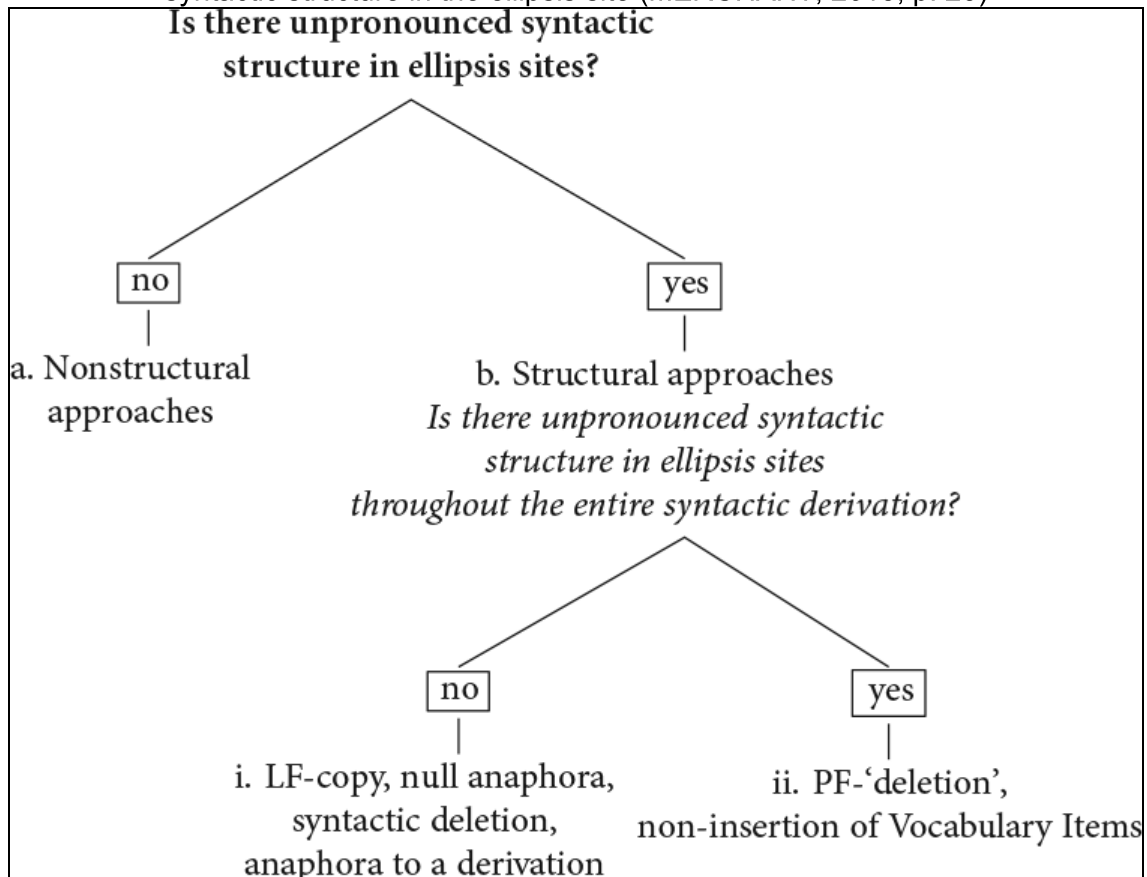
(iii) **Licensing:** what heads or positions or structures allow for ‘ellipsis’, and what are the locality conditions on the relation between these structures and ellipsis?

Adapted from Merchant (2018, pp. 21-22)

The first question is concerned to answer to what extent an ellipsis site contains an internal syntactic structure (or an unpronounced one). There are two possible answers to this question, the theories that assume a structural approach and those that assume a non-structural approach. The former approach claims that there is structure which is not pronounced and it places the burden on the syntax. This means that “the only difference between an elliptical sentence and a non-elliptical is the lack of pronunciation of part of the former” (van CRAENEBROECK and TEMMERMAN, 2018, p. 4). The latter approach postulates that syntax is ‘what is you hear is what you get’, thus, there is no necessity to postulate the existence of more syntax than the one that is present (GANDÓN-CHAPELA and PÉREZ-GUERRA, 2016). Within the structural approach, there is a divergence with regard to the derivational status of the unpronounced structure (MERCHANT, 2018, p. 23): one side posits that the syntactic structure undergoes some kind of ‘deletion’ to make the syntax unpronounced; and the other side posits that a null lexical element is replaced

or identified at some level of representation not relevant to the pronunciation (at the Logical Form/LF or in some semantic/pragmatic component). The answers to the structure question can be summarized in the figure below:

Figure 1 – Structure approach and non-structural approach: the unpronounced syntactic structure in the ellipsis site (MERCHANT, 2018, p. 23)



Source: Merchant (2018, p. 23)

The second question intends to provide answers on how an ellipsis site recovers its meaning and what kind of identity relation between the ellipsis site and its antecedent exists. First of all, it is consensual that ellipsis is anaphorical in nature, which means that it depends on having an antecedent (implicit or inferred) for recovery of meaning.

Philips and Parker (2014) show three different views on what specific representation has to be identical with the ellipsis site: a syntactic account, a semantic account and a hybrid account. In the syntactic account, the representation of an elided site is recovered under some form of structural identity. On the other hand, in the semantic account the recovery process involves identity of meaning. The conflict between those two accounts has

motivated a hybrid account, which claims that both syntactic identity and semantic identity can help to recover the antecedent of an ellipsis site.

Overall, the question of whether this identity relation is syntactic or semantic, or even prosodic or discursive/pragmatic is still to be settled. Merchant (2018) argues that earlier studies have been suggesting an existence of a relation of parallelism that stands between the ellipsis site and its antecedent, and that would help in recovering the meaning of the ellipsis.

The answers to the structure and identity questions found in the literature can be summarized in the following table:

Figure 2 – Research on the structure and identity ellipsis questions (MERCHANT, 2018, p. 21)

		Is there syntax in the ellipsis site?	
		Yes	No
Is identity syntactic or semantic?	Syntactic	Sag 1976a, Williams 1977b, Fiengo and May 1994, Chung et al. 1995, Fox 2000, etc.	N/A (incoherent)
	Semantic	Sag and Hankamer 1984, Merchant 2001, Aelbrecht 2010, van Craenenbroeck 2010b, etc.	Keenan 1971, Dalrymple et al. 1991, Hardt 1993, Ginzburg and Sag 2001, Culicover and Jackendoff 2005, etc.
	Both	Kehler 2002, Chung 2013, Merchant 2013c	N/A (incoherent)

Source: Adapted from Merchant (2018, p. 21)

With regard to the third question, the licensing refers to the restrictions on ellipsis, that is, what makes an elliptical construction grammatical in a given syntactic context and, more specifically, what elements – ‘the licensors’ – allow it (GANDÓN-CHAPELA and PÉREZ-GUERRA, 2016; van CRAENEBROECK and TEMMERMAN, 2018). According to Merchant (2018), this question has not received as much attention as the structure and identity questions. He points that ‘licensing question was traditionally addressed by writing the structural

description of a deletion transformation to be sensitive to whatever conditions the theorist thought relevant” (p. 22).

The current research will align with the view of Winkler (2018) for the aspects of abstract structure, recoverability/ellipsis identity and licensing. That work considers that the ellipsis site has a syntactic structure. In relation to the recoverability of the antecedent, this one can be motivated by syntactic, semantic and prosodic features. Additionally, we will explore whether context can also motivate the recoverability along with syntax, semantics and prosody. For licensing, it is argued that contrastive accent on remnants (i.e., the remaining overt constituents surrounding the ellipsis site) and deaccenting of given material can license an elliptical construction.

In the next section, the definition of the gapping ellipsis as well as its basic properties and distinctive characteristics are presented.

2.2 Gapping

The type of ellipsis under investigation in this study is known as Gapping (*Elipse Lacunar* in Portuguese). This language phenomenon is restricted to coordinate sentences and it is an optional syntactic process that involves the omission of position-specific constituents from the second or subsequent clauses (if present) of a coordinate structure. Only elements that present new information remain pronounced in the subsequent clause(s). The omission occurs to avoid the repetition of redundant information that is already present in the first conjunct. The interpretation of these sentences involves restoring and restructuring the missing elements into the remaining structure.

At least the finite verb in the first conjunct is always elided in the second conjunct. The missing verb is normally called the Gap. The first clause is called the *antecedent clause* and the second one the *gapped clause*. The pronounced elements of the gapped clause are called the *remnants* while the elements that correspond to the remnants in the first conjunct are called their *correlates* (CITKO, 2011). Consider an instance below:

(5) *O garoto leu um livro e a garota ~~leu~~ uma revista.*

The boy read a book and the girl ~~read~~ a magazine.

In the sentence above, the gap consists of the finite verb *read* (*leu*), the remnants are the DPs *the girl* (*a garota*) and *a magazine* (*uma revista*), and their correlates are respectively the DPs *the boy* (*o garoto*) and *a book* (*um livro*). The remnants are in a contrastive relation with their respective correlates. In order to understand the second conjunct, the speaker has to recover the missing information (*read*) in the first conjunct and transfer it to the gap. The presence of this verb in the second conjunct would be redundant and lead to unnecessary repetition.

In addition to the finite verb, further elements can be left unpronounced, such as direct and indirect objects. Consider the instance below:

(6) *A garota fez salada no almoço e o menino ~~fez salada~~ no jantar.*

The girl made salad for lunch and the boy ~~made salad~~ for dinner.

In sentence (6), the gap includes the finite verb *fez* (made) and its direct object *salada* (salad). The remnants are the DP *o menino* (the boy) and the PP *no jantar* (for dinner); their correspondents are respectively the DP *a garota* (the girl) and the PP *para o almoço* (for lunch). To understand the second conjunct, the speaker has to recover the missing information (*fez salada / made salad*) in the first conjunct and transfer it to the gap.

In some cases, the omission of linguistic material leads an element in the second conjunct to have two possible correspondents in the first conjunct. That results in ambiguity and the sentence ends up with two possible interpretations. Consider an instance of a potentially gapping sentence:

(7) *João encontrou Daniel ontem e Pedro hoje.*

João met Daniel yesterday and Pedro today.

(a) **Meaning 1** (Subject):

João encontrou Daniel ontem e Pedro encontrou Daniel hoje.

João met Daniel yesterday and Pedro met Daniel today.

(b) **Meaning 2** (Object):

João encontrou Daniel ontem e João encontrou Pedro hoje.

João met Daniel yesterday and João met Pedro today.

In sentence (7), it is impossible to uniquely identify which elements were left out in the second conjunct, since the noun *Pedro* can be read as a subject or as an object, so the noun *Pedro* has two possible correspondents in the first conjunct, the subject noun *João* or the object noun *Daniel*. Therefore, the sentence can be interpreted in two ways. Meaning 1 presents a gapping interpretation, in which both *João* and *Pedro* had met *Daniel* in different moments; *João* and *Pedro* are both subjects. Meaning 2 presents a conjunction reduction structure (HOEKS *et al.*, 2009), in which there are two conjoined objects within the same VP, *Daniel* and *Pedro*. In this interpretation, *João* visited both *Daniel* and *Pedro* in different moments. Ambiguous sentences of this type are the main interest of this thesis.

According to Repp (2009) and Citko (2011), several properties distinguish gapping sentences from other elliptical constructions since they are subject to a number of constraints in different levels of linguistic analysis, such as prosodic, semantical and syntactic levels. Repp (2009, p. 5) argues that these restrictions “determine the semantic relation between the conjuncts, the identity of gap and antecedent, and the syntax and semantics of the contrast pairs”. The authors list some basic features of gapping sentences with examples from different languages. Here, the focus is on BP gapping sentences, which resembles English gapping sentences in many relevant respects. The following restrictions will be outlined:

(8) **Gapping restrictions**

- (a) Gaps must be surrounded by lexical material;
- (b) Remnants must be contrastive;
- (c) Gapping is only possible in coordinate clauses;
- (d) Gaps require linguistic antecedents;
- (e) Gapping requires matching in tense;
- (f) Gapping can target non-constituents;

(g) Gapping is sensitive to head directionality.

(h) Gapping obeys islands.

Source: adapted from Citko (2011, pp. 79-80)

The first restriction means there should be overt lexical elements in the second conjunct following the ellipsis site. Those lexical elements are usually the subject and some postverbal elements (object or indirect objects, adjuncts etc). Example (9) is infelicitous because there is nothing following the gapped verb *estudou* (studied) in the second conjunct.

(9) **Ana estudou inglês e Pedro ~~estudou~~.*

*Ana studied English and Pedro ~~studied~~.

The second restriction claims that the remnants must contrast with their correlates, that is, they must be distinct and present new information. The contrast between the elements could be in relation to different locations, times, agents, etc. The example (10) is infelicitous because the remnants and their correlates (*inglês/English* and *ontem/yesterday*) are exactly the same.

(10) **Ana estudou inglês ontem e Pedro ~~estudou inglês ontem~~.*

*Ana studied English yesterday and Pedro ~~studied English yesterday~~.

Another restriction of gapping is being restricted to coordinated clauses. This means that gapping is ungrammatical in non-coordinate contexts. For instance, gapping constructions are not grammatical in subordinate clauses:

(11) *?*Ana estudou inglês enquanto Pedro português.*

* Ana studied English while Pedro Portuguese.

The fourth restriction implies that gaps must have linguistic antecedents, which can be recovered in the first conjunct or in the discourse. In sentence (12), the verb *estudou* (studied) is the antecedent of the gap (marked by the

underscore) in the second conjunct. In sentence (13), the antecedent of the gap in Speaker B's utterance can be recovered in Speaker A's utterance.

(12) *Ana estudou inglês e Pedro __ português.*
 Ana studied English and Pedro __ Portuguese.

(13) Speaker A: *A Ana estudou inglês.*
 Ana studied English.
 Speaker B: *E o Pedro __ Português.*
 And Pedro __ Portuguese.

The fifth feature is still related to the antecedent. The elided verb must be semantically identical to its overt antecedent, which means that they must have the same tense. Sentence (14) is ungrammatical because the verb *estudou* (studied) in the first conjunct is in the past tense while the verb *estuda* (studies) in the second conjunct is in the present tense.

(14) **A Ana estudou ontem e a Maria ~~estuda~~ hoje.*
 *Ana studied yesterday and Maria ~~studies~~ today.

On the other hand, non-semantic features do not have to be identical. This means that the elided verb and its antecedent do not need to have identical person, number, and gender features. The elided verb in (15) has a subject that differs in number and gender features – *Ana* is a feminine noun and a singular subject of the verb in the first conjunct, while *Pedro* and *João* are masculine nouns and they are both subjects of the verb – and the sentence remains felicitous.

(16) *Ana estudou ontem e Pedro e João ~~estudaram~~ hoje.*
 Ana studied yesterday and Pedro and João ~~studied~~ today.

Structural parallelism of remnants and correlates has played an important role in the analysis and processing of gapping. The syntactic category of a

remnant and its correlate does not necessarily have to be the same, but it is important that it fits the requirements of the gapped verb. In sentence (17), the correlate is an adjectival predicate whereas the remnant is a nominal predicate.

(17) *A Maria é muito boba e Peter é um completo idiota.*

Mary is rather foolish and Peter is a complete idiot.

The sixth restriction is related to the nature of the elements that can be elided. The gaps can be quite complex and do not necessarily have to form a constituent.

(18) *A Maria estuda inglês no quarto e o João ~~estuda português no quarto~~.*

Mary studies English in the bedroom and John studies Portuguese in the bedroom.

The seventh restriction concerns the directionality of gapping sentences. The direction of gapping – backward or forward – shows the setting of the head directionality parameter in the language. Head-initial languages, such as BP and English, for instance, gap forward and thus the elision takes place in the second conjunct. Head-final languages, such as Japanese or Korean, elide the finite verb in the first conjunct.

The last restriction points that gapping sentences usually obey island constraints. This means that the remnants in the elliptic clause may not be contained in a syntactic island. In sentence (19), the remnant is within an embedded clause that constitutes a *wh*-island, here marked by the square brackets. If the matrix verb (*sabe/knows*) is elided or not, the sentence is still infelicitous.

(19) **O João sabe qual garoto comprou um livro e o Pedro (sabe) [qual garoto comprou um caderno].*

*John knows which boy bought a book and John (knows) [which boy bought a notebook].

It is noteworthy to mention that different syntactic analyses have been proposed in the linguistic literature to explain the derivation and interpretation of the incomplete conjunct of gapping and other ellipsis types. The authors Ross (1967), Kuno (1976), and Sag (1980) adopt a theory of deletion which predicts that a gapped sentence is a result of semantic or syntactic deletion under identity. Johnson (2004) argues that there is syntactic movement; this means that there is a full second clause built and the missing elements are raised to higher position by the Across-the-Board (ATB) movement. Hazout (1995) proposes that an incomplete conjunct is built and completed through syntactic reconstruction from the complete conjunct. Rooth (1992) claims that the interpretation of the incomplete conjunct is derived through the application of a semantic property from the full clause. Reinhart (1991) suggests that a QR-like process adjoins the arguments in the incomplete conjunct with arguments from the full clause, and then interpretation takes place. Citko (2011) claims that gapping is derived via multidominance. However, the current doctoral thesis does not aim to commit to a particular analysis for the interpretation of gapping sentences.

This section aimed to report some of the basic features of gapping sentences that are considered relevant to the scope of this doctoral thesis. Gapping sentences seem to present key structural similarities in both BP and AE. On the other hand, gapping sentences might differ in the two languages in respect to prosodic characteristics (i.e. pitch accent type, pitch range). In the following section, the role of prosody in the processing of gapping sentences will be covered. Additionally, intonational phrasing and prosodic aspects of gapping sentences are also provided.

2.3 Prosody

This thesis will explore the processing of both written and auditory gapping sentences; thus, it is essential to point out the prosodic theory and representations that will be used as well as the importance of prosody in the processing.

2.3.1 Prosody and processing

As prosody can help the processor parse the syntactic structure and semantics of an utterance, it can affect the interpretation of sentences (BECKMAN, 1996), especially the ambiguous ones. Therefore, it has an important role in the interpretation of ellipsis since in this kind of structure there is a rupture between sound and meaning correspondence. In this sense, prosody can contribute to the understanding of what licenses ellipsis, the recoverability of deletion and the question of whether there is structure in the ellipsis site.

The effects of the deaccentuation and elision of given and redundant material, and the distribution of pitch accents on the remnants and their correlates have been central in the research on prosody and ellipsis (WINKLER, 2018). Three questions are important to be discussed on the relation between prosody and ellipsis – the license of ellipsis, the recoverability of the ellipsis site and the presence or absence of structure in the ellipsis site (WINKLER, 2018, p. 379):

- (i) How does prosody contribute to the licensing of ellipsis?
- (ii) How does prosody contribute to the process of recoverability of the elided material at the syntax-prosody and syntax-Logical Form interfaces?
- (iii) What role does prosody play in the derivation and interpretation of ellipsis? Can the investigation of the prosodic requirements for extraction from ellipsis provide evidence for structure in the ellipsis site?

In ellipsis sentences, there is absence of sound and even so these structures have meaning and are licensed by the grammar. In the classic view of Chomsky (1965, 1981, 1995), the grammar accounts for the matching of sound and meaning in the levels Phonological Form (PF) and Logical Form (LF) in order to interpret the syntactic structures. These two levels interface respectively with the articulatory–perceptual system and the conceptual–

intentional system. In this sense, it is important to explain how speakers can produce ellipsis sentences and how listeners can interpret them. Therefore, the prosody of these type of sentences can be relevant in answering this question (HARTMANN, 2000; FÉRY and HARTMANN, 2005; WINKLER, 2005, 2018).

Two crucial observations are made in the literature about the prosodic description of ellipsis and its information-structure, the *givenness-marking hypothesis*, which argues that given material is subject to reduction; and the *contrastive remnant condition*, which requires that the remaining material in ellipsis structure, after the elision, must be highlighted. According to Winkler (2018), there are two kinds of ellipses, the contrastive ellipsis and the givenness-marking ellipsis. Gapping sentences are considered an instance of the first kind (the deleted linguistic material is marked by an underscore, and pitch accents by capitals):

(20) *A MARIA toca PIANO e a ANA ~~toca~~ VIOLÃO.*

Maria plays the PIANO and Ana ~~plays~~ the GUITAR.

Gapping sentences such as (20) typically occur in coordinate structures with parallel information structure. Thus, the verb *toca* (plays) is deleted in the second conjunct and the remnants *Ana* and *violão* (guitar) bear a contrastive pitch accent due to the semantic contrast they bear with their correlates *Maria* and *piano*. The first conjunct and the second conjunct (with the gapped verb) are semantically parallel except for the elements where contrastive accents signal their difference. A contrastive prosody is realized on the subject *Ana* and on the direct object *violão* (guitar) in the second conjunct. They occur in a contrastive relationship to their correlates *Maria* and *piano* in the first conjunct. The parallel interpretation allows the verbal head *toca* (plays) to be elided.

According to Kuno (1976), contrastive focus and elision of redundant elements play a crucial role in licensing the discourse appropriateness of gapping sentences. To give a better idea of that argument, consider the three instances below:

- (21) (a) *A MARIA toca PIANO e a ANA ~~toca~~ VIOLÃO.*
 Maria plays the PIANO and Ana ~~plays~~ the GUITAR.
- (b) *A MARIA toca PIANO e a MARIA toca VIOLÃO.*
 Maria plays the PIANO and Maria plays the GUITAR.
- (c) *A MARIA toca PIANO e a ANA toca PIANO.*
 Maria plays the PIANO and Ana plays the PIANO.

In a multiple wh-question such as *Who plays what? (Quem toca o que?)*, sentence (21a) can occur as an answer to this question because the subjects of the coordinated clauses *Maria* and *Ana* and the objects *piano* and *violão* are in a contrastive relation with each other, which is shown by the presence of contrastive pitch accents on them. On the other hand, there is obviously no requirement for contrast or newness on the subject and object in the second clause of examples (21b) and (21c); *Maria* is the subject of both clauses in (21b) while *piano* is the object of both clauses in (21c), the elements do not semantically contrast. Therefore, sentences (21b) and (21c) violate the two information-structural requirements that prosodically license gapping: (i) the redundant verb in the second conjunct has the information-structural status of *given* and, as a result of that, can go unpronounced; (ii) the remnants in gapping sentences must be interpreted as contrastive in relation to their correlates, being prosodically highlighted with pitch accents (WINKLER, 2018, p. 362). These two prosodic requirements can be defined in the *givenness-marking hypothesis* and in the *contrastive remnant condition*:

(22) **Givenness-marking hypothesis – GMH**

Given material is deaccented or deleted at the Phonological Form.

(23) **Contrastive remnant condition – CRC**

Given information licenses a contrastive focus interpretation of the remnant(s). The contrastive remnant(s) must be assigned a strong contrastive pitch accent.

Source: adapted from Winkler (2018, p. 363)

These prosodic notions would be instructions to the Phonological Form level. It can be inferred that the CRC is functionally dependent on the GMH.

Gapping sentences are instances of contrastive ellipsis type and they are subject to the CRC to be felicitous (WINKLER, 2018). These notions explain why sentences (21b) and (21c) were not appropriate in terms of discourse.

Another important aspect that prosodically licenses contrastive ellipsis such as gapping sentences is the notion of parallelism. In a syntax-prosody interface, it was observed that the remnants receive pitch accents to mark their discourse status, and they are interpreted contrastively with respect to their parallel correlates. Therefore, it was attested that contrastive ellipses occur in coordinated constructions and are subject to the parallelism condition. According to the notions in (24) and (25), gapping sentences would be ungrammatical if they occur in non-parallel structures (WINKLER, 2018).

(24) **Parallelism Condition (PC)**

A constituent satisfies the parallelism condition if it is semantically identical to another constituent, modulo-focus marked constituents.

(25) **Prosodic Requirement of the Parallelism Condition**

A constituent satisfies the prosodic requirement of the PC if the focus-marked constituents are prosodically highlighted by a contrastive pitch accent. The non-focus marked constituents are deaccented or deleted.

Source: Winkler (2018, p. 366)

In sum, it can be argued that prosody has a relevant role in the licensing process of ellipsis; it is required a parallel syntactic, semantic, and prosodic structure and contrastive accents on the remnants. The prosodic licensing is crucial for the discourse appropriateness of gapping sentences (WINKLER, 2018).

The second question concerns how prosody can contribute to the process of ellipsis recovery. More specifically, it is relevant to verify whether the syntax-prosody interface has influence in the reconstruction of the ellipsis site and how it contributes to the process of ellipsis recovery.

With regard to gapping sentences, it was observed that information structure and prosody can shed some light on how to recover the ellipsis site

(KUNO, 1976). The potentially gapping sentences that present the subject vs. object ambiguity such as (26), which is the focus of this thesis, can be disambiguated in terms of place of pitch assignment. That is, the position of the pitch accents can help in the recovery of the content of the ellipsis site.

(26) (a) *Pedro visitou Maria ontem e Ana hoje.*

Pedro visited Maria yesterday and Ana today.

(b) *PEDRO visitou Maria ONTEM e ANA visitou Maria HOJE.*

PEDRO visited Maria YESTERDAY and ANA visited Maria TODAY.

(c) *Pedro visitou MARIA ONTEM e ~~Pedro visitou~~ ANA HOJE.*

Pedro visited MARIA YESTERDAY and ~~Pedro visited~~ ANA TODAY.

In (26b), there is a subject reading (i.e., a gapping syntactic analysis) of *Ana* shown by a contrastive pitch accent on its correlate *Pedro*, which is also a subject in the first conjunct. On the other hand, in (26c) *Ana* has an object reading (i.e., a conjunct reduction structure) conveyed by a contrastive pitch accent on its correlate *Maria*, which is also an object in the first conjunct. Therefore, the parallelism condition and the position of pitch accents can show what is the content of the ellipsis site to be recovered. Some psycholinguistic studies have indeed shown that these prosodic factors can influence the preferred reading in ambiguous sentences such as the one above (CARLSON, 2002; HOEKS *et al.*, 2009).

Winkler (2018) draws the attention to the fact that the identity relation between the omitted material and its antecedent is a matter of syntax and semantics, and it is not exclusively determined by phonetic and phonological representations. Nevertheless, the lexical encoding of the identity relation seems to interact with the phonological component and with the syntax and semantic components in the antecedent retrieval.

The third question discusses whether there is evidence for structure in the ellipsis site from the perspective of prosody. By observing the prosodic and information structure of the remnants, it is possible to infer the prosodic

structure of the elided elements. Winkler (2018) affirms that prosody provides indirect evidence for structure in the ellipsis site. Two arguments are given, the first is theoretical and the second empirical. The first argument points that “ellipsis as a phonological deletion process at the level of phonological form is prosody-related” (p. 386). The second argument indicates that the remnants of contrastive ellipsis such as gapping are assumed to be extracted from the ellipsis site and there are prosodic requirements and discourse requirements that license extraction. This process of extraction would show that there must be structure in the ellipsis site.

2.3.2 Prosody and gapping sentences

It has been argued that prosody shows “the organizational structure of speech” (BEACKAMN, 1996) and it includes three independent aspects of the phonological representation of the sentence: “intonation, phrasal rhythmic patterning and prosodic phrasing” (SELKIRK, 1995, p. 550).

Intonation, also named pitch, is part of prosody and expresses phrase-level meanings in a linguistically structured manner (GUSSENHOVEN, 2007; LADD, 2008; FROTA and MORAES, 2016). Through the intonation contour of a sentence, it is possible to see the pitch movement – i.e., a sequence of one or more pitch accents (SELKIRK, 1995; WINKLER, 2018). The intonation has three main functions (FROTA and MORAES, 2016, p. 141): (i) *demarcation*, which shows the phrasing of the speech stream into intonation-based units; (ii) *highlighting*, which shows where the prominence within an utterance should be placed; and (iii) *distinction*, which shows whether a sentence is a statement, a question, an imperative or a vocative utterance.

Selkirk (1995) points that the phrasal rhythmic patterning is related to the prominence of a syllable within a sentence, which can be attributed to the accent, to the phrasing or to the rhythmic factor. The accent factor concerns the presence or absence of a pitch accent on a syllable. The phrasing factor regards to the prominence of the syllable considering its position within a constituent. The rhythmic factor is related to the presence or absence of other prominent syllables surrounding the prominent syllable in its immediate vicinity.

The prosodic phrasing regards to how the speech stream is divided and grouped into prosodic units that characterize the spoken utterances. This organization is not completely dictated by the syntactic structure of the utterance, it can also take into account the phonological grammar of the language as well as the particular choices made by the speaker to convey the meaning they intend to (FROTA and MORAES, 2016).

The Prosodic Phonology theory proposed by Nespor and Vogel (2007) is assumed here to describe the prosodic structure of the potentially gapping sentences. According to this theory, the flow of speech is organized into a finite set of meaningful prosodic units. The intonational aspects of prosodic representations will be described and labelled using the *Tones and Break Indices* (ToBI) transcription system created by Pierrehumbert (1980) and extended in Beckman and Pierrehumbert (1986) and Pierrehumbert and Hirschberg (1990). This system is mainly concerned with prosodic features above the word level. It is used to represent the changes in fundamental frequency (F0) in terms of prominence of particular words, durational patterns and groupings of words into phrases (CARLSON, 2002). The ToBI system implemented two basic functions of prosody, the pitch accent assignment and the prosodic phrasing, which together form the intonational contour of an utterance. The pitch accents serve to mark the most prominent segments in the utterance, while the prosodic phrasing divides the stream of speech into units through prosodic boundaries, i.e., breaks or pauses (WINKLER, 2018).

The pitch accents typically associate with the stress-prominent syllable in a word in languages which have stress (LADD, 2008; GUSENHOVEN & JACOBS, 2011), such as English and Portuguese, for instance. In other words, the pitch accents can sign prominence and importance of words within a sentence. They are produced on the main stressed syllable of the target word. The accented words are usually lengthened (CARLSON, 2002). In BP, for instance, almost every prosodic word is pitch accented (FROTA and MORAES, 2016) and the word stress may fall on one of the three last syllables in the word. Word stress location in BP has been argued to be weight-sensitive in non-verbs, that is, stress falls on the word final syllable if it is heavy, otherwise, on the penultimate syllable. Also, under stress clash, a word stress location can

move its position. Post-tonic syllables tend to be reduced in BP (FROTA *et al.*, 2015).

With regard to notation of pitch accents, the symbols H (for high) and low (L for low) represent the phonemic tones. Pitch accents can be simple (i.e., monotonal like L* or H*) or more complex (bitonal), being associated with preceding pitch movements, a low pitch target before a high accent (L+H*) or a high pitch target before a low accent (H+L*). Bitonal accents are formed by the combination T+T* or T*+T. The symbol * marks the target of the pitch accent and this tone is associated with the stressed syllable of the lexical element that is receiving the pitch accent (SELKIRK, 1995; WINKLER, 2018). The realization of pitch accents is measured in terms of hertz (Hz).

In the gapping sentences under study here, the remnants left in the second conjunct is in a contrastive focus relation with their correlates in the first conjunct (KUNO, 1976; SAG, 1980). This focus relation can be conveyed by pitch accents, which often sign the presence of new or contrastive information (SELKIRK, 1995). In English, pitch accent L+H* often signals new or contrastive information, whereas L* accents often mark given information (CARLSON, 2002). In BP, bitonal nuclear accents are the only nuclear pitch accent format available, and they always present a leading tone, followed by the starred tone (*) (FROTA *et al.*, 2015; MORAES, 2007). The leading tone is usually in the prenuclear syllable and the starred tone on the stressed syllable. In BP, there seems not to be a single pitch accent associated with focus; multiple prosodic strategies have been found. There might be regional differences in the implementation of the contrastive focus pattern (FROTA and MORAES, 2016). The audio data collected will be analyzed following Moraes (2007). The author reports that the contrastive focus pattern is characterized by a rise on the prenuclear syllable and a fall on the stressed syllable of the focused word, H+L* pitch accent. The focused word also presents increased duration and intensity, mainly on the stressed syllable, features that play an important role in the identification of this pattern.

Besides the pitch accents, the prosodic theory represents rhythmic and information units composed by more than one prosodic word in prosodic phrases such as the smaller intermediate phrase (ip) and the larger intonational

phrase (IPh). The ip and the IPh are two levels of prosodic phrasing over which the intonational contour is found (CARLSON, 2002; WINKLER, 2018).

In English, each intermediate phrase (ip) contains at least one pitch accent and it ends with a phrase accent, either high (H-) or low (L-). The phrase accent indicates the pitch movement that occurs between the last pitch accent of the ip and the beginning of the next ip, or the end of the utterance (WINKLER, 2018). Durational lengthening is expected at the boundary of an ip (CARLSON, 2002). Different from English, the intermediate phrase is usually not a relevant level of prosodic phrasing for the intonational structure (FROTA *et al.*, 2015; MORAES and FROTA, 2016). Thus, the annotation of intermediate phrases is not given in the pitch tracks of BP sentences in the current study.

The intermediate phrases are grouped within the intonational phrase (IPh), which is the prosodic constituent of the domain for the intonation contour (NESPOR and VOGEL, 2007). Each IPh contains at least one ip and one pitch accent as well. In other words, “an IPh is composed of one or more phrase-like prosodic units that are smaller than the IPh and larger than the prosodic word” (WINKLER, 2018, p. 358). In stress languages, such as English and Portuguese, the nuclear contour is the melody on the nuclear syllable and the following post-tonic syllables. The nuclear prominence is rightmost within the IPh, as in most Romance languages. In BP, the IPh is usually the only level of prosodic constituency that is relevant for the intonational structure. This means that sentences in BP usually have longer intonational phrases (FROTA *et al.*, 2015; MORAES and FROTA, 2016).

The IPhs end with boundary tones that can be high (H%) or low (L%). In English, the final boundary of an IPh is marked by the combination of the ip-final phrase accent and the IPh-final boundary tone. The intonational phrases are marked by long breaks while the intermediate phrases are marked by short breaks (WINKLER, 2018). The combination of L-H% is often associated with significant syntactic boundaries and it often signals that the sentence or information unit will continue; whereas the combination of L-L% often signals ends of sentences or utterances (CARLSON, 2002). In BP, prosodic phrases that are smaller than the IPh do not have tonal boundary marking (MORAES and FROTA, 2016). The boundary tones are only marked at the edges of IPhs

and the L% is the most common one (MORAES, 2007). The pitch accents in BP often occur near the edges of IPhs (FROTA *et al.*, 2015).

Turning to the prosodic description of the potentially gapping sentences under study here, the discussion on prosodic boundaries will be pointed out first. Many studies explored the relation between prosody and syntax in parsing ambiguous sentences (SCHAFER, 1997; KJELGAARD and SPEER, 1999; CLIFTON *et al.*, 2002; among others). However, prosodic boundary effects are not always able to disambiguate a particular syntactic structure. Carlson (2002) argues that this seems to happen with gapping constructions. A prosodic boundary should appear in the second conjunct between the ambiguous DP and the PP (... *and Sara # during the week*) to signal the elision. However, the natural phrasing of non-elided sentences that present a DP and a PP following the verb would also place a boundary between the DP and PP. Thus, the boundary in the second conjunct of a potentially gapping sentence is compatible with both readings, a subject or an object reading. In English, a boundary found in the second conjunct of an object analysis is likely to be compatible with the intermediate phrase (ip), whereas a boundary found in the second conjunct of a subject analysis is compatible with the intonational phrase (IPh). On both subject and object readings, a prosodic boundary is likely to appear before *and*, signaling the end of a clause or a VP. In BP, an ip boundary is not likely to appear in the prosodic structure compatible with an object analysis of potentially gapping sentences, the phrasing of the second conjunct occurs within a single IPh.

Other aspects of prosody could help parsing the potentially gapping sentences. Carlson (2002) points out three prosodic aspects to be explored: location of pitch accents, choice of pitch accent type and pitch range.

As mentioned before, pitch accents usually signal the presence of new or contrastive information. In the potentially gapping sentences, the material left in the second conjunct is in a contrastive relation with material in the first conjunct. Consider the examples below:

- (27) (a) JOHN visited Mary during the VACATION and SARA during the WEEK.

(b) John visited MARY during the VACATION and SARA during the WEEK.

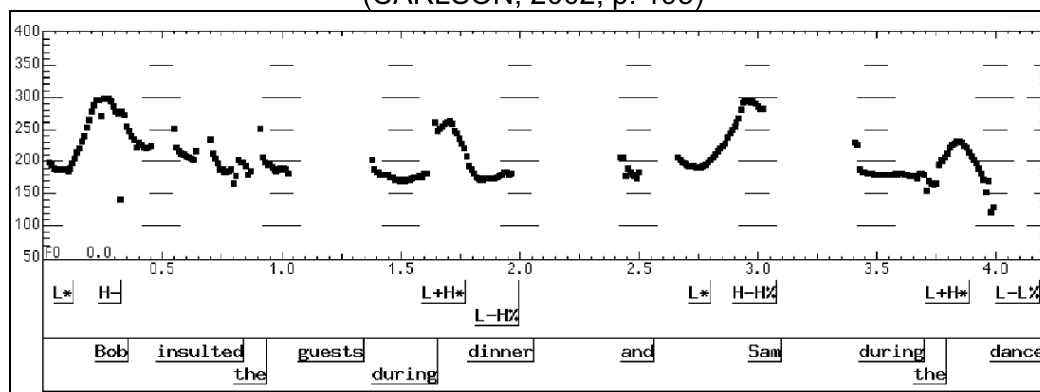
In a subject analysis (27a), *John* contrasts with *Sara*, and *during the vacation* contrasts with *during the week*; whereas in an object analysis (27b), *Mary* contrasts with *Sara*, and *during the vacation* contrasts with *during the week*. The second conjunct constituents will contrast with information in the first conjunct, and thus receive pitch accents. The placement of the pitch accents on different elements in the first conjunct can mark which arguments are in a contrastive relation. The remnant and its correlate being more prosodically similar can favor a subject or an object analysis of the sentence. Also, by choosing similar pitch accents the prosodic similarity between the arguments can increase, and it can also help to bias one of the two readings. Pitch range can also affect the interpretation by highlighting through intensity which arguments are contrasting with each other.

Carlson (2002), which motivated the present study, produced cooperating prosodies for the ambiguous gapping sentences in order to evaluate the roles played by structure, prosody and prosodic parallelism in the interpretation of these sentences. In cooperating prosodies, the ambiguous DP contrasts with a specific focused argument in the first conjunct, so that prosody can bias the interpretation towards the subject or the object analysis. The gapping prosody aims to bias subject reading while the nongapping prosody tries to bias object reading. In the cooperating prosodies, there were parallel placement of pitch accents, parallel pitch accent types, and parallel pitch peak heights. This was done at once to maximize any helpful effect of the prosody on the structuring of the sentences.

In the cooperating gapping prosody (see Figure 3), the two elements in the second conjunct were both accented because they are in contrastive relation with elements of the first conjunct. The remnants *Sam* and *during the dance* in the second conjunct contrast respectively with their correlates *Bob* and *during dinner* in the first conjunct. The correlates and the remnants are accented, except for the object DP in the first conjunct. Therefore, the ambiguous DP (*Sam*) is more prosodically parallel to the subject of the first

conjunct (*Bob*) than to the object DP *the guests*. These two parallel DPs have pitch accent L* followed by H- phrase tones; the PPs of both conjuncts have pitch accent L+H*. Elements with pitch accent parallelism had similar F0 values: the DPs averaged 314Hz and 293Hz in the first and second conjuncts, respectively; and the PPs averaged 253Hz and 245Hz, respectively. A high boundary tone (L-H%) is found at the end of the first conjunct and after the ambiguous DP *Sam*, which signals that the sentence will continue. At the end of the second conjunct, a low boundary tone (L-L%) indicates the end of the utterance. Therefore, the sentence is prosodically phrased into three intonational phrases. See pitch track below:

Figure 3 – Pitch track of Cooperating Gapping Prosody (Subject Accent) for the sentence “*BOB insulted the guests during DINNER and SAM during the DANCE*” (CARLSON, 2002, p. 195)

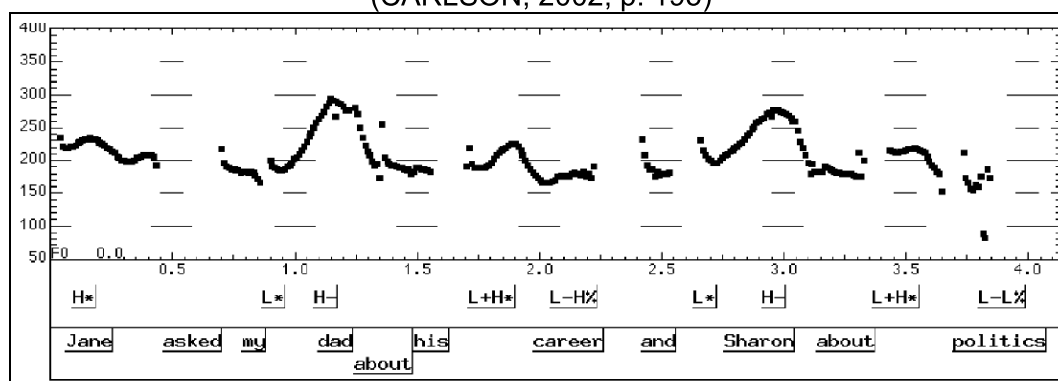


Source: Carlson (2002, p. 195).

The cooperating nongapping prosody (see Figure 4) was quite similar to the cooperating gapping prosody, differing only in the placement of the pitch accents in the first conjunct and the boundary size in the second conjunct. Here, the object DP (*my dad*) in the first conjunct and the ambiguous DP (*Sharon*) had the same pitch accent type (L*) and similar F0 values: the DPs averaged 303Hz and 294Hz in the first and second conjuncts, respectively; the PPs averaged between 241Hz and 240 Hz, respectively. The PPs were identical to those seen in Figure 3, with L+H* pitch accent. A high boundary tone (L-H%) appears at the end of the first conjunct. Between the ambiguous DP and the PP there is an ip boundary (H-). In the cooperating gapping prosody, the occurrence of a larger boundary, an IPh, is motivated by the presence of focus, that is, it is natural that a boundary occurs after a focused constituent. It is also natural for a boundary

to occur where some input has been deleted, which is the case in cooperating gapping prosody. See the pitch track below:

Figure 4 – Pitch track of Cooperating Nongapping Prosody (Object Accent) for the sentence “Jane asked my DAD about his CAREER and SHARON about POLITICS” (CARLSON, 2002, p. 195)



Source: Carlson (2002, p. 195).

The current thesis investigates the processing of spoken sentences in (BP and in AE. Thus, there are sentences recorded in the two languages for the auditory studies. The English sentences were recorded by a female native speaker of AE who grew up in the north Pennsylvania dialect area. The Portuguese sentences were recorded by two⁶ female native speakers of BP, one from Rio de Janeiro and the other one from Minas Gerais. The three people who recorded the stimuli for the auditory spoken studies have experience in recording experimental sentences.

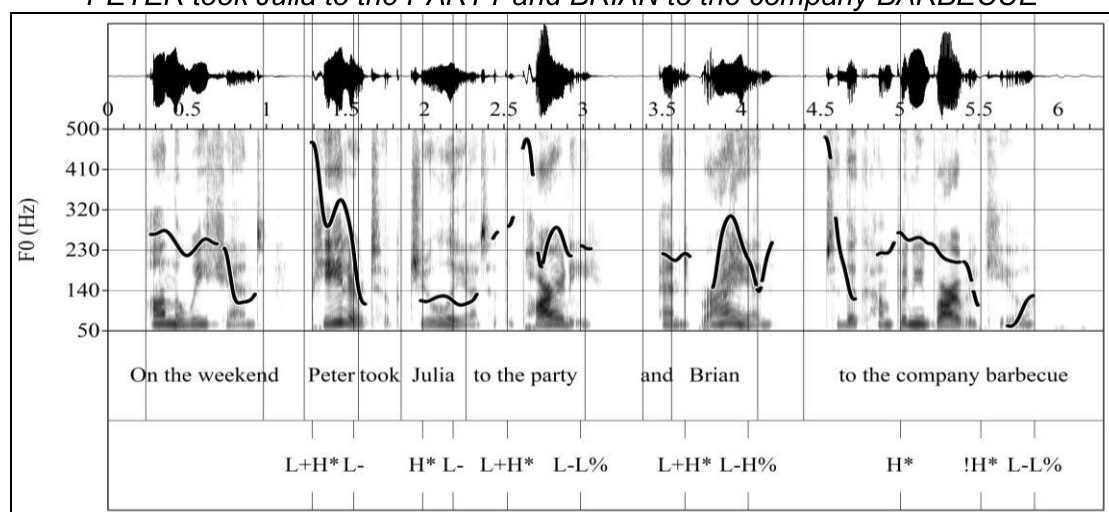
The description of the AE sentences will be given first. The prosodic features of the recorded sentences of this thesis are similar to Carlson (2002) sentences described above, with some differences regarding pitch accent types and phrase accents. What Carlson (2002) names cooperating gapping prosody and cooperating nongapping prosody will be named in our study as biasing subject prosody and biasing object prosody, respectively.

In the biasing subject prosody (see Figure 5), the prosodically parallel subject DPs *Peter* and *Brian* are both accented with the contrastive accents (L+H*). The remnant PP *to the party* and its correlate *to the company barbecue*

⁶ The reason for having two speakers from different regions is because one of the studies was conducted in partnership with a research laboratory at the Universidade Federal do Rio de Janeiro. The other studies were conducted at the Universidade Federal de Juiz de Fora.

in the first conjunct are also accented. The object DP *Julia* receives a high pitch accent (H*), but it has a lower F0 value (129Hz) in comparison to the subject DPs (485Hz and 316Hz, respectively). Differently from Carlson (2002), the speaker of this study has a pattern of putting almost every DP into its own prosodic phrase, thus a lot of ip boundaries can be observed in the pitch tracks here. A high boundary tone (L-H%) is found after the ambiguous DP *Brian*, which signals that the sentence will continue. At the end of both the first and second conjuncts, a low boundary tone (L-L%) is found instead. Although the sentence will continue after the first conjunct, it is possible that the low boundary tone occurred because it is showing a complete statement sentence. Overall, the sentence is prosodically phrased into three intonational phrases. See pitch track below:

Figure 5 – Pitch track of Biasing Subject Prosody for the sentence “On the weekend, PETER took Julia to the PARTY and BRIAN to the company BARBECUE”

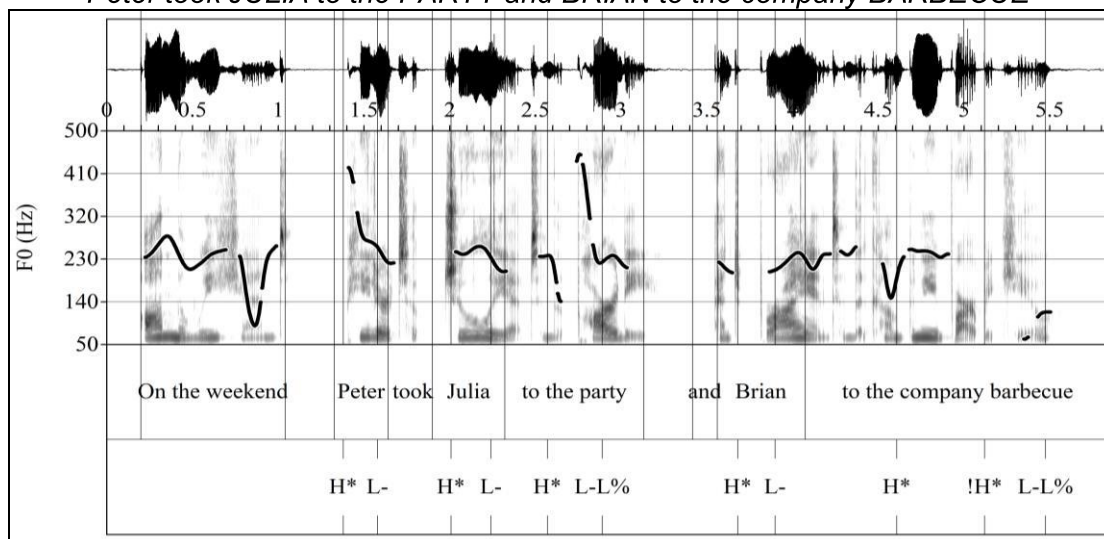


Source: the author (2021).

In the biasing object prosody (see Figure 6), the DPs *Peter*, *Julia* and *Brian* receive the same pitch accent (H*). The DPs *Julia* and *Brian* are more prosodically parallel in terms of F0 values, they have respectively 259Hz and 248Hz. On the other hand, the subject DP *Peter* has 495Hz. This high F0 value might be due to the fact that this DP is at the beginning of the utterance, which favors a higher rate of F0. The DPs *Julia* and *Brian* are also more lengthened than the subject DP *Peter*. A low boundary tone (L-L%) appears at the end of the first conjunct and at the end of the sentence. Between the ambiguous DP

and the PP, there is an ip boundary (L-). Overall, the sentence is grouped into two intonational phrases. See pitch track below:

Figure 6 – Pitch track of Biasing Object Prosody for the sentence “*On the weekend, Peter took JULIA to the PARTY and BRIAN to the company BARBECUE*”



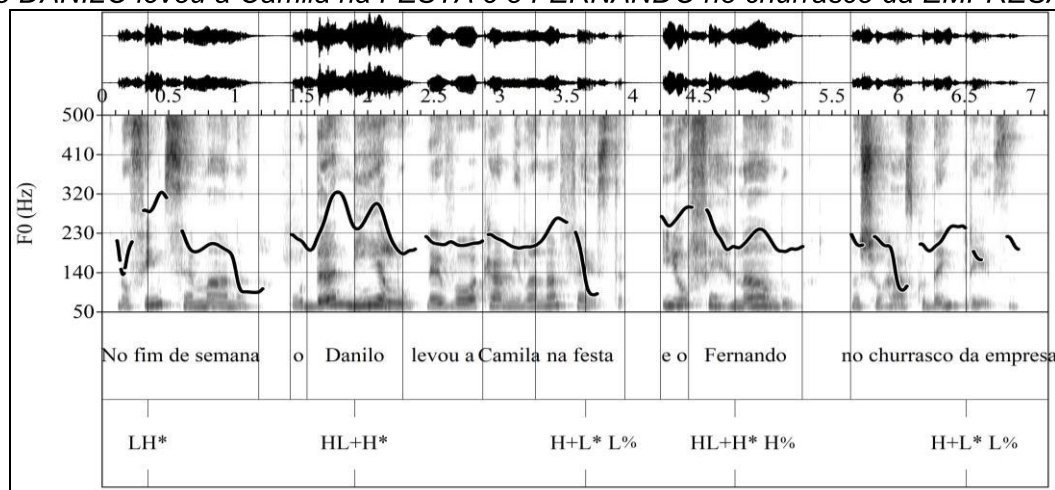
Source: the author (2021).

The prosodic description of the BP sentences will be given next. There are no main significant prosodic differences between the sentences recorded by the speaker from Rio de Janeiro and the speaker from Minas Gerais; the latter was chosen for the description here because the sentences recorded by her were explored in most of the studies conducted in this thesis. The only difference observed between the two speakers is that the speaker from Rio de Janeiro produces sentences with a higher F0 rate pattern than the speaker from Minas Gerais.

In biasing subject prosody (see Figure 7), the subject DP of the first conjunct (*o Danilo*) is in contrastive relation with the ambiguous DP (*o Fernando*) of the second conjunct. Both present similar pitch accent types, HL+H*. In BP, it is common to find pitch accent H+L* to sign contrastive focus (MORAES, 2007), although this author argues that there is not a single pitch accent associated with focus. In our data, on the other hand, there is a falling contour on the prenuclear syllable (HL) followed by a rise on the stressed syllable (H*). The parallel subject DPs (*o Danilo* and *o Fernando*) have similar F0 values (328Hz and 293Hz, respectively) and their prenuclear syllable is lengthened. The object DP (*a Camila*) is deaccented and has F0 value of

236Hz. The PPs of both conjuncts (*na festa* and *no churrasco da empresa*) are also contrasting with each other, signaled by the pitch accent H+L*. With regard to the boundaries, low boundaries (L%) are present at the end of the first conjunct and at the end of the utterance. A high boundary (H%) is found at the IPh containing the ambiguous DP (*o Fernando*).

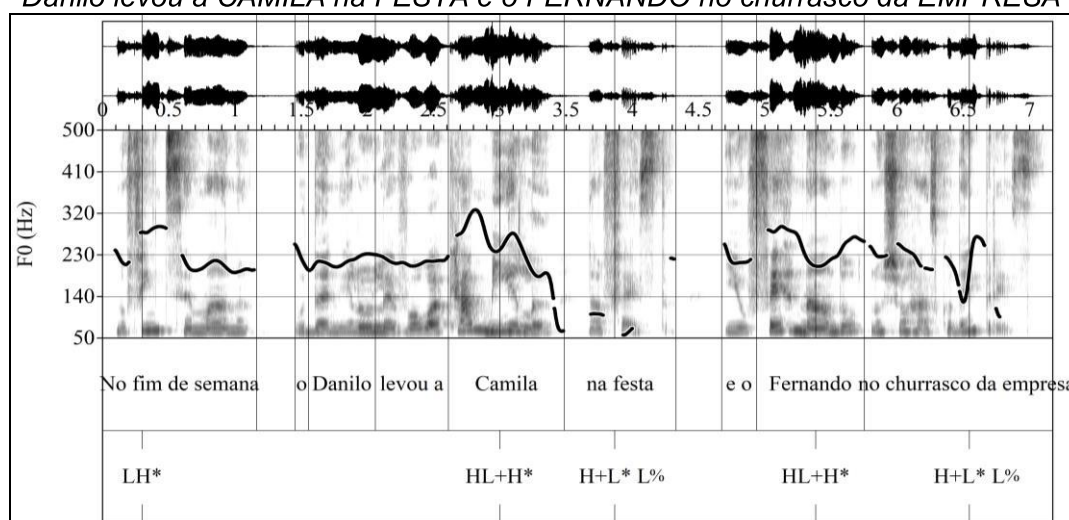
Figure 7 – Pitch track of Biasing Subject Prosody for the sentence “No fim de semana, o **DANILO** levou a Camila na FESTA e o **FERNANDO** no churrasco da EMPRESA”



Source: the author (2021).

In object biasing prosody (see Figure 8), the object DP of the first conjunct (*a Camila*) is in contrastive relation with the ambiguous DP (*o Fernando*) of the second conjunct. Both DPs present the same pitch accent type (HL+H*), a falling contour on the pre-nuclear syllable (HL) followed by a rise on the stressed syllable (H*). The parallel object DPs (*a Camila* and *o Fernando*) have similar F0 values (332Hz and 303Hz, respectively) and their pre-nuclear syllable is lengthened. The subject in the first conjunct (*o Danilo*) is deaccented and has an F0 value of 233Hz. The PPs of both conjuncts (*na festa* and *no churrasco da empresa*) are also contrasting with each other, signaled by the pitch accent H+L*. With regard to the boundaries, a low boundary tone (L%) occurs at the end of the first conjunct and at the end of the utterance.

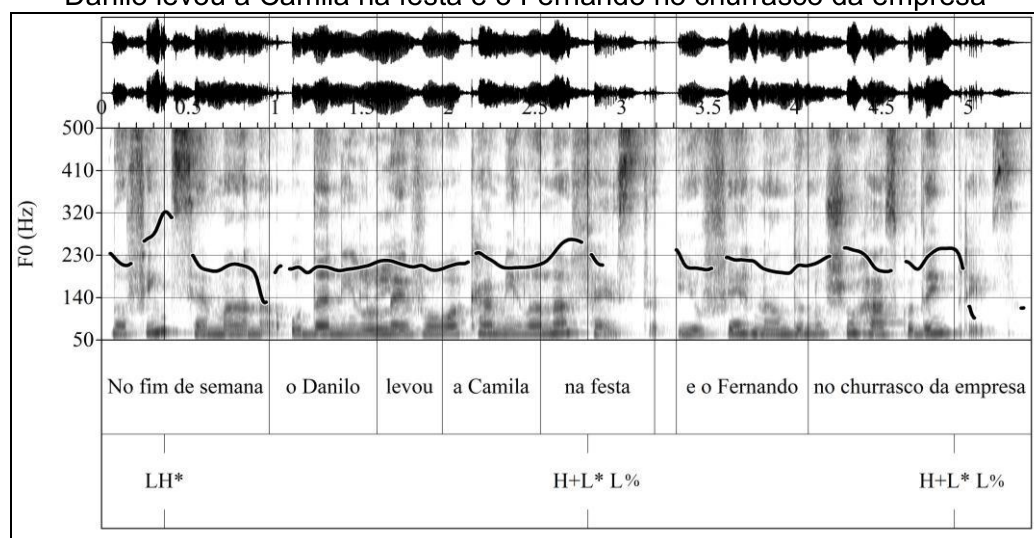
Figure 8 – Pitch track of Biasing Object Prosody for the sentence “No fim de semana, o Danilo levou a CAMILA na FESTA e o FERNANDO no churrasco da EMPRESA”



Source: the author (2021).

In one of the studies, a neutral prosody – named here baseline prosody – was also explored (see Figure 9). This kind of prosodic structure is compatible with both subject and object readings. The DPs are not focused and pitch accents (H+L*) are only found on the PPs *na festa* and *no churrasco da empresa*. A low boundary tone (L%) occurs at the end of the first conjunct and at the end of the utterance.

Figure 9 – Pitch track of Baseline Prosody for the sentence “No fim de semana, o Danilo levou a Camila na festa e o Fernando no churrasco da empresa”



Source: the author (2021).

One of the goals of the current study is to manipulate prosodic parallelism between DPs of the two conjuncts in potentially gapping sentences.

The aim of this manipulation is to verify if contrasting prosodically the ambiguous DP in the second conjunct with the intended correspondent in the first conjunct (subject or object) is possible to bias the interpretation of this DP towards a subject reading or an object reading.

2.4 Processing Ellipsis

In this section, the processing issues of the gapping sentences are discussed. Firstly, some general aspects of parsing ellipsis constructions will be given. After that, a report of the Garden-Path Theory (FRAZIER and FODOR, 1978; FRAZIER, 1979; FRAZIER and RAYNER, 1982) will be done. The section ends with the presentation of two hypotheses formulated by Carlson (2002) to account for the interpretation of globally ambiguous gapping sentences: Simple Structure Hypothesis and DP Parallelism Hypothesis.

Yoshida (2019) presents a summary of experimental studies on ellipsis and their evidence about the mechanism of online sentence processing. He argues that grammatical studies have shown three prominent aspects concerning the parsing of ellipses. The first aspect indicates that when an ellipsis construction becomes licensed, the ellipsis site normally has a salient linguistic antecedent material. The second aspect is kind of related to the first aspect; it states about the necessity of a certain parallelism relation between the ellipsis site and its antecedent. This means the ellipsis site is only licensed when it has a parallel antecedent. The third aspect is related to the fact that the ellipsis site is often licensed in a specific syntactic configuration. Therefore, to successfully comprehend sentences with ellipsis, the parser⁷ has to identify the ellipsis site, then find its correlate to recover the elided content of the ellipsis site by using the correlate as a reference.

The psycholinguistic studies have been concentrating on answering three questions concerning the online processing of elliptical constructions (SHAPIRO and colleagues, 1995, 2003, 2010; FRAZIER and CLIFTON 2000, 2005, 2006,

⁷ “It is an abstraction that refers to the cognitive mechanisms in people’s heads that carry out the syntactic analysis of a sentence” (GODFROID, 2020, p. 9).

DICKEY and BUNGER, 2011; YOSHIDA and colleagues, 2012, 2013; KAAN and colleagues, 2004, 2013 apud YOSHIDA, 2019):

- (a) What structure does the parser build in the ellipsis site, and how?
- (b) When does the parser recognize ellipsis?
- (c) Where does the parser find the antecedent of ellipsis?

With respect to question (a), the parser looks at the structure of the antecedent site in the first conjunct in order to infer and build the structure of the ellipsis site. The parser accesses the antecedent of an ellipsis when the ellipsis site is being processed. The parser is also sensitive to the structural details of the antecedent site. With regard to how this process happens, it has been argued that the parser builds the silent syntactic structure within the ellipsis sites by copying the structural and lexical details from the antecedent site.

In relation to question (b), it is argued that the parser recognizes the ellipsis site immediately when it finds a structure in which ellipsis can be grammatically licensed. By looking at ellipsis sites, it is possible to notice that they are compatible with both elliptical and non-elliptical syntactic structures. Thus, processing an ellipsis sentence, in many cases, involves resolving a kind of potential local ambiguity. The parser can employ two possible strategies to resolve it, a **delay strategy** or an **incremental strategy**. In the former, the parser does not decide immediately if an element is part of an elliptical structure or not, it waits until decisive bottom-up information becomes available. In the latter, the parser immediately decides if the element is part of an elliptical or non-elliptical structure, so it does not wait for later information. Most of the studies pointed by Yoshida (2019) have shown that the parser uses the incremental strategy when processing ellipsis constructions.

Regarding question (c), when processing ellipsis sentences successfully, the parser has to find an antecedent for the ellipsis site and decide what constituents are proper antecedents for the ellipsis site. Studies have shown that the parser looks for the antecedent in the position closest to the ellipsis site.

As for gapping constructions, there might be processing costs to parse such sentences because the processor obeys a local attachment bias (HARRIS

and CARLSON, 2016) with a preference for the structure which contains fewer nodes, what is compatible with the Minimal Attachment Principle (FRAZIER, 1987). On the other hand, the parallelism (semantic and prosodic, for instance) held among the conjuncts combined with biasing contexts might reduce the processing costs. These aspects will be explored in the current thesis. Studies have been consensual in arguing that a coordinated structure is processed more easily if the conjuncts are parallel to each other, but when they are not, the coordinated structure induces some processing cost (KIM *et al.*, 2020).

In a study that is concerned in exploring the processing of sentences, presenting the Garden-Path Theory (FRAZIER and FODOR, 1978; FRAZIER, 1979; FRAZIER and RAYNER, 1982) is of paramount importance. The processing model proposed by Frazier and Fodor (1978) predicts that human sentence parsing device assigns phrase structure to word strings in two steps. The first stage is called PPP (Preliminary Phrase Packager) or “Sausage Machine”, it consists in assigning lexical and phrasal nodes to groups of words within the lexical string that is received. In the second stage, the device called SSS (Sentence Structure Supervisor) combines the structured phrases into a complete phrase marker for the sentence by adding higher nonterminal nodes. The main motivation for a two-stage parser is the limited capacity of the working memory. A single-stage parser has to retain the phrase marker for the whole sentence; thus, the available computation space inevitably decreases as more and more of the lexical string is processed. On the other hand, in a two-stage parser, the first stage parser assigns a certain amount of low-level structure to a previously unstructured word string, whereas the second stage parser groups the resulting units into a complete sentence. Therefore, each stage handles roughly with the same number of units at the relevant level of structure.

One hallmark of the Garden-Path Theory is that a serial parser is assumed. It means that the parser chooses only one syntactic analysis compatible with the input for constructing the syntactic structure of a sentence. In case this analysis becomes impossible (the sentence is ambiguous, for instance), the parser must abandon this analysis and start again. The Garden-Path processing model is regulated by two-language universal processing strategies: *Minimal Attachment* and *Late Closure* (FRAZIER, 1979). These two

principles determine the initial decisions of the PPP on the structural relations between the syntactic nodes.

(28) **Minimal Attachment:** attach incoming material into the phrase-marker being constructed using the fewest nodes consistent with the well-formedness rules of the language under analysis. (FRAZIER, 1979, p. 24)

(29) **Late closure:** when possible, attach incoming material into the phrase or clause currently being parsed. (FRAZIER, 1979, p. 33)

The Minimal Attachment principle predicts that language users' parser prefers to construct the structure that is the least syntactically complex in terms of number of tree structure nodes. On the other hand, if two possible syntactic analyses of an ambiguous structure have the same number of nodes, the Late Closure principle comes into play. This principle predicts that an ambiguous phrase preferentially attaches to the phrase that is currently being processed, that is, to the most recent phrase (van GOMPEL, 2013).

Turning to the gapping sentences under study here, there are different ways of processing this structure type. As the second conjunct is a sequence of unconnected elements, little lexical and syntactic information is available to guide the processor in the construction of the sentence structure. Additional sources of information, such as parallelism, could be useful for the processor. Many studies have shown that coordinate structures, even those without ellipsis, are easier to interpret when the second clause is parallel to the first one (FRAZIER *et al.*, 1984; FRAZIER *et al.*, 2000; CARLSON, 2002), that is, if the second conjunct is similar to the first conjunct somehow. Therefore, parallelism between the incomplete clause and the complete clause can be helpful for the processor to interpret gapping sentences. As gapping sentences do not generally allow major syntactic differences between the clauses, parallels are more limited to the form of the DPs. With regard to the globally ambiguous gapping sentences, in which the conjoined DP can be understood as a subject

or as an object, the parallelism between DPs in both conjuncts could bias the interpretation of these sentences.

There are different ways of varying parallelism between the DPs in the conjoined clauses, through semantics or prosody, for instance. The parallelism of semantic cues can include definiteness (the article *a/an* vs. *the*), number (singular vs. plural), form (proper names vs. other noun phrase types), animacy (human vs. nonhuman), gender, and coherence within a field (e.g., nurse and doctor are both terms from medicine, and thus more parallel than nurse and engineer). The parallelism of prosodic aspects between the DPs can include pitch accent position, pitch accent type and pitch range; aforementioned in section 2.3.

Based on the importance of parallelism between the DPs in the processing, Carlson (2002) proposes the following hypothesis:

(30) **Parallelism Hypothesis (PH):** The processor favors analyses in which DPs that share internal properties (have similar syntactic, prosodic, and semantic features) share external properties (appear in similar structural positions within their respective clauses or phrases), and vice versa (CARLSON, 2002, p. 26).

The PH is also compatible with parallel models (ALTMANN and STEEDMAN, 1988), in which different sources of information are considered in parsing decisions. In this sense, the preference for syntactically simpler structures may be weighed against other aspects, the sentence processor can exploit semantic, prosodic or contextual features. The simplest syntactic analyses are still expected to be preferred by the parser, but non-syntactic sources of information might help to disambiguate towards a more syntactically complex structure (ENGELHARDT and FERREIRA, 2010; KAPS, 2020).

According to this PH, the interpretation of a potentially gapping sentence would depend on the similarities between the DPs in the different conjuncts. The ambiguous DP in the second conjunct could be similar to the subject or the object of the first conjunct. A parallel analysis would place it in the corresponding structural position. The gapping reading should be preferred

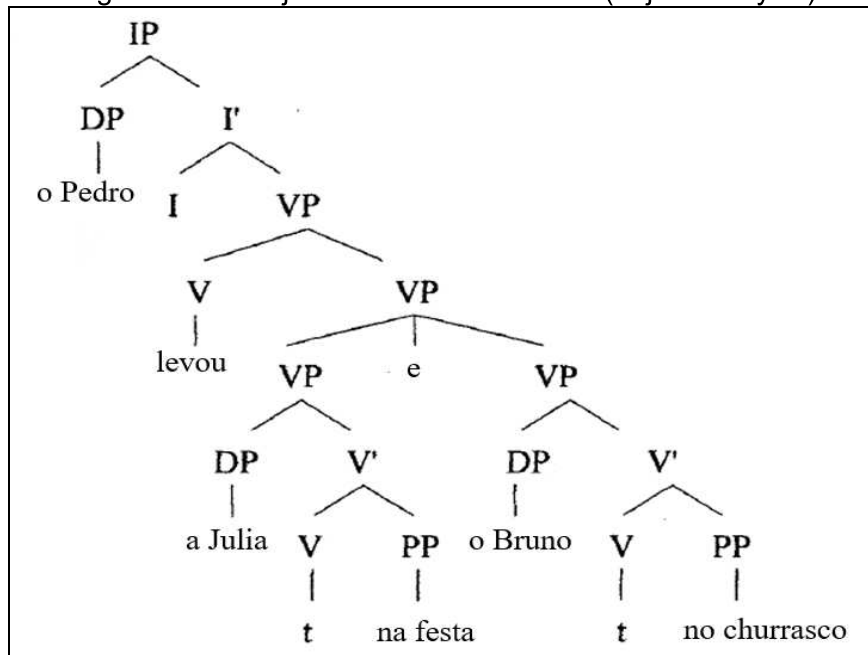
when the DP following the conjunction *and* is similar to the subject of the first conjunct, and not to the object. This hypothesis might also apply to unambiguous gapping sentences as well. In following this hypothesis, the conjunction reduction/nongapping sentences – the counterpart of gapping sentences – should also be easier to process when the DPs within the same VP are parallel to each other.

On the other hand, it might be the case that processing a gapping sentence or another conjoined sentence type is not entirely determined by the parallelism itself. Perhaps, the simplest structure, the one that involves less syntactic nodes, may determine the favored interpretation. This statement is expressed in the Simple Structure hypothesis, which is consistent with the Minimal Attachment principle predicted by the Garden-Path model. Thus, according to this hypothesis, the nongapping structure or the object reading of a potentially gapping sentence would be simpler than a gapping structure, since it involves less syntactic nodes, and thus it would be easier to process.

(31) **Simple Structure Hypothesis (SSH):** The simplest legitimate syntactic analysis of an input is preferred (CARLSON, 2002, p. 27).

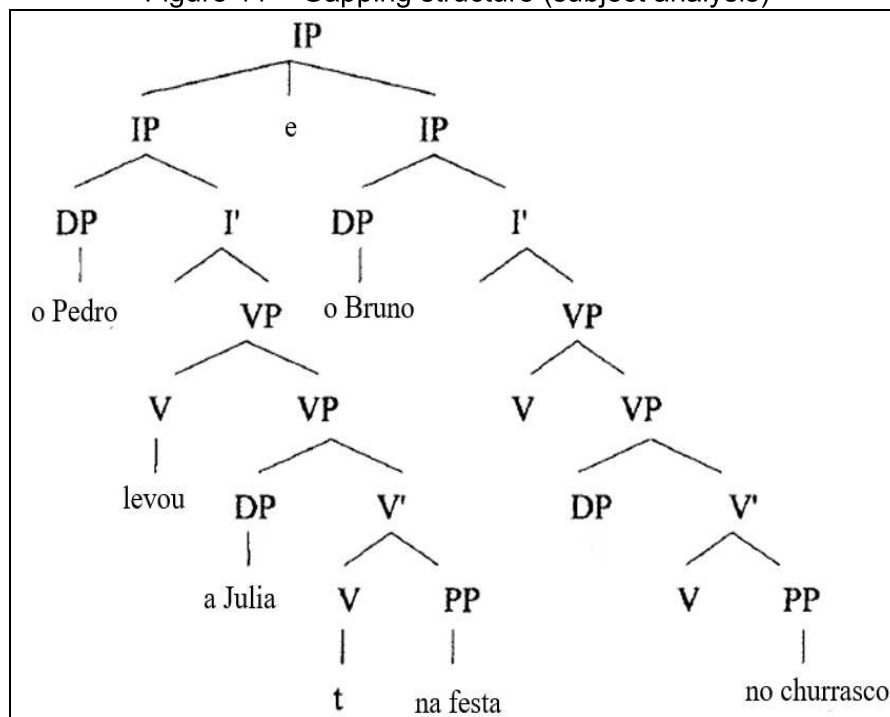
This hypothesis predicts that language users choose the smallest syntactic structure compatible with the input. For potentially gapping sentences, the simplest structure in terms of syntactic nodes is the object reading (nongapping structure or conjunction reduction structure), rather than the subject analysis (gapping structure). Thus, globally ambiguous gapping sentences would be biased towards an object interpretation. For an ambiguous sentence such as *O Pedro levou a Julia na festa e o Bruno no churrasco* (Pedro took Julia to the party and Bruno to the barbecue), an object analysis structure would appear as in (10) and a subject analysis would appear as in (11). The object analysis has less syntactic nodes than the subject analysis.

Figure 10 – Conjunct reduction structure (object analysis)



Source: the author (2021).

Figure 11 – Gapping structure (subject analysis)



Source: the author (2021).

Alternatively, it is possible that both the Parallelism Hypothesis and the Simple Structure Hypothesis (SSH) are at work in the interpretation of the sentences under study in this thesis. According to the Garden-Path Theory mentioned before, if both hypotheses take place in the interpretation of gapping

sentences, the simplest structure would be built first, and then immediately evaluated for parallelism. If evidence from parallelism contradicts with simple structure, reanalysis would take place and a more complex structure would be built (CARLSON, 2002).

This chapter intended to introduce the concept of ellipsis and characterize the gapping sentences, which are the object of study of this thesis. The syntactic and prosodic features of gapping sentences were covered. The relation between prosody and the processing of gapping sentences was also explored. Finally, key issues in the mechanism of online processing of ellipses in general, as well as the processing of gapping sentences, were also presented. In the next chapter, studies that had investigated the processing of gapping sentences in a psycholinguistics perspective will be introduced.

CHAPTER 3: Psycholinguistic Studies on Gapping Sentences

This chapter aims to introduce some previous studies on gapping sentences that used experimental methodology in Psycholinguistics. The first section brings the study that served as inspiration to this doctoral thesis. Carlson (2002) explored the role of lexical parallelism and prosodic parallelism in the processing of ambiguous English gapping sentences. The second section presents another study from Carlson *et al.* (2005), in which she investigated ambiguous gapping sentences with a different syntactic configuration; the remnant prepositional phrases (PPs) come preposed to the ambiguous DP in the second conjunct. In the third section, two studies by Kaan and colleagues (2004, 2013) are presented. The first study (2004) investigated the plausibility of the word that followed the gapped verb in English gapping sentences. The second study (2013) investigated the semantic and syntactic integration of the gapped verb in Dutch gapping sentences. The fourth section covers the study of Hoeks and colleagues (2009), which tested the influence of pragmatic and prosodic information in the processing of ambiguous Dutch gapping sentences. The last section presents a study by Kim and colleagues (2020), in which they tested lexical parallelism and grammatical constraints in the processing of English gapping sentences.

3.1 Carlson (2002): Parallelism and Prosody in Gapping Sentences

This work investigated the processing of ambiguous ellipsis sentences; conjoined sentences such as gapping, and non-conjoined sentences, such as comparative, replacive and stripping. The author explored lexical parallelism and prosodic parallelism between DPs in those sentences in order to study the influence of these features in the processing. The main interest of the current thesis is gapping sentences, thus only the findings for this structure will be reported. Carlson (2002) is of paramount importance here because it inspired this thesis.

The researcher explored the processing of gapping sentences in written and spoken studies, through offline and online experiments. Two offline experiments tested written gapping sentences: Written Gapping Questionnaire and Fill-in Questionnaire. Spoken sentences were tested in two offline experiments: Prosodic Parallelism Auditory Questionnaire and Context-rating and Naturalness Study. The online auditory processing of gapping sentences was tested in two Self-paced experiments.

The Written Questionnaire was designed to test the Parallelism hypothesis⁸ (PH) and the Simple Structure hypothesis⁹ (SSH); cf. section 2.4 of chapter 2 for more details. The activity consisted of an end-of-sentence judgment (the DP and the PP following the coordinate conjunction *and*). Stimuli were constructed according to the verb selection restrictions and the lexical parallelism between DPs. The sentences were based on three verb types: *Bake*, *Take* and *Introduce*. Five experimental conditions were elaborated:

(32) Sentence types in Written Questionnaire (CARLSON, 2002, p. 29)

- (a) **Bake A:** Alice bakes cakes for tourists and Caroline for her family.
- (b) **Bake B:** Alice bakes cakes for tourists and brownies for her family.
- (c) **Take A:** Josh visited the office during the vacation and Sarah during the week.
- (d) **Take B:** Josh visited Marjorie during the vacation and Sarah during the week.
- (e) **Introduce:** Dan amazed the judges with his talent and James with his musicality.

Verbs like *bake* usually have human subjects and non-human objects. Bake A example is more appropriate with a gapping reading, since *Caroline* is more subject-like rather than object-like. Post-*and* DP is parallel to the subject

⁸ The processor favors analyses in which DPs that share internal properties (have similar syntactic, prosodic, and semantic features) share external properties (appear in similar structural positions within their respective clauses or phrases), and vice versa. (CARLSON, 2002, p. 26)

⁹ The simplest legitimate syntactic analysis of an input is preferred. (CARLSON, 2002, p. 27)

of the first conjunct *Alice* in animacy. Bake B example can only have an object analysis because *brownies* is parallel just to the object DP *cakes* in the first conjunct; both are inanimate DPs. Verbs like *take* or *visit* can have human or non-human objects, so the ambiguous DP *Sarah* could be parallel in animacy to both the subject and the object in Take B example, or to the subject alone in Take A example. Verbs like *introduce* or *amaze* only take human arguments, so the ambiguous DP *James* is parallel in animacy to both the subject and the object in first conjuncts.

To summarize, sentences *Bake A*, *Take A*, and *Introduce* were constructed to present parallelism between only the first conjunct subject and the ambiguous DP. The ambiguous DP in a Bake A or Take A sentence was parallel in animacy, number, gender, definiteness to the subject, and not to the object; the ambiguous DP in Introduce sentence was parallel in animacy to both prior arguments, but parallel in number, gender and definiteness only to the subject. The Bake B and Take B sentences were designed to check the sentence biases in conditions of neutral or opposite parallelism. Bake B sentences had inanimate ambiguous DP parallel only to the object, not to the subject of the first conjunct; these sentences were implausible with gapping analysis. The Take B sentences were constructed with equal parallelism between the ambiguous DP and the first conjunct subject and object DPs.

The participants were asked to choose between two options (subject analysis or object analysis) the best paraphrase for the sentence read. They were given a space to write their own paraphrases in case they disliked both options. They were also asked to rate on a scale of 1-5 the difficulty in understanding the sentence, with 5 as hard. Additionally, they were asked to write other possible meanings the sentence might have. The table below summarize the results of the task:

Table 1 – Percentages of interpretive analysis of end-of-sentence and difficulty rate
(CARLSON, 2002, p. 34)

Verb Type	Subject Responses	Difficulty	Object Responses	Difficulty
<i>Bake A</i>	81%	2.43	19%	2.83
<i>Bake B</i>	3%	2.70	97%	1.91
<i>Take A</i>	40%	3.07	60%	2.47

<i>Take B</i>	4%	3.42	96%	2.11
<i>Introduce</i>	21%	2.45	79%	2.45

Source: adapted from Carlson (2002, p. 34).

The results show that sentences with the strongest subject-biased parallelism (Bake A and Take A) received more subject analysis responses than the sentences with weaker parallelism (Introduce), but only Bake A received overwhelmingly subject analysis responses (81%) due to extra pragmatic bias. The other two conditions, Take A and Introduce, presented subject analysis under 50%. In Take B condition, in which parallelism was not clear, participants preferred object analysis responses. Participants did not unanimously prefer the subject analysis or considered it easy to understand. The overall results suggest that parallelism and plausibility have a role to play in the interpretation of these sentences, but structural factors are more important. SSH was clearly at work in the pattern results of this experiment.

Carlson (2002) concluded that the results from the previous experiment show that different structural positions may have different expected values of features such as definiteness and animacy. That is, speakers tend to link definite, animate and human arguments to subject position rather than to object position. This was evidenced by the results for the sentence “*Josh visited the office during the vacation and Sarah during the week*”, which received more subject analysis responses (40%) than when the sentence had neutral parallelism, as in “*Josh visited Marjorie during the vacation and Sarah during the week*”.

The next experiment is a sentence completion activity which was designed to investigate whether the parallelism of features such as definiteness/animacy between the ambiguous DP and first conjunct DPs can affect completion choices. The first two conditions were based on the Bake A and B sentence types from the previous experiment. The other three conditions were based on the Introduce sentence type.

- (33) Sentence types in Fill-in Questionnaire (CARLSON, 2002, p. 38-39)
- (a) Emmy chopped mushrooms for the stir-fry and Bella _____

- (b) Emmy chopped mushrooms for the stir-fry and peaches _____
- (c) _____ John met a doctor at the café and Bill _____
- (d) John met a doctor at the café and a dentist _____
- (e) John met a doctor at the café and the dentist _____

Taking into account the PH, sentences (a) and (c) have subject lexical parallelism and should be completed using the ambiguous DP as a subject more often than sentences (b) and (d), with object lexical parallelism. That result is also compatible with the definite/animacy bias as sentences (a) and (c) present more subject-like arguments than conditions (b) and (d). Condition (e) will directly test the interaction between parallelism and definiteness. It presents all animate arguments, but the ambiguous DP is more similar to the object DP but more definite than it.

The sentences received different types of continuations, which were coded as whether the post-*and* DP was used as the subject of the second clause or as a conjoined object. The uses of the subject in a passive structure were also coded as subject interpretation. The results are summarized below:

Table 2 – Percentage of subject uses of ambiguous DP (CARLSON, 2002, p. 40)

Conditions	% Subject
a. Emmy chopped mushrooms for the stir-fry and Bella...	99
b. Emmy chopped mushrooms for the stir-fry and peaches...	12
c. John met a doctor at the café and Bill...	77
d. John met a doctor at the café and a dentist...	20
e. John met a doctor at the café and the dentist...	47

Source: adapted from Carlson (2002, p. 40).

Conditions (a) and (b), which had strong pragmatic biases, showed results compatible with the author's hypotheses. Condition (a) received 99% of continuations with the ambiguous DP as the subject of a new clause and condition (b) received only 12% of continuations using the ambiguous DP as a subject. The author explains that these 12% of subject responses comprises a large number of passive sentences, such as "*Mitch washed plates after the party and the silverware was done by Kathy*". In condition (c), the subject

parallelism and animacy led to a high rate of subject responses, 77%. Thus, the combination of parallelism and definiteness raises the rate of subject responses. In condition (d), the object parallelism and the indefiniteness of two DPs led to a low rate of subject responses, 20%; the lowest rate among the five conditions. In condition (e), partial lexical parallelism between DPs crossed with definiteness led to almost half of subject responses, 47%.

Overall results of this experiment revealed that participants were willing to produce both sentences with conjoined objects or with conjoined clauses. They also revealed that lexical parallelism and features of animacy and definiteness can influence speakers' syntactic choices of continuations. It seems that the interpretation of gapping sentences was based mainly on structural factors, since there was a preference for a simpler structure, the nongapping, except when this structure was anomalous (Bake A). Thus, the results support SSH, although speakers consider other types of information in interpreting these sentences. These results are compatible with a modular processing system, such as the Garden-Path model, in that the simple structure is first constructed, and then evaluated and re-analyzed, if necessary, in light of aspects such as context, semantics and parallelism. Evidence also points out that the processing of ellipses and other coordinate structures follows general principles of language processing, such as the SSH. However, the results also indicate that factors such as verb type and parallelism are important in interpreting gapping sentences, since there were significant differences between experimental sentences with different parallelisms between clauses.

Processing theory predicts that parallelism between DPs can affect the parser to some extent, as there is a preference for a simple structure compatible with the input. These experiments provided a first demonstration that parallelism operates as a facilitator in processing unambiguous conjoined sentences, and at the same time it has a complementary effect, predicted by the PH, of also biasing ambiguous sentences towards the interpretation that maximizes parallelism. Finally, to be effective, lexical parallelism requires the use of non-local information during parsing. In this sense, the processor must be able to compare the ambiguous DP to the subject DP and to the object DP of the first clause. This means that the characteristics (number, animacy,

definiteness etc.) of these arguments must be retained in working memory to be available when the ambiguous DP is encountered. Experiments that can evaluate the importance of each feature alone have not been proposed yet. Therefore, the combination of these characteristics in the reported experiments seems to have affected processing.

The two previous experiments explored written stimuli. Carlson (2002) also proposes experiments that aim to verify whether the results in written experiments can also be found in auditory studies. The reason for that was the possibility of gapping sentences being ambiguous only in the absence of prosody, thus the factors of lexical parallelism observed in the written studies might have less effect when presented auditorily. Another objective is to investigate the contribution of prosody in solving the ambiguity of these gapping sentences. In the other experiments, it was only possible to evaluate the impact of semantic and syntactic characteristics. If prosodic parallelism can influence the processing of gapping, this will show that the PH also extends to other linguistic levels, such as the phonological level. With respect to prosodic parallelism, the PH predicts that prosody may favor the argument position that will be attributed to the ambiguous DP.

With regard to the prosodic structure of potentially gapping sentences, three prosodic factors have been taken into account: location, choice, and range of the pitch accents (cf. section 2.3.2. of chapter 2). The author explored baseline prosody and cooperating prosodies (gapping and nongapping). A baseline prosody adds no prosodic bias to the sentence interpretation. The cooperating prosodies intend to bias one of the two interpretations through prosodic parallelism between DPs (cf. section 2.3.2. of chapter 2). In cooperating gapping prosody, the subject DP of the first conjunct and the post-*and* ambiguous DP are contrastive, that is, they are prosodically parallel to each other; the PPs of both conjuncts are also in contrastive relation. In cooperating nongapping prosody, the object DP of the first conjunct and the post-*and* ambiguous DP are prosodically parallel to each other; the PPs of both conjuncts are also in contrastive relation.

The experiment Prosodic Parallelism Auditory Questionnaire was designed to evaluate the role of prosodic parallelism and the influence of

structural simplicity on the auditory processing of potentially gapping sentences. The conditions were named *Cooperating Subject Prosody*, *Cooperating Object Prosody* and *Baseline Prosody*. The experimental sentences are those used in the written questionnaire. The *Take A* sentences were used in baseline condition, as they were considered the most ambiguous; 40% of subject analysis. The *Introduce* sentences were used for the cooperating conditions. Each sentence was produced with both types of cooperating prosody.

- (34) Sentence types in Experiment Prosodic Parallelism Auditory Questionnaire (Adapted from CARLSON, 2002, p. 56)
- (a) Cooperating Subject Prosody: Subject Accent (SA)
[BOB insulted the guests during DINNER] and [SAM during the DANCE]
 - (b) Cooperating Object Prosody: Object Accent (OA)
Bob insulted [the GUESTS during DINNER] and [SAM during the DANCE]
 - (c) Baseline Prosody
Josh visited the office during the vacation and Sarah during the week.

In the experiment, participants heard the sentences and then chose the best paraphrase for the sentence they had heard before. One paraphrase pointed to the subject interpretation and the other to the object interpretation.

The overall results of the auditory study support the results of the written questionnaire. The baseline condition worked as expected, subject response rates were 38%, a result similar to the written experiment (40%). The factors that produced the results of the written test (parallelism and structural simplicity) may have had the same effect on the auditory experiment. The results of the written questionnaire were not an artifact of the written language, since similar results were found with auditory stimuli. This means that there is no need of a special prosody for choosing a gapping interpretation. In the cooperating subject prosody, more gapping responses were found than in the cooperating

object prosody, 44% and 28% respectively. This indicates that participants were able to use prosodic parallelism between the ambiguous DP and the corresponding DP of the first clause to choose the final interpretation for the sentence. Not only boundaries, but also pitch accent parallelism and pitch range can be used in processing to bias different interpretations. However, even with cooperating subject prosody, the subject responses were not the most preferred; rates were under 50%.

These results suggest that there is not a specific prosody that favors only a gapping interpretation or one that favors only a nongapping interpretation. As in the written experiment, parallelism was not the determining factor in interpreting potentially gapping sentences, as the simplest syntactic structure remains preferred. Parallelism influences processing, but does not necessarily dictate the structural analysis. The results of this auditory experiment also show that there are no special mechanisms involved in ellipsis processing. Gapping sentences may be influenced by lexical and prosodic parallels, but SSH remains dominant in interpreting these sentences. Therefore, it can be concluded that, in general, the results of the auditory experiment confirm the results of the written questionnaire.

In the previous experiment, prosodic differences between conditions with cooperating prosody (subject and object accent) revealed that there were interpretive differences between them. However, the author inquired about the naturalness of the stimuli, as they were produced on the basis of the objectives of the task. During the record, the researcher was careful to maximize the contrasts between the elements under investigation, which may have affected the naturalness of the prosody of these sentences.

The experiment Context-Rating and Naturalness Study aimed to verify whether prosody of stimuli was artificial and, as a consequence, had affected the processing. The task was divided into two parts: (i) the potentially gapping sentences were rated for their felicitousness within context questions; (ii) the sentences were rated for their general naturalness given an intended meaning through the presentation of disambiguated (non-elided) versions for each experimental sentence.

For Part 1, two context questions were elaborated for each sentence of the experiment, one biasing the subject analysis and the other the object analysis. Participants read one of the two questions and then listened to a corresponding sentence, with prosody of subject or object. After hearing the sentence, the question reappeared on the computer screen. The participants ranked on a scale of 1-7 (with 7 considered good) if the sentence heard was a good answer to the question read.

(35) Part 1 of Experiment Context-Rating and Naturalness Study

Subject Question: How did Dan and James amaze the judges?

Object Question: How did Dan amaze the judges and James?

Dan impressed the judges with his talent and James with his musicality.

(Adapted from CARLSON, 2002, p. 65)

For Part 2, paraphrases were constructed with the possible interpretations for the potentially gapping sentences. Before each trial, the following sentence appeared on the computer screen: "*The sentence you will hear next should mean that...*". After that, the participant read one of the two paraphrases, gapping or nongapping, and then listened to the experimental sentence in one of the two prosodic versions (gapping or nongapping). The participants had to rank the naturalness of the sentence heard, according to the intended meaning, on a scale of 1-7 (7 being considered good).

(36) Part 2 of Experiment Context-Rating and Naturalness Study

Dan amazed the judges with his talent and James with his musicality.

Gapping Meaning: Dan and James amazed the judges in some way.

Nongapping Meaning: Dan amazed the judges and he also amazed James.

(Adapted from CARLSON, 2002, p. 65)

The results of scale 1-7 averages for parts 1 and 2 are summarized in the table below:

Table 3 – Naturalness/Felicitous Averages (CARLSON, 2002, p. 66)

	<i>Part 1</i>		<i>Part 2</i>	
	Subject Question	Object Question	Gapping Meaning	Nongapping Meaning
Subject Accent	5.1	4.8	4.2	5.0
Object Accent	3.8	5.0	4.0	5.0

Source: Carlson (2002, p. 66).

The results of Part 2 show that Nongapping Meaning conditions scored higher than Gapping Meaning conditions, regardless of the prosody. This indicates that the task could not test what was intended, because instead of testing the naturalness of both prosody types, it may have tested the naturalness of the meanings. It was not surprising that the object meaning was more favored, since in the other experiments the same occurred. What is surprising is that the prosodic differences had no effect.

The results of Part 1 had the most relevant effects. In general, there were slightly higher rates for Object Question condition than for Subject Question condition. On average, rates are higher for the subject accent than for the object accent. Subject accent was more preferred with the gapping context and object accent with the nongapping context. In general, both prosody types were accepted with the context of object interpretation, while the context of subject interpretation was not quite accepted with object prosody. Subject prosody was compatible with both contexts.

In summary, Carlson (2002) concludes that the results of Part 1 revealed an asymmetry between contexts and accents, since the accented subject was only well accepted with only one context. This can be explained by the fact that the accentuation of the subject in sentences is quite common, while the lack of this accent may sound odd to the hearer. Overall, the judgment scores were high, indicating that these sentences do not sound awkward to the hearers. The results of Part 2 showed a preference for the context of object interpretation.

What was unexpected about the results was that prosodic manipulation had no effect.

The four experiments reported so far have demonstrated a structural preference for the object analysis of potentially gapping sentences and the interpretative biases provided by two types of parallelism: lexical parallelism and prosodic parallelism. However, all of these experiments measured responses at the ends of sentences, i.e., they required responses from the participants after they had heard or read an entire sentence. The Fill-in Questionnaire did not involve any time-limits or measures of difficulty. Therefore, these tasks were unable to determine when different types of information are used in the online processing of ellipsis or in which part of the sentence difficulties may arise.

Taking these aspects into consideration, the researcher conducted two Self-paced listening (SPL) experiments to measure the time course of auditory processing. Experiments with this technique consist in presenting spoken inputs (words or phrases) segmented (RAYNER and CLIFTON, 2002). The listening pace is controlled by the participant by pressing a button. The experimenter is interested in how long it takes a subject to listen to the segments. Carlson (2002) modified the technique by breaking up the sentences into prosodic phrases rather than words. The segmentation into prosodic units was to eliminate some of the artificiality of the technique. It also allowed intended boundaries to emerge more clearly since the experimentally-needed pauses generally occurred where prosodic boundaries naturally occur.

The first SPL experiment was designed with two goals: (i) to verify whether only gapping sentences are sensitive to the parallelism effects in online processing, or other ellipsis types are also sensitive to parallelism; (ii) to find an online measure of auditory processing that can reveal interaction effects of lexical and prosodic parallelism and structural preferences. The experiment tested other ambiguous ellipses as control conditions, but only the results for gapping sentences will be reported. The example below shows the segmentation:

- (37) Robert insulted the guests during dinner / and Sam / during the
dance

Source: adapted from Carlson (2002, p. 70).

To explore the online effects of prosodic parallelism in a variety of structure types, stimuli were produced with subject accent and object accent prosodies. For gapping, it is expected a preference for object analysis due to the structural bias already observed in other experiments. As for lexical parallelism, only subject parallelism was used. However, this choice led to an asymmetrical experimental design: subject prosody was always compatible with lexical parallelism while object prosody was always conflicting. Prosodies were very similar to the cooperating prosodies used in the auditory experiment previously reported here.

Participants performed the task by pushing a button to play each segment. After hearing the entire sentence, a question appeared on the screen with two possible paraphrases as answers. The computer recorded the time measurement for each segment, as well as the answers chosen for the questions.

The overall results showed a preference for object analysis. The gapping sentences received more subject analysis with subject accent prosody (46%) than with object accent prosody (35%). With regard to the online measure (reaction time – RT), the main effect observed was in relation to sentences with object prosody, they presented higher RTs in the first two segments than sentences with subject prosody. A possible explanation for this is the unpreferredness of statements beginning with non-accented material, which is the case of object prosody sentences, the subject is not accented. Another possible explanation is the observed mismatch between prosody and lexical parallelism in the conditions; sentences with object prosody were always incompatible with lexical parallelism, whereas subject prosody only appeared with matching lexical parallelism. Given these factors, the author argues that it is not possible to draw conclusions about parallelism and structural information and online processing in this experiment.

Another SPL experiment was designed to distinguish the effects of prosody and parallelism in the processing of ellipses. This was not possible in the previous experiment due to the asymmetric conditions. To correct this problem, both prosody types were crossed with subject and object lexical parallelism. This resulted in four conditions with exactly the same words. To

eliminate the unnaturalness of object prosody, an adverb was included at the beginning of each sentence. Each adverb received a H* pitch accent followed by a L-. Both subject and object conditions began with pitch accents early in the utterance.

- (38) Sentence types for SPL experiment (CARLSON, 2002, p. 81)
- (a) Subject Accent, Subject Parallelism
Apparently, Morgan annoyed my mother at dinner / and David / at the movie
- (b) Subject Accent, Object Parallelism
Apparently, my mother annoyed Morgan at dinner / and David / at the movie
- (c) Object Accent, Subject Parallelism
Apparently, Morgan annoyed my mother at dinner / and David / at the movie
- (d) Object Accent, Object Parallelism
Apparently, my mother annoyed Morgan at dinner / and David / at the movie

The table presents the percentages of paraphrase choices with subject analysis:

Table 4 – Percentage of Subject Interpretations (CARLSON, 2002, p. 83)

% Subject	Subject Accent	Object Accent
Subject Parallelism	30	17
Object Parallelism	8	9

Source: adapted from Carlson (2002, p. 83).

Despite the low subject interpretation rates, the factors lexical parallelism and prosodic parallelism had effects. The highest percentage of subject interpretation was found in condition (a), which had the most bias of subject. Nonetheless, it was the lowest rate among the experiments. The researcher

believes that the presence of the adverb may have reduced the effect of pitch accent on the subject of the first sentence.

With regard to the response times (RTs), there was a marginal effect of the accent pattern after segment 2 (conjunction and ambiguous DP). The object accent conditions were slower than the subject accent conditions. This fact is intriguing because it was expected higher RTs in the conditions with a mismatch between lexical parallelism and prosody, conditions (b) and (c). What happened instead was a dispreference for object accent prosody regardless of lexical parallelism. For the author, this suggests that some aspect of prosody was noticed early in processing, but this effect it is not due to the interaction with lexical parallelism. Nor would it be an effect of structural preference, since the favored structure is more consistent with object accent prosody, which has been dispreferred. One explanation for this effect would be the intrinsic properties of the ambiguous DP. This DP is always human and definite in both SPL experiments. It is possible that the prosodic effect in this segment is due to local information, i.e., subject-like properties are noticed and subject accent prosody is favored. At this point in processing, it is still possible for a verb to follow this DP. When it does not, the processor may find that object analysis is more salient because of the simplicity of the structure, which would explain why these sentences receive far less subject analysis, despite the early preference for this analysis.

In segment 3, there was an interaction of prosody and lexical parallelism, which is reflected in faster RTs for conditions with prosody and lexical parallelism compatible, conditions (a) and (d). It makes sense that processing is faster when lexical and prosodic parallelism point to the same direction. Processing is slower when different types of information point to differing analyses, since the processor will need to evaluate which information has the most weight.

The two SPL experiments left many questions about the time course of auditory processing unanswered. The major problem is to sort out what possible types of information are affecting the RTs at a particular segment.

To summarize this section, the experiments reported here arose some relevant generalizations about the processing of gapping sentences in English.

First, the results found in written language were also found in spoken language, so gapping sentences are similarly ambiguous in both modalities. Second, there is no need of a special prosody for the gapping analysis to be chosen, it can also be chosen with a baseline prosody, depending on the bias present in the sentence. Only the presence of a prosodic boundary cannot disambiguate these sentences, since similar boundaries were present in all prosodic conditions. Parallelism of pitch accent type, range and location along with lexical parallelism can bias sentence interpretation. Finally, the properties of DPs in first clause are clearly relevant to the processing of the ambiguous DP and must be available for comparison over a potential clause boundary and an ip or an IPh boundary.

One of the aspects that might contribute for the processing difficulties and the dispreference of subject reading in globally ambiguous gapping sentences is the absence of context. The experiments reported here presented the gapping sentences isolated from a context. The study by Hoeks *et al.* (2009), for instance, support the necessity of context combined with parallelism of language features (lexical and prosodic); this study will be presented on section 3.4 of this chapter. Context, in addition to lexical and prosodic parallelism, can make the gapping reading as easy as the nongapping reading.

Another problem might be the type of experimental paradigm used, the SPL. Rayner and Clifton (2006) argue that a problem with this type of paradigm is the artificiality it imposes to the sentences; it does not mimic natural spoken language. It takes more time to listen to a whole sentence by pressing buttons manually than to listen to it at once. The participants might even develop some interpretation strategies due to the slowness of the task.

Therefore, by taking into account contextual aspects in addition to prosodic and lexical cues; and also developing experiments using techniques that are more accurate in relation to time-course, might provide deepen insights on the cognitive processes involved in the interpretation of ambiguous gapping structures. In the current thesis, eye-tracking studies exploring written and spoken sentences are conducted. Contextual cues are also manipulated in an eye-tracking reading experiment, and in a sentence-picture matching task designed for a cross-language study spoken gapping sentences in BP and in

AE. We intend to find out if a biasing context combined with prosodic parallelism can make gapping the most preferred analysis in AE and in BP.

3.2 Carlson *et al.* (2005): Gapping and Structural Economy

In this study, the authors explore the processing of ambiguous English gapping sentences, in which one of the remnants is a preposed PP, such as in the example below:

(39) At Marshall Field's, Melissa saw a classmate, and at J.C. Penney's, Sabrina.

(a) Subject reading: Sabrina also saw a classmate.

(b) Object reading: Melissa also saw Sabrina.

Source: adapted from Carlson *et al.* (2005, p. 2010).

In this sentence, the locative remnant PP *at J.C. Penney's* is preposed to the ambiguous remnant DP *Sabrina*, which can be interpreted as a subject or as an object; the subject and the object readings are paraphrased in (39a) and (39b), respectively. Globally ambiguous gapping sentences show a strong preference for an object reading due to the structural economy¹⁰, already observed in Carlson (2002). However, the preposed remnant PP might weaken this object reading preference. The argument for that is the assumption that preposed temporal and locative PPs tend to adjoin to clausal projections rather than to VPs. These kinds of adverbials tend to appear to the left of material like *wh*-phrases, topicalized and left-dislocated phrases. Therefore, the preposed PP in sentence (39) would indicate that in the second conjunct there is a clausal structure.

Two studies were conducted, a written questionnaire and an auditory questionnaire. The former aimed to verify what analysis of the ambiguous sentences was preferred in the absence of prosody. The latter experiment tested the influence of prosodic manipulations in the resolution of the ambiguity.

¹⁰ The object analysis of globally ambiguous gapping sentences involves less structure and fewer derivational steps (CARLSON *et al.*, 2005, p. 2013).

The written questionnaire involved a forced-choice task. After reading the experimental sentence, the participant had to choose, between two options, the paraphrase the best fitted their understanding of the sentence. One paraphrase was consistent with the subject reading and the other with the object reading.

(40) At Marshall Field's, Melissa saw a classmate, and at J.C. Penney's, Sabrina.

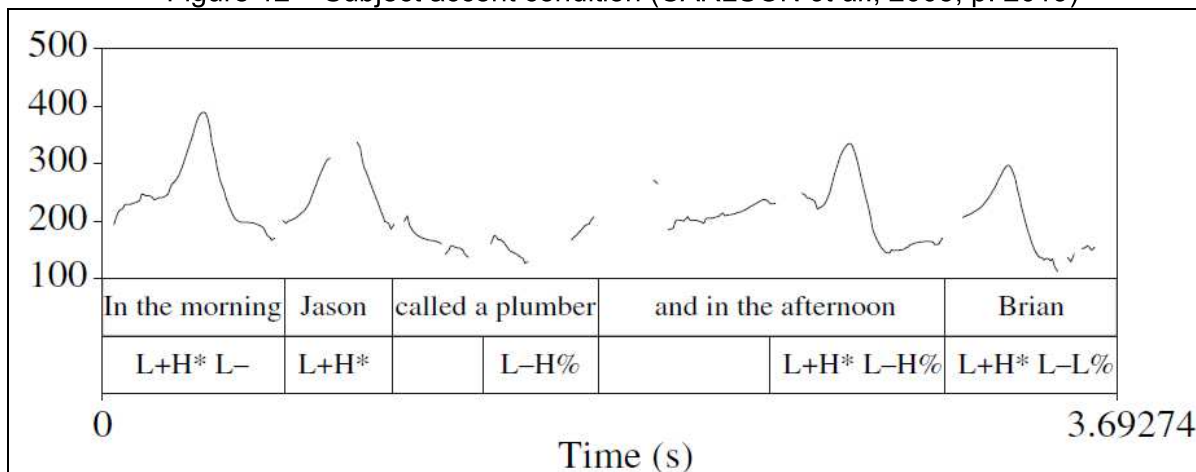
(a) Subject paraphrase: Sabrina saw a classmate at J.C. Penney's.

(b) Object paraphrase: Melissa saw Sabrina at J.C. Penney's.

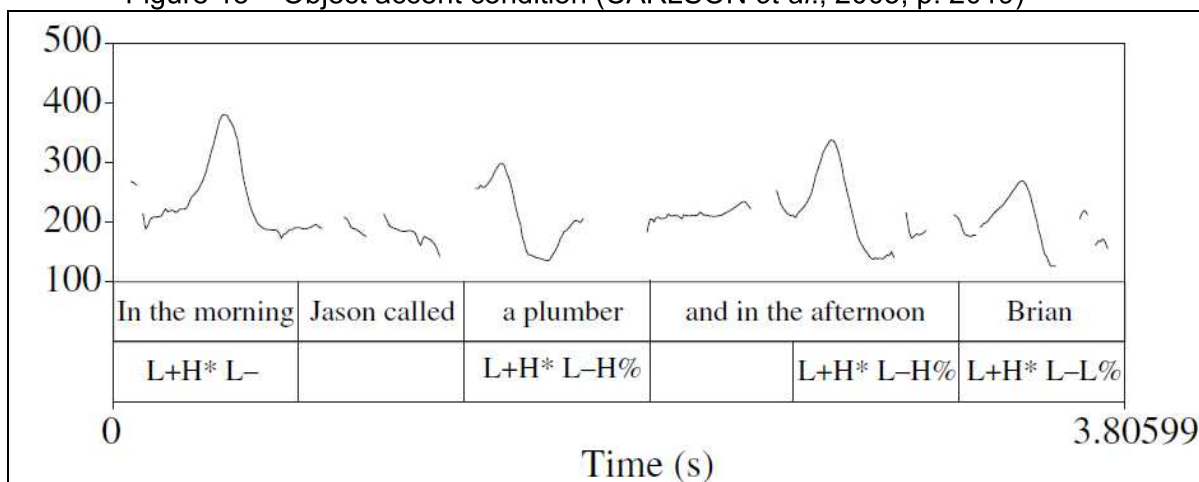
Source: adapted from Carlson *et al.* (2005, p. 2017).

Sixteen trials such as (40) were shown to participants. The results indicated that 36% of subject responses were given to these ambiguous sentences, which pointed to a strong object preference despite the presence of the preposed remnant PP. The authors argue that the results of this experiment revealed that the subject interpretation was slightly more attractive in this syntactic configuration in comparison to the findings in Carlson (2002). Gapping sentences without preposed PPs received only 20% of subject responses in the written questionnaire; c.f. section 3.1. for more details. In sum, although the structural factor does not favor the object analysis, the subject responses still remained under 50%.

Taking into account the findings from the written questionnaire, the authors designed a second experiment to test whether these ambiguous sentences would be more affected by prosodic manipulations. The same sentences from the previous experiment were recorded in two prosodic versions, subject accent prosody and object accent prosody. In the first version, the first-clause subject was accented (Figure 12) with L+H* contrastive accent, and in the other version, the object was accented (Figure 13). The ambiguous remnant DP and the preposed PP were both accented in the two prosodic versions.

Figure 12 – Subject accent condition (CARLSON *et al.*, 2005, p. 2019)

Source: Carlson (2005, p. 2019)

Figure 13 – Object accent condition (CARLSON *et al.*, 2005, p. 2019)

Source: Carlson (2005, p. 2019)

This auditory questionnaire also involved a forced-choice task; the paraphrases were the same from the written questionnaire. The participants heard a sentence in one of the prosodic versions, and then chose the paraphrase for the comprehension question; see (40) for an instance. Differently from the written questionnaire, the results of the auditory study showed more subject interpretations with the subject accent prosody (60%) than with the object accent prosody (14%). In Carlson (2002), subject accent prosody in globally ambiguous gapping sentences received only 33% of subject responses. The authors point that it seems gapping sentences without preposed PPs, such as in Carlson (2002), are less mobile in response to prosodic manipulations than when these sentences have a preposed PP.

The gapping sentences seem to be affected by a structural bias somehow, indicated by a considerable rate of object responses in the subject accent condition (40%). However, the auditory study revealed that the combination of a preposed PP and the accent on the first-clause subject is able to significantly weaken the object bias that stands in gapping sentences.

3.3 Kaan *et al.* (2006, 2013): Gapping and ERPs

The two studies conducted by Kaan and colleagues (2006 and 2013) used event related potentials (ERPs) to explore the time course processing of gapping sentences. The first study focusses on the plausibility of the word that follows the gapped verb and how it affects the time course of identification and resolution of the gap in English gapping sentences. The second study explores the time course in the processing of gapped verbs in Dutch gapping sentences, by comparing gapping sentences with nongapping sentences.

The ERPs comprise “the changes in the electrical patterns of the brain that are associated with the processing of various kinds of linguistic stimuli” (FERNANDEZ and CAIRNS, 2010, p. 89). With this type of technique, it is possible to measure electrical activity in the brain while stimuli are being presented to participants. The ERPs unfold as a series of positive and negative peaks (KUTAS *et al.*, 2006). The brain is sensitive to linguistic anomalies and this is shown through different electrical responses. Two linguistic-related components are widely known in language processing studies, the N400 and the P600. The N400 component is related to the processing of semantic-pragmatic information and is sensitive to semantic anomalies. The P600 component is related to the processing of syntactic information and is sensitive to syntactic violations. The N400 component shows a negative peak voltage that appears around 400ms after the onset of a particular stimulus, while the P600 component shows a positive peak voltage that appears between 600ms and 1000ms (FERNANDEZ and CAIRNS, 2010).

The first study (2004) aimed to use ERPs to explore the time course of identification and resolution of the gapped verb in English gapping sentences. More specifically, the authors intended to investigate when during processing

the gapped verb is detected and the omitted information in the second conjunct is recovered. The plausibility of the word that follows the gapped verb in the second conjunct was manipulated in order to determine if there is reconstruction or re-activation of verb information in the second conjunct. In one condition, the critical word was plausible and in the other condition it was implausible (the critical words are underlined in the examples):

(41) **Plausible gapping condition**

Jane ordered a coffee with cream, and Bill a sandwich with cheese.

(42) **Implausible gapping condition**

Jane drank a coffee with cream, and Bill a sandwich with cheese.

Source: adapted from Kaan *et al.* (2004, p. 590).

In the (41) condition, the noun *sandwich* is a plausible direct object for the verb *order*, thus this verb can be gapped in the second conjunct. On the other hand, in (42) condition the same noun is an incompatible object for the verb *drink*, then the second conjunct is an infelicitous gapped clause. The authors expected to find an N400 effect at the critical word (*a sandwich*) of the implausible condition if the gapped verb has already been identified by the time this critical word is processed. The N400 effect is understood as a reflection of difficulty to integrate the meaning of the critical word into the preceding context. If the effect is found, it will indicate that the information of the elided verb was reconstructed at or before the critical word.

Thirty-two sentences were presented to the participants, half of each condition. The written sentences were presented to them word by word, while the electroencephalogram (EEG) recorded their brain activity. After reading each experimental sentence, the participants had also to judge them for semantic and syntactic acceptability by determining if they were good or bad sentences.

With regard to the behavioral data, the participants correctly judged the plausible items as 'acceptable' in 92% of the time, and the implausible ones as 'unacceptable' in 96% of the time. The critical points of measure were the determiner and the noun after the gapped verb. The ERP results to the

plausibility manipulation after the gapped verb revealed an N400 effect followed by a positivity P600 on the critical word (*sandwich*) of the implausible condition. This finding suggests that the processor tries to integrate the critical word with the gapped verb, thus the information associated with this verb is available at this moment. In the implausible condition, this attempt leads to semantic integration difficulty (N400 effect) and a syntactic reanalysis is necessary (P600 effect). The ERPs on the determiners following the gapped verb were also analyzed in comparison to a general ERP response to determiners after overt verbs in other sentence types. There was an increased negativity on the determiners following a gapped verb in comparison to the determiners in post-verbal positions in sentences that did not involve elision. This finding suggests that the processor experiences a phrase structure violation, what implicates that a syntactic structure is being constructed for the second conjunct, even in the absence of an overtly pronounced verb.

The authors concluded that the ERP results found in the study demonstrate that the position of the ellipsis site is detected at the first opportunity and the omitted information is retrieved immediately, which is at the first word position after the ellipsis site. They also point that the retrieval process of the elided information is mediated by syntactic persistence, evidenced by the results in the implausible condition.

The second study by Kaan and colleagues (2013) revisited the investigation on the time course processing of gapped verbs in reading; this time with Dutch sentences. The study aimed to find out when the ellipsis site in gapping constructions is detected and when the gapped verb information is retrieved and integrated to the structure. One aspect of the previous study (2004) is that it did not directly compare gapping conditions to well-matched conditions without gapping. Therefore, the authors decided to compare sentences with and without gapping in their structure. The choice for testing Dutch sentences was because in this language the verb comes in the second position in main clauses, but appears at the end of the clause in subordinate clauses. Thus, a closer comparison between gapping and non-gapped coordinated sentences would be possible because only coordinated main

clauses allow gapping to occur. Four conditions were constructed (the underscore shows the ellipsis site):

(43) Experimental conditions in ERP study (KAAN *et al.*, 2013, p. 309)

(a) **Verb Gapping, Plausible**

*Anouk zond de kaart aan haar vader, en Julia ___ **de bloemen** aan haar moeder*

Anouk sent the card to her father, and Julia ___ the flowers to her mother.

(b) **Verb Gapping, Implausible**

*Anouk schreef de kaart aan haar vader, en Julia ___ **de bloemen** aan haar moeder*

Anouk wrote the card to her father, and Julia ___ the flowers to her mother.

(c) **No Gapping, Plausible**

*Anouk zond de kaart aan haar vader, terwijl Julia **de bloemen** aan haar moeder stuurde.*

Anouk sent the card to her father, while Julia shipped the flowers to her mother.

(d) **No Gapping, control for b**

*Anouk schreef de kaart aan haar vader, terwijl Julia **de bloemen** aan haar moeder stuurde.*

Anouk wrote the card to her father, while Julia shipped the flowers to her mother.

In conditions (43a) and (43b), the first position where it is clear that the verb has been gapped is at the determiner (**de** / the). In the first condition (43a), the DP *the flowers* (*bloemen*) is a plausible direct object for the verb *sent* (*zond*), while in the second condition (43b) it is not a plausible direct object for the verb *wrote* (*schreef*). In conditions (43c) and (43d), the second conjunct is a

subordinate clause, so the finite verb has to come at the end of the clause (*stuurde / shipped*). Thus, they serve as nongapping control conditions.

In this study, the authors aimed to test two hypotheses about the processing of ellipsis, a top-down approach and a bottom-up approach. The former approach predicts that “an ellipsis site is anticipated before it is clear that information has been elided” (KAAN *et al.*, 2013, p. 308). According to the top-down approach, considering that both conjuncts are parallel, when the processor finds the coordinating connective, some information from the first conjunct could be reactivated before the ellipsis site is encountered. The latter approach predicts that “the ellipsis site is not anticipated but inferred only when words or phrases are “missing” from the input” (KAAN *et al.*, 2013, p. 308). Thus, according to the bottom-up approach, the antecedent is reactivated only when it is clear for the processor that some information has been elided. These two approaches are similar to the incremental strategy and the delay strategy, respectively (cf. section 2.4., Chapter 2).

The authors predicted that if the ellipsis site is detected bottom-up, a LAN (left anterior negativity) effect is expected at the determiner for gapping conditions (43a and 43b) in comparison to nongapping conditions (43c and 43d). The LAN effect is associated with the presence of later semantic and syntactic integration effects; this effect is compatible with a bottom-up approach. On the other hand, if the elided information is semantically and syntactically integrated with the verb immediately in a top-down approach, they expect to find an N400 effect for the implausible gapping condition (43b) versus plausible gapping condition (43a), and perhaps a P600 effect at the noun *flowers* (*bloemen*) following the determiner *the*. With regard to the comparison between gapping conditions and nongapping conditions, they argued that if syntactic integration is more effortful in gapping (43a and 43b) than in nongapping (43c and 43d), they expect a P600 effect for gapping versus nongapping constructions at the noun.

The procedures of the experiment were similar to the previous study (2004). With regard to the semantic and syntactic acceptability of the sentences, participants judged accurately the plausible conditions (43a) and (43c) 90.1% and 88.9% of the time, respectively. The implausible conditions

(43b) and (43d) were accurately judged 88.7% and 91.1% of the time, respectively.

The critical points of measure were the determiner and the noun (*the flowers/de bloemen*). No ERP effects were found out at the determiner (*the/de*) of the four conditions. Only the participants who did not perform accurately at the judgment task showed a LAN effect rather late (between 400–700ms) for gapping versus nongapping conditions at the determiner. This finding suggests that the processing of gapping was subject to individual variation. The authors point that a sequence of proper noun followed by a determiner is more frequent in Dutch than in English. Therefore, it is possible that the determiner has not been interpreted as a phrase structure violation in the present study, as observed for the English gapping sentences tested by Kaan *et al.* (2004). With regard to the noun, no N400 effect was found for the implausible conditions in comparison to plausible gapping condition, and neither in the comparison with their nongapping versions. The ERP results on the noun showed a P600 effect between 700ms and 900ms in the comparison between gapping and nongapping conditions. The authors understood this finding as an indication that the elided information is retrieved at or before the noun (critic word) and is integrated into the structure of gapping sentences.

In sum, Kaan and colleagues concluded that some of the participants did not anticipate the missing verb, but inferred this gapped verb in a bottom-up approach, which was shown by the LAN effect. Additionally, the P600 effect found for gapping conditions in comparison to nongapping conditions was not affected by plausibility. They understood that this finding suggests a late process of semantic and syntactic integration of the missing verb into the structure.

3.4 Hoeks *et al.* (2009): Gapping, Prosody and Context

This work tested gapping sentences in Dutch. The authors argue that prosodic parallelism along with the presentation of a pragmatic context can reduce the dispreference for the subject analysis of potentially gapping sentences already seen in Carlson (2002). The authors pointed out that the

context is very important because it usually determines the topic of the sentence (i.e., the thing the utterance provides information about), which is usually the subject of the sentence. Speakers tend to process easily utterances that present a single topic, unless contextual or prosodic cues suggest otherwise. A gapping sentence is predicted to lead to processing difficulties because it presents two contrastive topics, for instance “*Bob [Topic1] met David yesterday and James [Topic2] today*”. In addition to that, gapping sentences are also syntactically more complex than nongapping sentences (conjunction reduction) in terms of nodes of the respective syntactic trees. Therefore, the authors argue that a preceding context could prepare the way for a sentence with two topics, and then processing difficulties could decrease.

In an offline speeded auditory decision experiment, they manipulated context and prosody in globally ambiguous gapping sentences. The context biased the possible topics (i.e., one subject or two subjects) of the target sentences. This experiment was designed to verify if it is possible to make gapping reading the preferred interpretation of an ambiguous structure containing ellipsis. There were two prosodic and two context question types, one consistent with gapping and the other with nongapping. Four conditions were designed by crossing prosody and context. In two conditions, context and prosody pointed to the same interpretation: gapping or nongapping. In the other two conditions, there was a mismatch between context and prosody, that is, they pointed to different interpretations. Examples of the experimental materials are given as follows:

(44) Materials of Speeded Auditory Experiment 1 (HOEKS *et al.* 2009, p. 224-225)

(a) Gapping Context, Gapping Prosody

Context: Wilma has bought a new house. What did Nathan and Tessa help her with?

Target: NATHAN helped Wilma with PAINTING and TESSA with WALLPAPERING.

Verification Statement (Gapping): Tessa helped Wilma.

- (b) Gapping Context, Nongapping Prosody
Context: Wilma has bought a new house. What did Nathan and Tessa help her with?
Target: Nathan helped WILMA with PAINTING and TESSA with WALLPAPERING.
 Verification Statement (Gapping): Tessa helped Wilma.
- (c) Nongapping Context, Gapping Prosody
Context: Wilma and Tessa have each bought a new house. What did Nathan help them with?
Target: NATHAN helped Wilma with PAINTING and TESSA with WALLPAPERING.
 Verification Statement (Gapping): Tessa helped Wilma.
- (d) Nongapping Context, Nongapping Prosody
Context: Wilma and Tessa have each bought a new house. What did Nathan help them with?
Target: Nathan helped WILMA with PAINTING and TESSA with WALLPAPERING.
 Verification Statement (Gapping): Tessa helped Wilma.

Pragmatic contexts consisted of statement sentences followed by a direct question. The contexts served three objectives: (i) they suggest the most likely topics for the ambiguous elliptical sentence (i.e., there are two topics when the biased interpretation is the gapping reading, and one topic when the biasing interpretation is the nongapping reading); 2) they suggest the most likely focus for the ambiguous sentence by asking for a time, a location, an instrument, etc.; 3) they also provide background information on the nature of the event ('to help'), and on the patient associated with the event ('Wilma'), so the combined information ('Wilma was helped') can be considered 'given' information that can be elided in the gapping interpretation of the ambiguous sentence. Prosody also plays a role in the interpretation of gapping sentences, as seen in Carlson (2002). Prosodic parallelism between DPs in the two clauses helps to bias one

of the two interpretations. The accented elements are in capital letters in the examples above.

In the task, participants listened to the pragmatic contexts, spoken by a male speaker. After that, the target sentence was played, spoken by a female speaker. The verification statement (male speaker again) was played subsequently, and participants had to indicate if the verification statement corresponded to the statement (i.e., the target sentence) made by the female speaker. The responses were 'yes' or 'no'; positive responses were always compatible with the gapping reading, and negative responses compatible with the nongapping reading. Participants were also encouraged to respond as fast as they could.

The proportion results of gapping responses showed that when both context and prosody pointed towards the gapping interpretation, condition (44a), participants answered 'yes' to verification statements almost 60% of the time. When context points to gapping but prosody to nongapping, condition (44b), 'yes' responses were given around 40% of the time. With regard to the nongapping conditions, when context points to nongapping but prosody to gapping, condition (44c), 'yes' responses were around 20%; when both context and prosody point towards the nongapping reading, condition (44d), 'yes' responses were less than 10%.

The results of decision times showed that participants were faster in giving 'yes' responses when both context and prosody pointed towards the gapping interpretation, condition (44a), they took on average 2431ms to give the positive answer to the gapping interpretation. In condition (44b), in which context points to gapping and prosody to nongapping, they were slightly slower, on average 2677ms. The nongapping conditions had the slowest RTs, especially condition (44d), in which both context and prosody contradicts the gapping reading.

This experiment had very interesting results, suggesting that given the right context and the right prosody, participants choose gapping interpretation most of the time. The results also indicate that even if structural factors were to play a role in resolving ambiguous ellipsis, they can be overcome by the right combination of pragmatic and prosodic information. Prosody and context both

have independent contributions to the processing of gapping sentences. The effect of prosody in promoting gapping responses was significant in both the gapping and the nongapping contexts. However, when context and prosody point towards different directions, context has more influence in the decision. Pragmatic context outweighs prosody in the processing of gapping, so in combination these factors are strong enough to reduce the strong preference for nongapping reading.

The authors conducted a second experiment in order to explore the online processing. It was the same type of experiment, a speeded auditory decision experiment, but with an extra task to probe online processing: a cross-modal gender decision. In order to find out if there are differences in online processing between gapping and nongapping sentences, visual probes (proper nouns) were presented near the end of the sentence to estimate the easiness of processing associated with gapping. Participants had to decide quickly if the probe was a girl's or a boy's name. Visual probes were of two kinds, identical or control. The control probe was constructed to bear superficial phonological resemblance with the identity probe.

For practical reasons, only three conditions of the previous experiment were considered for this task. They obtained six conditions in total by crossing the previous three conditions with the factor probe type (identical vs. control).

(45) Materials of Speeded Auditory Experiment 2 (HOEKS *et al.* 2009, p. 231)

(a) Gapping Context, Gapping Prosody

Context: Wilma has bought a new house. What did Nathan and Tessa help her with?

Target: NATHAN helped Wilma with PAINTING and TESSA with <Wilma/Willem> WALLPAPERING.

Verification Statement (Gapping): Tessa helped Wilma.

(b) Gapping Context, Nongapping Prosody

Context: Wilma has bought a new house. What did Nathan and Tessa help her with?

Target: Nathan helped WILMA with PAINTING and TESSA with <Wilma/Willem> WALLPAPERING.

Verification Statement (Gapping): Tessa helped Wilma.

(c) Nongapping Context, Nongapping Prosody

Context: Wilma and Tessa have each bought a new house. What did Nathan help them with?

Target: Nathan helped WILMA with PAINTING and TESSA with <Wilma/Willem> WALLPAPERING.

Verification Statement (Gapping): Tessa helped Wilma.

Sentences such as those in (45) are globally ambiguous, that is, there are no contextual or semantic cues present in their structure that indicate which is the correct interpretation of the sentence. Presenting a strong linguistic context prior to the target sentence might make listeners reluctant to choose the nongapping reading, but it does not make gapping necessary, at least not from the start. Only when participants get to the second preposition (i.e., the 'with' of 'with wallpapering') it is clear that they are dealing with a gapping sentence. If gapping is understood immediately, this would mean that from that point onwards, the elided material ('helped Wilma') is presumably reactivated somehow. It is believed that the concepts denoted by 'helped' and by 'Wilma' are strongly activated at that point in the utterance. On the other hand, when listeners choose the nongapping interpretation, there would be no reason to assume that the concept associated with 'Wilma' is activated at the second preposition, at least not to the same degree as in the gapping interpretation. Therefore, the probe visuals are going to be explored in order to find out whether or not the concept of 'Wilma' is activated. For the identity probe, faster recognition in conditions with a predominant gapping response is expected as compared to conditions where nongapping is the predominant response. The recognition of the control probe does not primarily depend on the level of

activation of the concept belonging to 'Wilma', so recognizing this control probe would be mainly sensitive to the amount of processing difficulty occurring in the sentence where the probe is located. Thus, control probes mainly measure processing load.

The procedures were identical to those in the previous speeded auditory decision experiment. The difference was that participants had the extra task of deciding the gender of the proper noun presented. It was a dual task, in the sense that they had to press a button to make a decision about the probe; and after listening to the sentence, they had to press a button to make a decision about the verification statement.

The participants were good at the dual task, since they chose the correct gender 96% of the time. The results of the responses to the verification statements were practically a replication of the pattern of the offline results. When gapping context and gapping prosody matched, participants again chose the gapping reading over 60% of the time, whereas when context and prosody biased towards nongapping, gapping was clearly dispreferred, being chosen only 16% of the time. With respect to the online processing, there was a significant identity priming effect, the identical probes received faster responses than the control probes. However, no difference in reactivation between the conditions was found. It seems that the probes only measured processing load rather than activation, that is, when an utterance is embedded in the right context and spoken with the right prosody, computing the gapping interpretation was as easy as computing the preferred nongapping interpretation. The only processing difficulty was found in the mismatch condition (45b), in which context and prosody point towards different analysis.

This study shed light on the processing of ambiguous gapping sentences by showing that nonstructural factors such as context and prosody have strong and independent effects on both offline preferences and online processing of these sentences. Combining context and prosody properly seems to reduce processing difficulty associated with gapping, and make it the structure of choice.

In an eye-tracking reading task of this thesis, pragmatic context was combined with semantic parallelism to explore if both could affect the

interpretation of globally ambiguous gapping sentences. Also, in two identical sentence-picture matching tasks of this thesis, pragmatic context is combined with semantic parallelism and with prosody in order to verify if these features can affect the interpretation choices of globally ambiguous gapping sentences in BP and in AE.

3.5 Kim *et al.* (2020): Gapping and Eye-Tracking

In this study, Kim and colleagues investigated two hypotheses in the online processing of gapping sentences, the Incremental Ellipsis Hypothesis and the Ellipsis as a Last Resort Hypothesis. The former hypothesis predicts that “the parser inserts an ellipsis site in an incremental fashion in certain coordinated structures” (KIM *et al.*, 2020, p. 781). The latter hypothesis predicts that the ellipsis site is only inserted when it is clear to the processor that there are no other options; in this sense, ellipsis would be a late and dispreferred option. These two hypotheses can be respectively related to the incremental strategy and the delay strategy described by Yoshida (2018); cf. section 2.4. of Chapter 2.

The authors tested a kind of ambiguous ellipsis with a syntactic structure that challenges the incremental parsing. The second conjunct of the sentence under study is compatible with both a non-elided syntactic structure as with an elided structure; decisive evidence for an ellipsis structure can be found rather late in the sentence.

(46) The guitarist hid behind the curtain suddenly, and the singer
behind the stage . . .

(a) ...and [_{IP} the singer [_{VP} hid [_{PP} behind the stage]]].

(b) ...and [_{NP} the singer [_{PP} behind the stage]]...

Source: Kim *et al.* (2020, p. 781).

Example (46) has two possible readings for the string *the singer behind the stage*. It is compatible with a gapping interpretation (46a), in which the verb (*hid*) can be elided in the second conjunct, and with a non-ellipsis interpretation

(46b), in which the PP *behind the stage* is a modifier of the noun phrase (NP) *the singer*. If a verb appears after the PP, this PP should be understood as a modifier of the NP and the structure is non-elided (46b). On the other hand, if the sentence ends with the PP, it becomes clear that the verb *hid* was gapped and there is a gapping sentence. The challenge of the incrementality of the parser relies on the fact that evidence for an ellipsis sentence is available at a point later where the actual ellipsis site is located, that is, only after the PP *behind the stage* and not before it.

The authors draw attention to the parser's preference for structures with fewer nodes. According to this notion, the parser will obey a local attachment bias and will prefer to interpret a sentence such as (46) as a non-elided structure rather than a gapping structure. The attachment of the PP to the NP involves fewer nodes than attaching it to the VP. Therefore, it is possible that the ellipsis site is not inserted in an incremental manner by the parser and ellipsis occurs only when it is clear enough that another possible interpretation for the sentence is not available. That view is compatible with the Ellipsis as a Last Resort Hypothesis. On the other hand, there is also the parallelism preference observed in the processing of coordinated sentences. According to this extra-grammatical constraint, the online processing of coordinated sentences is facilitated when the conjuncts are maximally parallel to each other. In this sense, it is possible that the insertion of the ellipsis site might be the parser's first resort since the gapping structure in (46a) is more parallel to the structure of the first conjunct than to the NP-attachment structure in (46b); the subject NP in the first conjunct does not have a PP modifier. If the parser prefers to maintain the structure of both conjuncts parallel to each other, an insertion of the ellipsis site at an early point of the structure might satisfy this parallelism preference; this view is compatible with the Incremental Ellipsis Hypothesis.

Another important aspect related to gapping sentences pointed by the authors is the Coordination Constraint (JOHNSON, 1996, 2004 apud KIM *et al.*, 2020). This kind of grammatical restriction explains why gapping sentences occur only with a certain class of connectives (i.e., the coordinate ones) and

why gapping tends to be infelicitous in subordinative contexts. This property helps to differentiate gapping from other ellipsis constructions.

The authors conducted an eye-tracking while reading experiment to verify to what extent the parser prefers ellipsis in real-time processing when presented to sentences with structural ambiguity. Therefore, they aimed to explore whether the parser opts for an ellipsis structure only when there is enough evidence for positing an ellipsis site (Ellipsis as a Last Resort Hypothesis) or it posits an ellipsis site whenever gapping is grammatically licensed and favored by parallelism (Incremental Ellipsis Hypothesis).

Two factors were manipulated in the experimental conditions, the Parallelism (Parallel versus Non-parallel) and the Connective Type (Coordinate versus Subordinate). With regard to the syntactic structure, the NP-PP sequence in the second clause was structurally ambiguous only temporarily because the disambiguating verb *hid* appears after the PP *behind the stage* in all four conditions. The connectives are underlined in the conditions.

(47) Conditions of the eye-tracking while reading experiment (KIM *et al.*, 2020, p.789)

(a) **Parallel/Coordinate**

The guitarist hid behind the curtain suddenly, and the singer behind the stage hid from the sneaky photographers.

(b) **Parallel/Subordinate**

The guitarist hid behind the curtain suddenly, whereas the singer behind the stage hid from the sneaky photographers.

(c) **Non-parallel/Coordinate**

The guitarist noticed his recording agent suddenly, and the singer behind the stage hid from the sneaky photographers.

(d) **Non-parallel/Subordinate**

The guitarist noticed his recording agent suddenly, whereas the singer behind the stage hid from the sneaky photographers.

If the parser waits for disambiguating information to appear in the structure to decide on the insertion of an ellipsis site, slower reading times were not expected to be found on the second verb when the gapping analysis become grammatically licensed. On the other hand, if the parser immediately inserts an ellipsis site whenever the parallelism between the two conjuncts makes it possible, the presence of the second verb will contradict the parser's expectations. Thus, an interaction between parallelism and connective type is expected.

Participants were exposed to thirty-two experimental sentences like (47). They were instructed to read them at their natural reading pace. The second conjunct, which started with the connective, always appeared on a second line below the first conjunct. After each sentence, there was a yes/no comprehension question. Eye-tracking measures¹¹ such as fixation duration (FFD), regression path duration (RPD) and total fixation time (TFT) were collected for the following regions: verb region (*hid*), spillover region 1 (*from the*), and spillover region 2 (*the sneaky photographers*).

In general, some of the eye-tracking measures indicated an interaction of Parallelism and Connective at spillover region 1 (TFT measure) and spillover region 2 (RPD measure). The authors understood this finding as an indication that the parser respects the structural parallelism held between the two conjuncts and tries to build a gapping structure. The results showed that Parallel/Coordinate condition was read significantly slower than the Parallel/Subordinate, Non-parallel/ Coordinate, and Non-parallel/Subordinate conditions. The authors interpreted this finding as an indication of the parser's reanalysis of the verb in the second conjunct. As an effect of parallelism, the parser had an initial preference for a gapping structure as a first resort (the Incremental Ellipsis Hypothesis) but found an overtly pronounced verb instead, being necessary to reanalyze the PP as an NP-attachment structure. This reanalysis process occurs later in the sentence, in the spillover regions and not on the verb itself.

¹¹ "First fixation duration (FFD) is the duration of the first fixation in a region. Regression path duration (RPD) is the sum of fixation durations from when the region is first entered until exiting to the right. [...] Total fixation time (TFT) is the sum of all fixations on the region, which includes re-reading times." (KIM *et al.*, 2020, p. 791).

This study revealed that parallelism (extra-grammatical constraint) permits a gapping structure to emerge in both parallel and non-parallel conditions, but it is the grammatical syntactic constraint (Coordination Constraint) that truly licenses the gapping structure. Therefore, the insertion of ellipsis site in gapping is influenced by an interaction of parallelism and coordination constraint.

3.6 Summary

The reported studies in this chapter are relevant to this thesis because they explore the processing of gapping sentences through a psycholinguistic perspective. In sum, they reveal how different kinds of linguistic and non-linguistic information can influence the processing of such sentences. Carlson (2002) showed that the manipulation of lexical and prosodic parallelism can increase the choices of subject readings in globally ambiguous gapping sentences. In a later study, Carlson *et al.* (2005) showed that a specific syntactic configuration of remnants and prosodic parallelism can reduce the object bias preference observed for the ambiguous gapping sentences. Kaan and colleagues (2004 and 2013), in turn, revealed that ERP effects occur in time course process of semantic and syntactic integration of plausible and implausible gapping sentences. Hoeks and colleagues (2009) revealed the importance of combining a pragmatic context and prosodic parallelism in the processing of ambiguous gapping sentences. Finally, Kim and colleagues (2020) showed the interaction of grammatical and extra-grammatical constraints in the processing of ambiguous gapping sentences. The structural parallelism licenses gapping sentences only in coordinated clauses and the parser reflects a preference for maximal parallelism between the conjuncts in order to insert a gap in a coordinated structure.

The next chapter brings a description of the experimental paradigms used to design and conduct the experimental activities of this thesis.

CHAPTER 4: Methodology in Psycholinguistics Research

As this doctoral thesis takes a Psycholinguistic approach to investigate the processing of spoken and written gapping sentences, it is relevant to describe the methods adopted here. First of all, it is relevant to point that psycholinguistics is concerned in understanding the mental representations and processes through which humans are able to produce, comprehend and storage written and spoken language (GARROD, 2006; WARREN, 2013). Psycholinguistic researchers can study how humans acquire language or how they process language. The domains of language processing area comprise language production and language comprehension. The focus of this thesis relies on language comprehension, and more specifically on how adults process gapping sentences.

In order to study language, psycholinguistic research tend to combine the theoretical background of linguistics with the experimental methodology of psychology (WARREN, 2013). Through an experiment, researchers can test hypotheses about a language phenomenon of their choice. In an experiment, “the researcher manipulates an independent linguistic variable to control some aspect of language processing and then measures the effect of the manipulation on a dependent variable of interest” (GARROD, 2006, p. 251). The collected data are statistically analyzed and validated. After that, the researchers draw generalized conclusions about the observed effect in light of the assumed theoretical background on how language is represented and processed.

The advantages of experimental methods are the possibilities of reducing the researcher observation bias and controlling what participants are required to do in the experiment. On the other hand, a disadvantage of experimental methods is related to a certain lack of ecological validity, that is, participants are usually asked to provide a metalinguistic judgment about a written or spoken stimulus (WARREN, 2013). Despite this disadvantage, the experiments have been of paramount importance in Psycholinguistics studies, allowing researchers to reveal cognitive processes related to language processing.

The types of methods and measures used in the experiments can be categorized in off-line and on-line (LEITÃO, 2013). The off-line methods capture the final outcome of language processing, that is, the response given by an individual to a written or a spoken stimulus occurs after the complete integration of the phonological, morphological, lexical, syntactic and semantic levels. Common off-line measures are accuracy, grammatically judgments, interpretation preferences etc. The on-line methods capture aspects of language processing as it is happening, that is, the integration of the grammatical levels is still occurring. Through them it is possible to investigate how the parser accesses and uses different types of linguistic information such as syntactic, semantic and prosodic (KAISER, 2013). The on-line methods can be divided into behavioral methods and neurophysiological methods (GARROD, 2006). The behavioral methods aim to capture a behavioral response from the participants, and through them inferences about language processes are possible to be made. The most common behavioral measures are reaction times (RTs). The neurophysiological methods capture a physiological response to stimuli. Some known measures are the ERP components and fMRI (i.e., changes in blood flow); both measures are related to brain activity (COWLES, 2011). It is worth to point out that a single experiment can capture both on-line and off-line measures depending on the purpose of the study.

The next sections introduce the experimental methods used to design and conduct the written and spoken experiments that will be respectively reported in chapters 5 and 6. Two kinds of off-line experiments will be described first, a questionnaire and a sentence-picture matching task. After that, the on-line methods are described, the self-paced reading and two types of eye-tracking experiments.

4.1 Questionnaires

The questionnaires are a very useful and an inexpensive off-line method widely used in psycholinguistics studies. They allow researchers to collect data from conscious responses (COWLES, 2011). This kind of method can be used to accomplish different purposes in psycholinguistic investigations, some of

which could be the following: (i) acceptability judgment of sentences; (ii) the final interpretation given to sentences; (iii) the accuracy of participants' responses.

In relation to questionnaires with judgment tasks, participants could be asked to answer if a given sentence is a possible utterance in their language (SCHÜTZE and SPROUSE, 2013), for instance. They could be required to classify a particular sentence in "good or bad" or in "acceptable or unacceptable" (non-numerical task). Another way of judging the sentences is by using Likert scales (numerical task). Thus, a questionnaire could have a continuum numeric scale ranging from 1-5 or 1-7, for instance. Through scales participants have more options to evaluate how acceptable a particular sentence is. In such a scale, one end (e.g., 1) corresponds to "Bad" and the other end (e.g., 5) to "Excellent" (COWLES, 2011, 40). Judgment data are an important source of evidence for making inferences about the cognitive system and they also provide information about the status of a phenomenon in the investigated language (SCHÜTZE and SPROUSE, 2013).

The questionnaires are also crucial to collect final interpretations. In an experiment, the participant can be asked to answer a comprehension question about a sentence read or heard. Through the questionnaire, it is possible to find out the final interpretation given to the sentence. It is quite common to combine both off-line and on-line methods and measures in a single experiment; then it is possible to find out what would not be available from either method on its own (KAISER, 2013). The comprehension questions could ask participants to answer 'yes' or 'no' or choose between paraphrases; the second type of task is also called as forced-choice task (SCHÜTZE and SPROUSE, 2013). The final interpretations are important because they might "yield insights into the nature of on-line processing as well" (KAISER, 2013, p. 137). The questionnaires can also evaluate the accuracy of responses given by the participants. In this case, the researcher will verify whether answers to the comprehension questions are correct or incorrect.

In this thesis, a written questionnaire was designed to explore the temporally ambiguous gapping sentences in BP, and an auditory questionnaire investigated the potentially gapping sentences in BP. The written questionnaire

was a type of judgment task and it aimed to investigate participants' interpretative preferences for completing the main clause of coordinate sentences with three different options of syntactic structures, one of them being a gapping structure. More specifically, they had to rank the options ordering them from 1-3 positions, according to their preferences; and they were also encouraged to reject one of the options in case they judged it an unacceptable completion. This experiment intends to find out how acceptable a gapping structure is in comparison to other coordinate sentences. The auditory questionnaire was a type of forced-choice task, in which participants had to choose an answer between two available options. This experiment explores the role of prosody in biasing the final interpretation of potentially gapping sentences. In this task, participants hear ambiguous gapping sentences in different prosodic versions and they have to choose the best paraphrase for the sentence heard.

4.2 Sentence-picture matching

The sentence-picture matching task (SPMT), also referred as the sentence-picture verification task or sentence-picture comparison task, is an off-line experiment that consists in presenting "a sentence and a picture to the participants either simultaneously or in succession" (JIANG, 2012, p. 216). The participants have to decide whether the sentence describes the picture correctly. There are usually two buttons for participants to press, one with a positive response and the other with a negative response. Therefore, the understanding of a particular sentence is checked by means of the chosen picture (JIANG, 2012).

A number of studies started to use this method between the 1960s and 1970s. Nowadays, with the advance of technology, studies tend to use the SPMT in combination with ERP and fMRI measures, then it is possible to collect both behavioral (RT and accuracy) and neurological data (JIANG, 2012). Psycholinguists have also been using the eye-tracker to study spoken language comprehension with presentation of pictures and auditory stimuli simultaneously; section 4.5. will introduce the Visual World Paradigm (VWP).

In this thesis, the SPMT paradigm was adapted to investigate the processing of potentially gapping sentences in BP and in AE. Both experiments are part of a cross-language study between the two languages. The aim of these experiments was to explore whether the combination of pragmatic contexts with prosodic parallelism of pitch accents on DPs can influence the interpretation of ambiguous gapping sentences that are similar in the two languages. The spoken sentences were simultaneously presented with two options of pictures, one biased a subject reading and the other an object reading. The participants' task was to choose between the two pictures the one that best matched the sentences heard. It is worth to point out that the SPMT tasks conducted here were an adaptation¹² of a VWP task. It will not be possible to collect eye-tracking measures to evaluate the moment-by-moment processing of the ambiguous sentences, only the final interpretation of them. The choice of pictures (off-line measure) can indicate the final interpretation of the ambiguous sentences and still shed some light in what kind of information (context or prosody) is more influential to decide on the interpretation of these sentences. Measures of time will be considered to evaluate if one the experimental conditions was considered more difficult among the others.

4.3 Self-paced reading

The self-paced reading (SPR) paradigm is a type of online reaction-time method in which sentences are broken up and presented into word-by-word or phrase-by-phrase segments (GODFROID, 2020). The participant has to press a button to proceed to the next segments. The task is self-paced in the sense that the participants control the presentation of the segments and their pace of reading. The participants are usually asked to read as fast as possible and then answer a comprehension question. This type of task has been widely used in Psycholinguistics to study issues related to sentence processing (JIANG, 2012).

¹² Due to the outbreak of the world coronavirus pandemic (Covid-19) in 2020, it was not possible to collect eye-tracking data. The solution was to redesign the VWP task to an SPMT that resembled this VWP task.

Through this procedure, it is possible to measure how much time a participant spends reading a particular word or phrase of the written stimulus. The reaction time (RT) “is usually the duration between the onset of the segment and the time when the participant presses a button” (JIANG, 2012, p. 170). The time a participant spends to read a segment before moving to the next is recorded and taken as a processing-time measure (RAYNER and CLIFTON, 2002). The recorded reading times can reveal what point in a sentence is associated with increased processing difficulties (KAISER, 2013).

Through segmentation of written stimuli, the researcher can control the size of the segments as well as the amount of text the participant will read at one time (RAYNER and CLIFTON, 2002). The size of the segment is a reflection of the topic under investigation. For instance, if a researcher wants to compare the processing of an ambiguous sentence with an unambiguous sentence, the part of the sentence with ambiguity will be in a single segment. Then RTs of the segment with ambiguity will be compared to a segment in the same position in the unambiguous sentence. Therefore, it is possible to analyze the processing costs of parsing an ambiguous sentence.

According to Jiang (2012), there are three common design versions of the SPR, and all of them present one segment at a time. In the linear cumulative format, the segment starts to appear from the upper-left corner of the screen; the subsequent segments appear to its right and all the preceding segments remain on the screen. In the stationary-window format, the segments are presented at the center of the screen, one by one, in a non-cumulative design. Most SPR studies are designed in a moving-window format. In this version, segments are presented in a linear display, starting from the upper-left corner of the screen. The subsequent segments appear on the right and the preceding segment disappears from the screen. The current thesis designed a SPR study in moving-window version, as the example below shows:

(48) SPR in a moving-window version

 The -----

--- sentence -- ----- ----
 --- ----- is ----- ----
 --- ----- -- presented ---- -- ----
 --- ----- -- ----- word -- ----
 --- ----- -- ----- ---- by ----
 --- ----- -- ----- ---- -- word.

The SPR study of this thesis compared the processing of temporally ambiguous gapping sentences with other coordinate sentence types. The aim was to verify if there are processing costs to parse the second conjunct of gapping sentences (i.e., where the ellipsis site is encountered) in comparison to the second conjunct of other coordinate sentences that are non-elliptical.

The SPR is sometimes referred to as a “lower-tech” version of an-eye-tracking experiment (KAISER, 2013), although it certainly has some limitations that the eye-tracking can avoid. In the latter, the sentences can be presented in a holistic manner (not word-by-word) and proportionate a more natural reading experience. Besides that, the eye-tracker is highly accurate, making it possible to record with letter-by-letter accuracy where people are looking at (KAISER, 2013). Despite the drawbacks, the SPR is an inexpensive alternative method, which is relatively easy to implement and analyze. Additionally, for the last decades it has been provided relevant and informative results about how humans process written sentences (COWLES, 2013).

4.4 Eye movements in reading

With concurrent methodological advancements, it is now possible to record people’s eye movements as they carry out relatively natural tasks involving language, such as reading words or sentences, following spoken instructions, inspecting images that are being described, among others (TRUESWELL, 2008). This is possible thanks to the equipment eye-tracker, which allows the investigation of language processing moment-by-moment by recording of the eye movements. In comparison to other available experimental techniques, eye-tracking is a relatively natural online method to investigate

linguistic phenomena, since the eye movements are not part of an artificially induced task. They are part of the normal process of reading, for instance. Thus, monitoring readers' eye movements does not disturb their normal reading rate (RAYNER and POLLATSEK, 2006). The last decades have witnessed a growing interest in this technique to investigate language processing in psycholinguistic studies. In Brazil, the technique began to be incorporated into psycholinguistic research more precisely in the late 2000s. A pioneering work in Brazilian Portuguese was Maia (2008), in which the processing levels bottom-up and top-down were investigated through the observation of images.

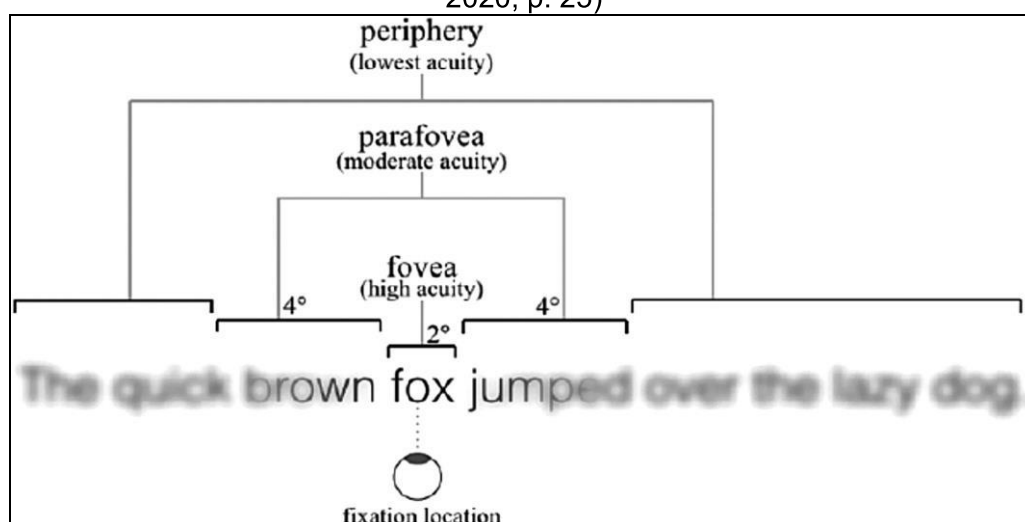
This thesis presents a reading while eye-tracking experiment; thus, it is relevant to comment on some aspects of eye movements during reading. Researchers interested in reading conduct experiments in which they record the eye movements while participants are reading an amount of text, usually on a computer screen. The eye movements are computed to check how long people take to read different portions of the text and this information is used to draw inferences about the underlying psychological processes. There is an assumption that there is a close correspondence between the pattern of the eye movements made by a reader and the mental processes needed to understand the text that they are currently inspecting. Thus, the direction of gaze indicates what part of the text is being processed, and the time taken to process the text is indicative of the easiness with which processing occurred (LIVERSEDGE *et al.*, 1998). In comparison to other methodologies, the eye-movement technique does the best job of revealing moment-by-moment processes in reading (RAYNER and POLLATSEK, 2006).

With regard to the movements, three types might reveal underlying cognitive processes: saccades, fixations and regressions. The *saccades* comprehend a series of rapid movements separated by periods of time when the eyes are relatively still (i.e., fixations). Typically, saccades last about 20–40ms. During the *fixations*, new visual information is encoded from the text because vision is functionally suppressed during the saccades. The fixations usually last around 200–250ms, although individual fixations in reading can be as short as 50–100ms or as long as 500ms. When reading a piece of text is difficult, readers make longer fixations and shorter saccades. Readers might

also move their eyes backwards in the sentence; these movements are called *regressions*. Many regressions are short (i.e., back to the word on the left of the current fixation) and probably reflect oculomotor irregularities or word recognition difficulties due to ambiguity, for instance. Other regressions are longer, and probably reflect comprehension difficulties (RAYNER and POLLATSEK, 2006).

With regard to the point of fixation, the reader's retina can be divided into three different regions: foveal region, parafoveal region and peripheral region. The *foveal region* comprehends the central 2° visual angle around the fixation point, and it is specialized in processing for detail (RAYNER and POLLATSEK, 2006). The fovea has a high cell density called cones, which are photo-receptors responsible for the visual perception of shape and color details (MAIA, 2008). Psycholinguistic studies usually focus their interest on the foveal region. The *parafoveal region* extends from the foveal region out to about 5° of visual angle to each side of fixation. Readers are able to use some letter information from this region. The *peripheral region* comprises everything that is beyond the parafoveal region. This region is of little use in reading (RAYNER and POLLATSEK, 2006). The figure below shows the visual acuity in the three regions:

Figure 14 – Visual acuity in the fovea, parafovea and peripheral regions (GODFROID, 2020, p. 25)



Source: Rayner *et al.* (2016) apud Godfroid (2020, p. 25)

The eye-tracking measures are extracted for specific regions on the screen, which are termed as interest areas or as regions of interest¹³(GODFROID, 2020). According to Conklin *et al.* (2019), the fixations and their durations, usually measured in milliseconds (ms), tend to be more focused on text-based studies than saccades due to their sensitiveness to linguistic factors. The saccades are more important for finding regression patterns connected to possible processing difficulties. The fixations can be classified in ‘early’ and ‘late’ measures since they indicate different stages of reading processing. Early measures are more related to processes of word recognition and lexical access, while late measures indicate more conscious and controlled processes such as word integration and syntactic processing.

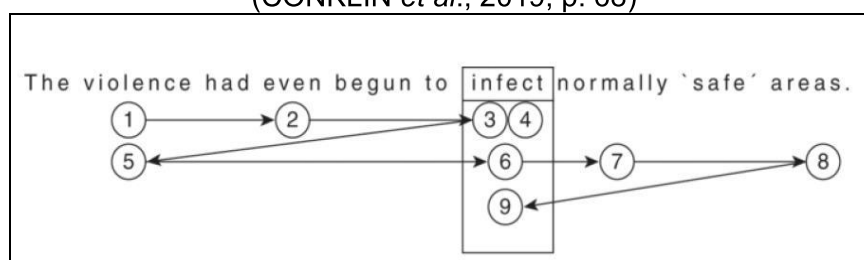
Conklin *et al.* (2019) points the most common eye-tracking measures collected to investigate the processing time associated with a given target word in a region of interest (ROI), which are the first fixation duration (FFD), total fixation duration (TFD), fixation count (FC) and regression path duration (RPD). The *first fixation duration* is an early measure that comprehends the time the reader spends reading a word or a ROI for the first time without skipping it. This type of measure indicates how easily a word is recognized and retrieved from the lexicon (CONKLIN *et al.*, 2019). The *total fixation duration* (also known as *dwelt time*) is a late measure and comprises the sum of the durations of all fixations on the critical word or ROI, including the regressions. The *fixation count* is the sum of the number of fixations made on the critical word or ROI (CONKLIN *et al.*, 2019). The analysis of this measure supplements the analysis of fixation duration measures (GODFROID, 2020). The *regression path duration* (also known as *go past time*) is an intermediate measure and comprehends the time spent on the critic word or ROI and any prior parts of the sentence before the eyes move to the right (CONKLIN *et al.*, 2019). This type of measure reflects the time the parser takes to overcome a processing difficulty (GODFROID, 2020).

The figure below illustrates the eye-movement pattern in a particular sentence. The ROI around the word ‘infect’ is indicated by the box. The fixations are indicated by circles in the order of their occurrence. Circle 3 indicates the

¹³ This dissertation will use the term regions of interest.

FFD measure on the ROI 'infect', for instance. The sum of fixations [3+4+6+9] reveals the TFD measure on the ROI 'infect' and also that it had a total of four fixations. The sum of fixations [3+4+5+6] comprises the RPD measure of the ROI 'infect'.

Figure 15 – Example of reading patterns for a sentence of an eye-tracking experiment (CONKLIN *et al.*, 2019, p. 68)



Source: adapted from Conklin *et al.* (2019, p. 68)

The described eye-tracking measures of this section are going to be reported and analyzed in the reading while eye-tracking experiment carried out in this thesis.

4.5 Eye movements in spoken language comprehension

According to Tanenhaus and Trueswell (2006), for more than two decades eye-tracking experiments has focused in measuring written word recognition and sentence reading. More recently, the eye movements have become a widely used response measure for studying spoken language processing in both adults and children. These experiments focus in natural everyday tasks where participants have to comprehend and produce utterances that are circumscribed in a "visual world." The Visual World Paradigm (VWP) was introduced in the Psycholinguistics by Tanenhaus *et al.* (1995), and it covers a wide range of tasks which simultaneously present auditory stimuli – sentences with instructions or descriptions – and a visual scene containing several objects to the participants, while their eye movements are monitored (CONKLIN *et al.*, 2019). The auditory stimulus is usually related to one or more objects in the scene and the research question is whether and when the participants look at the objects. By manipulating the relation between objects

and linguistic input, researchers can explore theories about how language users access information in their mind during processing (BERENDS *et al.*, 2016).

The VWP has several advantages for experimental research, Berends *et al.* (2016) points at least five. First, it is an online method, which allows to explore the comprehension of spoken language at the time it actually occurs, revealing processing aspects that listeners are often completely unaware of their occurrence. In contrast to other offline tasks, listeners do not need to perform metalinguistic judgments that may lead to an over or underestimation of their language abilities. It generates data in a high temporal resolution. The topics of research interest can be explored in relatively realistic and natural conditions in which listeners hear words, phrases or stories that are pragmatically relevant. Finally, it can be used with participants at most ages, since they do not need to perform complex tasks. Since the eye movements are time-locked to the speech stream, Kaiser (2013) also argues that the VWP is a very suitable method for studying issues linked to the moment-by-moment processing of different kinds of prosodic cues. Studies using the VWP revealed indeed that prosodic features are used to guide syntactic ambiguity resolution and the analysis of information structure (DAHAN *et al.*, 2002; SNEDEKER and TRUESWELL, 2003; CARVALHO *et al.*, 2017). Therefore, properties of the speech stream might be used to guide syntactic ambiguity resolution of gapping sentences as well, which is the interest of this thesis.

The VWP experiments can have different tasks depending on the purpose of the study. The spoken stimuli can be instructions to the participants or only descriptions of the display. With the first type of stimuli, participants might be asked to click on objects on the screen; while the second type of stimuli is typical of a 'look and listen' task, participants might be asked to look at the screen and to listen carefully to the sentences and, after that, answer a comprehension question about the images and the heard sentence. Another type of task is the sentence-picture verification, in which participants have to indicate whether the picture they saw and the sentence they heard match (HUETTIG *et al.*, 2011; CONKLIN *et al.*, 2019).

The VWP experiment of this thesis is a type of a 'look and listen' task. The study presented spoken sentences, with the manipulation of prosodic

parallelism between DPs, along with pictures that biased a subject interpretation or an object interpretation. The stimuli were followed by a comprehension question about the sentence heard. The aim of the experiment was to evaluate which cue (prosodic or visual) is more influential in deciding the final interpretation of globally ambiguous gapping sentences.

In visual tasks with the VWP, the most common analyzed eye-tracking measures are the *proportion of fixations* on the ROIs, *total fixation duration* (TFD) times and *fixation counts* (FCs). The measures are usually time-locked to the onset of a critical stimulus. The FC measure and the proportion of fixations reveal how many fixations were made on a specific ROI, while the TFD measure indicates how long the fixations were in a specific time window. It is assumed that the picture that is being processed during the unfolding of the critical part of the audio will receive more and longer fixations than the other pictures on the screen (CONKLIN *et al.*, 2019). The measures TFD and FC will be analyzed and reported for the VWP study of this thesis.

CHAPTER 5: Written Studies

This chapter reports three written experimental activities that have been carried out in this thesis. Experiments 1 and 2 explored written BP gapping sentences with temporary structural ambiguity, while experiment 3 investigated the processing of globally ambiguous gapping sentences. The first experiment was an offline task that aimed to evaluate interpretative preferences for completing coordinated structures. The second experiment consisted of a Self-paced Reading task that explored the time-course processing of temporally ambiguous gapping sentences in comparison to other coordinated sentences, such as conjunction reduction sentences and non-elided coordinated clauses. The third experiment was an eye-tracking while reading experiment that explored the role of pragmatic context and semantic parallelism between DPs in the interpretation of globally ambiguous gapping sentences.

5.1 Experiment 1: Written Questionnaire

Experiment 1 was an offline task designed as a written questionnaire, in which subjects had to judge how suitable three types of completing options for the main clause of coordinated sentences were, according to their interpretive preferences. The purpose of this experiment was to verify to what extent BP speakers prefer a coordinated sentence with a gapping syntactic structure among other available coordinated structures, such as conjunction reduction and non-elided coordinated clauses.

Readers usually prefer conjoining object DPs rather than clauses (HOEKS *et al.*, 2002, 2006). According to the authors, this preference is because the processor chooses the simplest syntactic analysis in terms of number syntactic nodes, which is predicted by the Minimal Attachment Principle (FRAZIER, 1979). The authors argue that the Principle of Minimal Topic-Structure (HOEKS *et al.*, 2002) also explains this preference. Language users prefer to have one topic (i.e., the syntactic subject) rather than two in a sentence. The conjunction reduction is syntactically simpler than gapping

sentences and coordinated clauses because it has fewer syntactic nodes and only one subject in the topic-structure. Taking this into account, the hypothesis of this experiment is that the simplest syntactic structure is the most preferred by language users. If that hypothesis applies, the prediction is that the conjunction reduction completion option will be ranked as the best suitable option most of the time in comparison to the completion options that form gapping sentences or coordinated clauses.

5.1.1 Method

Materials

Fourteen sets of sentences were constructed, each of them containing three types of coordinate sentences. The first conjunct of all trials always had an animate subject DP, a verb, an inanimate object DP, a PP (Prepositional Phrase) and the connective *and*. The verbs of the first conjunct were those that only allowed inanimate direct objects. The three sentences in each set had the same first conjunct, differing only in the second conjunct, which completed the rest of the coordinate structure. The first type of completion contained an inanimate DP that functioned as a conjoined object followed by a PP adjunct – it formed a **conjunction reduction** sentence. The second type contained an animate DP that functioned as the subject of an elliptical clause followed by a PP adjunct – it formed a **gapping** sentence. The third type contained an unelided coordinate sentence, with different types of structures – it was called **coordinated clauses (non-elided)**. This condition served as a control so that the participants did not realize the goal of the study and they did not have to choose only between a gapping or a conjunction reduction sentence. An example of a set of trials is shown below (the brackets bring the completion options).

(49) Set of sentences in Experiment 1

(a) **Conjunction reduction**

Alice assou bolos para suas amigas e [biscoitos para sua prima.]

Alice baked cakes for her friends and [cookies for her cousin.]

(b) **Gapping**

Alice assou bolos para suas amigas e [Camila para sua prima.]

Alice baked cakes for her friends and [Camila for her cousin.]

(c) **Coordinated clauses (non-elided)**

Alice assou bolos para suas amigas e [o forno parou de funcionar.]

Alice baked cakes for her friends and [the oven stopped working.]

The trials were randomly interspersed with another twenty-one additional unrelated sentences of varied syntactic structures. The experimental sentences were always preceded and succeeded by an unrelated sentence. The order of appearance of completion options (a, b or c) was also randomly counterbalanced in each set (cf. Appendix 1 for a complete version of the questionnaire).

Procedures

The questionnaire was printed on sheets of A4 size paper on portrait mode. The questionnaires were handed to the participants and the printed instructions were read to them. Before asking them to start the task, it was certified that they had understood the procedures of the task.

The instructions indicated that the participant would read the beginning of a sentence and then three possible options to complete the rest of it. After that, they were asked to rank these options according to their preference for them, ordering them in first (1st), second (2nd) and third (3rd) positions. They should choose as first position the option they judged to be the most suitable completion for the sentence; on second position, the second-best option; and on third position, the third-best option. The instructions also indicated that if the

participant considered that any of the options was an inappropriate completion for the sentence, they could mark it with an X (for rejection). After the instruction guidelines, three examples appeared to illustrate what was expected from the participants in the task. An example to illustrate the task is shown below:

Table 5 – Example of a trial from Experiment 1

Alice assou bolos para suas amigas e...	Rank
a. biscoitos para sua prima.	
b. Camila para sua família.	
c. o forno parou de funcionar.	

Source: the author (2021).

Subjects could reread the sentences as much as they judged it was necessary. They took on average 25 minutes to complete the entire questionnaire.

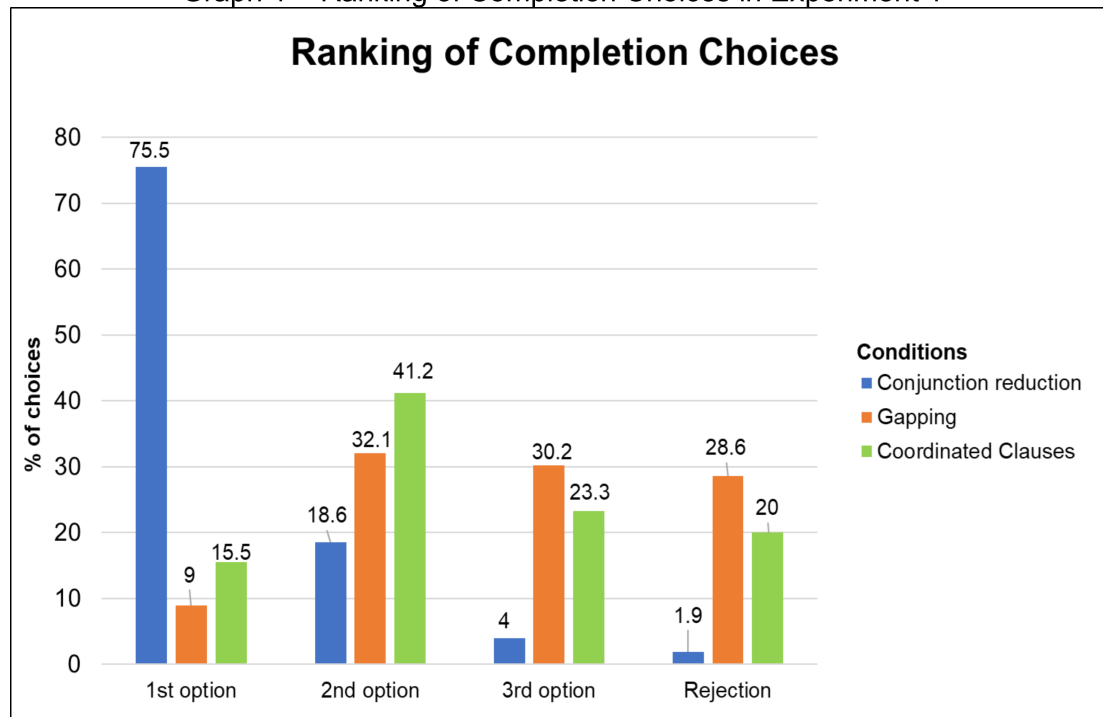
Participants

The participants were thirty native Brazilian Portuguese speakers, who were undergraduate students enrolled in a Linguistic course at the Universidade Federal de Juiz de Fora (UFJF). They all reported normal or corrected to normal vision. They also signed a term of consent and volunteered to take part in the experiment.

5.1.2 Results and Discussion

It was obtained in total 420 responses (30 participants x 14 sets of sentences). A graph with the ranking of completion choices in percentages is shown below:

Graph 1 – Ranking of Completion Choices in Experiment 1



Source: the author (2021).

The conjunction reduction completion option (in blue) was the most chosen as the first best option, 75.5% of the time, and it was also the option that presented the lowest rejection rate, only 1.9%. The gapping completion option (in orange) was the least chosen as the first best option, only 9% of the time, and it was the option that presented the highest rejection rate, 28.6% of the time. The completion option that formed a sentence with non-elided coordinated clauses (in green) was the most chosen as the second-best option, 41.2% of the time. At first and third options, it was the second most chosen, presenting respectively 15.5% and 23.3% rates. It was also the second most rejected option, 20% of the time. Chi-square tests were performed and revealed that the results of this experiment were statistically relevant: $\chi^2 = 546.9(6)$, $p < 0.001$.

The results found in this offline task aligns with the prediction of this study, participants showed a strong preference for conjoining objects DPs rather than subject clauses. The results corroborate with the Minimal Attachment principle since the conjunction reduction structure was the most preferred completion option (75.5%), the coordinated structure with conjoined objects. The results show that BP speakers, when given the chance to choose, prefer the simplest syntactic structure, the one conjoining two objects within the

same VP. This does not mean that BP speakers consider gapping an ungrammatical syntactic structure, it is just not often their first choice. The dispreference for gapping and the considerable rate of rejection might be due to a possible temporary ambiguity noticed in the DP of the second conjunct in gapping completion options. Readers might initially have used the Late Closure strategy and read the DP of the second conjunct (*Camila*) as part of a simple lowest DP conjunction (... *bolos para [suas amigas e Camila] / ...cakes for [her friends and Camila]*). This analysis had to be rejected right after that DP, when they read the PP (*para sua família/ for her family*), by this point gapping was the only possible grammatical structure. For that reason, some participants might have decided to reject that completion for judging it an infelicitous structure that contradicted their initial expectations.

The results presented so far do not allow us to make inferences about the real-time processing of these structures, since participants had plenty of time to consider and reconsider their choices. In order to evaluate the real-time processing of gapping sentences in BP, a Self-paced Reading task was designed.

5.2 Experiment 2: Self-paced Reading¹⁴

The purpose of this SPR experiment was to verify whether BP speakers process gapping sentences in a similar manner to other non-elided coordinated sentences or if there are any processing differences between them. A task with the SPR in a moving-window format (KAISER, 2013) investigates the resolution of a temporary syntactic ambiguity and the identification of the ellipsis site during the reading of gapping sentences. The time course processing of gapping sentences will be compared to another two types of coordinated sentences, conjunction reduction and non-elided coordinated clauses. This study explores the following type of sentences:

(50) *A Beatriz assou a pizza e a Carla o bolo de limão pro lanche.*

Beatriz baked a pizza and Carla a lemon cake for snack.

¹⁴ This study was published in Silva and Fonseca (2021).

- (51) *A Beatriz assou a pizza e o bolo de limão pro lanche da tarde.*
 Beatriz baked a pizza and a lemon cake for snack in the afternoon.
- (52) *A Beatriz assou a pizza e a Carla preparou um suco de limão.*
 Beatriz baked a pizza and Carla made a lemon juice.

In sentence (50), there is an implausible combination between the DP *a Carla* and the verb *assou* (baked). There is a conflict between the animacy feature of the ambiguous DP *a Carla* and the thematic requirements of the verb *assou* (baked). This type of verb accepts only non-human nouns as arguments. As the DP *a Carla* is animate, the parser must at some point reject it as part of a complex object structure (...*assou* [*a pizza e a Carla*] / ...*baked* [*a pizza and Carla*]) and analyze it as the subject of a conjoined clause instead.

In sentence (51), the DPs *a pizza* and *o bolo de limão* (a lemon cake) are conjoined objects of the verb *assou* (baked). As mentioned before, readers are inclined to interpret a DP as part of a complex object structure whenever possible, because the processor chooses the simplest syntactic structure in terms of nodes (HOEKS *et al.*, 2002, 2006; FRAZIER, 1987a). Thus, there might be processing costs to parse the temporary ambiguous DP in sentence (50) since it cannot be conjoined within the VP. If that is the case, the second clause of sentence (51) is expected to be processed faster than sentence (50). On the other hand, readers might promptly recognize the DP as an implausible object and use the thematic information to resolve the temporary ambiguity and minimize processing difficulties (HOEKS *et al.*, 2006).

The coordinated structure with two clauses (52) has the same ambiguous DP *a Carla* in the second conjunct, with the difference that it is followed by the disambiguating verb *preparou* (made), it is a non-elided structure. This sentence will serve as a control condition, making it possible to verify whether the ambiguity is rapidly resolved by the use of thematic information in addition to the presence of a disambiguating verb, which clearly shows that the ambiguous DP *a Carla* is the subject of a new clause. On the other hand, this ambiguity in sentence (50) might be accentuated by the occurrence of an ellipsis site immediately after the ambiguous DP.

There is controversy among authors about how the thematic information is used in sentence processing. Ferreira and Clifton (1986) argue that thematic information does not help to overcome a garden-path effect (FRAZIER, 1987b) while Clifton *et al.* (2003) and Hoeks *et al.* (2006) affirm that it slightly reduces this effect, but there is still some processing difficulty. Trueswell *et al.* (1994), on the other hand, claim that thematic information can avoid the garden-path effect if this information is sufficiently strong. Thus, the present study could contribute with evidence to support one of these accounts and shed some light on this issue.

The results from the previous experiment indicated that readers when given a choice have a strong preference for conjunction reduction sentences rather than for gapping sentences or for non-elided coordinated clauses. The hypothesis for Experiment 2 is that processing conjunction reduction sentences is less costing than processing gapping sentences, what is predicted by the Minimal Attachment Principle (FRAZIER, 1979).

The following predictions are made for this study: (i) if processing conjunction reduction sentences is less costing than processing gapping sentences, there will be significant RT differences between the two sentences in critical parts of the second conjunct; (ii) if both structures are equally natural to speakers, there will be no significant RT differences between gapping and conjunction reduction sentences; (iii) if the thematic information of the ambiguous DP is promptly used to avoid processing difficulties, no significant increases in RTs are expected to occur after the ambiguous DP of gapping sentences and the non-elided coordinated clauses; (iv) if the thematic information of the ambiguous DP is not sufficiently strong to avoid processing difficulties, significant increases in RTs are expected to occur after the ambiguous DP of gapping sentences and the non-elided coordinated clauses.

5.2.1 Method

Materials

Three sets of eighteen experimental sentences were constructed. They were all coordinated sentences: gapping, coordinate with conjoined objects, and non-elided coordinated clauses. The syntactic structure and the lexical content of the first conjunct were the same in the three versions: subject – verb – direct object – coordinating connective ‘e’. The verbs chosen were those that only allowed non-human direct objects, in order to create the temporary ambiguity in gapping and in non-elided coordinated clauses. The sentences differed with regard to the second conjunct. Gapping sentences had a temporary ambiguous noun followed by the direct object of the gapped verb and some extra information of varied syntactic categories (DPs, adjectives, prepositional phrases). The conjunction reduction sentences had a conjoined direct object followed by extra information. The coordinated sentences with conjoined clauses had a temporary ambiguous noun followed by a disambiguating verb and its direct object, and extra information. The three experimental conditions were named respectively as Gapping (GAP), Objects (OBJ) and Sentences (SEN):

(50) Examples of experimental conditions of Experiment 2

(a) **Gapping** (GAP)

A Beatriz₁ / assou₂ / a pizza₃ / e₄ / a Carla₅ / o bolo₆ / de limão₇ / pro
lanche₈.

(b) **Objects** (OBJ)

A Beatriz₁ / assou₂ / a pizza₃ / e₄ / o bolo₅ / de limão₆ / pro lanche₇ /
da tarde₈.

(c) **Sentences** (SEN)

A Beatriz₁ / assou₂ / a pizza₃ / e₄ / a Carla₅ / preparou₆ / um suco₇ / de
limão₈.

The sentences were broken up into word-by-word segments, represented by the slashes. In GAP and SEN conditions, the DP *a Carla* is an incompatible object for the verb *assou* (baked) in the first conjunct, whereas in OBJ condition the DP *o bolo* (a cake) is a feasible conjoined object for the verb *assou* (baked). In GAP and SEN sentences, there are two conjoined clauses while in OBJ sentences there are two conjoined objects. SEN condition will serve as a control condition; it will be possible to compare the processing costs of the same temporary ambiguous DP in an elliptical context, GAP condition, with a non-elliptical context.

The second conjunct is the relevant part of the sentence for measuring time-course processing, it is where possible processing difficulties can emerge. The words of the second conjunct in segments 5, 6 and 7 were considered relevant for time measurement comparisons between the conditions. In GAP condition, segment 5 shows the temporary ambiguous DP (*a Carla*) followed by the ellipsis site and the direct object (*o bolo / cake*) within segment 6. It is by segment 6 that participants will find the elision of the verb (*assou / baked*), only the direct object will be present (*o bolo / cake*). There might be a spillover¹⁵ effect of resolution of the ellipsis site in the object modifier¹⁶ (*de limão / 'of lemon'*) in segment 7. In OBJ condition, the conjoined object (*o bolo de limão / a lemon cake*) is found in segments 5 and 6, followed by an adjunct PP (*pro lanche / for snack*) in segment 7. Finally, in SEN condition, the temporary ambiguous DP (*a Carla*) is shown in segment 5, followed by the disambiguating verb and its direct object (*preparou um suco / made a juice*) in segments 6 and 7. It is worth mentioning that the proper nouns in GAP and SEN conditions were always parallel in gender. This was done to maximize lexical parallelism as much as possible. Also, the number of word syllables in the critic segments were controlled for size, they had three syllables in all experimental sentences.

¹⁵ Increased RTs may be observed not exactly at the expected position (at the ambiguous word or at disambiguating word, for instance), but at one or more words later (JIANG, 2012).

¹⁶ The order in English would be modifier and noun (“a lemon cake”) whereas in BP is the opposite order, noun and a PP modifier (“o bolo de limão” / ‘a cake of lemon’).

Another twenty-two filler sentences from unrelated experiments were combined with the experimental sentences. The participants read forty sentences in total during the experiment.

Procedures

The experiment was carried out on the *PennController for Internet Based Experiments* – PCIBex (ZEHR and SCHWARZ, 2018). To perform the task, participants had to access a link previously sent to them. When they opened the link, there was a “Welcome screen” giving instructions about how the experiment worked. They were asked to read the sentences carefully and with understanding at their normal rate of speed. They were also warned that the experiment only worked in a laptop or desktop computer because it was necessary to use the space bar in the keyboard. Before start doing the experiment, there was a practice session to help them to get familiar with the procedures of the task. After this session, they were encouraged to start the experiment. The instructions of the study recommended to do the task in a comfortable and silent place, and also to complete the study in one sitting.

Participants read the sentences word-by-word in a moving-window fashion (KAISER, 2013). First, they saw on the computer screen a set of dashes representing each word in the sentence. To get the first word, they had to press the space bar on the keyboard. When they pressed it, the first set of dashes was replaced by the appropriate letters of the first word. After they finished reading it, they pressed the space bar again, and then the first word was replaced by a set of dashes, while the second word appeared to its right. This process repeated until they reached the end of the sentence. The time they spent to read each word of the sentence was recorded. See an instance of the task procedures below:

```

-----
A Beatriz -----
----- assou -----
----- a pizza -----

```

----- e -----
 ----- a Carla -----
 ----- o bolo -----
 ----- de limão -----
 ----- pro lanche.

A yes-no comprehension question appeared after the presentation of each sentence. For the experimental sentences, the comprehension question always asked some information mentioned in the second conjunct (e.g., *A Carla assou uma pizza pro lanche? / Did Carla bake a pizza for snack?*). This was relevant to evaluate whether the participants were able to identify and resolve the ambiguity and the ellipsis in gapping sentences. The experimental sentences appeared in an individually randomized order. Each participant was exposed to an equal number of items in each condition over the experiment in a Latin-square design. The task took approximately 10 minutes to be totally completed.

Participants

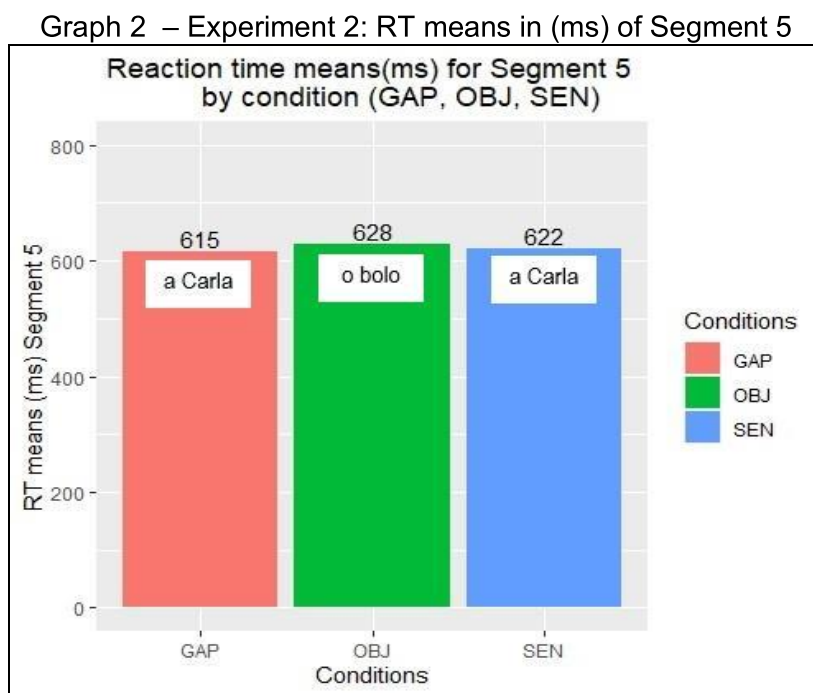
The participants were twenty-eight native BP speakers. Four participants were excluded from the final sample because they did not perform accurately at answering the comprehension questions. All participants gave their consent to take part in the experiment. They were randomly and equally divided into three groups by the PClbex platform.

5.2.2 Results and Discussion

The PClbex recorded reading times (RTs) of each segment for all of the sentences as well as the answers given to the comprehension questions. The experimenters analyzed only segments 5, 6 and 7. Segment 8 was not

analyzed due to sentence wrap-up¹⁷ effects. RTs under 200ms and above 2000ms were dropped from the analysis.

Graph 2 shows RT means for segment 5 of the three conditions. RT means of GAP were faster (615ms) than those of OBJ condition (628ms) and SEN condition (622ms), -13ms and -7ms respectively.

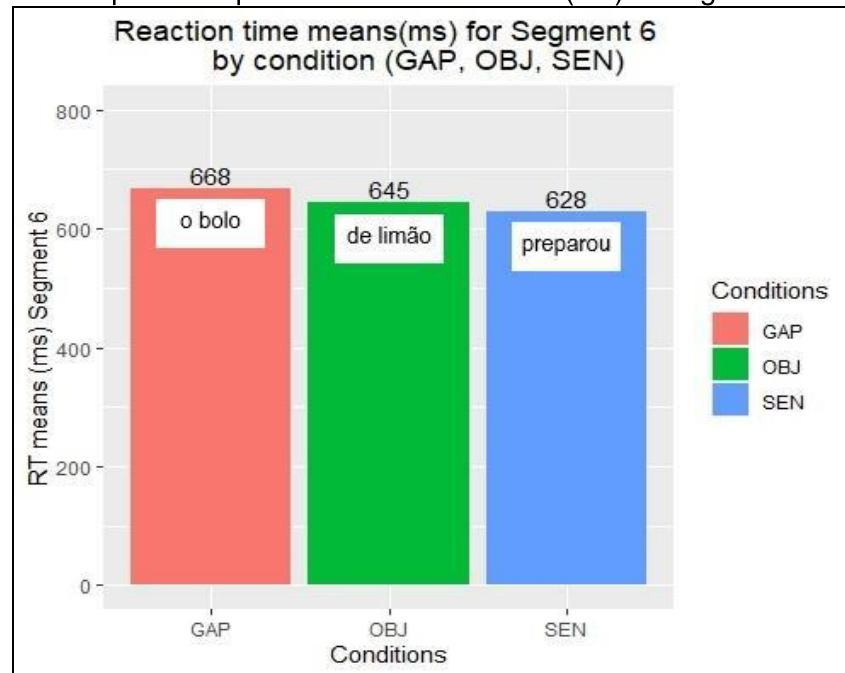


Source: the author (2021).

Graph 3 shows RT means for segment 6 of the three conditions. It is possible to observe that GAP condition had slower RTs (668ms) than OBJ condition (645ms) and SEN condition (628ms); respectively +23ms and +40ms.

¹⁷ Participants usually take more time to press a button at the end of a sentence, thus the measure of the last segment is not a reliable reflection of the actual amount of reading time spent (JIANG, 2012).

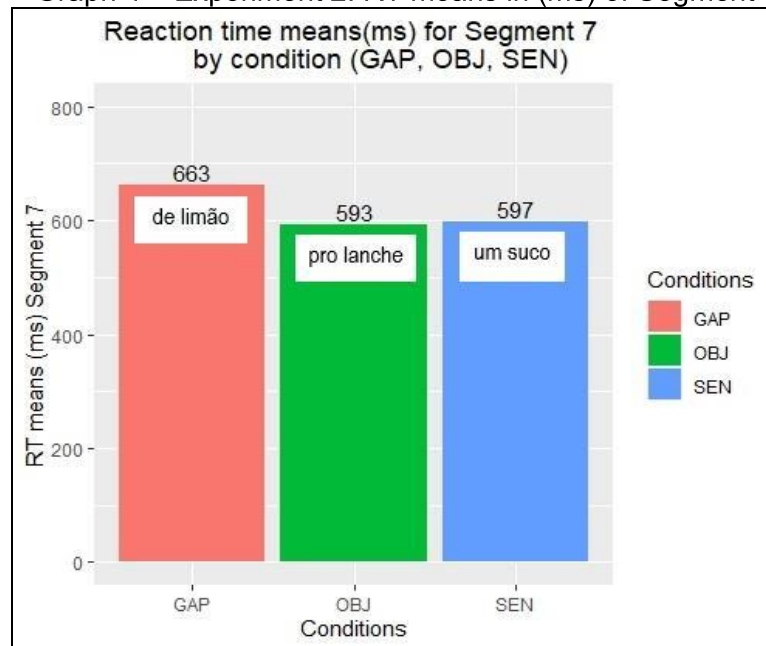
Graph 3 – Experiment 2: RT means in (ms) of Segment 6



Source: the author (2021).

Graph 4 shows RT means for segment 7 of the three conditions. GAP condition remains with the slowest RT means (663ms) in comparison to OBJ condition (593ms) and SEN condition (597ms); +70ms and +66ms respectively.

Graph 4 – Experiment 2: RT means in (ms) of Segment

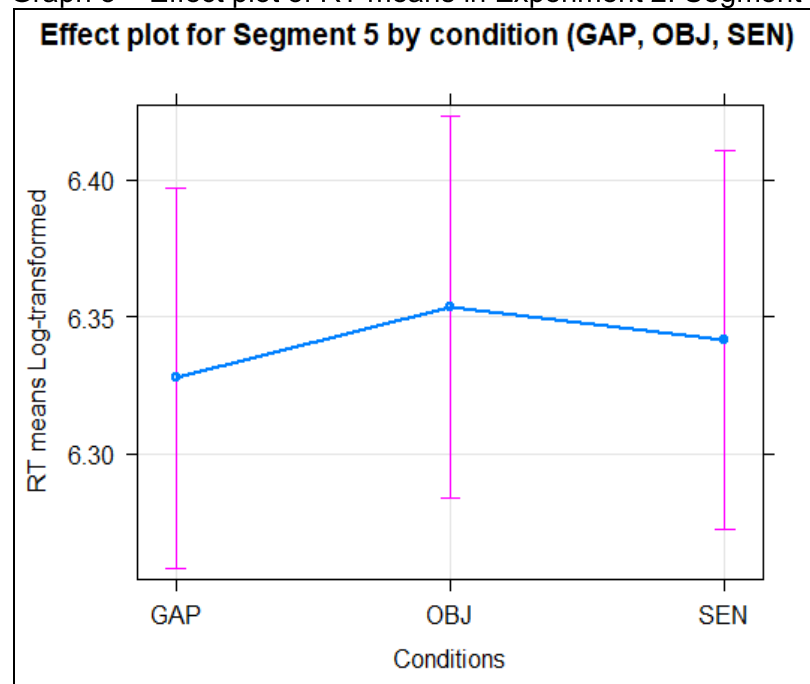


Source: the author (2021).

Obtained data were analyzed using linear mixed effects regression models (BAYEN, 2008; BAYEN *et al.*, 2008), using RStudio software version 4.0.5 (R CORE TEAM, 2021), with the packages *lme4* and *lmerTest*. Each model included log-transformed reading times as a function of condition type (GAP, OBJ and SEN) as fixed effects, and participants and items as random effects.

The RT means of the three critic segments were log-transformed and submitted to Kolmogorov-Smirnov and Levene statistical tests; both presented satisfactory results. The linear mixed effect model for Segment 5 did not reveal any significant statistical differences between the conditions since the RTs means were quite similar across the conditions: GAP x OBJ ($\beta = 0.03$, CI = [-0.07 ~ 0.12], SE = 0.049, $t = 0.534$, $p = .59$) and GAP x SEN: ($\beta = 0.03$, CI = [-0.08 ~ 0.11], SE = 0.049, $t = 0.268$, $p = .79$). See the effect plot graph for segment 5 of the three conditions:

Graph 5 – Effect plot of RT means in Experiment 2: Segment 5

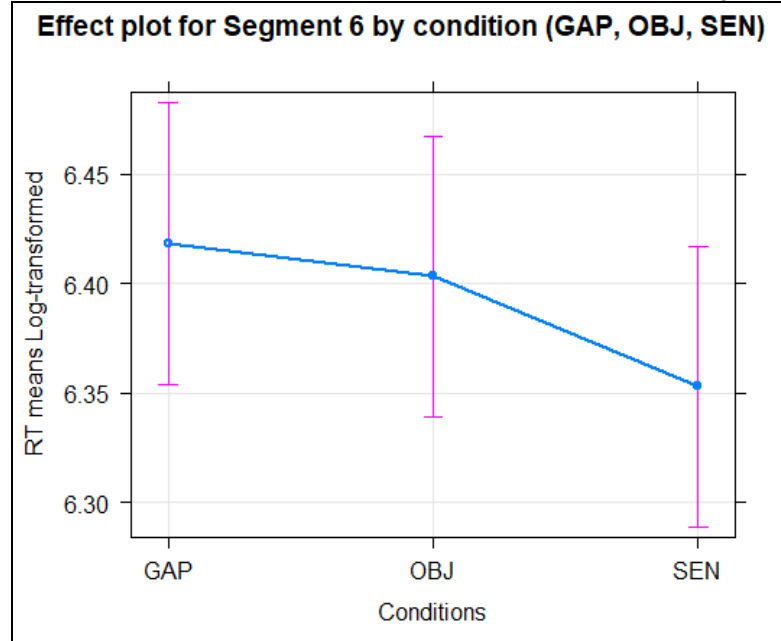


Source: the author (2021).

The linear mixed effect model for Segment 6 did not reveal any significant statistical differences between the conditions as well: GAP x OBJ ($\beta = -0.02$, CI = [-0.10 ~ 0.07], SE = 0.043, $t = -0.350$, $p = .72$) and GAP x SEN: ($\beta = -0.02$, CI = [-0.10 ~ 0.07], SE = 0.043, $t = -0.350$, $p = .72$) and GAP x SEN: ($\beta = -0.02$, CI = [-0.10 ~ 0.07], SE = 0.043, $t = -0.350$, $p = .72$)

= -0.07, CI = [-0.15 ~ 0.02], SE = 0.043, $t = -1.544$, $p = .12$). See the effect plot graph below:

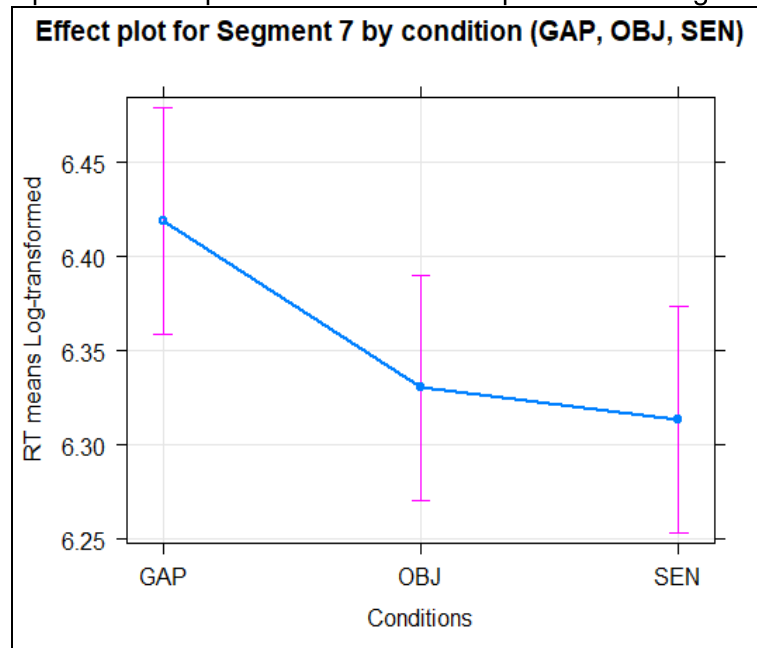
Graph 6 – Effect plot of RT means in Experiment 2: Segment



Source: the author (2021).

Only the linear mixed effect model for Segment 7 revealed significant results. There was a marginal statistical difference between GAP and OBJ conditions ($p = .058$) while there was a significant statistical difference between GAP and SEN conditions ($p = .03$). Graph 7 shows the effect plot with the differences between the three conditions. Table 6 brings a summary of the statistical analysis.

Graph 7 – Effect plot of RT means in Experiment 2: Segment 7



Source: the author (2021).

Table 6 – Statistical analysis for Segment 7 of Experiment 2

Log RT Segment 7			
<i>Predictors</i>	<i>Estimates</i>	<i>CI</i>	<i>p</i>
(Intercept)	6.42	6.32 – 6.52	<0.001
condition [OBJ]	-0.09	-0.18 – 0.00	0.058
condition [SEN]	-0.10	-0.20 – -0.01	0.030
Random Effects			
σ^2	0.09		
τ_{00} item	0.01		
τ_{00} participant	0.03		
ICC	0.30		
$N_{\text{participant}}$	24		
N_{item}	54		
Observations	426		
Marginal R^2 / Conditional R^2	0.016 / 0.308		

Source: the author (2021).

The results suggest that sentences in GAP condition seem to have been more difficult to process in comparison to sentences in OBJ and SEN

conditions. No processing difficulties were observed when participants read segment 5, which is the temporary ambiguous DP (*a Carla*) in GAP and SEN conditions, and the conjoined object DP (*o bolo / a cake*) in OBJ condition. The animate proper noun (*a Carla*), an implausible direct object for the verb, was read faster than the inanimate conjoined object (*o bolo / a cake*). This could sign those readers promptly used the thematic role information of the DP to avoid a garden-path effect. Or it could mean that processing costs would still emerge in spillover effects in the two succeeding segments. The segment 6 in GAP condition (*o bolo / a cake*) had an increase of 53ms when the ellipsis site was found. The RT means remained similar in segment 7 (*de limão / 'of lemon'*) as well, it dropped from 668ms to 663ms (-5ms) only. There might have been a spillover effect of ellipsis resolution from segment 6 to segment 7. Participants might have used the delay strategy (YOSHIDA, 2018) to resolve the ellipsis. They identified an ellipsis site in segment 6 but waited for more bottom-up information become available (the object modifier *de limão / 'of lemon'*) to decide that the direct object DP (*o bolo / a cake*) was part of an elliptical structure. In SEN condition, there was an increase of only 6ms from segment 5 to segment 6. Participants seem to have rapidly used the thematic role information and recognized the ambiguous DP (*a Carla*) as the subject of a new clause. This was confirmed when they saw the disambiguating verb (*preparou / made*) in segment 6. This could also explain why RT means dropped from 628ms in segment 6 to 597ms in segment 7. For sentences in OBJ condition, no processing costs were expected since this structure is the simplest in terms of syntactic nodes. There were no spillover effects in segments 6 and 7 as observed in GAP condition.

The results partially confirm the first prediction. The conjunction reduction sentences seem to be less costing to process than the gapping sentences, but the difference between them was only marginally significant in segment 7. The results found for SEN and GAP conditions seem to corroborate with Trueswell *et al.* (1994) and they confirm the third prediction, thematic role information seems to have been strong enough to avoid processing difficulties. No spillover effects were found for SEN condition. With regard to GAP condition, it is possible that the thematic information was strong enough to avoid a garden-

path effect and the RT increases in segment 6 and segment 7 (spillover effect) is only a reflection of ellipsis resolution. This might indicate that readers used the delay strategy and waited for more information become available to resolve the ellipsis site.

5.3 Experiment 3: Reading and Eye-Tracking – Biasing Context

This experiment explores the moment-by-moment processing of globally ambiguous gapping sentences such as “*A Maria visitou a Sara/a obra nas férias e a Carla no feriado de Carnaval*” (Maria visited Sara/the construction on vacation and Carla on Carnival holiday). In this type of sentence, the DP in the second conjunct (*a Carla*) has two possible readings, an object interpretation (conjunction reduction structure) or a subject interpretation (gapping structure). In an object reading, the DP *a Carla* is a conjoined object of the verb (*visitou*), while in a subject reading this DP is the subject of a new clause and there is elision of the VP (*visitou a Sara/a obra*).

The two previous experiments, one off-line and another online, showed a strong preference for the object reading due to structural simplicity. However, it is possible that contextual factors may be in part responsible for the dispreference for a subject reading of these potentially gapping sentences. Pragmatic information, such as biasing contexts, can help to make gapping structure the interpretation of choice (KELLER, 2001; HOEKS *et al.*, 2009). The relevance of including a previous context is that it can in part determine what will be the most likely topic of the following sentence. Most of the time the topic provides information about the subject of the sentence. Therefore, a previous context can prepare the way for the presence of two topics (i.e., subjects) in the target sentence and, as a consequence, processing difficulties might be reduced (HOEKS *et al.*, 2009). Another important feature is the semantic parallelism between arguments in the two conjuncts, the processor tends to attribute similar syntactic roles to DPs that are semantically similar (CARLSON, 2002). Thus, when an ambiguous DP in a potentially gapping sentence is more subject-like rather than object-like, it might receive more subject readings than object readings.

Taking those aspects into account, the present study investigates the role of semantic parallelism (i.e., definiteness, animacy, form, gender etc.) between DPs in the two conjuncts and biasing contexts (subject or object reading) in the processing of potentially gapping sentences. This experiment aims to answer two research questions: when semantic parallelism and context bias a gapping structure, does it become the interpretation of choice? On the other hand, when both cues conflict, which one is more influential in deciding the final interpretation, the semantic parallelism or the biasing context?

The hypotheses of this study are: (i) the context help determine the topic(s) of the succeeding sentence; and (ii) DPs that share semantic features appear in similar structural positions within their respective clauses. If both context and semantic parallelism influence the interpretation of potentially gapping sentences, there will be more interpretation choices of subject reading (i.e., gapping structure) when both context and parallelism bias a sentence with two subjects, and there will be more interpretation choices of object readings when context and parallelism bias a sentence with conjoined objects (i.e., conjunction reduction structure). If the biasing context is more influential than semantic parallelism, it will determine the final interpretation when both cues conflict. On the other hand, if semantic parallelism is more influential, the semantic feature of the ambiguous DP will determine the final interpretation when both cues conflict. With regard to the time-course processing of these sentences, if both context and semantic parallelism can bias the interpretation, longer fixation times and more regressions will occur in the second clause of gapping sentences with conflicting cues.

5.3.1 Method

Materials

Stimuli consisted of twenty-four sets of sentences constructed in a 2x2 within-subjects factorial design: Context (Subject versus Object) and Semantic Parallelism (Subject versus Neutral) were manipulated as independent factors. The experimental sentences were constructed with the following syntactic

structure: the first conjunct contains subject, verb, object and PP; whereas the second conjunct contains two remnants, a DP that can be understood as a subject or as an object, and a final PP. In one sentence type, semantic parallelism was manipulated to be neutral, that is, subject and object of the first conjunct and the ambiguous DP of the second conjunct share the same semantic features: they are proper nouns of the same gender (feminine or masculine proper noun). Thus, the ambiguous DP in the second conjunct is parallel to both the subject and the object. The other sentence type was designed to bias subject reading. Subject and ambiguous DP are proper nouns of the same gender, whereas the object in first conjunct is a non-human DP. Thus, the ambiguous DP in the second conjunct is more parallel to the subject in the first conjunct than to the object. See examples of the two sentence types, the first one has DPs with neutral parallelism while the second one has subject parallelism; the parallel DPs are underlined.

- (53) *A Maria visitou a Sara nas férias e a Carla no feriado de Carnaval.*
Maria visited Sara on vacation and Carla on Carnival holiday.
- (54) *A Maria visitou a obra nas férias e a Carla no feriado de Carnaval.*
Maria visited the construction on vacation and Carla on Carnival holiday.

In order to bias a subject or an object reading, biasing contexts matching one of the two interpretations were created. They were simple statement sentences. By crossing context and the two sentence types, four conditions were created, named as follows: Subject Context, Neutral Parallelism (SCNP); Object Context, Neutral Parallelism (OCNP); Subject Context, Subject Parallelism (SCSP); Object Context, Subject Parallelism (OCSP). Comprehension questions were also elaborated for a forced-choice task, they inquired information about the second conjunct, and two paraphrases were provided; one paraphrase pointed towards the subject interpretation and the other towards the object interpretation. A sample set of stimuli is given below;

the parallel DPs are underlined (c.f., Appendix 3 for a complete list of the experimental sentences).

(55) Sample set of conditions

(a) **Subject Context, Neutral Parallelism (SCNP)**

SC: *Fazia tempo que a Maria e a Carla não viam a amiga Sara.*

It's been a long time since Maria and Carla had seen their friend Sara.

NP: *A Maria visitou a Sara nas férias e a Carla no feriado de Carnaval.*

Maria visited Sara on vacation and Carla on Carnival holiday.

(b) **Object Context, Neutral Parallelism (OCNP)**

OC: *Fazia tempo que a Maria não via as amigas Sara e Carla.*

It's been a long time since Maria had seen her friends Sara and Carla.

NP: *A Maria visitou a Sara nas férias e a Carla no feriado de Carnaval.*

Maria visited Sara on vacation and Carla on Carnival holiday.

(c) **Subject Context, Subject Parallelism (SCSP)**

SC: *Maria e Carla estão construindo uma casa.*

Maria and Carla are both having a house built.

SP: *A Maria visitou a obra nas férias e a Carla no feriado de Carnaval.*

Maria visited the construction on vacation and Carla on Carnival holiday.

(d) **Object Context, Subject Parallelism (OCSP)**

OC: *Maria é engenheira e é amiga de Carla.*

Maria is an engineer and she's friends with Carla.

SP: *A Maria visitou a obra nas férias e a Carla no feriado de Carnaval.*

Maria visited the construction on vacation and Carla on Carnival holiday.

It is worth to mention that the experimental sentences were controlled for number of syllables, the manipulated DPs had three syllables and the final PPs in the second conjunct had around eight or nine syllables.

Conditions SCNP and OCNP can reveal the role played by the context itself, since the semantic parallelism does not clearly bias a particular interpretation. The neutral parallelism between DPs might slightly bias an object reading due to the local attachment bias that will lead to the structural simplicity of the sentence. Condition SCSP explores the combination of semantic parallelism and context, both cues point towards a subject reading. This condition explores whether context along with parallelism is able to make gapping interpretation the most preferred. Condition OCSP has a certain mismatch between context and semantic parallelism, the context favors object reading whereas the parallelism favors subject reading. This condition can reveal which factor has more weight, context or parallelism.

The second conjunct of conditions in which context and DP parallelism match – SCSP and OCNP – are expected to be processed faster than conditions in which context and DP parallelism do not point towards the same direction – SCNP and OCSP. Condition OCNP is expected to be the easiest one to process, since context and parallelism are more favorable to the object interpretation, which is strongly preferred by readers. Condition SCSP might also be easier and faster to process than the SCNP and OCSP conditions, since the context and parallelism clearly favors subject interpretation. SCNP and OCSP are expected to be more difficult to process and to have longer fixation times than OCNP and SCSP conditions if the possible mismatch between context and DP parallelism is perceived by readers.

With regard to the interpretation responses, most subject interpretation choices are expected for SCSP condition, since context and parallelism bias this interpretation. Condition OCNP, in which context and parallelism favor the object reading, is expected to receive more object reading responses than subject reading responses. Condition SCNP is expected to receive more subject reading responses than object reading responses if context has more weight than the parallelism in processing, and vice-versa. Finally, condition OCSP is expected to receive more object reading responses than subject

reading responses if context has more weight than the parallelism in processing, and vice-versa.

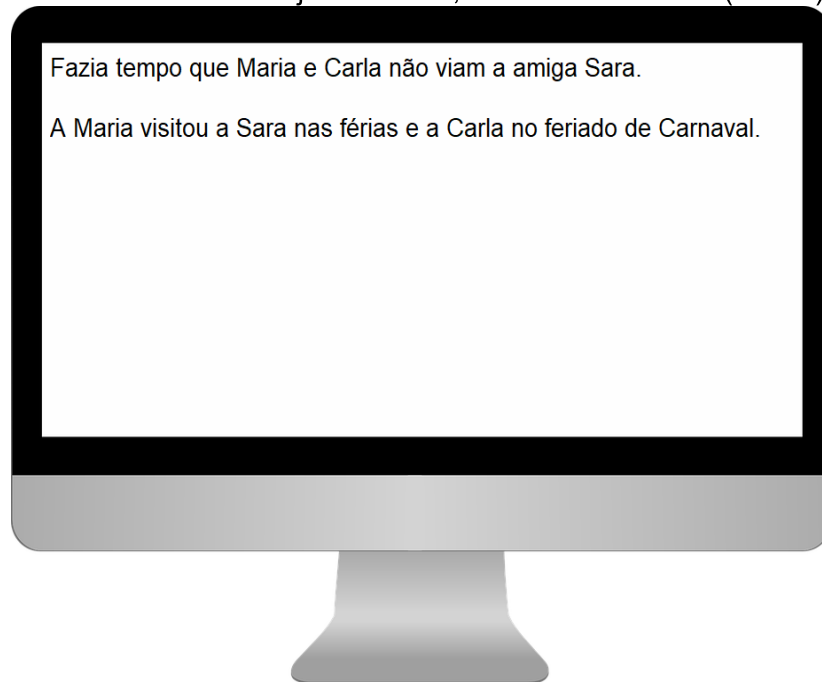
The experimental sentences were interspersed with another twenty sentences from an unrelated experiment, and with more sixteen unrelated sentences. In the task, each participant read sixty sentences in total. Trials were randomized in Latin-square design. The position of subject and object paraphrases to the comprehension questions were counterbalanced, half of the time on the left (option A) and the other half on the right (option B).

Procedures

The experiment was carried out on an SR Research Eyelink 1000 eye-tracker. Participants' head was stabilized with a tower mount of the eye-tracker. Subjects were calibrated before beginning the experiment with a five-point calibration system. They were given a short practice session to illustrate the task. They were instructed to read silently at a comfortable pace.

First, the biasing context sentence (subject or object bias) appeared along with a potentially gapping sentence (neutral or subject parallelism between DPs). Participants were instructed to read both sentences and to press a button when they had understood and finished reading both sentences. Figure 15 shows the first computer screen presentation of a trial in SCNP condition.

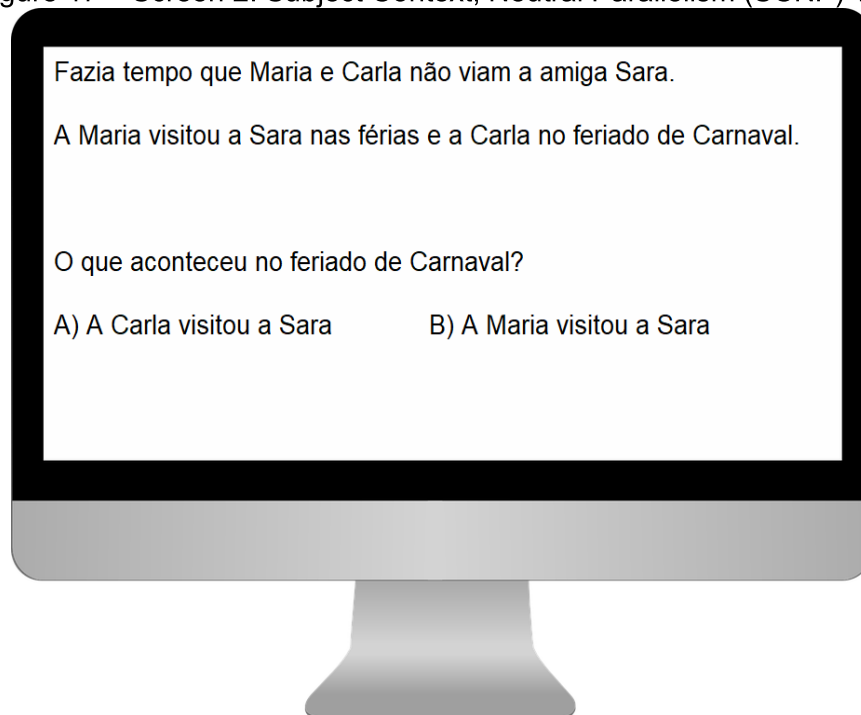
Figure 16 – Screen 1: Subject Context, Neutral Parallelism (SCNP) Trial



Source: the author (2021).

When participants decided to press the button, a comprehension question (*O que aconteceu no feriado de Carnaval? / What happened on Carnival holiday?*) followed by two paraphrases (options A and B) appeared on the screen; one biasing subject interpretation (*A Carla visitou a Sara / Carla visited Sara*) and the other biasing object interpretation (*A Maria visitou a Sara / Maria visited Sara*). The context sentence and the target sentence were kept on the screen along with the question and the two options. Thus, participants could reread the context sentence and the target sentence how many times they judged it was necessary before answering the question. They had to choose between options A and B and press a button to choose it. The eye-tracker recorded eye movements during reading and the answer chosen. Figure 16 shows the second computer screen presentation of a trial in SCNP condition. Subject interpretation paraphrase is on the left while the object interpretation paraphrase is on the right.

Figure 17 – Screen 2: Subject Context, Neutral Parallelism (SCNP) Trial



Source: the author (2021).

Participants

The participants were thirty-six native speakers of BP, undergraduate students at the Universidade Federal do Rio de Janeiro (UFRJ). They were compensated with a certificate of participation for extracurricular activities. Eight participants were excluded from the final data for not completing the task accurately or due to problems with calibration. All participants reported normal or corrected to normal vision. They also signed a term of consent and volunteered to take part in the experiment. They were randomly and equally divided into four groups.

5.3.2 Results and Discussion

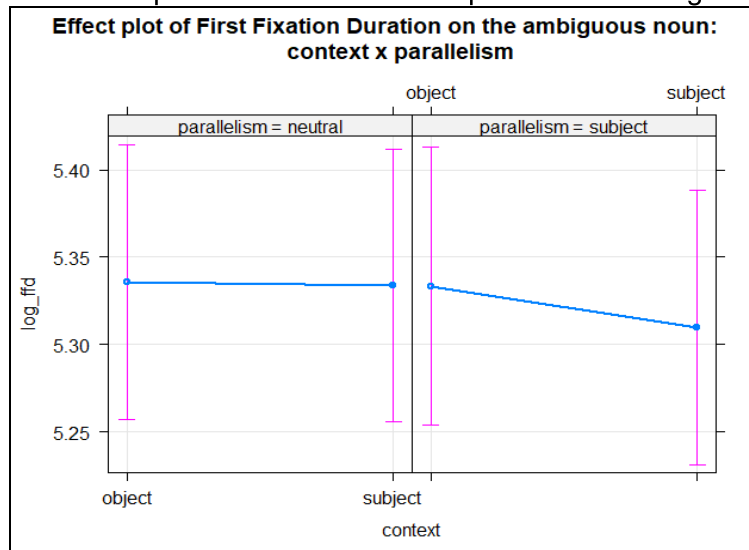
The analyzed regions of interest (ROIs) of the target sentences were the ambiguous DP (*a Carla*) and the final PP (*no feriado de Carnaval*) in the second conjunct. The analyzed eye-tracking measures for both ROIs were first fixation duration (FFD), total fixation duration (TFD), fixation count (FC) and regression path duration (RPD).

Obtained data were analyzed using linear mixed effects regression models (BAYEN, 2008; BAYEN *et al.*, 2008), using RStudio software version 4.0.5 (R CORE TEAM, 2021), with the packages *lme4* and *lmerTest*. Each model included log-transformed reading times as a function of condition type as fixed effects, and participants and items as random effects. The RT means were log-transformed for the purpose of normality.

With regard to the ambiguous noun (*a Carla*), the mismatch condition OCSP had the slowest fixation times (TFD and RPD measures) and the highest number of fixations (FC measure) in comparison to the other three conditions. For FFDs, RTs under 80ms and above 600ms were dropped from the analysis. As for TFDs, RTs under 80ms and above 2000ms were dropped from the analysis. As for RPDs, RTs under 80ms and above 4000ms were dropped from the analysis. And for FCs, the outliers dropped from the analysis were fixations with values equal to 0 and those above 12.

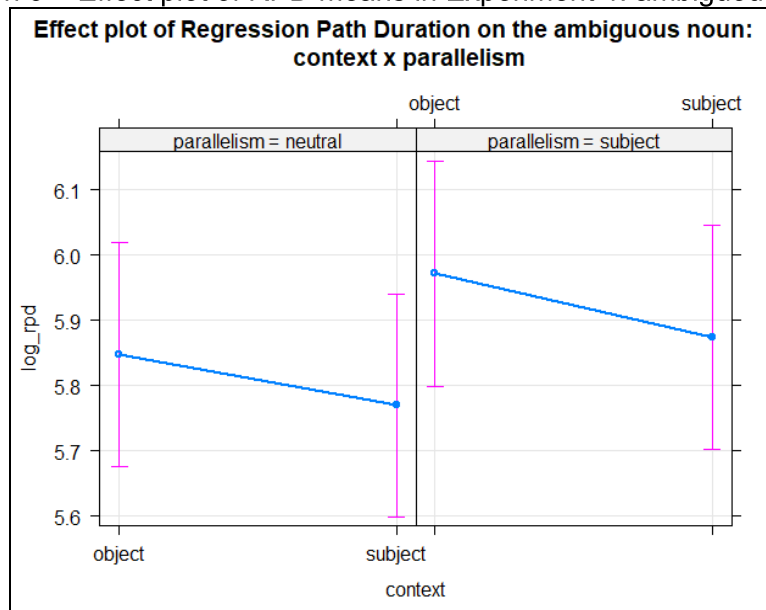
The analyses of FFD and RPD measures were not statistically significant. FFD average RTs were quite similar across conditions, thus no effect of context ($p = .95$) or parallelism ($p = .94$) or interaction between context and parallelism ($p = .67$) were observed. The OCSP condition had the slowest RPD averages across conditions, but no effect of context ($p = .33$) or parallelism ($p = .13$) or interaction between context and parallelism ($p = .86$) were observed. The graphs below show the effect plot for FFD and RPD averages.

Graph 8 – Effect plot of FFD means in Experiment 4: ambiguous noun



Source: the author (2021).

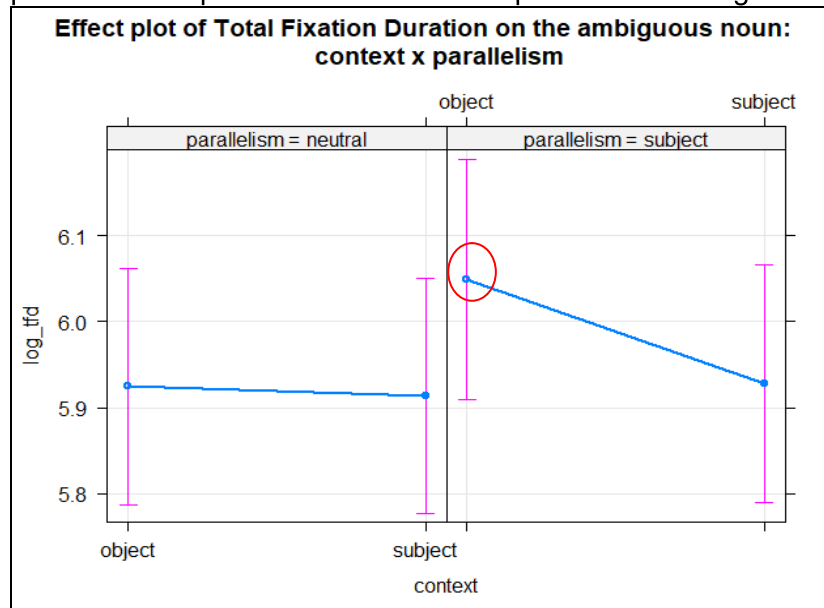
Graph 9 – Effect plot of RPD means in Experiment 4: ambiguous noun



Source: the author (2021).

The analyses revealed statistically significant results only for TFD and FC measures. For TFDs, there was a marginal effect of semantic parallelism, the ambiguous noun in OCSP condition was read slower than in the other conditions: $\beta = 0.12$, $SE = 0.069$, $t = 1.796$, $CI [-0.01 \sim 0.26]$, $p = 0.07$. No effect of context was found ($p = .88$) and no interaction between context and parallelism was found either ($p = .25$). The graph below shows the effect plot for TFD averages.

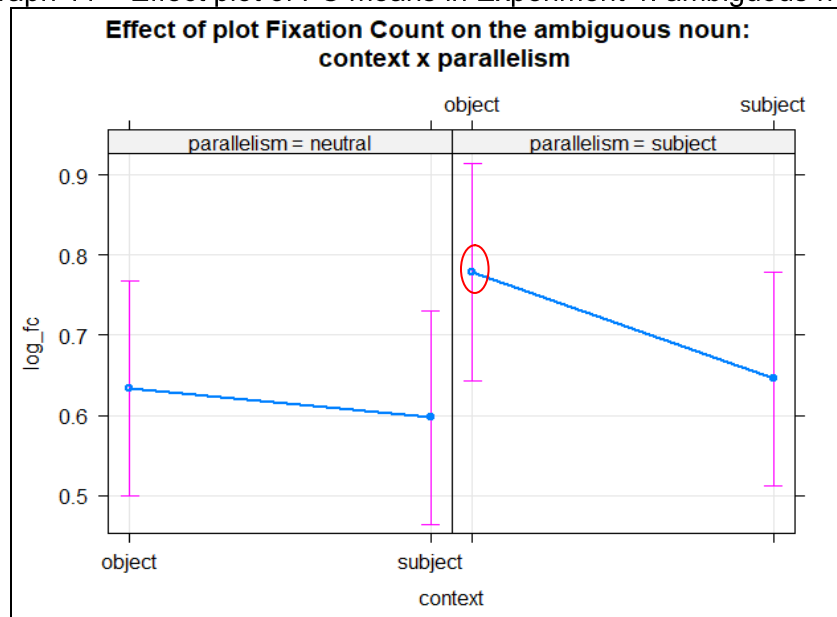
Graph 10 – Effect plot of TFD means in Experiment 4: ambiguous noun



Source: the author (2021).

As for FCs, a significant effect of parallelism was found, the ambiguous noun in OCSF condition received more fixations than in the other conditions: $\beta = 0.15$, $SE = 0.063$, $t = 2.304$, $CI [0.02 \sim 0.27]$, $p = 0.02$. No effect of context was found ($p = .55$) and no interaction between context and parallelism was found either ($p = .27$). The graph below shows the effect plot for FC averages.

Graph 11 – Effect plot of FC means in Experiment 4: ambiguous noun

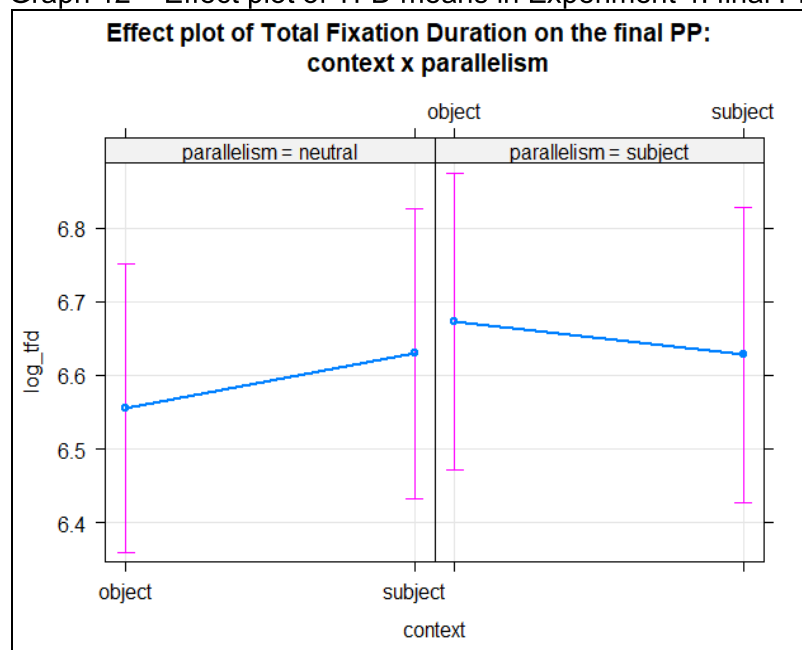


Source: the author (2021).

In relation to the final PP (*no feriado de Carnaval*), the conditions in which context and semantic parallelism pointed to different interpretations, OCSP and SCNP, had slower TFD and RPD averages in comparison to OCNP and SCSP conditions. For TFDs, RTs under 100ms and above 4000ms were dropped from the analysis. As for RPDs, RTs under 100ms and above 10,000ms were dropped from the analysis. And for FCs, the outliers dropped from the analysis were fixations with values equal to 0 and those above 20.

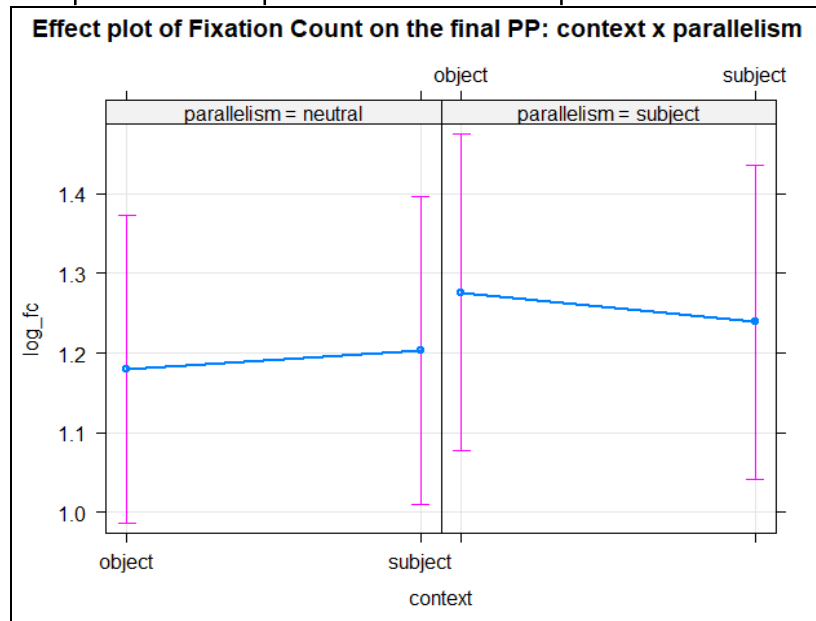
Although the conditions OCSP and SCNP had the slowest TFD averages, no effects of context ($p = .29$) or parallelism ($p = .10$) were found. No interaction between semantic parallelism and context was found either ($p = .24$). The graph below shows the effect plot for TFD averages. The condition OCSP also had the highest number of fixations, but no effects of context ($p = .72$) or parallelism ($p = .16$) were found. No interaction between semantic parallelism and context was found either ($p = .53$). The graphs below show the effect plot for TFD and FC averages.

Graph 12 – Effect plot of TFD means in Experiment 4: final PP



Source: the author (2021).

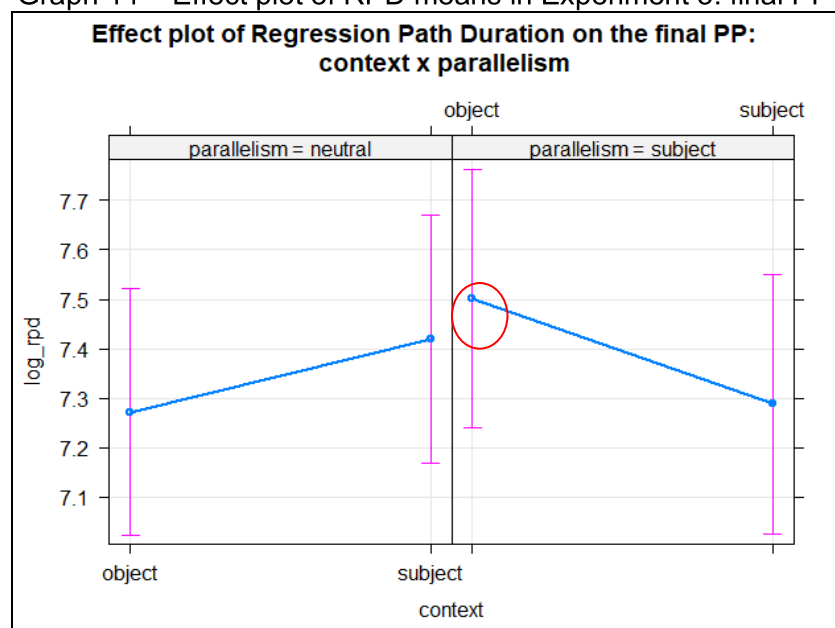
Graph 13 – Effect plot of FC means in Experiment 3: final PP



Source: the author (2021).

The analysis revealed statistically significant results only for the RPDs. The conditions OCSP and SCNP had slower RPD averages in comparison to OCNP and SCSP conditions. There was an effect of parallelism: $\beta = 0.23$, $SE = 0.093$, $t = 2.451$, $CI [0.05 \sim 0.41]$, $p = 0.01$; and an interaction between context and parallelism: $\beta = -0.36$, $SE = 0.133$, $t = -2.708$, $CI [-0.62 \sim -0.10]$, $p < 0.01$. No effect of context was found ($p = .10$). The graph below shows the effect plot for the RPD averages on the final PP.

Graph 14 – Effect plot of RPD means in Experiment 3: final PP



Source: the author (2021).

The biasing contexts were also analyzed as a single ROI for FFD, TFD, FC and RPD eye-tracking measures, but no statistically significant results were encountered. For that reason, they are not reported here.

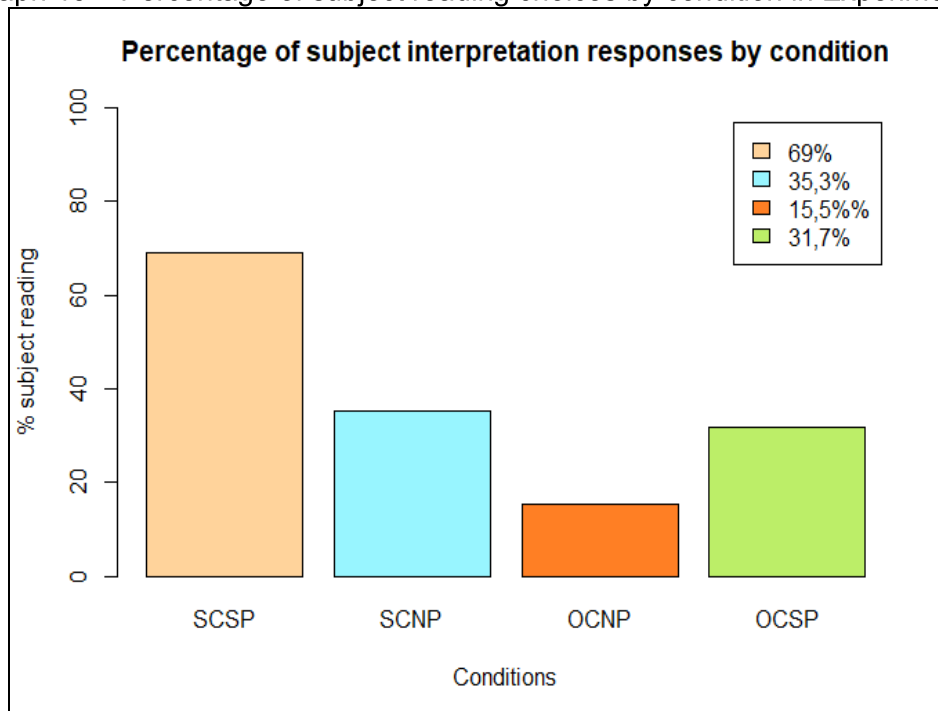
The interpretation choices to the comprehension questions were also analyzed. Participants chose between subject and object paraphrases. Table 7 shows the amount of object and subject reading responses chosen in each condition, while graph 15 reports the percentage of subject interpretation responses in each condition:

Table 7 – Number of object responses and subject responses chosen in each condition in Experiment 3

Condition	Object Responses	Subject Responses	Sum
SCSP	50	111	161
SCNP	108	59	167
OCNP	142	26	168
OCSP	110	51	161
	410	247	657

Source: the author (2021).

Graph 15 – Percentage of subject reading choices by condition in Experiment 3



Source: the author (2021).

The results revealed that SCSP condition, in which both context and parallelism biased a subject interpretation, had the highest rate of subject responses (69%), followed by SCNP condition (35.3%), in which only the context favored a subject interpretation. The OCSP condition, in which there was a mismatch between context and parallelism, had a considerable rate of subject responses (31.7%). Finally, the OCNP condition, in which context and parallelism did not bias a subject interpretation, received the least rate of subject responses (15.5%) among the four conditions.

The data for the responses to the comprehension questions were analyzed in RStudio (R CORE TEAM, 2021) with a linear mixed-effects regression model using the *glmer* function from the *lme4* package because the data were binomial. The model included given responses as a function of condition type as fixed effects, and participants and items as random effects. The statistical analysis revealed significant statistical differences of given responses between SCSP and the other conditions; a report of the statistical is given on the table below.

Table 8 – Statistical analysis for Comprehension Questions Responses of Experiment 3

<i>Predictors</i>	Comprehension Question Responses		
	<i>Odds Ratios</i>	<i>CI</i>	<i>p</i>
(Intercept)	2.52	1.55 – 4.10	<0.001
condition [SCNP]	0.20	0.12 – 0.33	<0.001
condition [OCNP]	0.06	0.03 – 0.10	<0.001
condition [OCSP]	0.17	0.10 – 0.28	<0.001
Random Effects			
σ^2	3.29		
τ_{00} participant	0.71		
τ_{00} item	0.05		
ICC	0.19		
$N_{\text{participant}}$	28		
N_{item}	24		
Observations	657		

Marginal R^2 / Conditional R^2 0.206 / 0.355
 Source: the author (2021).

The mismatch between context and semantic parallelism in OCSP condition was noticed by participants, and this reflected on the increased number of fixations and the total reading times on the ambiguous noun (*a Carla*). This is also evidenced on the final PP (*no feriado de Carnaval / on the Carnival holiday*), which had the longest RPD averages among the four conditions. The RPD averages suggest that readers needed to look for information in previous parts of the target sentence, or even in the context sentence, to interpret the second conjunct of the ambiguous gapping sentence. The context biased conjoined objects that were not semantically parallel, the ambiguous DP (*a Carla*) was more parallel to the subject of the first conjunct (*a Maria*) than to the non-human object DP (*a obra / the construction*). The eye-tracking measures suggest that OCSP condition was more costly to parse among the four conditions. The SCNP condition also had significantly slower RPD times and this may be because the ambiguous DP (*a Carla*) was semantically parallel to both the subject (*a Maria*) and the object (*a Sara*) DPs in the first conjunct; all of them are human nouns.

The results of interpretation choices revealed that a subject interpretation (gapping structure) is the mostly preferred reading only when context and parallelism bias a subject reading of the ambiguous DP (SCSP condition). When context and semantic parallelism conflict (OCSP condition), the context seemed to be more decisive in the final interpretation. However, some aspect of semantic parallelism seems to be noticed by readers due to a considerable rate of subject readings observed in that condition. Some participants might have found awkward having non-parallel DPs, a non-human noun and a human noun (*a obra e a Carla / the construction and Carla*), conjoined within the same VP (*visitou / visited*). In SCNP condition, despite the presence of a subject biasing context, readers still preferred the object reading. As parallelism was neutral, the structural factor might have had more influence, since the object reading is the simplest syntactic structure.

Another possible explanation is related to the design of the contexts. Some of the context sentences did not introduce the three referent DPs of the

target sentence. Therefore, some contexts were not clearly biasing a subject reading of the target sentence as intended. As mentioned before, the context should help determining the probable topics of the sentence (i.e., a situation of X [Topic 1] and Y [Topic 2] doing something to Z, or X [Topic 1] doing something to Y and Z). This lack of pattern across context sentences might have led to difficulties in considering the context helpful to interpret some sentences of SCNP condition as a gapping structure. In future research, it would be relevant to replicate this study with a more balanced design of the context sentences. By using non-parallel but still animate DPs in the target sentences, such as *a Sara* versus *o(a) dentista / the dentist*, instead of an inanimate DP (*a obra / the construction*), for instance, might result in more similar contexts for biasing subject and object readings.

Overall, the results suggest that both context and semantic parallelism are relevant cues in the online processing of potentially gapping sentences. When both context and semantic parallelism are combined to bias a subject reading, gapping syntactic structure becomes the most preferred interpretation choice.

5.4 Summary

This chapter introduced three experiments that studied written gapping sentences in BP. Experiments 1 and 2 investigated gapping sentences with temporary ambiguity in a written questionnaire and a self-paced reading task, respectively. Experiment 3 explored gapping sentences with global ambiguity in a reading task with eye-tracking.

Experiment 1 aimed to find out how acceptable a gapping structure is in comparison to other coordinated sentences. The results showed that BP speakers prefer completing the main clause of coordinated sentences with a conjunction reduction structure rather than a gapping structure or a non-elided structure with coordinated clauses. BP speakers did not consider gapping an ungrammatical syntactic structure, it is just not often their first choice. Experiment 2 investigated the time-course processing of gapping sentences during reading in comparison to other coordinated sentences, conjunction

reduction and non-elided coordinated clauses. The results revealed that gapping sentences were more costly to parse than the other two coordinated sentences. The slower reading times in gapping might have been a reflection of the ellipsis resolution in the second conjunct. Overall, the findings of the two experiments are aligned with the Minimal Attachment Principle (FRAZIER, 1979), the Simple Structure Hypothesis (CARLSON, 2002), and the Principle of Minimal Topic-Structure (HOEKS *et al.*, 2002). Readers prefer a sentence compatible with the simplest syntactic structure (i.e., fewer nodes) and topic-structure (i.e., only one subject).

Experiment 3 explored the manipulation of semantic parallelism between the ambiguous noun in the second conjunct and the subject or the object of the first conjunct, and previous pragmatic contexts that biased subject reading or object reading of the ambiguous noun. The results show that when both cues bias subject interpretation, speakers choose a gapping syntactic analysis for the ambiguous sentence. This study revealed the importance of semantic parallelism and previous pragmatic context in biasing a subject reading of an ambiguous noun in potentially BP gapping sentences. The findings of this experiment are aligned with the Parallelism Hypothesis (CARLSON, 2002) and Principle of Minimal Topic-structure (HOEKS *et al.*, 2002). The semantic parallelism between the ambiguous noun and its intended correlate (i.e., the subject in the first conjunct) helps the parser determine the structural position of the parallel nouns in the sentence. Additionally, the previous context prepared readers for encountering two subjects in the potentially gapping sentences.

The next chapter introduces the studies that investigate the processing of spoken ambiguous gapping sentences in BP and in AE.

CHAPTER 6: Spoken Studies

This chapter reports four spoken experiments that have been carried out in this doctoral thesis. Experiment 4 was a pilot VWP task that combined prosodic and visual cues, aiming to find if both cues help resolving the global ambiguity of gapping sentences. Experiment 5 was an auditory questionnaire that explored the role of prosody itself in the interpretation of globally ambiguous gapping sentences. Three different prosodic structures were tested in this experiment, two biasing prosodic structures and a neutral prosodic version. Experiment 6 was a type of sentence-picture matching task that investigated the manipulation of pragmatic context and prosodic parallelism between DPs. The aim was to find out to what extent these cues influence in choosing the picture that best fits the interpretation of globally ambiguous gapping sentences in BP. Experiment 7 is an English version of the sixth experiment and is part of a cross-language study. The objective was to compare whether native speakers of BP and AE differ in their reliability on prosodic and pragmatic cues to interpret structures that are similar in the two languages.

6.1 Experiment 4: Visual World Paradigm – Pilot

This study is a pilot experiment with the Visual World Paradigm (VWP), designed to explore how prosodic and visual cues can influence the interpretation of potentially gapping sentences in BP. It was manipulated the prosodic parallelism (i.e., type, location and F0 range of pitch accents) between arguments in the two conjuncts along with pictures that bias a subject reading or an object reading. It is known that the manipulation of prosody (i.e., pitch accents) can affect the interpretation of ambiguous gapping sentences in English and Dutch, for instance (c.f. CARLSON, 2002; CARLSON *et al.*, 2005; HOEKS *et al.*, 2009), and also the syntactic attachment in other ambiguous sentences (CARLSON and TYLER, 2018). As almost every prosodic word is pitch accented in BP (FROTA and MORAES, 2016), it is relevant to find out if

BP speakers notice the contrastive accents on the intended DPs and use their prosodic cues to attribute the syntactic structure for potentially gapping sentences.

This study intends to answer two questions. First, when prosody and a biasing picture point to a gapping syntactic structure, does it become the interpretation of choice? Second, when prosody and the biasing picture point to different analysis, which cue is more influential in deciding the interpretation of these potentially gapping sentences, the visual cue or the prosodic structure of the sentence? This experiment has two hypotheses: (i) speakers use prosodic cues to assign the syntactic structure of ambiguous sentences; and (ii) non-linguistic information, such as visual cues, can influence the interpretation of ambiguous sentences. If visual cues and prosodic cues both influence the processing of potentially gapping sentences, there will be more subject reading responses when visual and prosodic cues bias a gapping structure. On the other hand, there will be more object reading responses when visual and prosodic cues bias a conjunction reduction structure. If visual cues are more influential than prosodic cues in resolving the ambiguity, there will be more subject reading responses when the visual cue biases subject interpretation, and there will be more object reading responses when the visual cue biases object interpretation. Nevertheless, if prosody is more influential than visual cues, there will be more subject reading responses when the subject DP of the first conjunct and the ambiguous DP are contrastively accented; and there will be more object reading responses when the object DP of the first conjunct and the ambiguous DP are contrastively accented.

6.1.1 Method

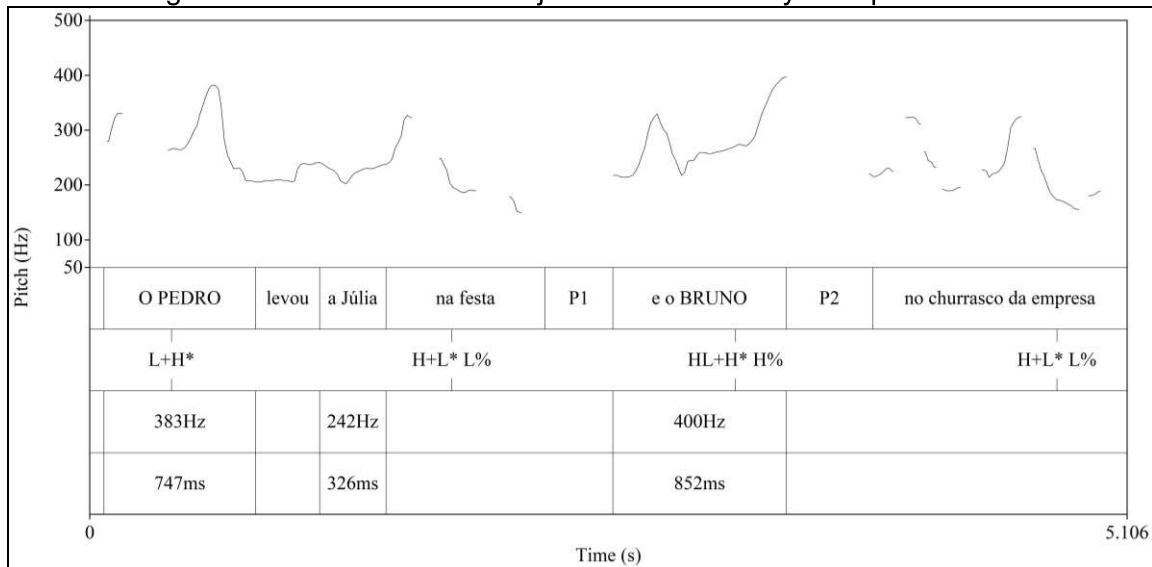
Materials

Only the sentences with neutral parallelism between DPs from Experiment 3 were kept in the present study, sentences such as *A Maria visitou a Sara nas férias e a Carla no feriado de Carnaval* (*Maria visited Sara on vacation and Carla on Carnival holiday*). The reason is to test the role of

prosodic parallelism itself. Stimuli consisted of twenty sets of sentences constructed in a 2x2 within-subjects factorial design: Prosody (Subject Accent versus Object Accent) and Second Conjunct Pictures (Subject bias versus Object bias) were manipulated as independent factors. Stimuli were recorded by a female native speaker of BP from Rio de Janeiro, with training in prosody. They were recorded with cooperating gapping prosody (subjects accented) and cooperating conjunction reduction prosody (objects accented). In the Subject Accent Prosody, the ambiguous DP and the subject DP of the first conjunct are prosodically parallel, being contrastively accented. The final PPs in both conjuncts were also accented (H+L*). In the Object Accent Prosody, the object DP in the first conjunct and the ambiguous DP are prosodically parallel, being contrastively accented. The accented DPs in both prosodic conditions have similar pitch accents (L+H* or HL+H*), and increased duration and intensity as well. Subject Accent Prosody has a low IPh boundary (L%) at the end of the first conjunct and at the end of the utterance, and after the ambiguous DP there is a high IPh boundary (H%). Object Accent Prosody has a low IPh boundary (L%) only at the end of the first conjunct and of the utterance. The final PPs in both conjuncts were also accented (L* on the first PP; H+L* on the second PP).

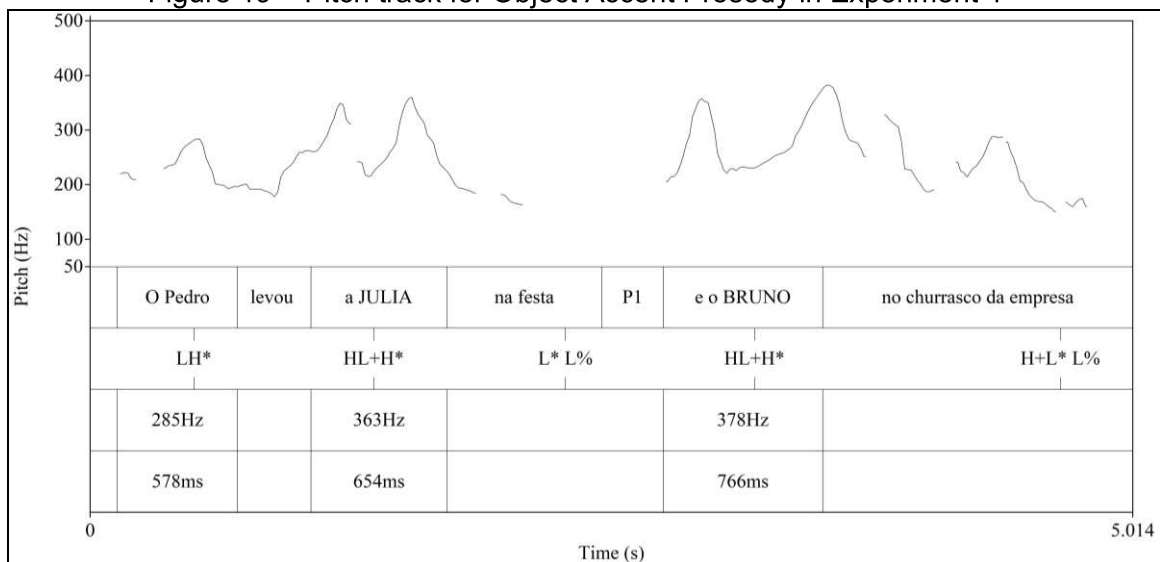
The pitch tracks below show respectively Subject Accent Prosody and Object Accent Prosody for the sentence *O Pedro levou a Júlia na festa e o Bruno no churrasco da empresa* (Pedro took Julia to the party and Bruno to the company barbecue). The capitalized words indicate the focused proper nouns. P1 and P2 means Pause 1 and Pause 2.

Figure 18 – Pitch track for Subject Accent Prosody in Experiment 4



Source: the author (2021).

Figure 19 – Pitch track for Object Accent Prosody in Experiment 4



Source: the author (2021).

In order to verify if the recorded sentences matched the intended prosodic features, all of them were viewed in Praat (BOERSMA and WEENINK, 2003) and analyzed for pitch accents, duration averages in (ms) and F0 peak averages. Any sentences with disfluent productions or recordings with incorrect prosody were re-recorded and reanalyzed. The filler sentences in the experiment were also produced by the same speaker.

F0 measurements show that sentences with Subject Accent Prosody started with high accent (L+H*) on the subject DP, while in the Object Accent

Prosody the subject DP had a simple accent (LH*), typical of beginning of utterances. The subject DPs of subject prosody condition averaged at least 85Hz higher than the subject DPs in the object prosody condition; a significant difference: $\beta = 85.55$, $SE = 8.1$, $df = 95$, $t = 10.568$, $p < .0001$. The focused object DPs in Object Accent Prosody had a contrastive accent (HL+H*) and their counterparts in subject accent prosody were focused. The focused object DPs in the first conjunct averaged at least 127Hz higher than their counterparts in subject prosody condition; a significant difference: $\beta = 127.15$, $SE = 8.1$, $df = 95$, $t = 15.707$, $p < .0001$. The ambiguous DPs were accented (HL+H*) in both prosodic conditions, in subject prosody condition they averaged 18Hz higher than their counterparts in object prosody condition; a non-significant difference: $\beta = 18.35$, $SE = 8.1$, $df = 95$, $t = 2.267$, $p = 0.21$. Table 9 shows the F0 averages for the two prosodic conditions, with the accented peaks on the DPs in boldface type (cf. Appendix 5 for a complete list of F0 peaks on DPs of the experimental sentences).

Table 9 – Average F0 measurements (in Hz) for critical words in Experiment 4.
Averages of accented elements are in bold.

<i>F0 averages (Hz)</i>	<i>Subject</i>	<i>Object</i>	<i>Ambiguous</i>
Subject Accent Prosody	387	267	392
Object Accent Prosody	301	394	374

Source: the author (2021).

The durational averages in Table 10 also support the intended prosodic structures (cf. Appendix 5 for a complete list of duration of DPs in the experimental sentences). The subject DPs were longer in subject prosody condition than in object prosody condition: $\beta = 315.6$, $SE = 24.2$, $df = 95$, $t = 13.053$, $p < .0001$. The focused object DPs in object prosody condition were longer than their counterparts in subject prosody condition: $\beta = 372.4$, $SE = 24.2$, $df = 95$, $t = 15.407$, $p < .0001$. The ambiguous DPs were lengthened in both conditions, but they were a bit longer in subject prosody condition: $\beta = 91.4$, $SE = 24.2$, $df = 95$, $t = 3.781$, $p < 0.003$.

Table 10 – Average durations (in ms) of critical words in Experiment 4. Averages of accented elements are in bold.

<i>Duration averages (ms)</i>	Subject	Object	Ambiguous	Pause 1	Pause 2
Subject Accent Prosody	886	403	950	327	315
Object Accent Prosody	570	776	858	318	---

Source: the author (2021).

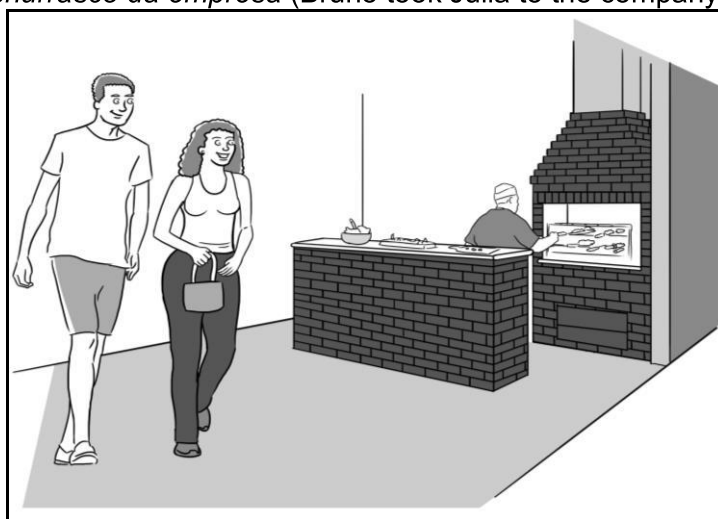
Additionally, pictures were designed to explain what happens on the two conjuncts of the coordinate sentences. Each experimental sentence had three pictures: figure 20 is compatible with the first conjunct (*O Pedro levou a Júlia na festa / Pedro took Julia to the party*), figure 21 biases subject reading (*O Bruno levou a Julia no churrasco da empresa / Bruno took Julia to the company barbecue*), and figure 22 biases object reading (*O Pedro levou o Bruno no churrasco da empresa / Pedro took Bruno to the company barbecue*). Half of the time, figures 20 and 21 were shown as a pair and the other half figures 20 and 22. Their position on the screen was counterbalanced during the experiment.

Figure 20 – First Conjunct Picture in Experiment 5: *O Pedro levou a Júlia na festa* (Peter took Julia to the party)



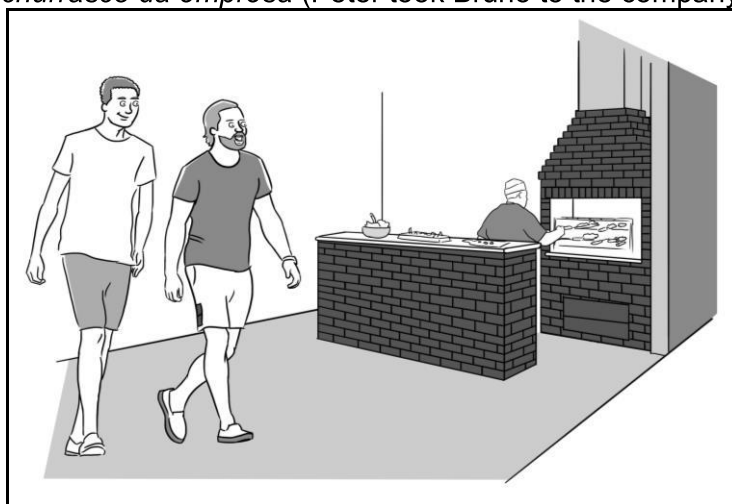
Source: the author (2021).

Figure 21 – Second Conjunct Picture with Subject Bias in Experiment 5: *O Bruno levou a Júlia no churrasco da empresa* (Bruno took Julia to the company's barbecue)



Source: the author (2021).

Figure 22 – Second Conjunct Picture with Object Bias in Experiment 5: *O Pedro levou o Bruno no churrasco da empresa* (Peter took Bruno to the company's barbecue)



Source: the author (2021).

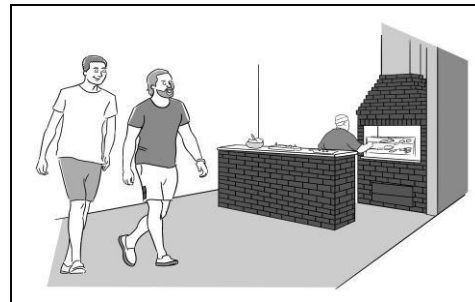
Crossing prosody and pictures resulted in four conditions: Subject Prosody Subject Picture (SPSP); Subject Prosody Object Picture (SPOP); Object Prosody Object Picture (OPOP); Object Prosody Subject Picture (OPSP). SPSP and OPOP are match conditions while SPOP and OPSP are the mismatch conditions. Instances of a set of conditions are shown below (c.f. Appendix 4 for a complete list of experimental sentences). The symbol (#) indicates the prosodic boundaries and the capitalized words in boldface are the prosodically parallel DPs.

(56) **Subject Prosody Subject Picture (SPSP)**

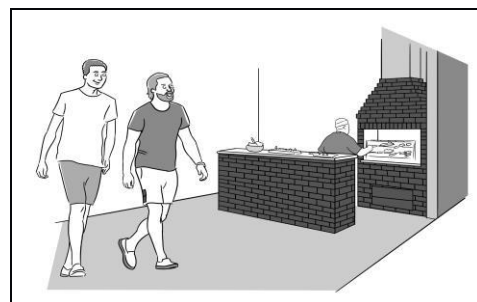
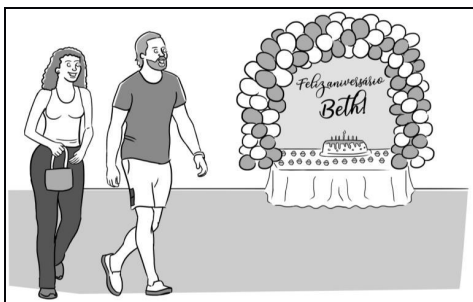
O **PEDRO** levou a Julia na festa # e o **BRUNO** # no churrasco da empresa.
PEDRO took Julia to the party # and **BRUNO** # to the company barbecue.

(57) **Subject Prosody Object Picture (SPOP)**

O **PEDRO** levou a Julia na festa # e o **BRUNO** # no churrasco da empresa.
PEDRO took Julia to the party # and **BRUNO** # to the company barbecue.

(58) **Object Prosody Object Picture (OPOP)**

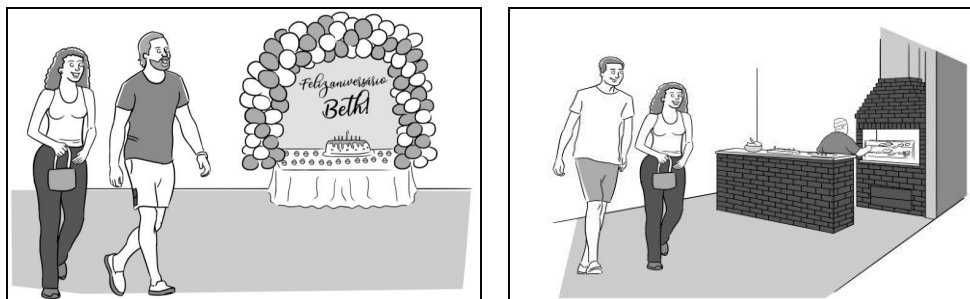
O Pedro levou a **JULIA** na festa # e o **BRUNO** no churrasco da empresa.
 Pedro took **JULIA** to the party # and **BRUNO** to the company barbecue.



(59) **Object Prosody Subject Picture (OPSP)**

O Pedro levou a **JULIA** na festa # e o **BRUNO** no churrasco da empresa.

Pedro took **JULIA** to the party # and **BRUNO** to the company barbecue.



The experimental sentences were interspersed with another thirty-eight sentences, being twenty-four sentences from an unrelated experiment and the other fourteen were filler sentences. Participants were exposed to fifty-eight trials.

Procedures

The experiment was carried out on an SR Research Eyelink 1000 eye-tracker. Participants' head was stabilized with a tower mount of the eye-tracker. Subjects were calibrated before beginning the experiment with a five-point calibration system. This study is a 'look and listen' VWP task, in which participants saw pictures on the computer screen while the audio was simultaneously playing. Their task was to look at the pictures on the screen and to listen carefully to the sentence and, after that, answer a comprehension question about the visual and the auditory linguistic stimuli.

The first screen presented only the pair of pictures, the picture illustrating the first conjunct (Figure 20) was always shown along with one of the biasing pictures, subject bias (Figure 21) or object bias (Figure 22). The pair of pictures were kept on the screen for about 6 seconds until they disappeared. The reason for first showing to the participants the pair of pictures without the audio was to provide them the opportunity of familiarization with the pictures. After this familiarization phase, a fixation cross at the center of the screen replaced the

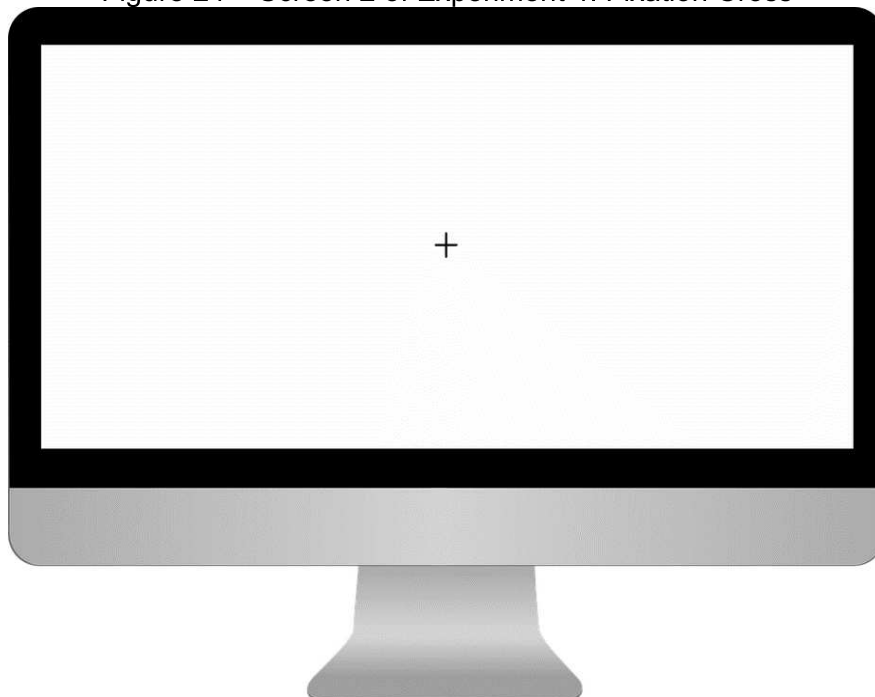
pictures on the screen for about 2 seconds. Figures 23 and 24 show an instance of the first and second screens.

Figure 23 – Screen 1 of Experiment 4: Familiarization



Source: the author (2021).

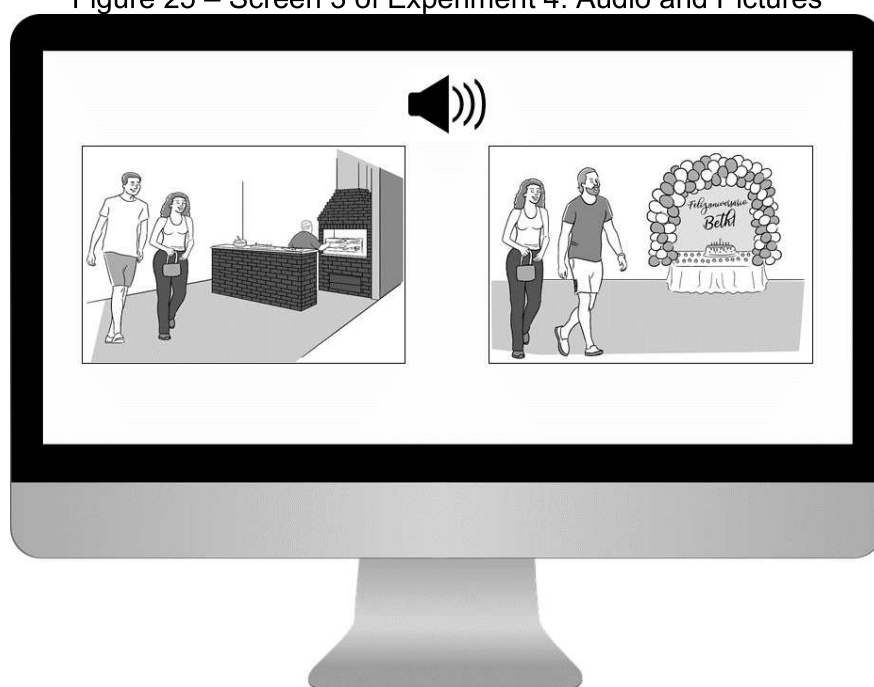
Figure 24 – Screen 2 of Experiment 4: Fixation Cross



Source: the author (2021).

When the fixation cross disappeared, the pair of pictures presented earlier was back on the screen along with an audio simultaneously playing the target sentence in one of the prosodic versions, Subject Accent Prosody or Object Accent Prosody. Figure 25 brings an instance of this third part of a trial presentation in SPSP condition (*O Pedro levou a Júlia na festa e o Bruno no churrasco da empresa / Pedro took Julia to the party and Bruno to the company barbecue*).

Figure 25 – Screen 3 of Experiment 4: Audio and Pictures

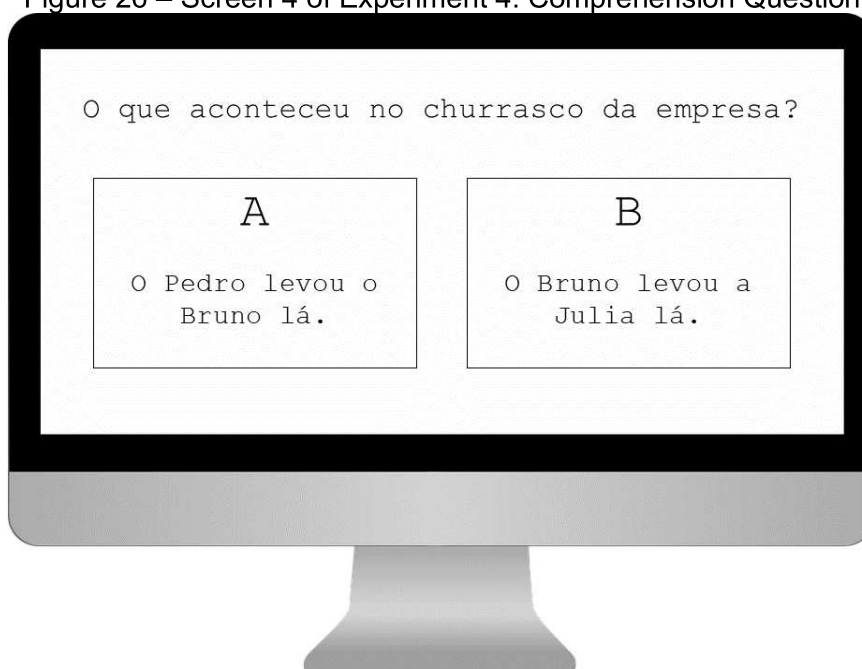


Source: the author (2021).

The eye movements were recorded while participants looked to the pair of pictures and heard the target sentence. The pictures explaining the second conjuncts of the sentences (Figures 21 and 22) were counterbalanced with the spoken sentences. Half of the time, the picture matched the prosodic structure of the sentence heard and half of the time it did not. The pictures were also counterbalanced with regard to their side on the screen. Half of the time, the picture of the first conjunct appeared on the left side and half of the time on the right side. After the presentation of the visual stimulus, participants had to press the space bar on the keyboard to see the comprehension question (*O que aconteceu no churrasco da empresa? / What happened on the company barbecue?*). They had to choose between two paraphrases (options A and B),

by indicating the one that best matched the visual stimulus, the object paraphrase (*O Pedro levou o Bruno lá / Pedro took Bruno there*) or the subject paraphrase (*O Bruno levou a Júlia lá / Bruno took Julia there*). They used predefined keys of the keyboard to indicate their answer. The order of appearance of the paraphrases was counterbalanced, so that half of the time the subject reading paraphrases were on the option A and the other half on the option B, and vice-versa with the object reading paraphrases. Figure 26 shows an instance of a comprehension question followed by the two paraphrases.

Figure 26 – Screen 4 of Experiment 4: Comprehension Question



Source: the author (2021).

Participants

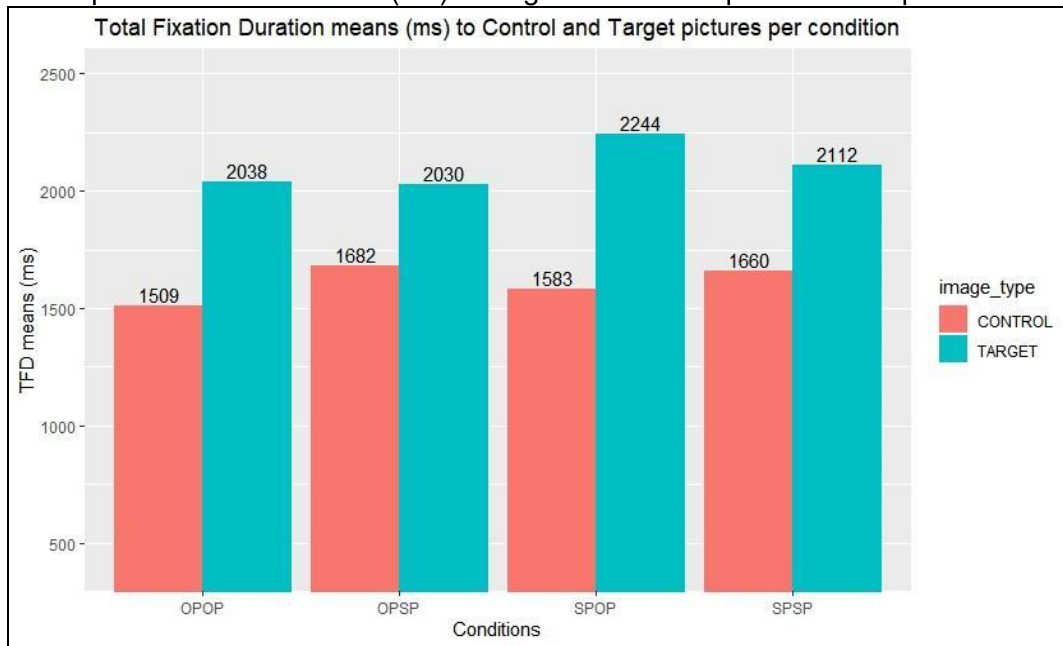
Twenty-eight native speakers of BP participated in the experiment. They were undergraduate students at the Universidade Federal do Rio de Janeiro (UFRJ). They were compensated with a certificate of participation for extracurricular activities. All participants reported normal or corrected to normal vision. They also signed a term of consent and volunteered to take part in the experiment. They were randomly and equally divided into four groups.

6.1.2 Results and Discussion

Participants' eye movements were recorded during the presentation of the whole trial, from the moment of familiarization with the pictures (Screen 1) until the comprehension question (Screen 4). For the purpose of analysis, the selected window will be the looks to the pair of pictures while the audio was playing the ambiguous DP in the second conjunct (*e o Bruno / and Bruno*) followed by an offset of 250ms after this DP. Total fixation duration (TFD) and fixation count (FC) eye-tracking measures were collected for analysis. The pictures that depicted the first conjunct were the control images in all conditions. The two biasing pictures, subject bias and object bias, were considered the target images.

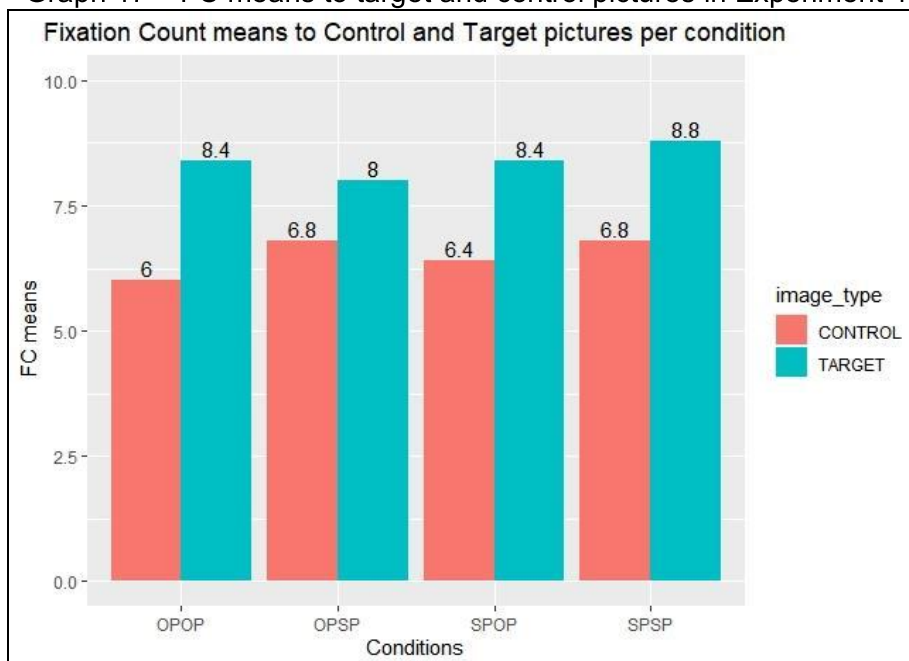
For TFDs, RTs under 100ms and above 5000ms were dropped from the analysis. As for FCs, the outliers dropped from the analysis were fixations with values equal to 0 and those above 20. The results of TFD and FC average means revealed that participants looked more to the target pictures in all conditions when they heard the ambiguous proper noun. Conditions with subject prosody (SPOP and SPSP) had longer TFDs in comparison to conditions with object prosody (OPSP and OPOP). Condition SPSP had the highest mean of FC among the four conditions. The graphs below show TFD and FC averages to target and to control pictures in the four conditions.

Graph 16 – TFD means in (ms) to target and control pictures in Experiment 4



Source: the author (2021).

Graph 17 – FC means to target and control pictures in Experiment 4



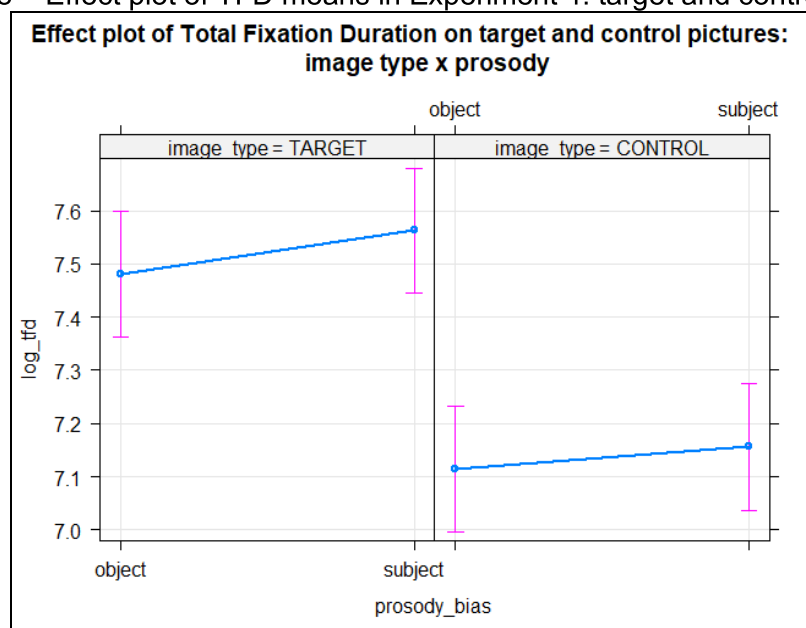
Source: the author (2021).

Obtained data were analyzed using linear mixed effects regression models (BAYEN, 2008; BAYEN *et al.*, 2008), using RStudio software version 4.0.5 (R CORE TEAM, 2021), with the packages *lme4* and *lmerTest*. Each model included log-transformed reading times as function of prosody and image

type as fixed effects, and participants as random effects. The RT means were log-transformed for the purpose of normality.

The analysis of the TFDs revealed a significant effect of image type, so that TFDs were longer in the target images than in control images in both object and subject prosodic conditions: $\beta = -0.37$, $SE = 0.054$, $df = 1005.97$, $t = -6.736$, $CI [-0.47 \sim -0.26]$, $p < 0.001$. No effect of prosody was found ($p = .12$) and neither an interaction between image type and prosody was found ($p = .59$). The graph below shows the effect plot of TFD averages on target and control images.

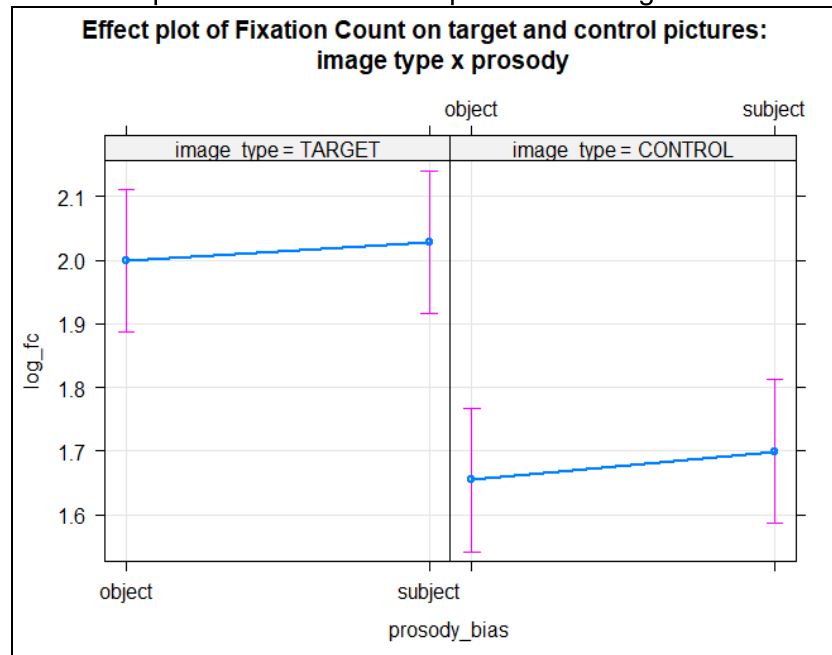
Graph 18 – Effect plot of TFD means in Experiment 4: target and control pictures



Source: the author (2021).

The analysis of the FC means revealed a significant effect of image type, so that there were more fixations on the target images regardless of the prosodic structure: $\beta = -0.34$, $SE = 0.04781$, $df = 1028.18$, $t = -7.201$, $CI [-0.44 \sim -0.2]$, $p < 0.001$. No effect of prosody was found ($p = .53$) and neither an interaction between image type and prosody was found ($p = .82$). The graph below shows the effect plot of FC averages on target and control images.

Graph 19 – Effect plot of FC means in Experiment 4: target and control pictures



Source: the author (2021).

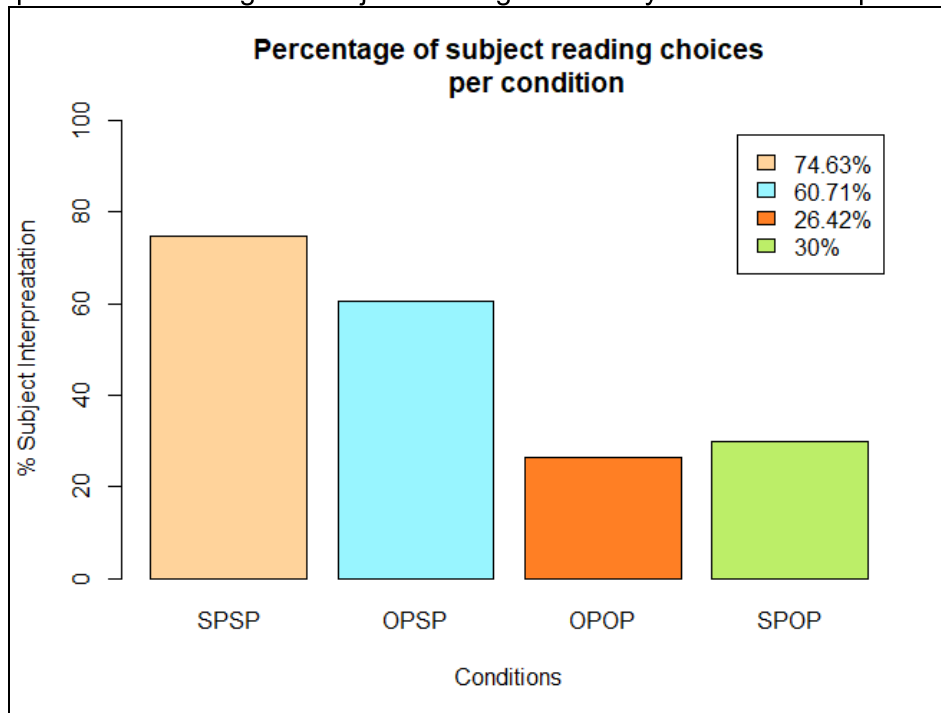
The interpretation choices to the comprehension questions were also analyzed. Participants chose between subject reading and object reading paraphrases. Table 11 shows the amount of object and subject reading responses chosen in each condition, while graph 20 reports the percentage of subject interpretation responses in each condition:

Table 11 – Number of object responses and subject responses chosen in each condition in Experiment 4

Condition	Object Responses	Subject Responses	Sum
SPSP	35	103	138
OPSP	55	85	140
OPOP	103	37	140
SPOP	98	42	140
	291	267	558

Source: the author (2021).

Graph 20 – Percentage of subject reading choices by condition in Experiment 4



Source: the author (2021).

The results revealed that SPSP condition, in which both visual and prosodic cues biased a subject interpretation, had the highest rate of subject responses (74.6%), followed by OPSP condition (60.7%), in which only the visual cue favored subject interpretation. The SPOP condition, in which prosody favored subject interpretation but the visual cue biased object interpretation, had a considerable rate of subject responses (30%). Finally, the OPOP condition, in which visual and prosodic cues did not bias a subject interpretation, received the least rate of subject responses (26.4%) among the four conditions.

The data for the responses to the comprehension question were analyzed in RStudio (R CORE TEAM, 2021) with a logistic mixed-effects regression model using the *glmer* function from the *lme4* package for binomial data. The model included given responses as a function of condition type as fixed effects, and participants and items as random effects. The statistical analysis revealed significant statistical differences of given responses between SPSP and the conditions that received fewer subject responses, OPOP and SPOP conditions. A report of the statistical is given on the table below. A graph

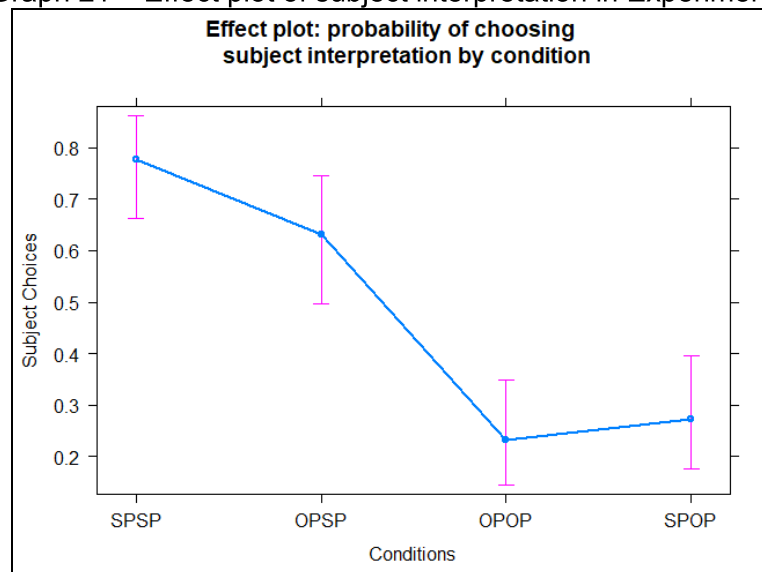
with the effect plot of probability of choosing subject interpretation in each condition is also shown.

Table 12 – Statistical analysis for Comprehension Questions Responses of Experiment 4

Answers to the comprehension questions			
<i>Predictors</i>	<i>Odds Ratios</i>	<i>CI</i>	<i>p</i>
(Intercept)	3.50	1.96 – 6.24	<0.001
condition [OPSP]	0.49	0.23 – 1.05	0.067
condition [OPOP]	0.09	0.04 – 0.19	<0.001
condition [SPOP]	0.11	0.06 – 0.19	<0.001
Random Effects			
σ^2	3.29		
τ_{00} item	0.74		
τ_{00} participant	0.12		
ICC	0.21		
$N_{\text{participant}}$	28		
N_{item}	40		
Observations	558		
Marginal R^2 / Conditional R^2	0.203 / 0.367		

Source: the author (2021).

Graph 21 – Effect plot of subject interpretation in Experiment 4



Source: the author (2021).

The eye-tracking measure results indicate that the pictures were adequate in biasing and depicting the second conjunct of the potentially gapping sentences, since participants looked more and during more time to the target pictures in all conditions (FC and TFD average means) when they heard the ambiguous proper noun. Participants looked slightly longer to target images in subject accent prosody in comparison to the object prosody, although this difference was not statistically significant. The ambiguous noun was accented in both subject and object accent prosody conditions, but it is more lengthened and has a higher F0 pitch range in subject accent prosody than in object accent prosody. Thus, the longer TFD means observed in subject prosody condition suggest that participants relied on prosodic cues, which in turn guided their eye movements towards the target picture for more time.

The combination of subject biasing prosodic and visual cues was able to influence the final interpretation of potentially gapping sentences, it reached 74.6% of subject interpretation responses (SPSP condition). When prosodic and visual cues conflicted, the visual cue was more influential in biasing the final interpretation. The mismatch OPSP condition with subject picture bias had 60.7% of subject responses while the mismatch SPOP condition with object picture bias had only 30% of subject responses. The results also suggest that prosody is an important feature in biasing towards a gapping structure since when the intended subjects are prosodically parallel, there were much more subject interpretations (SPSP and OPSP conditions).

Overall, it is possible to conclude that listeners are able to use prosodic and visual cues in processing to interpret potentially gapping sentences. The right combination of prosody and visual cues can bias a gapping syntactic structure and make it the most preferred interpretation for an ambiguous sentence.

6.5 Experiment 5: Auditory Questionnaire

This auditory questionnaire aims to explore the role of prosody itself in the interpretation of potentially gapping sentences in BP. In the previous VWP experiment, visual cues were combined with prosody to bias subject and object

readings. In the present experiment, we intend to manipulate only prosodic cues to find out if prosody alone is able to bias gapping interpretation. It is known that pitch accents can guide the syntactic analysis of ambiguous sentences (BECKMAN, 1996; CARLSON and TYLER, 2018) and also that prosodic parallelism influences the interpretation of ambiguous DPs in gapping sentences (CARLSON, 2002, 2005; HOEKS *et al.*, 2009).

Pitch accent type, position and F0 range were the manipulated prosodic features on the intended arguments of both conjuncts for biasing the intended prosodic structures. Almost every prosodic word is pitch accented in BP (FROTA and MORAES, 2016), thus we intend to explore whether BP speakers notice the contrastive accents on the intended DPs and use their prosodic cues to attribute the syntactic structure for potentially gapping sentences. Additionally, a neutral prosodic structure is explored in order to verify the preferred final interpretation in the absence of prosodic manipulation. In this sense it will be possible to verify if a specific prosodic structure is necessary to bias a subject interpretation of potentially BP gapping sentences.

We believe that prosodic parallelism of pitch accents on the intended DPs can help the parser in attributing the syntactic role to the ambiguous DP. Additionally, the prosodic structure of gapping sentences can also help the parser in identifying and recovering the content of the ellipsis site in the first conjunct. Therefore, the following hypotheses are investigated in this experiment: (i) the prosodic structure can guide the parser in the construction of the syntactic structure of sentences and in the resolution of ambiguity; (ii) prosodic parallelism (pitch accent placement, pitch accent type and F0 range) between the remnant DPs and their correlates can bias the interpretation of a potentially gapping sentence (CARLSON, 2002). If these hypotheses apply, we expect to find more subject readings when the subject of first conjunct and the ambiguous noun are prosodically contrasting with each other. On the other hand, we expect to find more object readings when the object of the first conjunct and the ambiguous noun are prosodically contrasting with each other. In a neutral prosodic version, we expect to find more object readings due to the structural simplicity bias.

6.2.1 Method

Materials

Stimuli consisted of eighteen sets of sentences constructed in a 3x1 within-subjects factorial design. The sentences were potentially gapping sentences with three prosodic structure types: Subject Accent, Object Accent, and Neutral Accent were manipulated as independent factors. Stimuli were recorded by a female native speaker of BP from Minas Gerais, with training in prosody. The sentences were recorded with cooperating gapping prosody (subjects accented), cooperating conjunction reduction prosody (objects accented), and a baseline version (none of the DPs were accented). The conditions were respectively named as Subject Accent Prosody, Object Accent Prosody and Baseline Prosody. Instances of a set of conditions are shown below (c.f. Appendix 6 for a complete list of experimental sentences). The capitalized words indicate the focused proper nouns and the symbol (#) indicates the IPh prosodic boundaries.

(60) Sample set of conditions

(a) **Subject Accent Prosody** (GAP)

No fim de semana # o DANILO levou a Camila na festa # e o FERNANDO # no churrasco da empresa.

On the weekend # DANILO took Camila to the party # and FERNANDO # to the company barbecue.

(b) **Object Accent Prosody** (OBJ)

No fim de semana # o Danilo levou a CAMILA na festa # e o FERNANDO no churrasco da empresa.

On the weekend # Danilo took CAMILA to the party # and FERNANDO to the company barbecue.

(c) **Baseline Prosody** (BASE)

No fim de semana, o Danilo levou a Camila na festa # e o Fernando no churrasco da empresa.

On the weekend, Danilo took Camila to the party # and Fernando to the company barbecue.

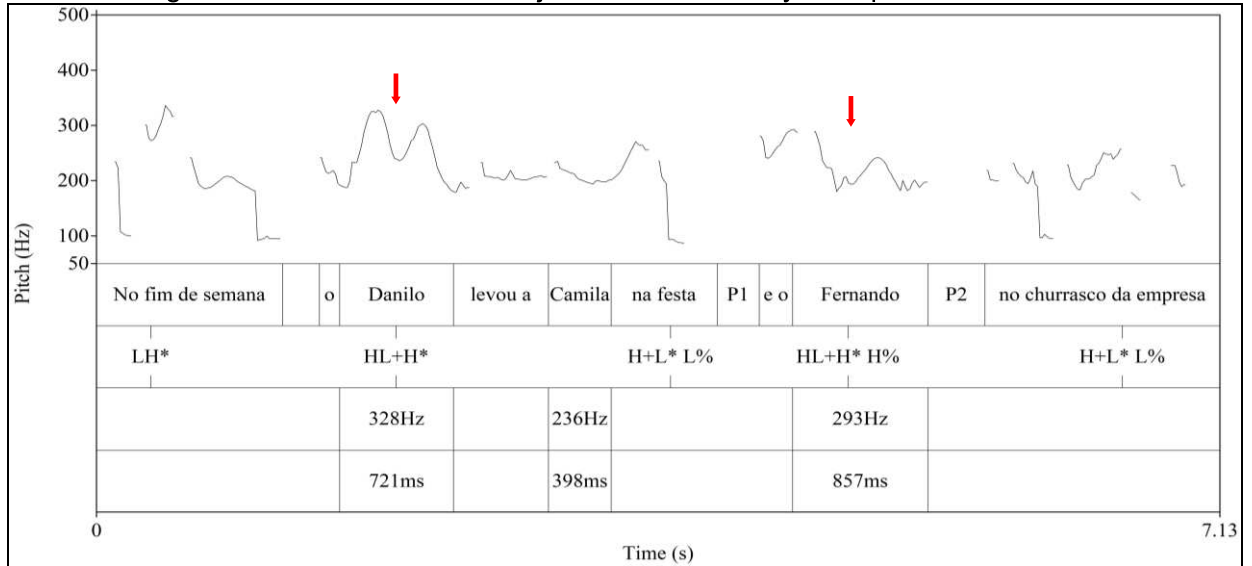
An initial adverbial phrase (e.g., *No fim de semana / On the weekend*) was included at the beginning of each experimental sentence to avoid having the subject DPs of the first conjunct as the first word in the utterance. As pitch accent is often observed at the initial position of an utterance in BP (FROTA and MORAES, 2016), the subject DPs in Object Accent Prosody and Baseline Prosody would likely be pitch accented in case it was the first word of the utterance. The intention was having a pitch accented subject DP only in Subject Accent Prosody to maximize prosodic parallelism between the intended subject DPs of both conjuncts.

In the Subject Accent Prosody, the subject DP of the first conjunct and the ambiguous DP are prosodically parallel, being contrastively accented. In the Object Accent Prosody, the object DP in the first conjunct and the ambiguous DP are prosodically parallel, being contrastively accented. The accented DPs have similar pitch accents (H+LH*) and increased duration and intensity as well. Subject Accent Prosody has a low IPh boundary tone (L%) at the ends of the first conjunct and of the utterance, and after the ambiguous DP there is a high IPh boundary tone (H%). The final PPs in both conjuncts were also accented (H+L*). Object Accent Prosody has a low IPh boundary tone (L%) only at the ends of the first conjunct and of the utterance. The final PPs in both conjuncts were also accented (H+L*). In the Baseline Prosody, the proper noun DPs were not accented. A low IPh boundary tone (L%) is found at the ends of the first conjunct and of the utterance. The final PPs in both conjuncts were also accented (H+L*).

The pitch tracks below show respectively Subject Accent Prosody, Object Accent Prosody and Baseline Prosody for the sentence *No fim de semana, o Danilo levou a Camila na festa e o Fernando no churrasco da empresa* (On the

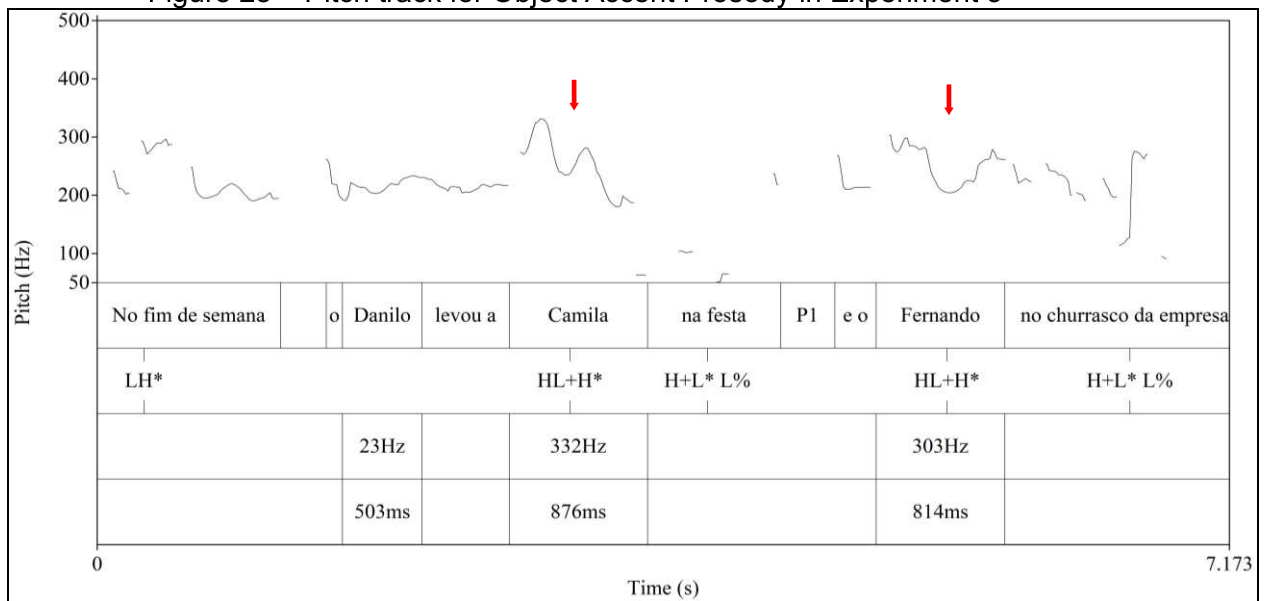
weekend, Danilo took Camila to the party and Bruno to the company barbecue).
 P1 and P2 means Pause 1 and Pause 2, respectively.

Figure 27 – Pitch track for Subject Accent Prosody in Experiment 5



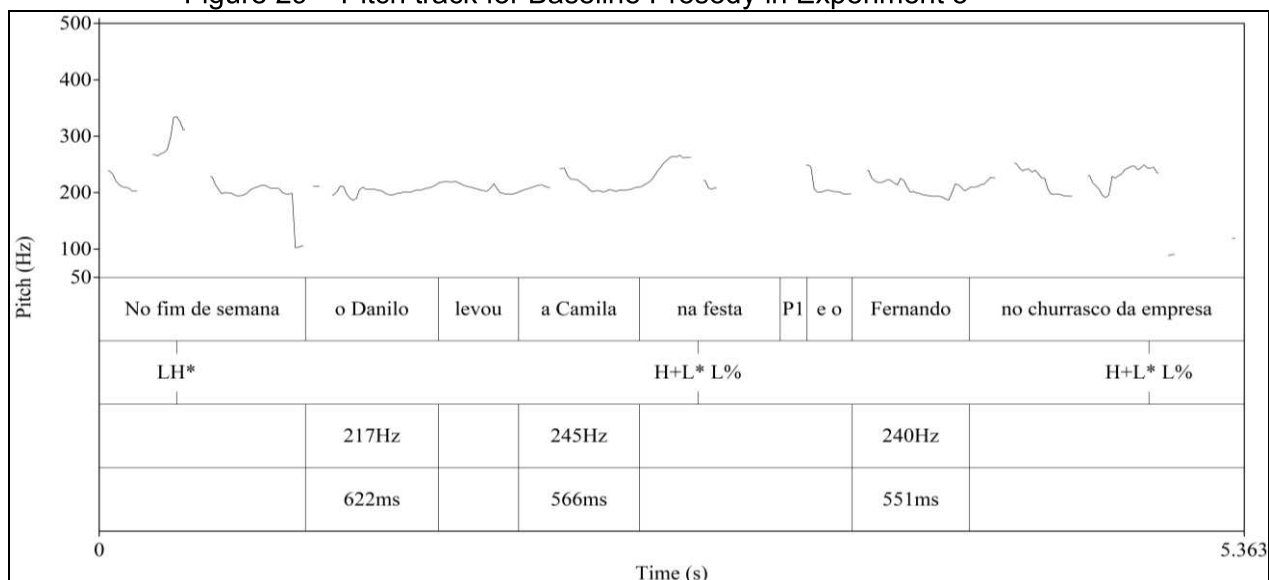
Source: the author (2021).

Figure 28 – Pitch track for Object Accent Prosody in Experiment 5



Source: the author (2021).

Figure 29 – Pitch track for Baseline Prosody in Experiment 5



Source: the author (2021).

In order to verify if the recorded sentences matched the intended prosodic features, all of them were viewed in Praat (BOERSMA and WEENINK, 2003) and analyzed for pitch accents, duration averages in (ms) and F0 averages. Any sentences with disfluent productions or recordings with incorrect prosody were re-recorded and reanalyzed. The filler sentences in the experiment were also produced by the same speaker. Table 13 shows the F0 averages for the three prosodic conditions, with the accented peaks on the DPs in boldface type (cf. Appendix 7 for a complete list of F0 peaks on DPs of the experimental sentences).

Table 13 – Average F0 measurements (in Hz) for critical words in Experiment 5.
Averages of accented elements are in bold.

<i>F0 averages (Hz)</i>	<i>Subject</i>	<i>Object</i>	<i>Ambiguous</i>
Subject Accent Prosody	327	249	310
Object Accent Prosody	231	342	313
Baseline Prosody	237	243	250

Source: the author (2021).

F0 measurements show that sentences with Subject Accent Prosody started with a high accent (L+H*) on the subject DP, while in the object accent prosody the subject DP had a simple accent (LH*), typical of beginning of

utterances. The subject DPs of subject prosody condition averaged at least 96Hz higher than their counterpart subject DPs in the object prosody condition; a significant difference: $\beta = 96.278$, $SE = 9.54$, $df = 138$, $t = 10.088$, $p < .0001$. They also averaged at least 90Hz higher than their counterpart subject DPs in the Baseline Prosody condition; a significant difference: $\beta = 90.500$, $SE = 9.54$, $df = 138$, $t = 9.482$, $p < .0001$. The focused object DPs in Object Accent Prosody had a contrastive accent (HL+H*) and their counterparts in Subject Accent Prosody and Baseline Prosody were not pitch accented. The accented object DPs in the first conjunct averaged at least 92Hz higher than their counterparts in Subject Prosody condition; a significant difference: $\beta = 92.944$, $SE = 9.54$, $df = 138$, $t = 9.739$, $p < .0001$. They also averaged at least 99Hz higher than their counterpart object DPs in the Baseline Prosody condition, a significant difference: $\beta = 99.000$, $SE = 9.54$, $df = 138$, $t = 10.373$, $p < .0001$. The ambiguous DPs were focused and accented (HL+H*) in subject and object prosodic conditions, in Object Prosody condition it averaged 3Hz higher than its counterpart in Subject Prosody condition; a non-significant difference: $\beta = 3.111$, $SE = 9.54$, $df = 138$, $t = 0.326$, $p = 1.00$. The ambiguous DPs in Subject Prosody condition averaged 59Hz higher than their counterparts in Baseline prosody, a significant difference: $\beta = 59.889$, $SE = 9.54$, $df = 138$, $t = 6.275$, $p < .0001$. The ambiguous DPs in Object Prosody condition averaged 63Hz higher than their counterparts in Baseline Prosody, a significant difference: $\beta = 63.000$, $SE = 9.54$, $df = 138$, $t = 6.601$, $p < .0001$.

The durational averages in Table 14 also support the intended prosodic structures (cf. Appendix 5 for a complete list of duration of DPs in the experimental sentences). The subject DPs were longer in Subject Prosody condition than in Object Prosody condition and Baseline Prosody condition: $\beta = 352.611$, $SE = 22.2$, $df = 143$, $t = 15.870$, $p < .0001$; $\beta = -352.500$, $SE = 22.2$, $df = 143$, $t = 15.865$, $p < .0001$. The accented object DPs in Object Prosody condition were longer than their counterparts in Subject Prosody condition and Baseline Prosody condition: $\beta = 291.278$, $SE = 22.2$, $df = 143$, $t = 13.110$, $p < .0001$; $\beta = 302.278$, $SE = 22.2$, $df = 143$, $t = 13.605$, $p < .0001$. The ambiguous DPs were lengthened in both Subject and Object Prosody conditions, but they were a bit longer in Subject Prosody condition, a non-significant difference: $\beta = 35.778$, SE

= 22.2, $df = 143$, $t = 1.610$, $p = .79$. The difference in duration averages of ambiguous DPs were significant in the comparison Subject Prosody condition versus Baseline Prosody condition: $\beta = 333.556$, $SE = 22.2$, $df = 143$, $t = 15.013$, $p < .0001$. This difference was also significant in the comparison Object Prosody condition versus Baseline Prosody condition: $\beta = 297.778$, $SE = 22.2$, $df = 143$, $t = 13.402$ $p < .0001$.

Table 14 – Average durations (in ms) of critical words in Experiment 5. Averages of accented elements are in bold.

<i>Duration averages (ms)</i>	<i>Subject</i>	<i>Object</i>	<i>Ambiguous</i>	<i>Pause 1</i>	<i>Pause 2</i>
Subject Accent Prosody	845	495	872	326	323
Object Accent Prosody	493	786	836	364	---
Baseline Prosody	493	484	538	153	---

Source: the author (2021).

The eighteen experimental sentences were interspersed with another thirty-two sentences, being eighteen sentences from an unrelated experiment and the other fourteen were filler sentences. Participants were exposed to fifty trials in total.

Participants

The participants were thirty native speakers of BP. They provided informed consent to take part in the study. Most of them were undergraduate students at the Universidade Federal de Juiz de Fora (UFJF). They were randomly and equally divided into three groups. Other ten participants were not included in final sample due to loss of data caused by technical failures on the platform.

Procedures

The auditory questionnaire was carried out on the *PennController for Internet Based Experiments* – PCIBex (ZEHR and SCHWARZ, 2018). The link to access the experiment was previously sent to participants. The task could be

performed on computers or on mobile devices. When they opened the link, there was a “Welcome screen” giving instructions about how the experiment worked. Before start doing the experiment, there was a practice session with some trial examples so that they could get familiar with the procedures of the task. When this session ended, they were encouraged to start the experiment. The instructions recommended to wear headphones and do the task in a comfortable and silent place, and also to complete the study in one sitting.

Each trial began with an audio playing a sentence in one of the three prosodic conditions (Subject Accent Prosody, Object Accent Prosody, or Baseline Prosody). When the audio finished playing, participants had to press a button (“*Próximo*” / “Next”) to see the comprehension question followed by two paraphrases on options A and B. One paraphrase biased the object reading and the other the subject reading. The order of appearance of the paraphrases was counterbalanced so that half of the time object paraphrase was on option A and the other half it was on option B, and vice-versa. Participants’ task was to choose, between options A and B, the paraphrase that best matched the sentence heard. They clicked on the option to choose it. An example with an instance of a comprehension question and its paraphrases are given below.

(61) *O que aconteceu no churrasco da empresa?*

What happened on the company barbecue?

(a) Object reading: *O Danilo levou o Fernando lá.*

Danilo took Fernando there.

(b) Subject reading: *O Fernando levou a Camila lá.*

Fernando took Camila there.

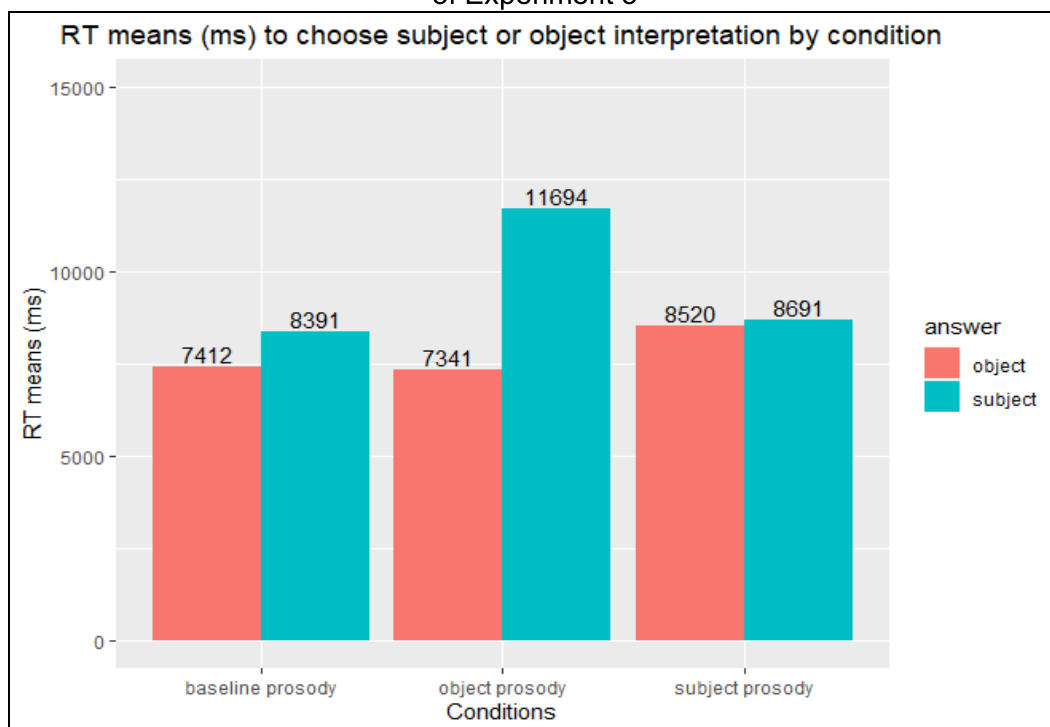
The experimental sentences appeared in an individually randomized order. Each participant was exposed to an equal number of items in each condition over the experiment in a Latin-square design; six sentences of each condition. The task took between 10 and 15 minutes approximately to be completed. The PClbex recorded the paraphrase chosen as well as the time spent to choose it.

6.2.2 Results and Discussion

The final interpretation given to the heard sentence and the amount of time spent to do it were analyzed. The PClbex started measuring time when participants pressed the button “*Próximo*” (“Next”) after listening to the target sentence until the moment they clicked on option A or B with the paraphrases. Reaction times (RTs) under 2000ms and above 45,000ms were dropped from the analysis. Those RTs are not exactly measures of the moment-by-moment processing of the sentences, since they had already finished hearing them. The RTs reflect how much time participants took to read the comprehension questions and the paraphrases, and make a decision about the final interpretation of the target sentence. With these data will be possible to evaluate if one of the conditions seemed to be more difficult to participants.

The RT means results were separated by the type of answer given in each prosodic condition, whether subject or object reading. The graph below summarizes the average RTs for choosing subject and object reading paraphrases in the three prosodic conditions.

Graph 22 – RT means in (ms) to choose subject and object readings in each condition of Experiment 5

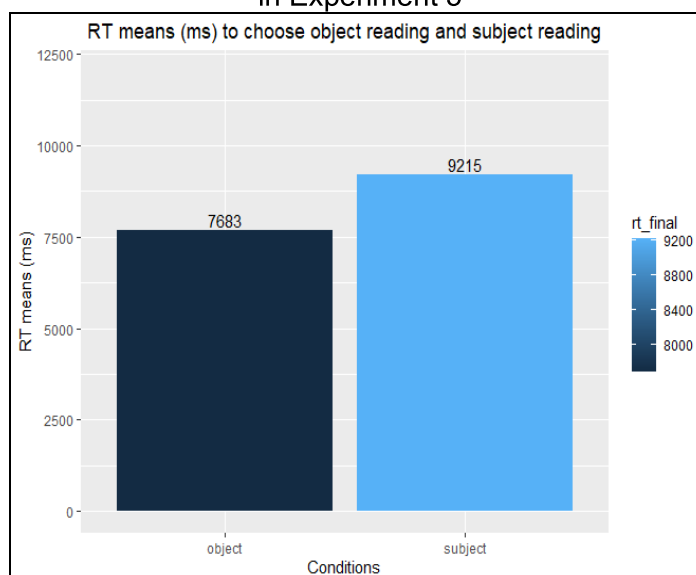


Source: the author (2021).

Overall, the graph reveals that participants spent more time to choose an answer when they decided for a subject reading paraphrase, regardless of the prosodic condition. The Object Accent Prosody condition had the slowest RT means (11694ms), followed by Subject Accent Prosody condition (8691ms) and Baseline Prosody condition (8391ms).

The RT results were also separated by the type of answer given, whether subject or object reading. The graph below shows that participants spent more time to choose subject reading paraphrase than object reading paraphrase, regardless of the prosodic condition: 9215ms versus 7683ms.

Graph 23 – RT means in (ms) to choose an answer (subject reading or object reading) in Experiment 5



Source: the author (2021).

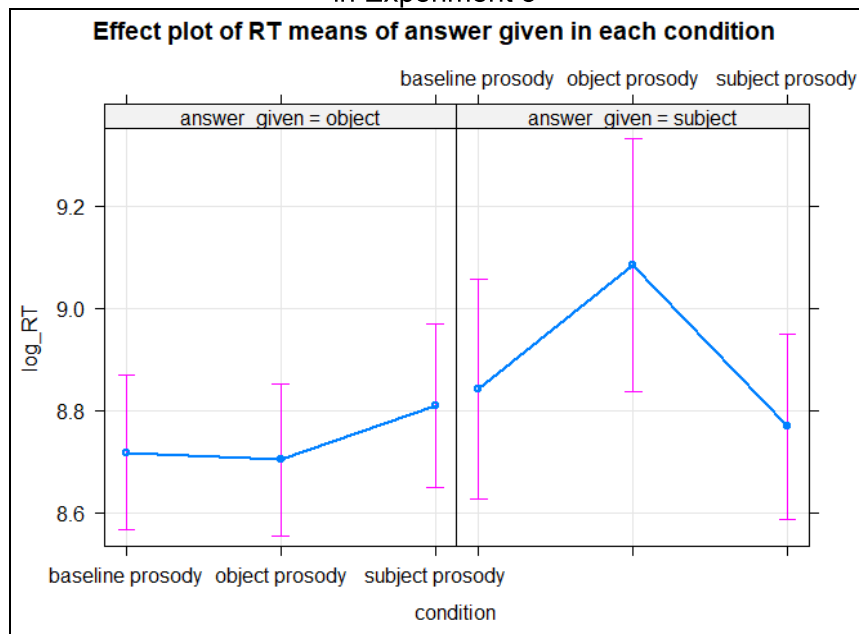
Obtained data were analyzed using linear regression model (BAYEN, 2008; BAYEN *et al.*, 2008), using RStudio software version 4.0.5 (R CORE TEAM, 2021). The RT means were log-transformed for the purpose of normality. The RT means under 2000ms and those above 45,000ms were dropped from the analysis.

The first model included log-transformed RTs as function of answer given and conditions as fixed effects, and participants and items as random effects. No statistically significant results were observed of RT means of the conditions in function of the answer given. In a post-hoc Tukey HSD test, a statistically significant difference was found for Object Prosody condition, so that

participants spent much more time choosing subject reading paraphrase rather than object reading paraphrase in this condition: $\beta = -0.38$, $SE = 0.1205$, $df = 496.2$, $t = -3.154$, $p = .02$. The Object Prosody condition clearly favored an object reading, thus there was more resistance in choosing the subject interpretation that contradicted both the default syntactic interpretation (i.e., object reading preference) and the prosodic structure (object DPs accented).

The effect plot graph shows the RT averages to choose an answer (subject reading or object reading) in each condition. A report of the statistical analysis is on Table 15.

Graph 24 – Effect plot RT means to choose subject and object readings per condition in Experiment 5



Source: the author (2021).

Table 15 – Statistical analysis for Log-transformed RT means to choose subject and object readings per condition in Experiment 5

<i>Predictors</i>	Log_RT		
	<i>Estimates</i>	<i>CI</i>	<i>p</i>
(Intercept)	8.72	8.57 – 8.87	<0.001
answer_given [subject]	0.13	-0.08 – 0.33	0.221
condition [object prosody]	-0.01	-0.14 – 0.11	0.833

condition [subject prosody]		0.09	-0.05 – 0.23	0.198
answer_given condition prosody]	[subject] * [object	0.26	-0.05 – 0.56	0.102
answer_given condition prosody]	[subject] * [subject	-0.17	-0.43 – 0.10	0.212

Random Effects

σ^2	0.28
τ_{00} item	0.00
τ_{00} participant	0.11
ICC	0.29
N participant	30
N item	54

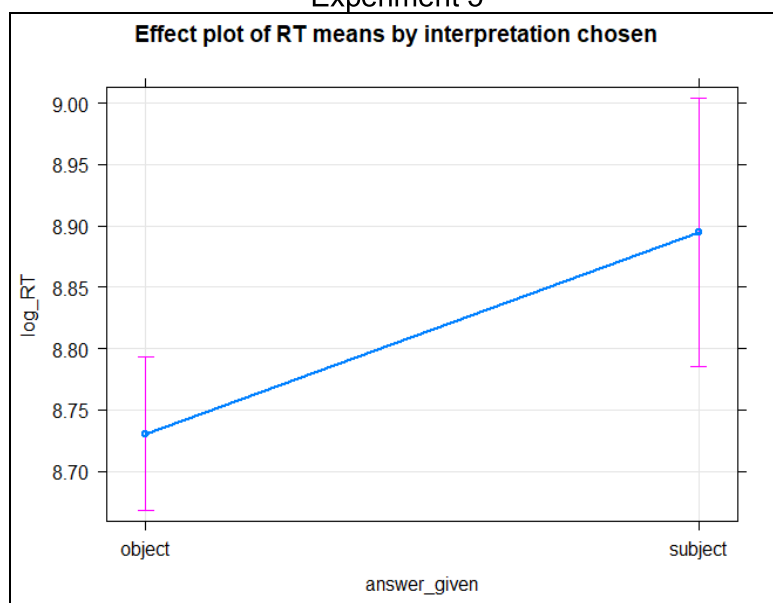
Observations	519
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Marginal R^2 / Conditional R^2	0.019 / 0.299
------------------------------------	---------------

Source: the author (2021).

The second model included log-transformed RTs as a function of answer given as fixed effects, and participants and items as random effects. There were significant statistical effects for RT means in the comparison between subject reading choices versus object reading choices, regardless of the prosodic condition: $\beta = 0.16$, $SE = 0.064$, $t = 2.567$, $CI [0.04 \sim 0.29]$, $p = 0.01$. Participants spent more time to choose the subject interpretation than object interpretation in all conditions. The effect plot below graph shows the comparison between subject and object reading choices.

Graph 25 – Effect plot of RT means to choose subject and object readings in Experiment 5



Source: the author (2021).

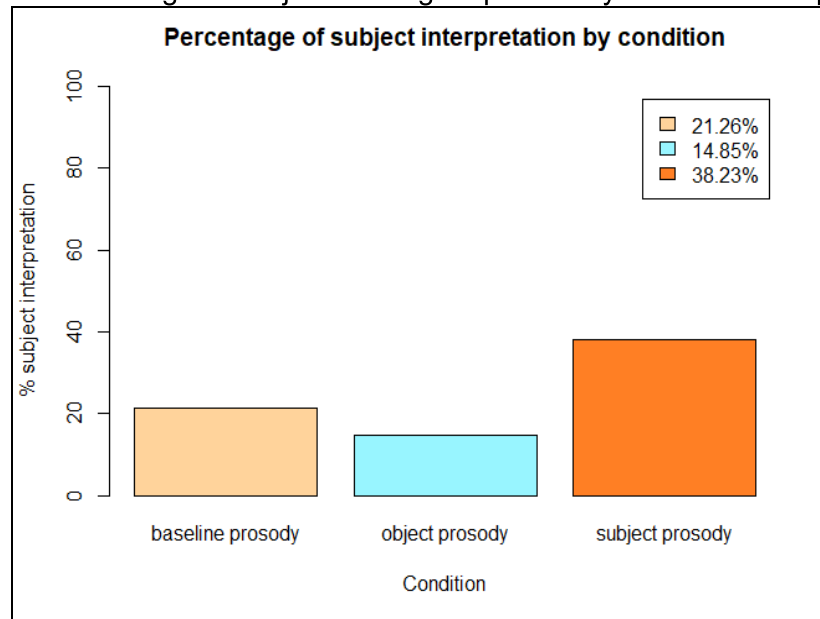
The answers to the comprehension questions were also evaluated. The Subject Prosody condition received the highest rate of subject interpretation (38.23%) among the three prosodic conditions, followed by the baseline prosody condition (21.26%). The Object Prosody condition received the least rate of subject readings (14.85%). Table 16 shows the amount of object and subject reading responses chosen in each condition, while graph 26 summarizes the percentage of subject interpretation choices of each condition.

Table 16 – Number of object responses and subject responses chosen in each condition in Experiment 5

Condition	Object Responses	Subject Responses	Sum
Baseline	137	37	174
Object	149	26	175
Subject	105	65	170
	391	128	519

Source: the author (2021).

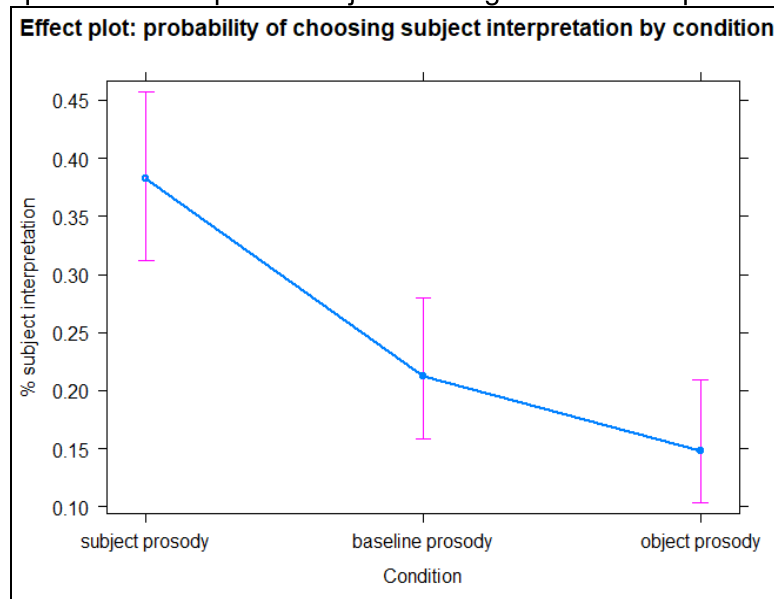
Graph 26 – Percentage of subject reading responses by condition in Experiment 5



Source: the author (2021).

The data of the responses to the comprehension questions were analyzed in RStudio (R CORE TEAM, 2021) with a logistic mixed-effects regression model using the *glmer* function from the *lme4* package for binomial data. The model included given responses as a function of prosodic condition type as fixed effects, and participants and items as random effects. The statistical analysis revealed significant statistical differences of given subject responses between Subject Prosody condition and the other two prosodic conditions, Object Prosody and Baseline Prosody conditions. A report of the statistical is given on the table 17. A graph with the effect plot of probability of choosing subject interpretation in each condition is also shown.

Graph 27 – Effect plot of subject reading choices in Experiment 5



Source: the author (2021).

Table 17 – Statistical analysis for Comprehension Question Responses of Experiment 5

<i>Predictors</i>	Comprehension Question Answers		
	<i>Odds Ratios</i>	<i>CI</i>	<i>p</i>
(Intercept)	0.60	0.40 – 0.89	0.010
condition [baseline prosody]	0.41	0.25 – 0.68	<0.001
condition [object prosody]	0.25	0.15 – 0.44	<0.001
Random Effects			
σ^2	3.29		
τ_{00} item	0.00		
τ_{00} participant	0.40		
ICC	0.11		
$N_{\text{participant}}$	30		
N_{item}	54		
Observations	519		
Marginal R^2 / Conditional R^2	0.080 / 0.180		

Source: the author (2021).

The results of this study shows that the prosodic structure of the sentences influenced the interpretation as intended. The parallelism between the subject of the first conjunct and the ambiguous noun increased the rate of subject interpretation reading of this ambiguous DP to 38%. On the other hand, when the object of the first conjunct and the ambiguous noun were prosodically parallel to each other, subject reading was clearly dispreferred as expected, the rate was only 14% of subject responses. The baseline prosodic structure, in which arguments were prosodically equal, showed that a special prosody is not mandatory for choosing subject reading, since it had 21% of subject responses. In the absence of explicit prosodic cues, listeners preferred to pair up the ambiguous noun with the nearest constituent in the preceding conjunct, which was the object.

The findings of this study contribute to the claim that prosody is an important factor for the discourse appropriateness of gapping sentences (WINKLER, 2018). Participants perceived the contrastive pitch accents on the intended subject arguments and were more willing to interpret the ambiguous sentences with gapping structure when their prosodic structure favored this interpretation. However, despite the manipulation of prosodic parallelism, gapping syntactic structure was not the most preferred interpretation since none of the prosodic conditions had more than 50% of subject readings. The results of RT means and of the comprehension question responses revealed that participants had a strong dispreference for subject reading. Even in the Subject Accent Prosody condition, which clearly biased subject interpretation of the ambiguous DP, percentage of subject responses was under 50%. When participants chose a subject reading, they also spent more time to decide for this interpretation in comparison to object reading responses. The structural factor bias (i.e., object preference) seems to have been more influential than the prosodic features. Thus, prosody itself was not sufficiently strong to make gapping structure the most preferred option.

When we compare this study with previous studies of this thesis, which explored context combined with semantic parallelism (Experiment 3), and prosodic parallelism combined with visual cues (Experiment 4), it is possible to observe that linguistic and non-linguistic information play an important role in

making gapping structure the most preferred interpretation. It seems that different kinds of linguistic and non-linguistic information are necessary for making gapping structure the most preferred choice. Therefore, it is possible that by combining context, visual cues and prosody will result in more subject readings of potentially gapping sentences. That will be explored in the next experiment.

6.3 Experiment 6: Sentence-picture matching – Brazilian Portuguese

Experimental evidence from previous research (CARLSON, 2002, 2005; HOEKS *et al.*, 2002; SILVA *et al.*, 2018) have shown a strong dispreference for subject reading interpretation of ambiguous coordinated sentences due to the structural simplicity bias, which is aligned with the Minimal Attachment Principle (FRAZIER, 1979, 1987) and the Principle of Minimal Topic-Structure (HOEKS *et al.*, 2002). Despite not making it the most preferred interpretation, the manipulation of prosodic cues (i.e., type, location and range of pitch accents) and semantic parallelism between the arguments in the two conjuncts can influence at some level the interpretation of potentially gapping structures (CARLSON, 2002, 2005). Hoeks *et al.* (2009) argue that gapping sentences are dispreferred and considered difficult because they are complex in terms of both syntactic structure and topic-structure. In other words, a gapping sentence has more syntactic nodes and, at the same time, it has two contrastive topics (i.e., two subjects in the same sentence). However, the authors have experimental evidence suggesting that the right combination of contextual and prosodic cues can reduce the unacceptability of gapping interpretation and make it the preferred structure in the interpretation of a globally ambiguous sentence, such as the ones studied here.

The findings of the previous experiments in this thesis seem to align with some findings of Carlson (2002, 2005) and Hoeks *et al.* (2009), since the results revealed that linguistic and non-linguistic information play an important role in biasing a subject reading of potentially gapping sentences in BP. The eye-tracking while reading task (Experiment 3) shows that semantic parallelism held between the ambiguous DP and the subject DP in the first conjunct combined

with a subject biasing context increases the rate of subject interpretation responses. The Visual World Paradigm task (Experiment 4) indicates that when both visual cues and prosodic parallelism of pitch accents between DPs point to subject reading, participants are inclined to choose subject interpretation for the potentially gapping sentences. The auditory questionnaire (Experiment 5) reveals that prosody alone was not able to make subject reading the most chosen interpretation, but it did show that prosody is an important factor to biasing a gapping syntactic analysis.

Taking these findings and arguments into account, the current experiment intends to manipulate semantic parallelism between DPs, prosodic cues, and pragmatic biasing contexts along with visual cues. We intend to find out if the combination of both linguistic and non-linguistic information is able to determine the final interpretation of potentially gapping sentences towards the subject reading.

This study intends to answer three questions. First, when a prosodic structure and a pragmatic context bias a gapping syntactic structure, does it become the most preferred interpretation of choice? Second, when prosodic structure and the pragmatic context point to different syntactic analyses, which cue is more influential in deciding the final interpretation of these potentially gapping sentences, the prosodic cue or the pragmatic context? When only prosodic structure is available with visual cues, does it influence the final interpretation of the ambiguous sentences or is the structural bias more influential? Two hypotheses will be tested in this study: (i) listeners rely on prosodic cues to process sentences and to attribute the syntactic structure of ambiguous sentences (BECKMAN, 1996; CARLSON and TYLER, 2018); and (ii) a pragmatic context help determining the topic (i.e., the likely subjects) of a potentially gapping sentence (HOEKS *et al.*, 2009). If both context and prosody are helpful to the processor, we expect to find out more subject reading picture choices when both cues bias gapping structure than when they bias a structure with conjoined objects. When we have mismatch conditions, if context is more helpful than prosody in deciding the final interpretation, we expect to find out more subject reading picture choices when context biases a gapping structure and prosody biases a structure with conjoined objects. On the other hand, if

prosody is more helpful than context in deciding the final interpretation, we expect to find out more subject reading picture choices when prosody biases a gapping structure and context biases a structure with conjoined objects. If prosody itself is helpful, we expect to find out more subject reading picture choices when prosody biases a gapping structure than when it biases a structure with conjoined objects.

6.3.1 Method

Materials

Sentences from Experiment 4 were explored in the present study, such as *O Pedro levou a Júlia na festa e o Bruno no churrasco da empresa* (Pedro took Julia to the party and Bruno to the company barbecue). Stimuli consisted of thirty sets of sentences constructed in a 3x2 within-subjects factorial design: Context (Subject Bias versus Object Bias versus No Context) and Prosody (Subject Accent versus Object Accent) were manipulated as independent factors. The conditions were named Subject Context, Subject Accent (SCSA); Subject Context, Object Accent (SCOA); Object Context, Object Accent (OCOA); Object Context, Subject Accent (OCSA); Subject Accent (SA); and Object Accent (OA). Twenty sets of sentences are from Experiment 4, and more ten sets of sentences were constructed for this experiment (c.f. Appendix 8 for a complete list of experimental sentences).

The experimental sentences (i.e., target sentences) always stated an action involving three characters. In order to maximize semantic parallelism between subjects in the two conjuncts, the subject in the first conjunct and the ambiguous noun in the second conjunct share the same gender noun (two feminine proper nouns or two masculine proper nouns). All conditions were preceded by an introduction of those three characters mentioned in the experimental sentence (e.g., “*Esses são X, Y e Z*” / “This is X, Y and Z”). These introduction sentences were designed to help participants to get familiar with the characters who would be mentioned in the context and in the target sentences; and they would also appear in the pictures. In four of the six

conditions, the introduction sentence was succeeded by a biasing context sentence. The context sentences aimed to determine the likely topics of the target sentence (i.e., the subjects of the sentence). One context sentence biased a subject reading of the target sentence, “X and Z did something to Y”, and the other context sentence biased an object reading of the target sentence, “X did something to Y and Z”. An instance of the introduction sentence and the biasing context sentences are given below:

(61) Example of Introduction Sentence and Biasing Context Sentences

(a) **Introduction Sentence**

Esses são o Pedro, a Júlia e o Bruno.

This is Pedro, Julia and Bruno.

(b) **Subject Context Bias**

Fazia tempo que o Pedro e o Bruno não viam a Júlia.

It’s been a long time since Pedro and Bruno had seen Julia.

(c) **Object Context Bias**

Fazia tempo que o Pedro não via a Júlia e o Bruno.

It’s been a long time since Pedro had seen Julia and Bruno.

With regard to the prosodic factors, in the Subject Accent Prosody the ambiguous DP and the subject DP of the first conjunct are prosodically parallel, being contrastively accented. In the Object Accent Prosody, the object DP in the first conjunct and the ambiguous DP are prosodically parallel, being contrastively accented. Examples of the target sentences in the two prosodic conditions are shown below (capitals indicate pitch accented words and the symbol # indicates IPh boundaries).

(62) **Subject Accent Prosody**

No fim de semana, o PEDRO levou a Júlia na FESTA # e o BRUNO # no churrasco da EMPRESA.

On the weekend, o PEDRO took Julia to the PARTY # and BRUNO # to the company’s BARBECUE.

(63) Object Accent Prosody

No fim de semana, o Pedro levou a JÚLIA na FESTA # e o BRUNO # no churrasco da EMPRESA.

On the weekend, o Pedro took JULIA to the PARTY # and BRUNO # to the company's BARBECUE.

The trial sequence of each condition can be summarized in the table below. First, the characters are introduced along with their pictures; after that, a context sentence follows the introduction sentence in SCSA, SCOA, OCOA and OCSA conditions; and finally, the target sentence comes at last with biasing pictures. SCSA and OCOA were designed to be match conditions; context and prosody bias the same analysis of the potentially gapping sentence (i.e., target sentence). The SCOA and OCOA were designed to be mismatch conditions, context and prosody bias different syntactic analyses. SA and OA conditions were designed to explore only the role of prosody itself along with biasing pictures.

Table 18 – Structure of condition trials in Experiment 6

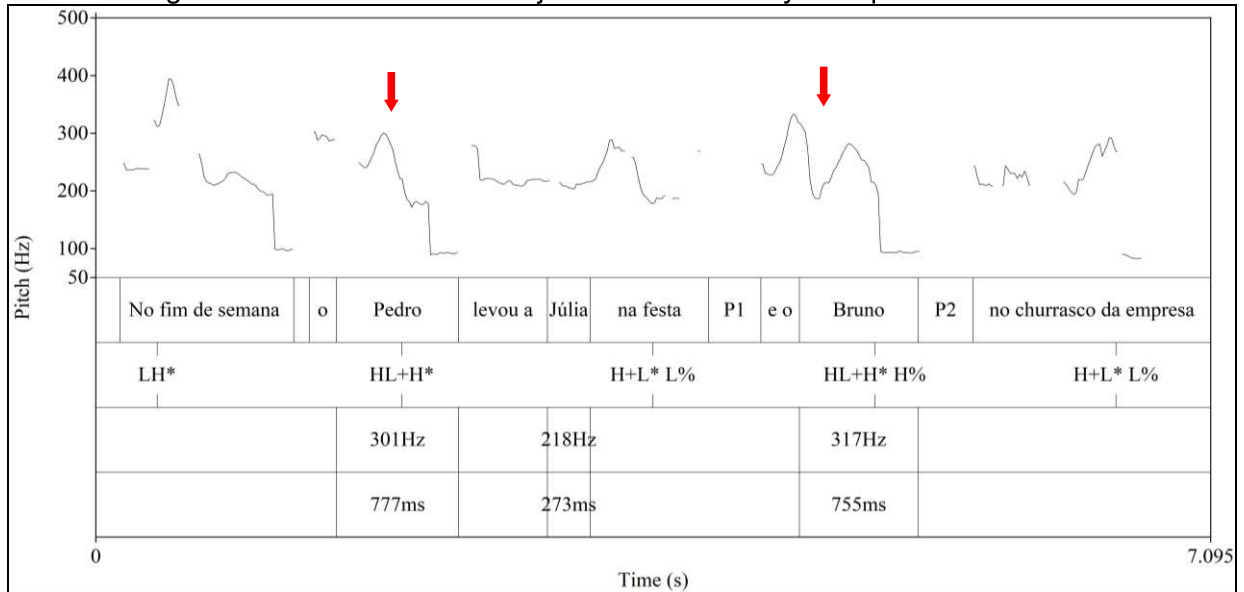
Condition	1. Characters	2. Context Sentence	3. Target Sentence
SCSA	Introduction Sentence	Subject Bias	Subject Prosody
SCOA	Introduction Sentence	Subject Bias	Object Prosody
OCOA	Introduction Sentence	Object Bias	Object Prosody
OCSA	Introduction Sentence	Object Bias	Subject Prosody
SA	Introduction Sentence	---	Subject Prosody
OA	Introduction Sentence	---	Object Prosody

Source: the author (2021).

In relation to the prosodic description of the target sentences, the parallel accented DPs have similar pitch accents (H+LH*) and increased duration and intensity as well in both prosodic conditions. Subject Accent Prosody has a low IPh boundary (L%) at the end of the first conjunct and at the end of the utterance, and after the ambiguous DP there is a high IPh boundary (H%). The final PPs in both conjuncts were also accented (H+L*). Object Accent Prosody has a low IPh boundary (L%) only at the end of the first conjunct and of the

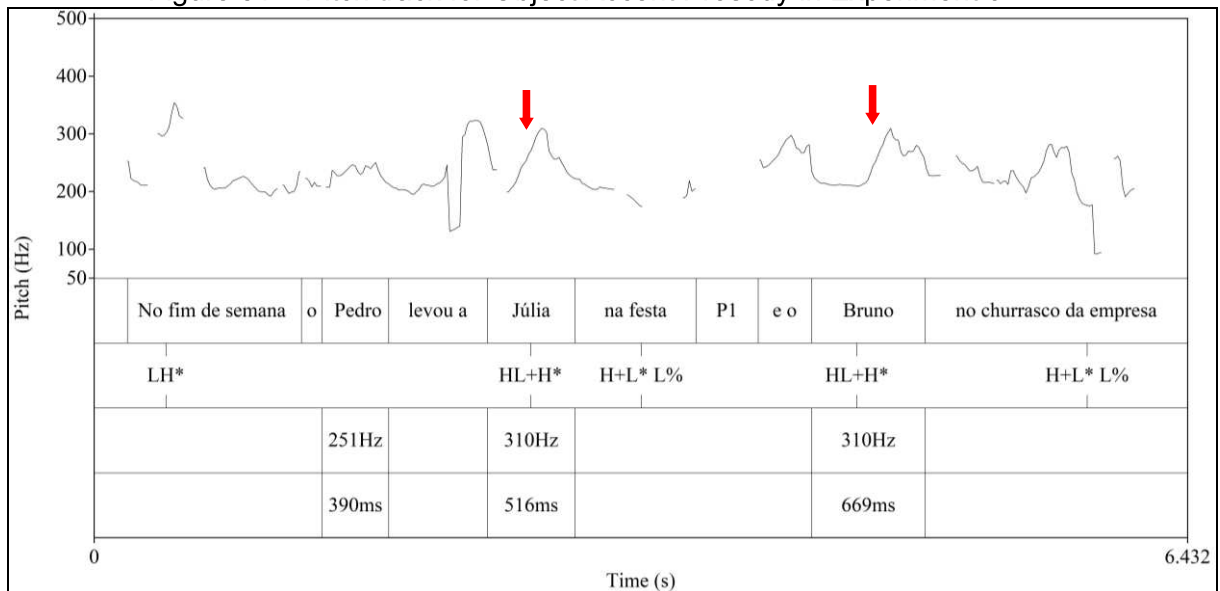
utterance. The final PPs in both conjuncts were also accented (H+L*). The pitch tracks below show respectively Subject Accent Prosody and Object Accent Prosody for the sentence *No fim de semana, o Pedro levou a Júlia na festa e o Bruno no churrasco da empresa* (On the weekend, Pedro took Julia to the party and Bruno to the company barbecue).

Figure 30 – Pitch track for Subject Accent Prosody in Experiment 6



Source: the author (2021).

Figure 31 – Pitch track for Object Accent Prosody in Experiment 6



Source: the author (2021).

In order to verify if the recorded sentences matched the intended prosodic features, all of them were viewed in Praat (BOERSMA and WEENINK,

2003) and analyzed for pitch accents, duration averages in (ms) and F0 peak averages. Any sentences with disfluent productions or recordings with incorrect prosody were re-recorded and reanalyzed. The filler sentences in the experiment were also produced by the same speaker.

F0 measurements show that sentences with Subject Accent Prosody started with a fall (HL) on the prenuclear syllable followed by a rise (H*) on the nuclear syllable of the subject DPs, while in the Object Accent Prosody the subject DPs were deaccented. The subject DPs of Subject Accent Prosody averaged at least 63Hz higher than their counterpart subject DPs in the Object Accent Prosody; a significant difference: $\beta = -63.30$, $SE = 5.64$, $df = 145$, $t = -11.214$, $p < .0001$. The accented object DPs in Object Accent Prosody had a contrastive accent (HL+H*) and their counterparts in Subject Accent Prosody were not focused and neither pitch accented. The accented object DPs in the first conjunct averaged at least 88Hz higher than their counterparts; a significant difference: $\beta = 88.90$, $SE = 5.64$, $df = 145$, $t = 15.750$, $p < .0001$. The ambiguous DPs were accented (HL+H*) in both prosodic conditions, in Object Accent condition they averaged 12Hz higher than their counterparts in Subject Accent condition; a non-significant difference: $\beta = 12.47$, $SE = 5.64$, $df = 145$, $t = 2.209$, $p = 0.24$. Table 19 shows the F0 averages for the two prosodic conditions, with the accented peaks on the DPs in boldface type (cf. Appendix 9 for a complete list of F0 peaks on DPs of the experimental sentences).

Table 19 – Average F0 measurements (in Hz) for critical words in Experiment 6.
Averages of accented elements are in bold.

<i>F0 averages (Hz)</i>	<i>Subject</i>	<i>Object</i>	<i>Ambiguous</i>
Subject Accent Prosody	312	238	313
Object Accent Prosody	249	327	325

Source: the author (2021).

The durational averages in Table 20 also support the intended prosodic structures (cf. Appendix 9 for a complete list of duration of DPs in the experimental sentences). The subject DPs were longer in Subject Accent Prosody condition than in Object Accent Prosody condition, a significant difference: $\beta = -332.1$, $SE = 19$, $df = 145$, $t = -17.495$, $p < .0001$. The accented object DPs in Object Accent Prosody condition were longer than their

counterparts in Subject Accent Prosody condition, a significant difference: $\beta = 185.9$, $SE = 19$, $df = 145$, $t = 9.791$, $p < .0001$. The ambiguous DPs were lengthened in both conditions, but they were a bit longer in Subject Accent condition, a significant difference: $\beta = -118.3$, $SE = 19$, $df = 145$, $t = 6.232$, $p < 0.001$.

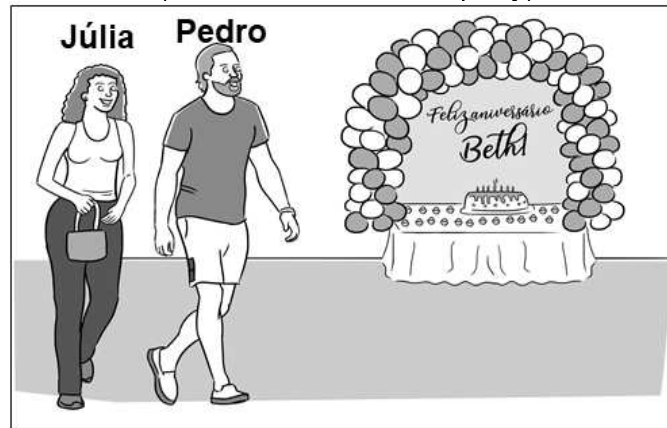
Table 20 – Average durations (in ms) of critical words in Experiment 6. Averages of accented elements are in bold.

<i>Duration averages (ms)</i>	<i>Subject</i>	<i>Object</i>	<i>Ambiguous</i>	<i>Pause 1</i>	<i>Pause 2</i>
Subject Accent Prosody	679	362	744	354	369
Object Accent Prosody	347	548	626	426	---

Source: the author (2021).

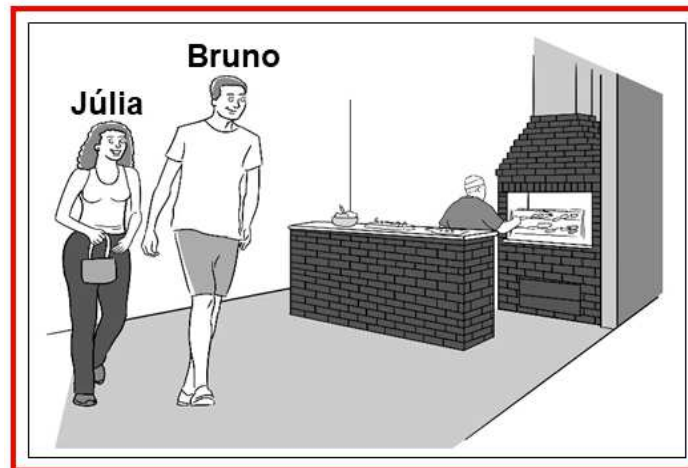
There were also pictures to explain what happens in the two conjuncts of the coordinate sentences. The pictures are those used in Experiment 4; additional pictures were designed for the other ten sets of sentences that were constructed for this experiment. Each experimental sentence had three pictures: Figure 32 is compatible with the first conjunct (*O Pedro levou a Júlia na festa / Pedro took Julia to the party*), Figure 33 biases subject reading (*O Bruno levou a Julia no churrasco da empresa / Bruno took Julia to the company barbecue*), and Figure 34 biases object reading (*O Pedro levou o Bruno no churrasco da empresa / Pedro took Bruno to the company barbecue*). Their position on the screen was counterbalanced during the experiment. Some features of design of the pictures are different from Experiment 4. In this study, the three pictures appear on the screen at the same time, instead of only two (first conjunct picture along with one of the two biasing pictures). Another difference is that we included the names of the characters in the three pictures. This was done to help participants to identify the characters while they were listening to the sentences. The pictures that described the second conjunct of the target came in red frames to draw participants' attention to them when the audio played the second conjunct of the sentences, and also to sign that they had to choose between the two of them. The three pictures are shown below.

Figure 32 – First Conjunct Picture in Experiment 6: *O Pedro levou a Júlia na festa* (Peter took Julia to the party)



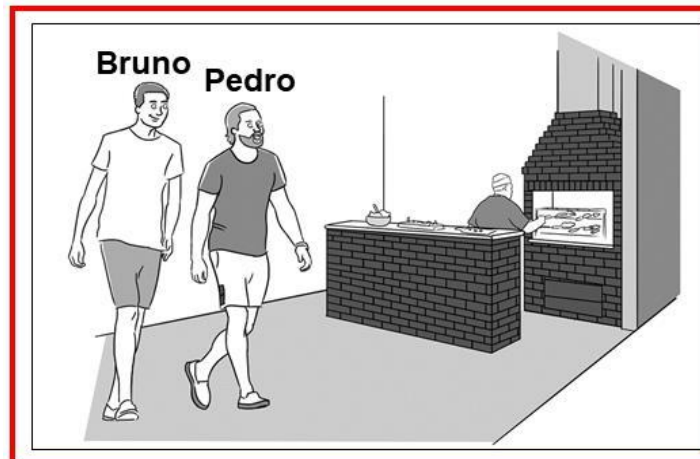
Source: the author (2021).

Figure 33 – Second Conjunct Picture with Subject Bias in Experiment 6: *O Bruno levou a Júlia no churrasco da empresa* (Bruno took Julia to the company's barbecue)



Source: the author (2021).

Figure 34 – Second Conjunct Picture with Object Bias in Experiment 6: *O Pedro levou o Bruno no churrasco da empresa* (Peter took Bruno to the company's barbecue)



Source: the author (2021).

The experimental sentences were interspersed with another thirty-six sentences, being twenty-four sentences from an unrelated experiment and the other twelve were filler sentences. Participants were exposed to sixty-six trials in total.

Participants

Forty-two native speakers of BP participated in this study. They all had normal or corrected-to-normal vision. They provided informed consent to take part in the experiment. They were randomly and equally divided into six groups. None of the participants were excluded.

Procedures

The experiment was carried out on the PCibex platform (ZEHR and SCHWARZ, 2018). The link to access the experiment was previously sent to participants. The task could be performed on computers or mobile devices. When they opened the link, there were a consent form and a “Welcome screen” giving instructions about how the experiment worked. Before start doing the experiment, there was a practice session with some trial examples so that they could get familiar with the procedures of the task. When this session ended, they were encouraged to start the experiment. The instructions recommended to wear headphones and to do the task in a comfortable and silent place, and also to complete the study in one sitting.

Each trial began with a button on the screen to be clicked (“*Clique aqui para ver uma nova história*” / “Click here to see a new story”); see an instance in Figure 35. When they pressed this button, pictures of the characters that participated in the short story appeared on the screen. Their names appeared on the upper part of the pictures. These pictures were simultaneously presented with an audio introducing the characters (“*Esses são o Pedro, a Júlia e o Bruno*” / “This Pedro, Julia and Bruno”). In conditions with biasing contexts, after the introduction sentence had been played, the biasing context sentence (with subject or object bias) was played in the sequence. When the audio finished

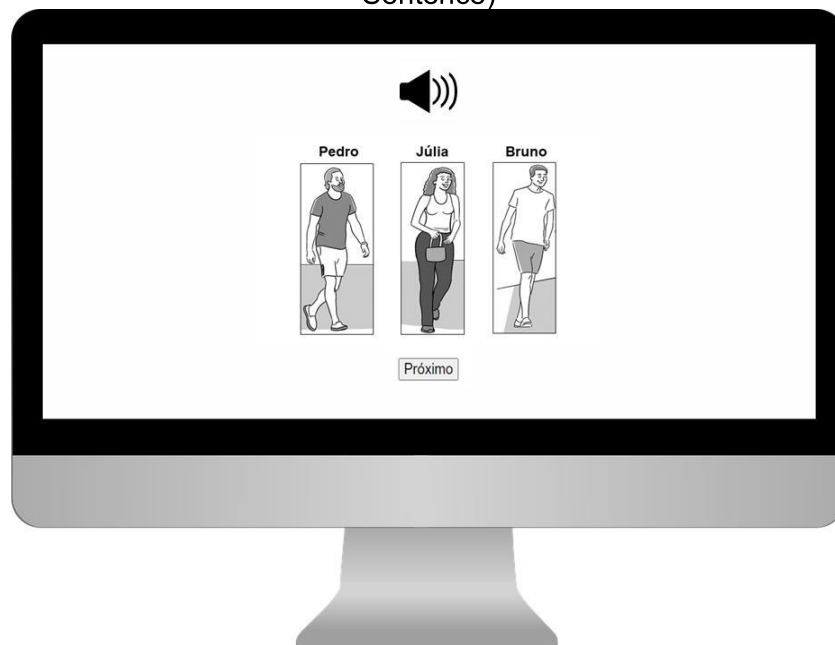
playing, a button appeared on the bottom part of the screen (“*Próximo*”/ “Next”). Participants had to click on this button to see the next screen. Figure 36 illustrates the second screen of the trial.

Figure 35 – Screen 1 of Experiment 6: Button



Source: the author (2021).

Figure 36 – Screen 2 of Experiment 6: Introduction of the characters + (Context Sentence)



Source: the author (2021).

When participants clicked on the button (“*Próximo*”/ “Next”), the picture that described the first conjunct of the target sentence (“*No fim de semana, o Pedro levou a Júlia na festa...*” / “On the weekend, Pedro took Julia to the party...”). appeared on upper-center part of the screen. The audio with the target sentence in one of the prosodic conditions (Subject Accent or Object Accent) started playing the first conjunct when that picture appeared on the screen. Figure 37 illustrates the third screen of the trial.

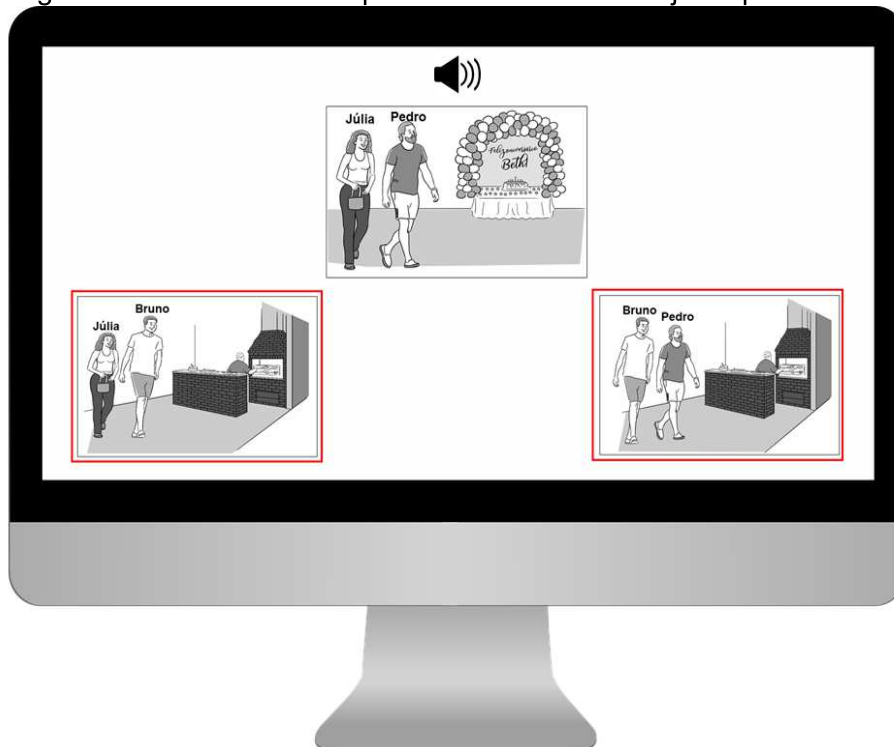
Figure 37 – Screen 3 of Experiment 6: First conjunct presentation



Source: the author (2021).

When the audio reached the end of the first conjunct (“*No fim de semana, o Pedro levou a Júlia na festa...*” / “On the weekend, Pedro took Julia to the party...”), two pictures in red frames appeared on the bottom part of the screen while the audio kept playing until the end of the target sentence. One picture appeared on the left side and the other on the right side of the screen. One picture biased subject reading and the other picture object reading. The position of the pictures was counterbalanced across the experiment, so that half of the time subject picture was on the left side and the other half on the right side of the screen. Figure 38 illustrates the presentation of the biasing pictures on the screen.

Figure 38 – Screen 3 of Experiment 6: Second conjunct presentation



Source: the author (2021).

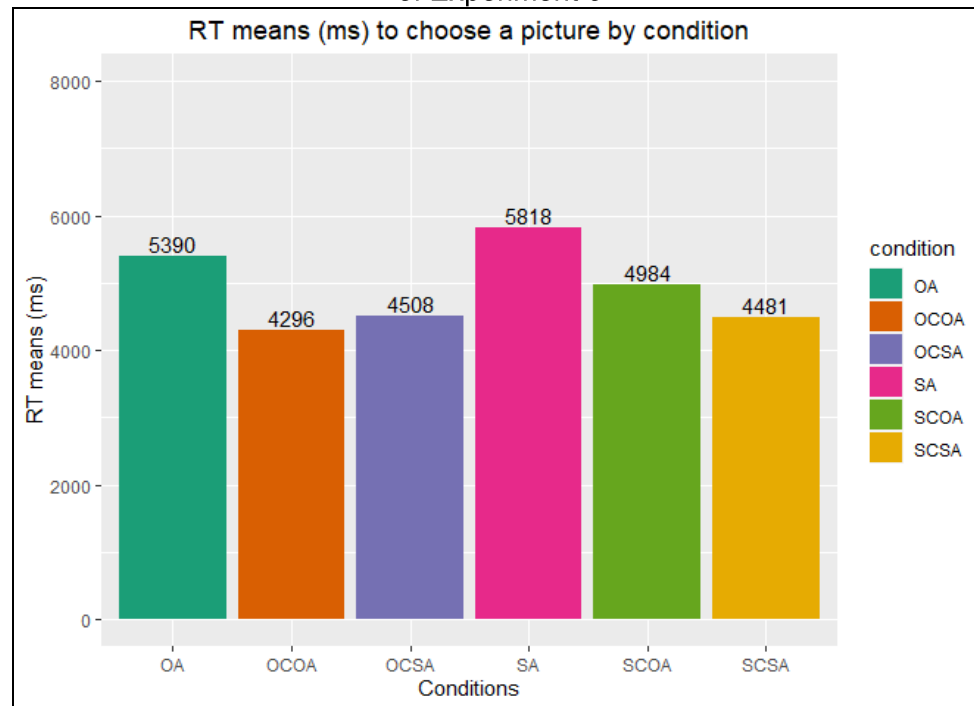
Participants were instructed to choose between the two red framed pictures the one that best matched the sentence heard. In order to choose their answer, they had to click on the picture they chose. The experiment last around 25 to 30 minutes to be completed.

6.3.2 Results and Discussion

Measures of time here were considered to evaluate if one the experimental conditions was considered more difficult among the others. The calculated RT means reflect the time participants took to choose a picture after being exposed to a complete sequence of visual stimulus: introduction of characters; context sentence (when available); pictures along with target sentence audio. Therefore, the analyzed RT means are an offline measure since processing of the target sentence had already occurred when participants chose a picture with the final interpretation for the target sentence. To calculate those RT means, we subtracted the exact time the picture was clicked from the duration of the target sentence audio. RTs above 40,000ms were dropped from

the analysis. The graph below summarizes the RT means in (ms) spent to choose a picture, either with subject or object bias, in the six experimental conditions.

Graph 28 – RT means in (ms) participants spent to choose a picture in each condition of Experiment 6

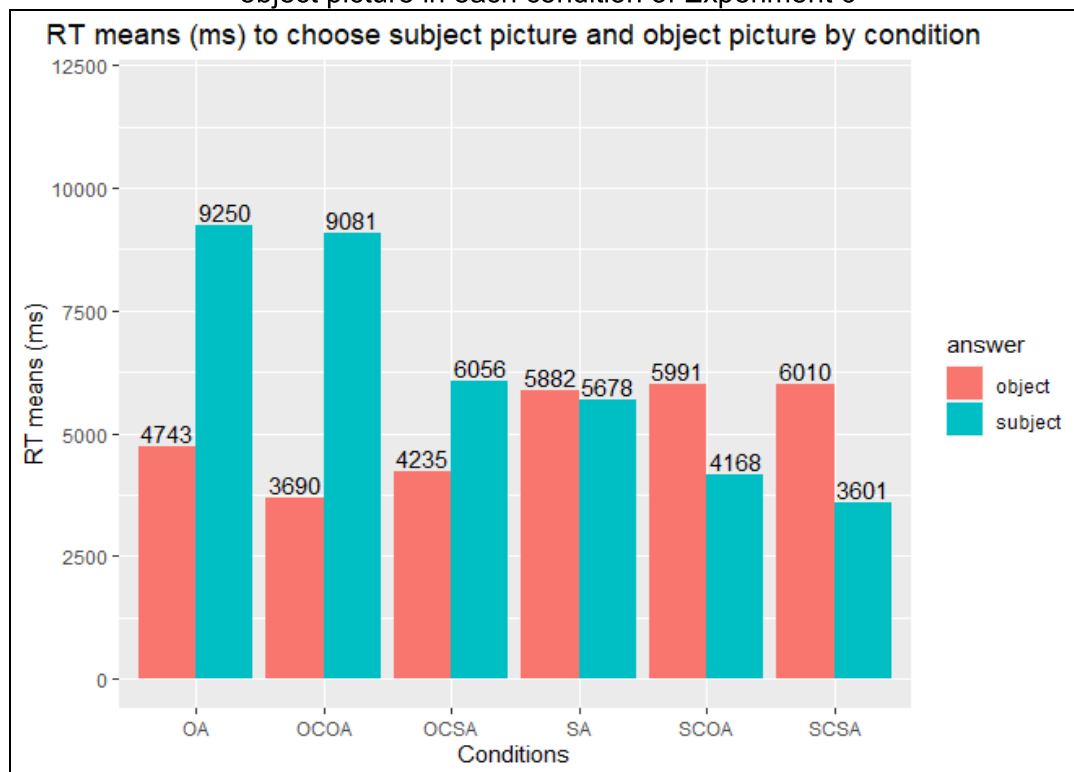


Source: the author (2021).

Graph 28 reveals that SA and OA conditions, in which a pragmatic context was not available, only a biasing prosodic structure was available, had the slowest RT means among the conditions, 5818ms and 5390ms respectively. The mismatch conditions SCOA and OCSA, in which context and prosody biased divergent syntactic analysis of the ambiguous noun, had slower RTs (4984ms and 4508ms, respectively) than the match conditions SCSA and OCOA conditions (4481ms and 4296ms, respectively), in which context and prosody biased the same syntactic analysis.

Another graph was designed to summarize time spent in (ms) to choose a picture after being exposed to the visual stimuli, considering whether participants decided for a subject biasing picture or an object biasing picture to interpret the target sentence. The graph below presents a summary of the RTs means by type of picture chosen and by condition type.

Graph 29 – RT means in (ms) participants spent to choose a subject picture or an object picture in each condition of Experiment 6



Source: the author (2021).

Graph 29 shows that participants took longer to choose subject picture in OA, OCOA and OCSA conditions than in SA, SCOA and SCSA conditions. The prosodic structure of OA condition biased object reading of the ambiguous noun; participants were slower in deciding for the subject interpretation that contradicted the object prosodic structure (9250ms vs. 4743ms). In OCOA condition, in which both context and prosody biased object reading of the ambiguous noun; participants were slower in choosing the subject interpretation that contradicted both context and prosodic structure (9081ms vs. 3690ms). In the mismatch OCSA condition, in which context biased object reading and prosody subject reading, participants were slower when they chose subject picture than when they chose object picture (6056ms vs. 4235ms). The graph also reveals that participants took longer times to choose object picture when the conditions were SA, SCOA and SCSA. The prosodic structure of SA condition biased subject reading of the ambiguous noun; participants were slightly slower in deciding for the object interpretation that contradicted the subject prosodic structure (5882ms vs. 5676ms). In SCSA condition, both context and prosody biased subject reading of the ambiguous noun; participants

were slower in deciding for the object interpretation that contradicted both context and prosodic structure (6010ms vs. 3601ms). In the mismatch SCOA condition, in which context biased subject reading and prosody object reading, participants were slower when they chose object picture than when they chose subject picture (5991ms vs. 4168ms). Overall, the time measures indicate that both context and prosody have affected participants' decisions.

Obtained data were analyzed using linear mixed effects regression models (BAYEN, 2008; BAYEN *et al.*, 2008), using RStudio software version 4.0.5 (R CORE TEAM, 2021), with the packages *lme4* and *lmerTest*. The RT means were log-transformed for the purpose of normality. The model included log-transformed times as function of context and prosody as fixed effects, and participants and items as random effects.

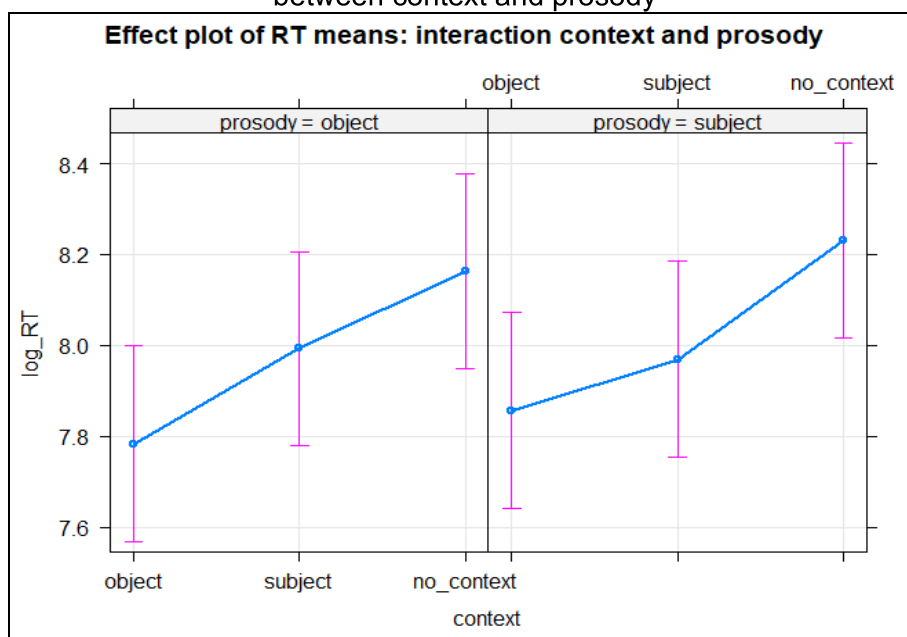
The statistical analysis revealed an effect of context, so that participants were slower to choose a picture when the context had a subject bias than when it had an object bias: $\beta = 0.21$, $SE = 0.102$, $df = 169.29$, $t = 2.038$, $CI [0.01 \sim 0.41]$, $p = 0.04$; and they were also slower to choose a picture when no biasing context was available: $\beta = 0.38$, $SE = 0.103$, $df = 170.43$, $t = 3.691$, $CI [0.18 \sim 0.58]$, $p < 0.001$. No effect of prosody was found ($p = .47$) and neither an interaction between context and prosody ($p = .50$ and $p = .96$). A post-hoc Tukey HSD test revealed a statistically significant difference between OCOA and OA conditions, so that participants spent more time choosing a picture (subject or object picture) when no biasing object context was available: $\beta = -0.38$, $SE = 0.103$, $df = 170$, $t = -3.691$, $p = .004$. As for the comparison between SCOA and SA conditions, the post-hoc Tukey HSD test did not reveal statistically significant difference between them: $\beta = -0.26$, $SE = 0.103$, $df = 169$, $t = -2.537$, $p = .11$.

A post-hoc Tukey HSD test was also conducted to compare RT means to choose subject picture and object picture in the same condition. Significant differences were observed only in SCOA and OA conditions. Participants spent more time to choose an object picture than a subject picture in the mismatch SCOA condition; object picture SCOA x subject picture SCOA: $\beta = 0.42$, $SE = 0.128$, $df = 1344$, $t = 3.342$, $p = .04$. Participants spent more time to choose a subject picture than an object picture in OA condition; object picture OA x

subject picture OA: $\beta = -0.62$, $SE = 0.180$, $df = 1327$, $t = -3.460$, $p = .02$. A marginal effect was found in OCOA condition, so that participants took longer to choose a subject picture in this condition; object picture OCOA x subject picture OCOA: $\beta = -0.63$, $SE = 0.198$, $df = 1332$, $t = -3.180$, $p = .06$.

The graph below shows the effect plot of RT means to choose a picture, while table 21 shows a report of the statistical analysis.

Graph 30 – Effect plot of Log-transformed RT means in Experiment 6: interaction between context and prosody



Source: the author (2021).

Table 21 – Statistical analysis of log-transformed RTs to choose a picture in Experiment 6

Log-transformed RTs to choose a picture			
Predictors	Estimates	CI	p
(Intercept)	7.78	7.57 – 8.00	<0.001
context [subject]	0.21	0.01 – 0.41	0.042
context [no_context]	0.38	0.18 – 0.58	<0.001
prosody [subject]	0.07	-0.13 – 0.28	0.476
context [subject] prosody [subject]	* -0.10	-0.38 – 0.19	0.506
context [no_context] prosody [subject]	* -0.01	-0.29 – 0.28	0.964

Random Effects

σ^2	0.88
τ_{00} item	0.04
τ_{00} participant	0.32
ICC	0.29
$N_{\text{participant}}$	48
N_{item}	180
<hr/>	
Observations	1385
Marginal R^2 / Conditional R^2	0.019 / 0.307

Source: the author (2021).

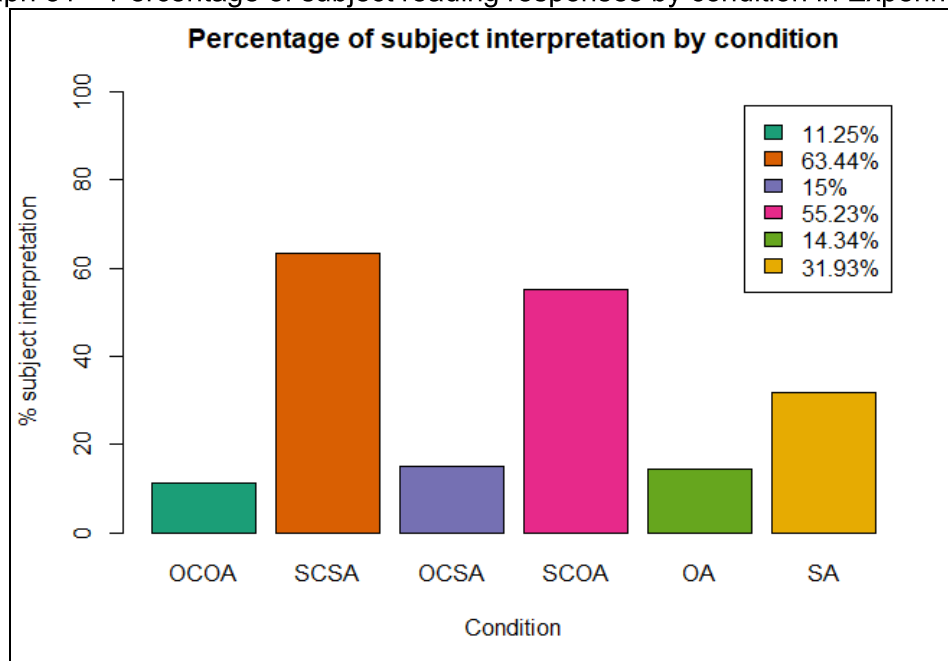
The picture choice responses to indicate the final interpretation for the target sentences were also analyzed. Participants chose between pictures with subject bias and object bias. Table 22 shows the amount of object and subject picture responses in each condition, while the graph below reports the percentage of subject picture interpretation responses in each condition:

Table 22 – Number of object responses and subject responses chosen in each condition in Experiment 6

Condition	Object Responses	Subject Responses	Sum
OCOA	213	27	240
SCSA	87	151	238
OCSA	204	36	240
SCOA	107	132	239
OA	203	34	237
SA	162	75	237
	976	455	1431

Source: the author (2021).

Graph 31 – Percentage of subject reading responses by condition in Experiment 6



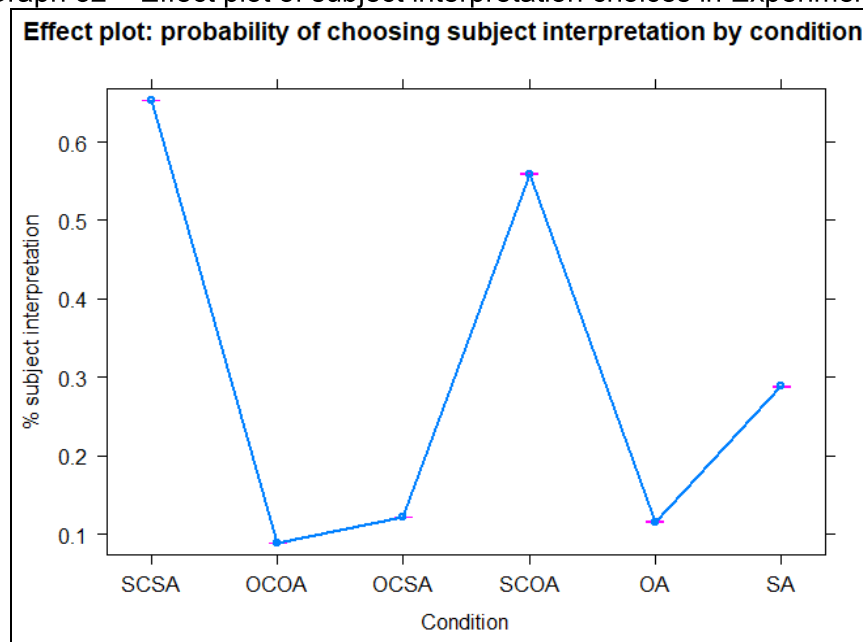
Source: the author (2021).

The results reveal that SCSA condition, in which both context and prosody biased a subject interpretation of the ambiguous noun, had the highest rate of subject responses (63.44%). The mismatch SCOA condition, in which only the context favored a subject interpretation but prosody biased object interpretation, also had a high rate of subject interpretation (55.23%). The SA condition, in which only subject biasing prosodic cue was available, had a lower rate of subject responses (31.93%) in comparison to SCSA and SCOA conditions with a biasing subject context. The result for SA condition is similar to the result found in Experiment 5 (38.23%). The conditions with biasing object contexts, OCOA and OCSA, had low rates of subject interpretation (11.25% and 15%, respectively). Even with the presence of a subject biasing prosodic cue in OCSA condition, the context was more decisive. OCOA and OA condition, with object biasing cues, had the lowest rates of subject interpretation (11% and 14%, respectively).

The data of picture choice responses were analyzed in RStudio (R CORE TEAM, 2021) with a logistic mixed-effects regression model using the *glmer* function from the *lme4* package because the data were binomial. The model included picture choice responses as a function of condition type as fixed effects, and participants and items as random effects. The statistical analysis

revealed significant statistical differences of picture subject responses between SCSA condition and the other conditions. A report of the statistical is given on the table 23. A graph with the effect plot of probability of choosing subject picture interpretation in each condition is also shown.

Graph 32 – Effect plot of subject interpretation choices in Experiment 6



Source: the author (2021).

Table 23 – Statistical analysis for Picture Interpretation Responses of Experiment 6

<i>Predictors</i>	Picture interpretation choices		
	<i>Odds Ratios</i>	<i>CI</i>	<i>p</i>
(Intercept)	1.88	1.88 – 1.89	<0.001
condition [OCOA]	0.05	0.05 – 0.05	<0.001
condition [OCSA]	0.07	0.07 – 0.07	<0.001
condition [SCOA]	0.67	0.67 – 0.68	<0.001
condition [OA]	0.07	0.07 – 0.07	<0.001
condition [SA]	0.22	0.21 – 0.22	<0.001
Random Effects			
σ^2	3.29		
τ_{00} item	0.15		
τ_{00} participant	0.60		

ICC	0.19
N _{participant}	48
N _{item}	180
<hr/>	
Observations	1431
Marginal R ² / Conditional R ²	0.248 / 0.388

Source: the author (2021).

The results of this study confirm hypothesis (ii), the pragmatic context helped determining the likely subjects of the potentially gapping sentences. The subject biasing context prepared participants for expecting two subject topics in the gapping sentences. Conditions with subject biasing contexts, SCSA and SCOA, were interpreted with a gapping syntactic structure most of the time. The same applies for OCOA and OCSA conditions, with biasing object contexts, participants interpreted these sentences as a conjoined object structure most of the time, even in the mismatch OCSA condition, with a subject biasing prosodic structure. When context cues were not available, participants took longer to make a decision on the final interpretation of the ambiguous sentences, OA and SA conditions had the slowest RT means.

With regard to prosody, the results revealed that prosody combined with a pragmatic context influence the final interpretation of potentially gapping sentences in BP. When both prosody and context biased a gapping structure, the unpreferredness for this structure was reduced and it became the most preferred interpretation in SCSA condition (63%). This finding is aligned with Hoeks *et al.* (2009, 2002), the topic prepared the way for two topics in the target sentence and the prosodic parallelism between the two intended subjects helped the processor to attribute structural positions for these nouns within the target sentence. On the other hand, when prosody and context conflicted, the context was more influential than prosody in the deciding the final interpretation of the sentences. SCOA condition, with subject biasing context and object prosody, had more subject than object interpretation choices while OCSA condition, with object biasing context and subject prosody, had more object than subject interpretation choices (55% vs. 15%). When prosodic structure was the only available cue, it was not able to make gapping the most preferred

interpretation, but it revealed that subject prosodic structure increases the rate of subject interpretation (31% in SA vs. 11% in OA).

We can conclude that context and prosody combined in the right way have a strong and rapid effect in the processing of BP gapping sentences. Even though prosody influences the interpretation, the pragmatic information in the context was stronger in promoting a gapping syntactic analysis. Overall, context and prosody reduced the unpreferredness of gapping interpretation and made it the structure of choice for a globally ambiguous sentence. The pragmatic context is a relevant cue in processing and it can be highlighted by the prosodic realization of the utterance.

6.4 Experiment 7: Sentence-picture matching – American English

This final experiment is part of a cross-language study between BP and AE. The aim of this study is to understand how adults interpret spoken ambiguous sentences that are syntactically similar in BP and in AE. Although the ambiguous BP gapping sentences are structurally identical to those in AE, the reliability on contextual and prosodic cues might differ across these two languages. The motivation for this study was the possibility of expanding the results of the processing of these structures in English, by exploring syntax-prosody interface along with a pragmatic context, what has not been done yet. Carlson (2002), for instance, tested spoken gapping sentences in auditory questionnaires and Self-paced reading tasks. In general, the results showed a strong dispreference for subject reading due to the structural bias. Therefore, the current study might reveal whether the combination of pragmatic context and visual cues along with prosody can reduce the object reading bias observed in potentially gapping sentences in AE.

This study is relevant in the sense that by comparing sentence processing in these two languages, we may gain a better insight into universal aspects of spoken language processing and how language-specific features alter this process.

We intend to answer the same questions discussed in Experiment 6. When prosodic structure and a pragmatic context bias a gapping syntactic

structure, does it become the most preferred interpretation of choice? On the other hand, when prosodic structure and the pragmatic context point to different syntactic analyses, which cue is more influential in deciding the final interpretation of these potentially gapping sentences, the prosodic cue or the pragmatic context? When only prosodic structure is available with visual cues, does it influence the final interpretation of the ambiguous sentences or is the structural bias more influential?

The same hypotheses from the previous study will be tested here: (i) listeners rely on prosodic cues to process sentences and to attribute the syntactic structure of ambiguous sentences (BECKMAN, 1996; CARLSON and TYLER, 2018); (ii) a pragmatic context help determining the topic (i.e., the likely subjects) of a potentially gapping sentence (HOEKS *et al.*, 2009). If both context and prosody combined are helpful to the processor, we expect to find out more subject reading picture choices when both cues bias a gapping structure than when they bias a structure with conjoined objects. When we have mismatch conditions, if context is more helpful than prosody in deciding the final interpretation, we expect to find out more subject reading picture choices when context biases a gapping structure and prosody biases a structure with conjoined objects. On the other hand, if prosody is more helpful than context in deciding the final interpretation, we expect to find out more subject reading picture choices when prosody biases a gapping structure and context biases a structure with conjoined objects. If prosody itself is helpful, we expect to find out more subject reading picture choices when prosody biases a gapping structure than when it biases a structure with conjoined objects.

6.4.1 Method

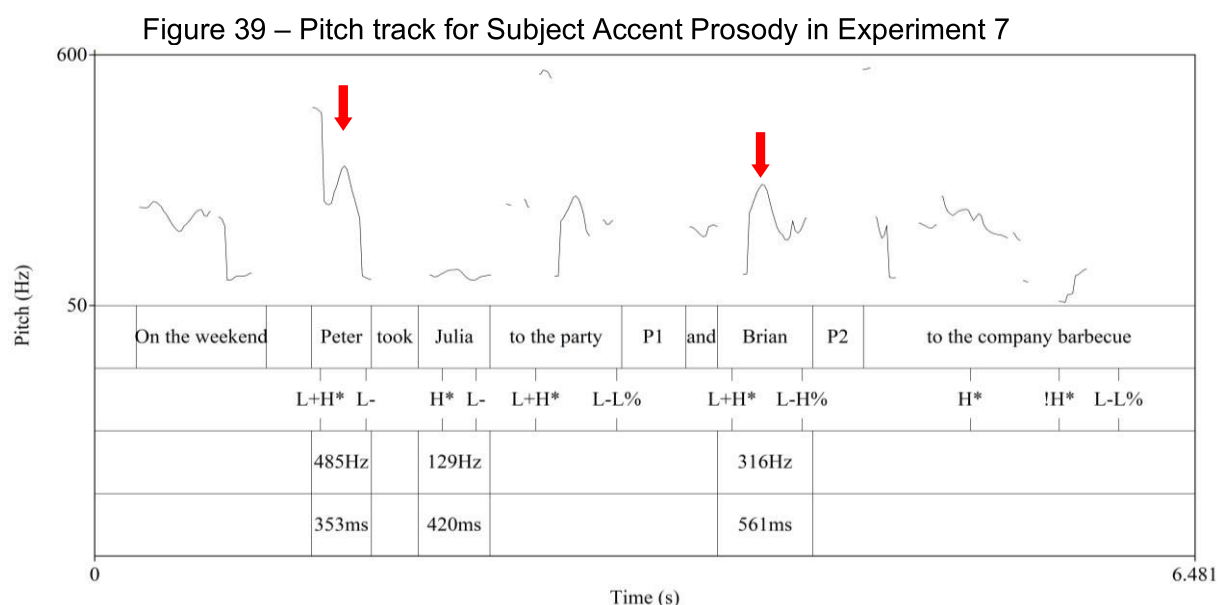
Materials

The sentences and the pictures tested in this experiment are the same from Experiment 6: *No fim de semana, o Pedro levou a Júlia na festa e o Bruno no churrasco da empresa* (On the weekend, Pedro took Julia to the party and Bruno to the company barbecue). The BP sentences were translated to AE with

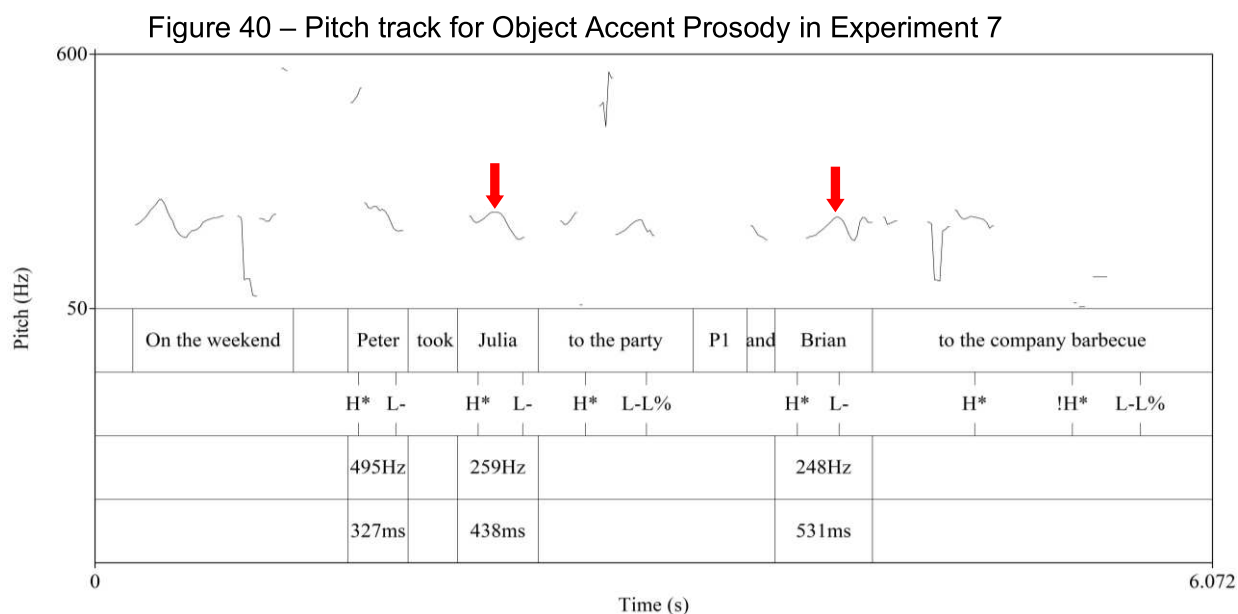
adaptations of vocabulary and proper nouns. We replaced the proper nouns in the sentences and in the pictures so that we had proper nouns that are common in the United States. Overall, the sentences in AE present the same ambiguity and content seen in BP sentences of Experiment 6.

The study has thirty sets of sentences constructed in six experimental conditions (c.f. Appendix 10 for a complete list of experimental sentences): Subject Context, Subject Accent (SCSA); Subject Context, Object Accent (SCOA); Object Context, Object Accent (OCOA); Object Context, Subject Accent (OCSA); Subject Accent (SA); and Object Accent (OA). See Table 15 in the previous section for a detailed explanation of conditions.

With regard to prosodic description of the experimental sentences, the parallel accented DPs have similar pitch accents and increased duration and intensity as well in both prosodic conditions. Subject Accent Prosody has a low boundary (L-L%) at the end of the first conjunct and at the end of the utterance, and after the ambiguous DP there is a rising boundary (L-H%). The final PPs in both conjuncts were also accented (L+H*; H* H!). Object Accent Prosody has a low boundary (L-L%) only at the end of the first conjunct and of the utterance. The final PPs in both conjuncts were also accented (H*; H* !H*). The pitch tracks below show respectively Subject Accent Prosody and Object Accent for the sentence “*On the weekend, Pedro took Julia to the party and Bruno to the company barbecue*”.



Source: the author (2021).



Source: the author (2021).

The sentences were recorded by a female native speaker of American English who grew up in the north Pennsylvania dialect area. The recorded sentences were viewed in Praat (BOERSMA and WEENINK, 2003) to check if they matched the intended prosodic features. We analyzed pitch accents, duration averages in (ms) and F0 peak averages. Any sentences with disfluent productions or recordings with incorrect prosody were re-recorded and reanalyzed. The filler sentences in the experiment were also produced by the same speaker.

The subject DPs of Subject Accent Prosody averaged at least 49Hz higher than the subject DPs in the Object Accent Prosody; a significant difference: $\beta = -49.47$, $SE = 10.5$, $df = 145$, $t = -4.693$, $p < .0001$. In Object Accent Prosody, the object DPs in the first conjunct were slightly higher (13Hz) than their counterparts in Subject Accent Prosody; a non-significant difference: $\beta = 13.90$, $SE = 10.5$, $df = 145$, $t = 1.319$, $p = .77$. This result is different from BP sentences, the object DPs in the Subject Accent Prosody were not pitch accented and neither focused. The ambiguous DPs were accented in both prosodic conditions, in Object Accent Prosody condition they averaged 20Hz higher than their counterparts in Subject Accent Prosody condition; a non-significant difference: $\beta = 12.47$, $SE = 5.64$, $df = 145$, $t = 2.209$, $p = .38$. Table 24 shows the F0 averages for the two prosodic conditions, with the accented

peaks on the DPs in boldface type (cf. Appendix 11 for a complete list of F0 peaks on DPs of the experimental sentences).

Table 24 – Average F0 measurements (in Hz) for critical words in Experiment 7. Averages of accented elements are in bold.

<i>F0 averages (Hz)</i>	<i>Subject</i>	<i>Object</i>	<i>Ambiguous</i>
Subject Accent Prosody	337	282	325
Object Accent Prosody	288	296	305

Source: the author (2021).

The durational averages in Table 25 also support the intended prosodic structures (cf. Appendix 11 for complete list of duration of DPs in the experimental sentences). The subject DPs were longer in Subject Accent Prosody condition than in Object Accent Prosody condition, a significant difference: $\beta = -89.8$, $SE = 15.8$, $df = 145$, $t = -5.702$, $p < .0001$. The object DPs in Object Accent condition were longer than their counterparts in Subject Accent condition, a significant difference: $\beta = 56.2$, $SE = 15.8$, $df = 145$, $t = 3.567$, $p = 0.0064$. The ambiguous DPs were lengthened in both conditions, but they were longer in Subject Accent condition, a significant difference: $\beta = -136.3$, $SE = 15.8$, $df = 145$, $t = -8.654$, $p < 0.001$.

Table 25 – Average durations (in ms) of critical words in Experiment 7. Averages of accented elements are in bold.

<i>Duration averages (ms)</i>	<i>Subject</i>	<i>Object</i>	<i>Ambiguous</i>	<i>Pause 1</i>	<i>Pause 2</i>
Subject Accent Prosody	448	415	626	349	332
Object Accent Prosody	358	471	490	338	---

Source: the author (2021).

The experimental sentences were interspersed with another thirty-six sentences, being twenty-four sentences from an unrelated experiment and the other twelve were filler sentences. Participants were exposed to sixty-six trials in total.

Participants

Seventy-two undergraduate students at the University of Pennsylvania participated in this study in exchange for course credit. All of them were native English speakers. They provided informed consent to take part in the experiment. They were randomly and equally divided into six groups.

Procedures

The procedures of the task were the same as those of Experiment 6 (c.f. section 5.6.1 for more details). The four figures below illustrate the sequence of screens that appeared in each trial.

Figure 41 – Screen 1 of Experiment 7: Button



Source: the author (2021).

Figure 42 – Screen 2 of Experiment 7: Introduction of characters



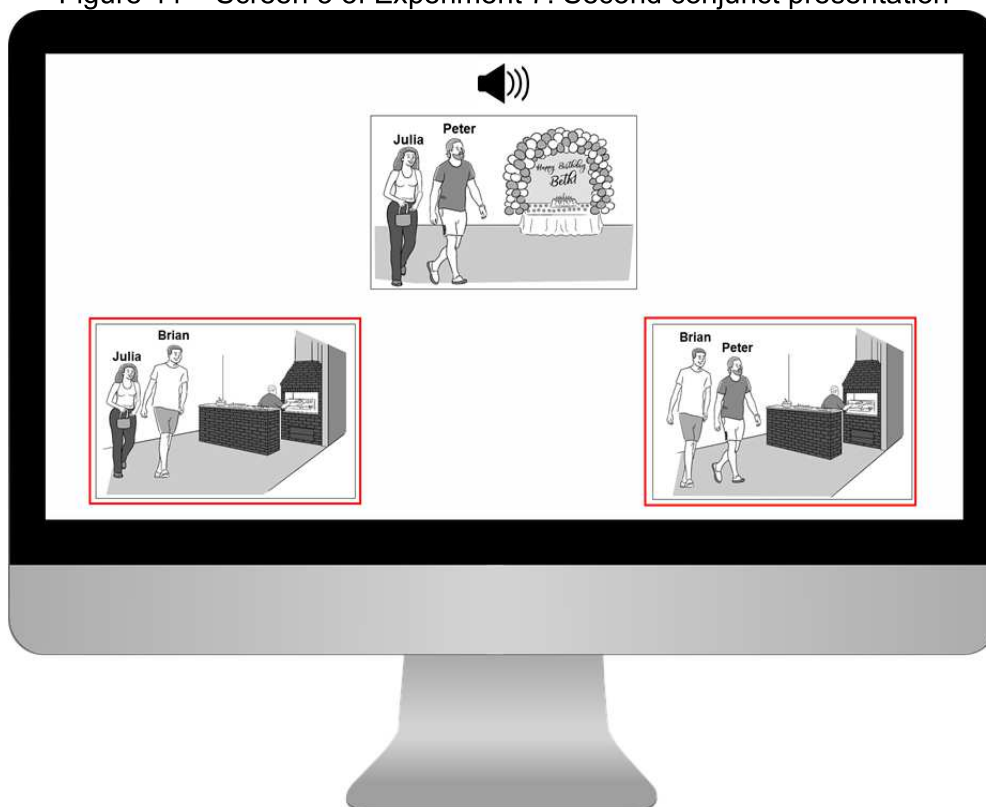
Source: the author (2021).

Figure 43 – Screen 3 of Experiment 7: First conjunct presentation



Source: the author (2021).

Figure 44 – Screen 3 of Experiment 7: Second conjunct presentation

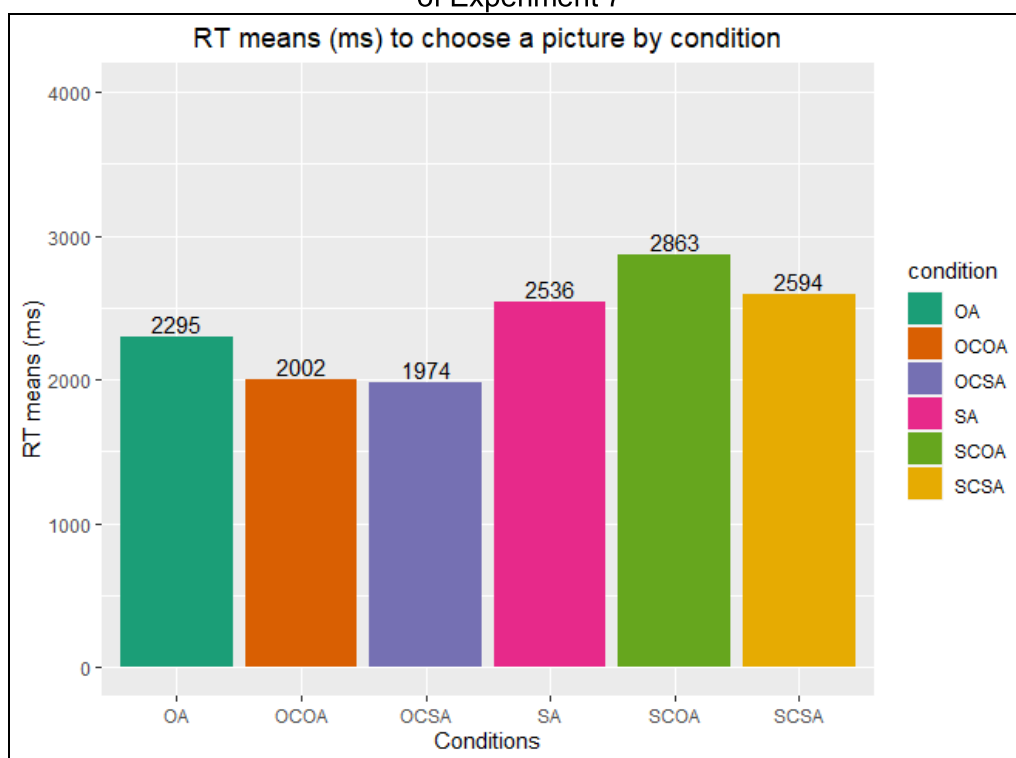


Source: the author (2021).

6.4.2 Results and Discussion

Measures of time were also analyzed here to evaluate if one the experimental conditions was considered more difficult among the others. The calculated RT means reflect the time participants took to choose a picture after being exposed to a complete sequence of visual stimulus: introduction of characters; context sentence (when available); pictures along with target sentence audio. To calculate those RT means, we subtracted the exact time the picture was clicked from the duration of the target sentence audio. RTs above 30,000ms were dropped from the analysis. The graph below summarizes the RT means in (ms) spent to choose a picture, either with subject or object bias, in the six experimental conditions.

Graph 33 – RT means in (ms) participants spent to choose a picture in each condition of Experiment 7

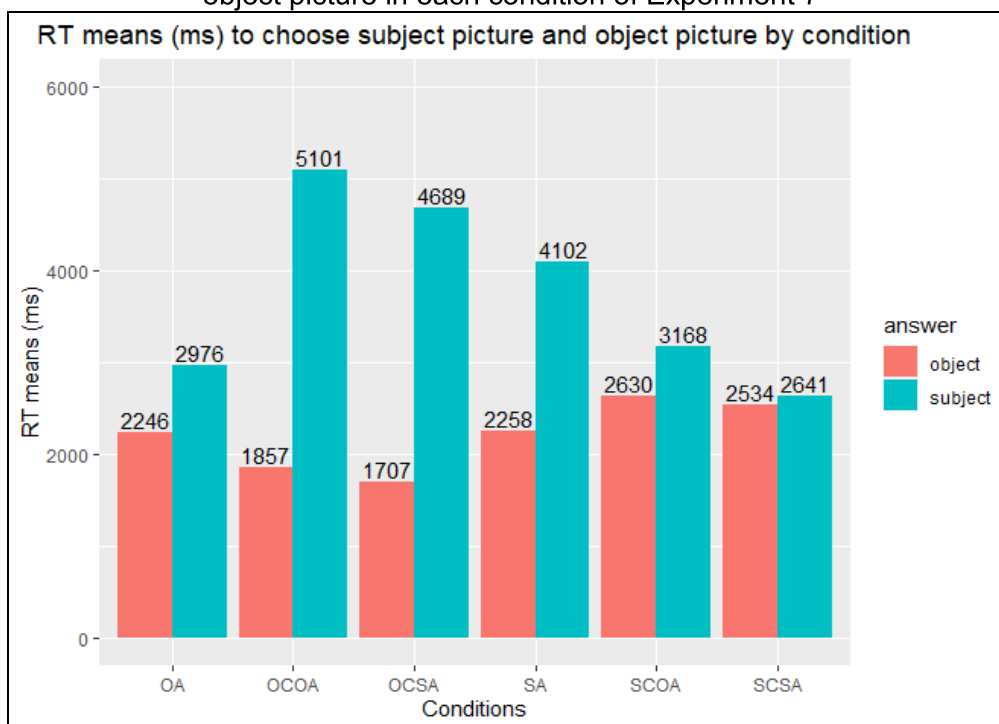


Source: the author (2021).

Graph 33 reveals that the mismatch SCOA condition, in which context biased subject reading of the ambiguous noun and prosody biased object reading, had the slowest RT means (2863ms) among the conditions, followed by SCSA and SA conditions, in which prosodic cues biased subject reading of the ambiguous had slower RTs (2536ms and 2594ms, respectively). OCSA and OCOA conditions, which had a biasing object context had the fastest RT means (1974ms and 2002ms, respectively), followed by OA condition (2295ms), in which prosody favored object reading of the ambiguous noun.

Graph 34 summarizes time spent in (ms) to choose a picture after being exposed to the visual stimuli, considering whether participants decided for a subject biasing picture or an object biasing picture to interpret the target sentence. The graph presents a summary of the RTs means by type of picture chosen and by condition type.

Graph 34 – RT means in (ms) participants spent to choose a subject picture or an object picture in each condition of Experiment 7



Source: the author (2021).

Graph 34 indicates that participants always took longer to choose a subject picture regardless of the condition. Condition OCOA, in which context and prosody clearly biased object reading of the ambiguous noun, had the slowest RT means among the six conditions (5101ms), as expected. Participants also took longer times to choose a subject picture in the mismatch OCSA condition with a biasing object context and subject biasing prosody, it was the second slowest condition (4689ms). Even though prosody biased subject reading in SA condition, it had the third slowest RT means (4102ms) for subject picture choices. Only in SCSA condition, the one that most biased subject reading, participants were a bit faster in choosing subject picture (2641ms for subject picture choice vs. 2534ms for object picture choice). In SCOA condition, in which context biased subject reading and prosody not, the difference between subject picture choice and object picture choice was not very wide (3168ms vs. 2630ms respectively) in comparison to the same RT differences in OCOA, OCSA and SA conditions.

Obtained data were analyzed using linear mixed effects regression models (BAYEN, 2008; BAYEN *et al.*, 2008), using RStudio software version 4.0.5 (R CORE TEAM, 2021), with the packages *lme4* and *lmerTest*. The RT

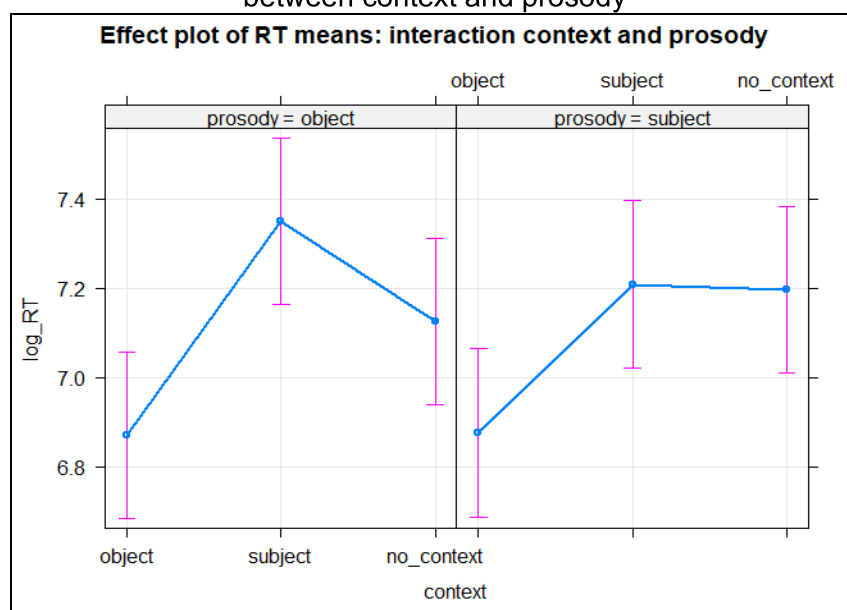
means were log-transformed for the purpose of normality. Each model included log-transformed times as function of context and prosody as fixed effects, and participants and items as random effects.

The statistical analysis revealed an effect of context, so that participants were slower to choose a picture when the context had subject bias than when it had object bias, regardless of prosody bias: $\beta = 0.48$, $SE = 0.09$, $df = 167.30$, $t = 4.900$, $CI [0.29 \sim 0.67]$, $p < 0.001$. The effect of context also indicates that participants took longer to choose a picture when no context was available, regardless of prosody bias: $\beta = 0.26$, $SE = 0.09$, $df = 167.59$, $t = 2.612$, $CI [0.06 \sim 0.45]$, $p = .009$. No effect of prosody was found ($p = .95$) and neither an interaction between context and prosody ($p = .29$ and $p = .64$). A post-hoc Tukey HSD test revealed a statistically significant difference between OCOA and SCSA conditions, so that participants spent more time choosing a picture in SCSA condition: $\beta = -0.33$, $SE = 0.0979$, $df = 169$, $t = -3.453$, $p = .009$. Significant differences were also found in the comparison between match condition and their mismatch versions, so that participants were faster in choosing a picture when both context and prosody pointed to the same interpretation than when there was a conflict between context and prosody; OCOA condition versus SCOA condition: $\beta = -0.47$, $SE = 0.0977$, $df = 168$, $t = -4.900$, $p < .0001$; OCSA condition versus SCSA condition: $\beta = -0.33$, $SE = 0.0988$, $df = 169$, $t = -3.365$, $p = .001$.

A post-hoc Tukey HSD test was also conducted to compare RT means to choose subject picture and object picture in the same condition. Significant differences were observed in OCSA and SA conditions. Participants spent more time to choose a subject picture than an object picture in these two conditions; object picture OCSA x subject picture OCSA: $\beta = -1.02$, $SE = 0.1995$, $df = 2023$, $t = -5.130$, $p < .0001$; and object picture SA x subject picture SA: $\beta = -0.60$, $SE = 0.1623$, $df = 1839$, $t = -3.722$, $p = .01$.

The graph below shows the effect plot of RT means to choose a picture, while table 26 summarizes the statistical analysis.

Graph 35 – Effect plot of Log-transformed RT means in Experiment 7: interaction between context and prosody



Source: the author (2021).

Table 26 – Statistical analysis of log-transformed RTs to choose a picture in Experiment 7

<i>Predictors</i>	<i>Estimates</i>	Log_RT	
		<i>CI</i>	<i>p</i>
(Intercept)	6.87	6.68 – 7.06	<0.001
context [subject]	0.48	0.29 – 0.67	<0.001
context [no_context]	0.26	0.06 – 0.45	0.009
prosody [subject]	0.01	-0.19 – 0.20	0.954
context [subject] prosody [subject]	* -0.15	-0.42 – 0.13	0.292
context [no_context] prosody [subject]	* 0.06	-0.21 – 0.34	0.641
Random Effects			
σ^2	1.06		
τ_{00} item	0.05		
τ_{00} participant	0.31		
ICC	0.25		
N participant	72		
N item	179		

Observations	2137
Marginal R ² / Conditional R ²	0.021 / 0.27
Source: the author (2021).	

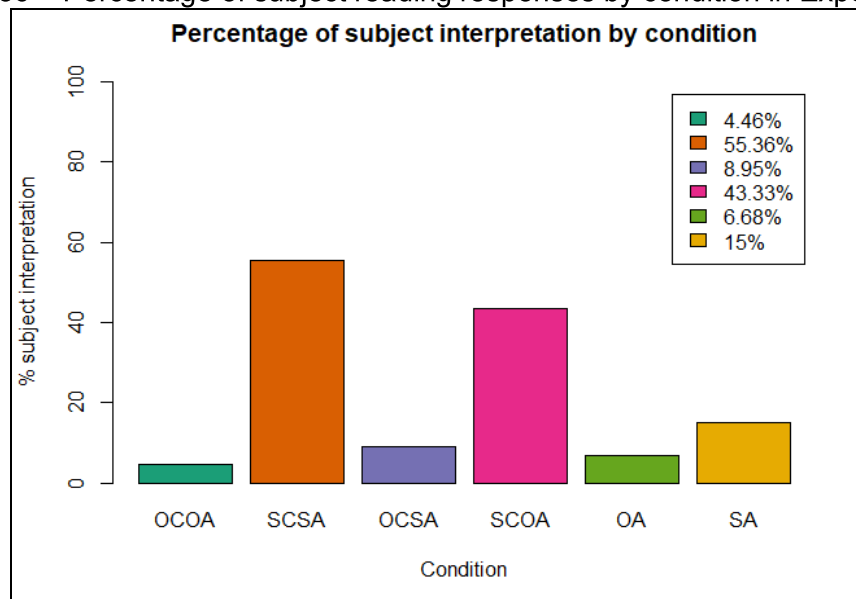
The picture choice responses indicating the final interpretation for the target sentences were also analyzed. Participants chose between pictures with subject bias and object bias. Table 27 shows the amount of object and subject picture interpretation responses chosen in each condition, while the graph below reports the percentage of subject picture interpretation responses in each condition.

Table 27 – Total of object and subject response choices by each condition in Experiment 7

<i>Condition</i>	<i>Object Responses</i>	<i>Subject Responses</i>	<i>Sum</i>
OCOA	342	16	358
SCSA	159	197	356
OCSA	315	31	346
SCOA	204	156	360
OA	335	24	359
SA	304	54	358
	1659	478	2137

Source: the author (2021).

Graph 36 – Percentage of subject reading responses by condition in Experiment 7

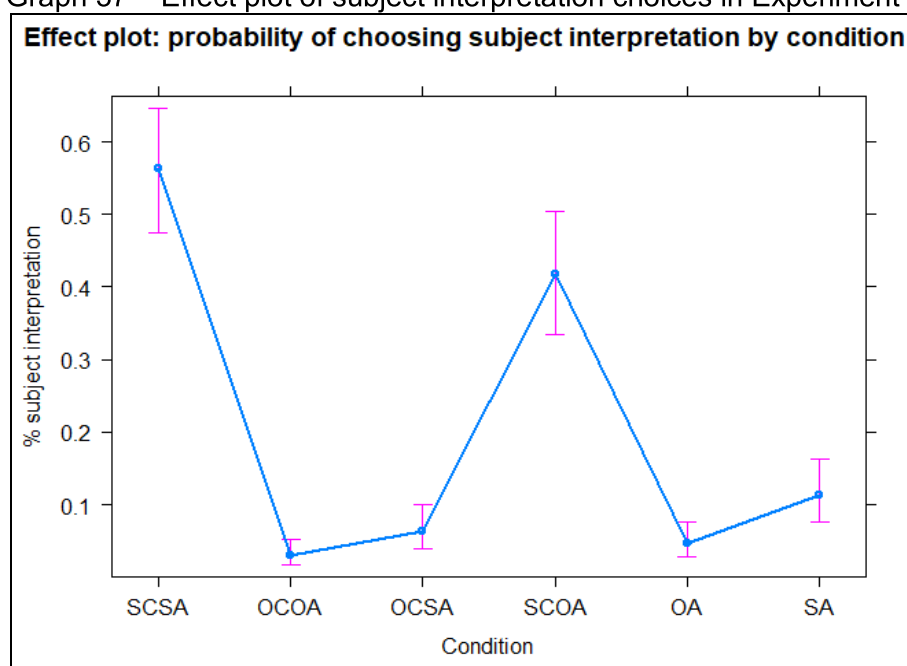


Source: the author (2021).

The results revealed that only SCSA condition, in which both context and prosody biased a subject interpretation of the ambiguous noun, had the majority of subject responses (55.36%). The mismatch SCOA condition, in which only context favored subject reading, had a considerable rate of subject responses (43.33%), despite being under 50%. SA condition, in which prosody biased subject reading, had only 15% of subject responses.

The data of picture choice responses were analyzed in RStudio (R CORE TEAM, 2021) with a logistic mixed-effects regression model using the *glmer* function from the *lme4* package for binomial data. The model included picture choice responses as a function of condition type as fixed effects, and participants and items as random effects. The statistical analysis revealed significant statistical differences of picture subject responses between SCSA condition and the other five conditions. A report of the statistical analysis is given on the table 28. A graph with the effect plot of probability of choosing subject picture interpretation in each condition is also shown.

Graph 37 – Effect plot of subject interpretation choices in Experiment 7



Source: the author (2021).

Table 28 – Statistical analysis for Picture Interpretation Responses of Experiment 7

<i>Predictors</i>	Picture interpretation choices		
	<i>Odds Ratios</i>	<i>CI</i>	<i>p</i>
(Intercept)	1.28	0.90 – 1.83	0.164
condition [OCOA]	0.02	0.01 – 0.05	<0.001
condition [OCSA]	0.05	0.03 – 0.09	<0.001
condition [SCOA]	0.56	0.37 – 0.84	0.005
condition [OA]	0.04	0.02 – 0.07	<0.001
condition [SA]	0.10	0.06 – 0.16	<0.001
Random Effects			
σ^2	3.29		
τ_{00} item	0.24		
τ_{00} participant	0.75		
ICC	0.23		
$N_{\text{participant}}$	72		
N_{item}	179		
Observations	2137		
Marginal R^2 / Conditional R^2	0.310 / 0.470		

Source: the author (2021).

The results of this study partially confirm hypothesis (ii), the pragmatic context was able to help determine the likely subjects of potentially gapping sentences only when a prosodic cue also biased a subject reading of the ambiguous noun. Only SCSA condition had the majority of subject reading responses (55.46%). In SCOA condition, in which context biased subject reading but prosody biased object reading, the context had a significant effect (43.33% of subject responses) but it was not strong enough to make gapping the most preferred structure. It is possible that the simple structural bias (object reading) was weighed by the object prosodic structure, and thus gapping was dispreferred. In OCOA and OCSA conditions, the context worked as expected, there was a strong preference for the object interpretation since these two conditions had the slowest rate of subject picture choices (4.46% and 8.95% respectively).

The findings suggest that subject prosody had a small effect in the AE sentences tested here. Gapping structure was the preferred choice only when subject prosody was combined with a subject biasing context. Subject prosody alone was not able to bias subject reading in SA condition, we found a very low rate of subject responses, only 15%. This result is very different from the findings of Carlson (2002), in which subject prosody was able to promote 44% of subject responses in an auditory questionnaire. In the mismatch OCSA condition, prosody did not seem to have affected participants' choices (8.95% of subject responses). It seems that the object structural bias present in this kind of sentence was weighed by the biasing object context, and gapping structure was clearly dispreferred.

This study was not able to show effects of prosody alone in the interpretation of potentially gapping sentences. Overall, the results of this experiment allow us to conclude that a pragmatic context is able to reduce the unpreferredness for gapping structure and make it the interpretation of choice for a globally ambiguous sentence, but only when prosodic parallelism highlights this interpretation. In the absence of prosody, there is still some resistance in choosing this structure, despite the presence of the context. It seems that gapping sentences are a marked structure in English, they are only acceptable when linguistic and non-linguistic cues clearly point to that structure.

6.5 Cross-language analysis between BP and AE

This section aims to compare the results found in the sentence-matching picture Experiments 6 and 7 for potentially gapping sentences in Brazilian Portuguese and American English. This cross-language study aimed to understand whether the reliability on contextual and prosodic cues to interpret sentences that are syntactically similar and present the same ambiguity differ across these two languages. The table below summarizes the rate of subject picture interpretation choices in each experimental condition explored in both languages.

Table 29 – Comparison between Experiment 6 and Experiment 7: rate of subject picture choices

Percentage (%) of subject picture choices		
Condition	Brazilian Portuguese	American English
OCOA	11.25%	4.46%
SCSA	63.44%	55.46%
OCSA	15%	8.95%
SCOA	55.23%	43.33%
OA	14.34%	6.68%
SA	31.93%	15%

Source: the author (2021).

We can observe that gapping structure is the most preferred option among the six conditions by both BP and AE language users in SCSA conditions, when both context and prosody point towards this syntactic analysis. In BP, subject responses in this condition seem to be more accepted than in AE (63% versus 55%). In SCOA condition, when only the context biases subject reading, subject interpretation responses remained significantly high rates in both BP and AE (55.23% versus 43.33% respectively), which shows that the pragmatic context had a strong effect in biasing subject reading of the ambiguous noun. The context seems to have been slightly more helpful in BP than in AE. In OCSA condition, in which prosody biases subject reading and the context not, the object context seems to be more helpful in deciding the final

interpretation in both BP and AE (15% and 8.95% respectively). In both OCOA and OA conditions, subject reading was clearly dispreferred as expected, since all cues point to object reading in addition to the existent simple structural bias. In SA condition, in which only subject biasing prosodic cue was available and it pointed to a subject analysis, subject reading was dispreferred in both languages, but it seems that prosody has a stronger effect in BP rather than in AE (31.93% versus 15% respectively).

Overall, both languages show a strong preference for the conjoined object structure, which is aligned with Minimal Attachment Principle (FRAZIER, 1979, 1987). However, when both context and prosody are combined to bias subject interpretation, the dispreference for gapping structure is reduced and it becomes the most preferred syntactic analysis. The pragmatic context revealed to be effective in preparing speakers for encountering two subject topics in globally ambiguous coordinated sentences. However, when context conflicted with the prosodic structure, only in BP speakers still preferred gapping structure most of the time. When it comes to prosody, BP and AE speakers differed in the reliability on this cue. It seems that prosodic cues had a stronger effect to BP speakers rather than to AE speakers for deciding the final interpretation of globally ambiguous gapping sentences.

This cross-language analysis was relevant in the sense that it revealed that both linguistic and non-linguistic information are used in the processing and these cues help to bias a gapping syntactic structure analysis in both BP and AE.

6.6 Summary

To summarize, this chapter introduced four spoken experiments that explored globally ambiguous gapping sentences. Experiments 4 and 5 investigated BP sentences in a Visual World Paradigm study and an Auditory Questionnaire, respectively. Experiments 6 and 7 consisted of a Sentence-picture matching task that studied BP and AE gapping sentences cross-linguistically.

Experiment 4 manipulated parallelism of prosodic cues (type, location and F0 range of pitch accents) between the ambiguous noun and its intended correlate in the first conjunct (the subject or the object noun) along with biasing visual cues (subject and object reading of the ambiguous noun). The findings of the study revealed that prosody and visual cues combined can bias a gapping syntactic structure and make it the interpretation of choice. The results are aligned with the Parallelism Hypothesis (CARLSON, 2002); the prosodic parallelism between the ambiguous noun and its intended correlate (i.e., the subject in the first conjunct) helps the parser determine the structural position of the parallel nouns in the sentence.

Experiment 5 explored the role of biasing prosodic structures (with subject or object bias) and a neutral prosodic structure in the final interpretation of potentially gapping sentences. This study shows that subject prosody increased the rate of subject interpretation of the ambiguous noun, but there is still a strong preference for object interpretation in the three prosodic conditions. The results are aligned with the Minimal Attachment Principle (FRAZIER, 1979) and the Simple Structure Hypothesis (CARLSON, 2002). Speakers prefer the simplest syntactic structure (i.e., fewer nodes) compatible with the input.

Experiments 6 and 7 investigated the influence of biasing pragmatic contexts, prosodic parallelism between nouns and visual cues in the processing of potentially gapping sentences in BP and AE. The results showed that when both context and prosody bias subject reading of the ambiguous noun, the dispreference for gapping structure is reduced and it becomes the most preferred syntactic analysis in both languages. These results are aligned with the Parallelism Hypothesis (CARLSON, 2002) and the Principle of Minimal Topic-structure (HOEKS *et al.*, 2002). The biasing pragmatic context prepared listeners for encountering two subjects in the potentially gapping sentences. Additionally, the prosodic parallelism between the ambiguous noun and its intended correlate (i.e., the subject in the first conjunct) weighed these two subjects in the target sentence, thus helping the parser determine the structural position of the parallel nouns in the sentence. On the other hand, in the absence of context, speakers had a strong preference for the conjoined object structure, which is aligned with the Minimal Attachment Principle (FRAZIER,

1979) and the Simple Structure Hypothesis (CARLSON, 2002). These two experiments provide evidence of the effects of prosody and pragmatic context combination in biasing a gapping syntactic analysis of an ambiguous sentence in both BP and AE. Moreover, the study with AE sentences allowed us to expand the results of the processing of these structures in English.

Conclusions

This doctoral thesis aimed to investigate the processing of written and spoken coordinate sentences with subject versus object ambiguity in BP. A cross-language study was also conducted in order to compare the processing of these spoken sentences that are globally ambiguous in BP and in AE. This type of sentence is usually interpreted as conjunction reduction structure (conjoined objects) due to structural simplicity bias, predicted by the Minimal Attachment Principle (FRAZIER, 1979, 1987), and the preference for sentences with simple topic structure, that is, only one subject in the sentence (HOEKS *et al.*, 2009). However, parallelism of features between DPs could produce a facilitation effect in the processing of these ambiguous sentences and reduce the difficulty and dispreference of gapping interpretation. Studies have shown indeed that coordinate structures, elided and unelided, are easier to interpret when the second conjunct is parallel to the first one (FRAZIER *et al.*, 1984; FRAZIER *et al.*, 2000; CARLSON, 2002). Therefore, different types of grammatical and extra-grammatical features were manipulated in the experiments in order to verify their role in determining the final interpretation of potentially gapping sentences. We manipulated parallelism of semantic features of the DPs in the two conjuncts, parallelism of prosodic cues on the DPs (location and type of pitch accent, and F0 range), biasing visual cues, and biasing pragmatic contexts. All of these features have shown to affect processing.

The written gapping sentences in BP were investigated in off-line and online experiments. The off-line experiment was a Written Questionnaire with a type of judgment task (Experiment 1); while the online experiments were a Self-paced Reading (Experiment 2) and an Eye-tracking and Reading (Experiment 3). Experiments 1 and 2 tested temporally ambiguous gapping sentences (i.e., when only subject reading was possible) while Experiment 3 tested globally ambiguous sentences.

Experiment 1 explored participants' interpretative preferences for completing the main clause of coordinate sentences with a gapping syntactic structure. We aimed to find out how acceptable a gapping structure was in comparison to other two unelided coordinate sentences, a sentence with

conjoined objects and a sentence with conjoined clauses. The results revealed a dispreference for gapping sentences in comparison to the other coordinate types. When given the chance to choose, readers preferred conjoining two objects rather than two clauses, especially the one with elision.

Experiment 2 intended to investigate the online processing of temporally ambiguous gapping sentences in comparison with the same coordinate sentence types from Experiment 1. We wanted to verify if there were processing costs to parse the second conjunct of gapping sentences in comparison to the second conjunct of the unelided coordinate sentences. The results indicated that gapping sentences were more difficult to process in comparison to the unelided coordinate sentences. Spillover effects found during reading of the gapping sentences indicate that readers waited for later information to become available in the sentence to resolve the ellipsis site.

Experiment 3 explored the moment-by-moment processing of potentially gapping sentences, that is, those that present the subject versus object ambiguity of the DP in the second conjunct. This experiment tested the manipulation of semantic parallelism between DPs (ambiguous DP being more similar to the subject or to the object of the first conjunct) in combination with pragmatic biasing contexts (subject bias or object bias). The results showed that both pragmatic context and semantic parallelism are relevant cues in the online processing of potentially gapping sentences. When both context and semantic parallelism were combined to bias a subject reading, gapping syntactic structure was the most preferred interpretation choice.

The potentially gapping sentences were also explored in spoken studies. Prosody has an important role in helping the processor to parse ambiguous sentences and attribute their syntactic analysis (BECKMAN, 1996). According to Winkler (2018) and Kuno (1976), contrastive focus and deletion of redundant elements play a crucial role in licensing the discourse appropriateness of gapping sentences. In other words, the remnants in the second conjunct should be focused and they should bear a contrastive relation with their correlates in the first conjunct. The given information in the sentence should be deleted. Therefore, we focused the ambiguous DP (the remnant) and one of the first conjunct arguments (the subject or the object) to produce prosodic similarity

and favor a focus structure which contrasted these arguments. The manipulated features were the type, the location and the F0 range of pitch accents. More specifically, we wanted to find out if a prosodic structure with two focused subjects could help disambiguate the potentially gapping sentences towards a subject interpretation. The experiments 4 to 7 explored prosodic parallelism in spoken ambiguous gapping sentences.

Experiment 4 investigated the time course processing of ambiguous BP gapping sentences in a Visual World Paradigm experiment, with a type of a 'look and listen' task. The study manipulated prosodic parallelism between DPs along with the presentation of pictures that biased a subject interpretation or an object interpretation. We aimed to find out how prosodic and visual cues can influence the interpretation of potentially gapping sentences in BP towards a subject reading. The results suggested that listeners were able to use prosodic and visual cues in processing. The right combination of prosody and visual cues make gapping structure the most preferred interpretation.

Experiment 5 was an offline auditory questionnaire with a forced-choice task. It explored the role of prosodic parallelism between DPs itself in the interpretation of potentially gapping sentences in BP. In this study, we produced three types of prosodic structures: a Baseline Prosody, in which none of the arguments were focused; a Subject Accent Prosody, with both intended subject DPs focused, and an Object Accent Prosody, with both intended object DPs focused. The results revealed that the prosodic parallelism between the subject of the first conjunct and the ambiguous noun increased significantly the rate of subject interpretation readings, however, it did not fully disambiguate the sentences. There was a strong preference for object reading in that questionnaire. The simple structural factor bias was more influential than the prosodic parallelism. Prosody alone was not sufficiently strong to make gapping structure the most preferred option.

Experiments 6 and 7 were initially designed to be a Visual World Paradigm Task and had to be adapted for an off-line sentence-picture matching task. This adaptation was due to the outbreak of the world coronavirus pandemic (Covid-19) in 2020, which prevented us from collecting eye-tracking data. The original eye-tracking experiment was adapted to be run online on the

PClbex (ZEHR and SCHWARZ, 2018). We redesigned the experiment in a way that resembled as much as possible the original eye-tracking experiment. These two experiments are part of a cross-language study between BP and AE respectively. Both of them explored the manipulation of semantic parallelism between DPs, prosodic parallelism between DPs, pragmatic biasing contexts, and visual cues. We aimed to investigate whether the combination of both linguistic and non-linguistic information was able to determine the final interpretation of potentially gapping sentences towards the subject reading. The results revealed that when prosodic, semantic, and pragmatic cues clearly biased subject interpretation of the ambiguous noun in the second conjunct, gapping structure became more acceptable and the most preferred interpretation in both BP and AE. When comparing the two languages, we observed that the reliability on prosodic cues slightly differed, they seem to have had a stronger effect in BP than in AE for deciding the final interpretation. In general, BP and AE speakers have a strong preference for the conjoined object structure, which is aligned with Minimal Attachment Principle (FRAZIER, 1979), but this preference can be reduced when grammatical and extra-grammatical features clearly bias subject interpretation. The gapping sentences seem to be a marked structure in both languages and need different biasing cues for being discourse appropriate (WINKLER, 2018).

This thesis proposed to explore the cognitive processes involved in linguistic processing of gapping sentences in both BP and in AE. This research verified the default interpretative preferences for ambiguous gapping sentences; described the prosodic characteristics of BP gapping sentences; manipulated prosodic and semantic features in gapping sentences; investigated the role of a pragmatic context in the interpretation of globally ambiguous gapping sentences; and developed a cross-linguistic study in BP and in AE. The findings of this study revealed that linguistic and non-linguistic features (i.e., semantic, prosodic, contextual and visual) play an important role in biasing a gapping syntactic structure analysis in both BP and AE. These features interacted with language users' structural preferences, but it seems that gapping sentences are processed by the same general mechanisms used to parse other unelided coordinated sentences. In the future, we plan to further investigate the moment-

by-moment processing of these sentences with eye-tracking experiments. Finally, this thesis hopes to have contributed to the grammar description of ellipsis structures in BP and also to have broadened the results of Psycholinguistic studies on the processing of ellipsis structures.

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Appendix 1 – Materials for Experiment 1

Written Questionnaire for Experiment 1

<h1>Complete a frase!</h1>	
----------------------------	--

Nome _____ do(a) _____ participante: _____

Instruções

Caro(a) participante,

você lerá, nesta atividade, o início de uma sentença e depois lerá 3 (três) opções que podem completar o restante desta sentença. A sua tarefa é classificar essas opções de acordo com a sua preferência por elas, ordenando-as como 1ª, 2ª e 3ª opção. Classifique em 1º lugar a opção que você julgue ser a melhor para completar o restante da sentença. Classifique em 2º lugar a que você julgar ser a segunda melhor opção para completar o restante da sentença. Classifique em 3º lugar a opção que você julgue ser a terceira melhor para completar o restante da sentença. Caso haja alguma das opções que julgue não ser apropriada para completar a sentença, você poderá marcar um X.

Para entender como funciona a atividade, veja alguns exemplos:

<i>O João visitou a Raquel e...</i>	Classificação
<i>a) ficou muito contente.</i>	3º
<i>b) a Paula sentiu ciúmes dele.</i>	1º
<i>c) e depois foi para o trabalho.</i>	2º

<i>Júlia chamou a Bruna e</i>	Classificação
<i>a) esperou para ver se ela respondia.</i>	2º
<i>b) as duas foram passear no shopping.</i>	3º
<i>c) a Carla escutou o chamado de longe.</i>	1º

<i>Camilo denunciou o pai e...</i>	Classificação
<i>a) a polícia veio prendê-lo no dia seguinte.</i>	1º
<i>b) o irmão ficou aborrecido com o fato.</i>	2º
<i>c) depois desistiu de ligar para a polícia.</i>	X

Agora que você já viu alguns exemplos, pode começar a atividade!

1. A Maria convidou o João e...	Classificação
a) o Pedro saiu para almoçar sozinho	
b) se esqueceu de fazer a reserva.	
c) o levou para a casa da sua mãe.	

2. Naquela época eram apresentados na tv programas muito melhores...	Classificação
a) do que os de hoje em dia.	
b) mas nem todos podiam ver.	
c) para o público infanto-juvenil.	

3. Alice assou bolos para as amigas e...	Classificação
a) o forno parou de funcionar.	
b) biscoitos para sua prima.	
c) Camila para sua prima.	

4. As festas juninas são sempre animadas pelas fogueiras e...	Classificação
a) pelas comidas típicas.	
b) isso é bem tradicional.	
c) a todos ela pode aquecer.	

5. A Mãe castigou o Paulo e...	Classificação
a) o Bruno atravessou o jardim aos gritos.	
b) todo mundo concordou com o que ela fez.	
c) então, ele não pôde ir ao jogo de futebol.	

6. Ricardo plantou rosas na varanda e...	Classificação
a) Marcelo no canteiro.	
b) o vaso caiu no chão.	
c) orquídeas no canteiro.	

7. A professora corrigiu as provas dos alunos...	Classificação
a) que não faltaram às aulas.	
b) e depois lhes disse a nota.	
c) e sorriu ao se lembrar deles.	

8. A debutante usou brilhantes na festa e...	Classificação
a) pérolas na igreja.	
b) a noiva na igreja.	
c) foi embora cedo.	

9. O projeto extinguiu-se faz mais de 5 anos e...	Classificação
a) ninguém buscou fazer algo parecido.	
b) nem parece que ajudou tanta gente.	
c) Pedro diz que irá, um dia, retomá-lo.	
10. Susana deu biscoito para as crianças e...	Classificação
a) Marina para os vizinhos.	
b) e comeu tudo sozinha.	
c) bolinhos para os vizinhos.	
11. O garoto protegeu a mãe e...	Classificação
a) a irmã espantou o cachorro com um grito.	
b) o policial conseguiu recuperar seus pertences.	
c) por isso, ele decidiu que iria ser um bombeiro	
12. Toda a turma ria quando...	Classificação
a) o João imitava o professor de matemática.	
b) as cortinas se abriram e entrou a cantora.	
c) chegou a professora com a nota da prova.	
13. Marília colocou livros na escrivaninha e...	Classificação
a) pegou a revista na mesa.	
b) cadernos na prateleira.	
c) Bárbara na prateleira.	
14. O cavalo de Pedro se chama Trovão e...	Classificação
a) vive correndo feliz pelos pastos.	
b) o cachorro se chama Napoleão.	
c) desde ontem ninguém o viu aqui.	
15. Mesmo com sono as crianças esperavam acordadas...	Classificação
a) pelo Papai Noel na noite de natal.	
b) enquanto os adultos já dormiam.	
c) e ansiosas pela grande surpresa.	
16. Rodrigo contou piadas para os adultos e...	Classificação
a) histórias para as crianças.	
b) Roberto para as crianças.	
c) ninguém riu das piadas.	
17. O professor aprovou o João e...	Classificação
a) o Lucas repetiu o semestre outra vez.	
b) ele ficou muito feliz com o resultado.	
c) pediu que ele tivesse mais atenção.	
18. Geraldo fez carteiras para a escola e...	Classificação
a) cadeiras para o asilo.	
b) vendeu para a igreja.	
c) Antônio para o asilo.	

19. Quando as outras meninas chegaram o time completou-se e...	Classificação
a) a partida pôde começar.	
b) tudo ficou resolvido.	
c) elas ficaram aliviadas.	
20. Leonardo comprou coxinha para sua esposa e...	Classificação
a) Rogério para sua noiva.	
b) empada para sua filha.	
c) foi de ônibus para casa.	
21. Ladrões atacaram a Maria e...	Classificação
a) a Laura atirou um sapato neles.	
b) fugiram com medo da polícia.	
c) o Tiago saiu correndo atrás deles.	
22. Os jurados escolheram o Paulo e...	Classificação
a) o Pedro ficou aborrecido com o resultado.	
b) automaticamente ele passou para a final.	
c) o abraçaram em sinal de agradecimento.	
23. Amanda cortou cenouras para a sopa e...	Classificação
a) cebolas para a salada.	
b) Cristina para a salada.	
c) fez uma sobremesa.	
24. Os pais abraçaram o filho e...	Classificação
a) a filha observou a cena comovida.	
b) depois lhe entregam o presente.	
c) a mãe disse que estava com frio.	
25. A Luísa levou a sogra e...	Classificação
a) o sogro foi se despedir delas no aeroporto.	
b) quis agradá-la para serem amigas de verdade.	
c) lhe pediu que fossem mais cedo para a casa.	
26. Vanessa escolheu cortinas para o quarto e...	Classificação
a) pintou a sala de branco	
b) cadeiras para o escritório.	
c) Priscila para o escritório.	
27. O delegado interrogou o Jorge e...	Classificação
a) o João ficou amargurado com a situação.	
b) lhe disse que não lhe escondesse nada.	
c) o que ele disse não fez nenhum sentido.	
28. Os cozinheiros lavaram os pratos depois do almoço e...	Classificação
a) os copos depois do jantar.	
b) os garçons depois do jantar.	
c) não voltaram a trabalhar.	

29. A ginasta apresentou a coreografia...	Classificação
a) com uma música clássica de Beethoven.	
b) e todos lhe aplaudiram de pé ao final.	
c) a fim de ser aprovada naquela etapa.	
30. Fernando vendeu roupas no brechó e...	Classificação
a) sapatos no calçadão.	
b) a loja acabou falindo.	
c) Camila no calçadão.	
31. A escola homenageou o professor e...	Classificação
a) a turma ficou emocionada com a cerimônia.	
b) ele teve que se conter para não chorar muito.	
c) então, ele pôde se despedir de todo mundo.	
32. Clarice preparou vitaminas para os seus pais e...	Classificação
a) Mirela para os seus amigos.	
b) batidas para os seus amigos.	
c) quebrou o liquidificador.	
33. O Padre abençoou a mãe e...	Classificação
a) a filha chorou emocionada com a cena.	
b) lhe disse que ela precisava ter mais fé.	
c) e o pai a abraçou com muita alegria.	
34. A mãe remendou camisas com a máquina de costura e...	Classificação
c) perdeu o rolo de linha.	
a) a filha com a agulha.	
b) vestidos com a agulha.	
35. O Juiz ouviu o Davi e...	Classificação
a) o José ficou angustiado no depoimento.	
b) depois disse que já lhes daria a sentença.	
c) calmamente, pediu que ele ficasse de pé.	

Appendix 2 – Materials for Experiment 2

GAP: Gapping; OBJ: Objects; SEN: Sentences

Set	Sentences
1	<p><u>GAP</u>: A Beatriz / assou / a pizza / e / a Carla / o bolo / de limão / pro lanche. <u>OBJ</u>: A Beatriz / assou / a pizza / e / o bolo / de limão / pro lanche / da tarde. <u>SEN</u>: A Beatriz / assou / a pizza / e / a Carla / preparou / um suco / de limão.</p>
2	<p><u>GAP</u>: O Ricardo / plantou / o cravo / e / o Marcos / a rosa / no jardim / dos fundos. <u>OBJ</u>: O Ricardo / plantou / o cravo / e / a rosa / no jardim / dos fundos / da casa. <u>SEN</u>: O Ricardo / plantou / o cravo / e / o Marcos / arrumou / o jardim / dos fundos.</p>
3	<p><u>GAP</u>: A Simone / usou / a pulseira / e / a Leda / o anel / de ouro / na festa. <u>OBJ</u>: A Simone / usou / a pulseira / e / o anel / de ouro / na festa / do bairro. <u>SEN</u>: A Simone / usou / a pulseira / e / a Leda / admirou / a joia / de ouro.</p>
4	<p><u>GAP</u>: A Susana / serviu / a bebida / e / a Márcia / o lanche / da tarde / na creche. <u>OBJ</u>: A Susana / serviu / a bebida / e / o lanche / da tarde / na creche / do bairro. <u>SEN</u>: A Susana / serviu / a bebida / e / a Márcia / derrubou / o lanche / na festa.</p>
5	<p><u>GAP</u>: A Marília / digitou / a prova / e / a Bruna / o texto / de inglês / pra aula. <u>OBJ</u>: A Marília / digitou / a prova / e / o texto / de inglês / pra aula / da tarde. <u>SEN</u>: A Marília / digitou / a prova / e / a Bruna / imprimiu / no xerox / do centro.</p>
6	<p><u>GAP</u>: O Rodrigo / varreu / o quarto / e / o Carlos / a sala / durante / a manhã. <u>OBJ</u>: O Rodrigo / varreu / o quarto / e / a sala / de jantar / durante / a manhã. <u>SEN</u>: O Rodrigo / varreu / o quarto / e / o Carlos / estendeu / a colcha / na cama.</p>
7	<p><u>GAP</u>: O Geraldo / limpou / o armário / e / o André / o quadro / da sala / de aula. <u>OBJ</u>: O Geraldo / limpou / o armário / e / o quadro / da sala / de aula / do curso. <u>SEN</u>: O Geraldo / limpou / o armário / e / o André / colocou / os livros / no lugar.</p>
8	<p><u>GAP</u>: A Talita / comprou / a saia / e / a Lara / a blusa / de linho / no shopping. <u>OBJ</u>: A Talita / comprou / a saia / e / a blusa / de linho / no shopping / do centro. <u>SEN</u>: A Talita / comprou / a saia / e / a Lara / emprestou / a blusa / de linho.</p>
9	<p><u>GAP</u>: A Alice / cortou / a laranja / e / a Kelly / a maçã / pro suco / natural. <u>OBJ</u>: A Alice / cortou / a laranja / e / a maçã / pro suco / natural / do lanche. <u>SEN</u>: A Alice / cortou / a laranja / e / a Kelly / preparou / o suco / natural.</p>
10	<p><u>GAP</u>: A Priscila / escolheu / a estante / e / a Vera / o sofá / pra sala / de estar. <u>OBJ</u>: A Priscila / escolheu / a estante / e / o sofá / de couro / pra sala / de estar.</p>

SEN: A Priscila / escolheu / a estante / e / a Vera / sugeriu / um outro / modelo.

11 GAP: A Isabel / lavou / a roupa / e / a Marta / a colcha / de crochê / no tanque.

OBJ: A Isabel / lavou / a roupa / e / a colcha / de crochê / no tanque / do quintal.

SEN: A Isabel / lavou / a roupa / e / a Marta / espanou / os móveis / da casa.

12 GAP: O Fernando / vendeu / o carro / e / o Denis / a moto / no ano / passado.

OBJ: O Fernando / vendeu / o carro / e / a moto / de trilha / no ano / passado.

SEN: O Fernando / vendeu / o carro / e / o Denis / consertou / a moto / antiga.

13 GAP: O Leandro / cozinhou / o arroz / e / o Fábio / o feijão / vermelho / pro jantar.

OBJ: O Leandro / cozinhou / o arroz / e / o feijão / vermelho / pro jantar / de ontem.

SEN: O Leandro / cozinhou / o arroz / e / o Fábio / esquentou / a carne / no forno.

14 GAP: A Mirela / remendou / a camisa / e / a Clara / a saia / com linha / vermelha.

OBJ: A Mirela / remendou / a camisa / e / a saia / rodada / com linha / vermelha.

SEN: A Mirela / remendou / a camisa / e / a Clara / arrumou / os botões / da saia.

15 GAP: O Henrique / derrubou / o prato / e / o Caio / o copo / de vidro / na sala.

OBJ: O Henrique / derrubou / o prato / e / o copo / de vidro / na sala / de jantar.

SEN: O Henrique / derrubou / o prato / e / o Caio / recolheu / os cacos / zangado.

16 GAP: O Marcelo / consertou / o relógio / e / o Jonas / o rádio / no final / da tarde.

OBJ: O Marcelo / consertou / o relógio / e / o rádio / de pilha / no final / da tarde.

SEN: O Marcelo / consertou / o relógio / e / o Jonas / estragou / o rádio / de pilha.

17 GAP: O Murilo / colou / o bilhete / e / o João / o cartaz / no mural / da sala.

OBJ: O Murilo / colou / o bilhete / e / o cartaz / no mural / da sala / de aula.

SEN: O Murilo / colou / o bilhete / e / o João / retirou / o cartaz / do mural.

18 GAP: O Daniel / esqueceu / o caderno / e / o Lucas / o livro / na mesa / da sala.

OBJ: O Daniel / esqueceu / o caderno / e / o livro / de inglês / na mesa / da sala.

SEN: O Daniel / esqueceu / o caderno / e / o Lucas / entregou / no curso / mais tarde.

Appendix 3 – Materials for Experiment 3

Set	Condition	Biasing Context + Target Sentences
1	Subject Context Neutral Parallelism	<u>Context</u> : Faz tempo que Maria e Carla estavam sem ver a amiga Sara. <u>Target</u> : A Maria visitou a Sara nas férias e a Carla no feriado de Carnaval.
	Object Context Neutral Parallelism	<u>Context</u> : Faz tempo que Maria estava sem ver as amigas Sara e Carla. <u>Target</u> : A Maria visitou a Sara nas férias e a Carla no feriado de Carnaval.
	Subject Context Subject Parallelism	<u>Context</u> : Maria e Carla estão construindo uma casa. <u>Target</u> : A Maria visitou a obra no feriado e a Carla no feriado de Carnaval.
	Object Context Subject Parallelism	<u>Context</u> : Maria é engenheira e é amiga de Carla. <u>Target</u> : A Maria visitou a obra no feriado e a Carla no feriado de Carnaval.
2	Subject Context Neutral Parallelism	<u>Context</u> : Daniel e Bruno são amigos de Lucas. <u>Target</u> : O Daniel levou o Lucas na festa e o Bruno no churrasco da empresa.
	Object Context Neutral Parallelism	<u>Context</u> : Daniel é amigo de Lucas e de Bruno. <u>Target</u> : O Daniel levou o Lucas na festa e o Bruno no churrasco da empresa.
	Subject Context Subject Parallelism	<u>Context</u> : Daniel é uma pessoa muito prestativa. <u>Target</u> : O Daniel levou a comida na festa e o Bruno no churrasco da empresa.
	Object Context Subject Parallelism	<u>Context</u> : Daniel e Bruno são pessoas prestativas. <u>Target</u> : O Daniel levou a comida na festa e o Bruno no churrasco da empresa.
3	Subject Context Neutral Parallelism	<u>Context</u> : Beatriz e Kátia são pessoas muito críticas. <u>Target</u> : Beatriz criticou a Célia no jantar e a Kátia no almoço de domingo.
	Object Context Neutral Parallelism	<u>Context</u> : Beatriz é uma pessoa muito crítica. <u>Target</u> : A Beatriz criticou a Célia no jantar e a Kátia no almoço de domingo.
	Subject Context Subject	<u>Context</u> : Beatriz e Kátia são pessoas muito críticas. <u>Target</u> : A Beatriz criticou a comida no jantar e a Kátia no almoço de

	Parallelism	domingo.
	Object Context Subject Parallelism	<u>Context</u> : Beatriz é uma pessoa muito crítica. <u>Target</u> : A Beatriz criticou a comida no jantar e a Kátia no almoço de domingo.
4	Subject Context Neutral Parallelism	<u>Context</u> : Diogo é muito amigo de Cláudio e Lúcio. <u>Target</u> : O Diogo encontrou o Cláudio na praça e o Lúcio no calçadão da cidade.
	Object Context Neutral Parallelism	<u>Context</u> : Diogo é muito amigo de Cláudio e Lúcio. <u>Target</u> : O Diogo encontrou o Cláudio na praça e o Lúcio no calçadão da cidade.
	Subject Context Subject Parallelism	<u>Context</u> : Diogo e Lúcio são rapazes muito sortudos. <u>Target</u> : O Diogo encontrou o relógio na praça e o Lúcio no calçadão da cidade
	Object Context Subject Parallelism	<u>Context</u> : Diogo é um rapaz muito sortudo. <u>Target</u> : O Diogo encontrou o relógio na praça e o Lúcio no calçadão da cidade.
5	Subject Context Neutral Parallelism	<u>Context</u> : Laís e Márcia são pessoas muito prestativas. <u>Target</u> : A Laís ajudou a Nara com o trabalho e a Márcia com o dever de português.
	Object Context Neutral Parallelism	<u>Context</u> : Laís é uma pessoa muito prestativa. <u>Target</u> : A Laís ajudou a Nara com o trabalho e a Márcia com o dever de português.
	Subject Context Subject Parallelism	<u>Context</u> : Laís e Márcia são pessoas muito prestativas. <u>Target</u> : A Laís ajudou a sala com o trabalho e a Márcia com o dever de português.
	Object Context Subject Parallelism	<u>Context</u> : Laís é uma pessoa muito prestativa. <u>Target</u> : A Laís ajudou a sala com o trabalho e a Márcia com o dever de português.
6	Subject Context Neutral Parallelism	<u>Context</u> : Tiago e João são pessoas muito prestativas. <u>Target</u> : O Tiago buscou o Márcio em casa e o João na fábrica de calçados.
	Object Context Neutral Parallelism	<u>Context</u> : Tiago é uma pessoa muito prestativa. <u>Target</u> : O Tiago buscou o Márcio em casa e o João na fábrica de calçados.
	Subject Context Subject	<u>Context</u> : Tiago e João são pessoas muito prestativas. <u>Target</u> : O Tiago buscou o contrato no trabalho e o João na fábrica de

	Parallelism	calçados.
	Object Context	<u>Context:</u> Tiago é uma pessoa muito prestativa.
	Subject Parallelism	<u>Target:</u> O Tiago buscou o contrato no trabalho e o João na fábrica de calçados.
7	Subject Context	<u>Context:</u> Talita e Lúcia são pessoas muito distraídas.
	Neutral Parallelism	<u>Target:</u> A Talita esqueceu a Nádia no shopping e a Lúcia na escola de música.
	Object Context	<u>Context:</u> Talita é uma pessoa muito distraída.
	Neutral Parallelism	<u>Target:</u> A Talita esqueceu a Nádia no shopping e a Lúcia na escola de música.
	Subject Context	<u>Context:</u> Talita e Lúcia são pessoas muito distraídas.
	Subject Parallelism	<u>Target:</u> A Talita esqueceu a bolsa no shopping e a Lúcia na escola de música.
	Object Context	<u>Context:</u> Talita é uma pessoa muito distraída.
	Subject Parallelism	<u>Target:</u> A Talita esqueceu a bolsa no shopping e a Lúcia na escola de música.
8	Subject Context	<u>Context:</u> Luiz e Fábio são grandes amigos de Bruno.
	Neutral Parallelism	<u>Target:</u> O Luiz trouxe o Bruno para o piquenique e o Fábio para a festa da escola.
	Object Context	<u>Context:</u> Luiz é amigo de Bruno e de Fábio.
	Neutral Parallelism	<u>Target:</u> O Luiz trouxe o Bruno para o piquenique e o Fábio para a festa da escola.
	Subject Context	<u>Context:</u> Luiz e Fábio são pessoas muito prestativas.
	Subject Parallelism	<u>Target:</u> O Luiz trouxe os doces para o piquenique e o Fábio para a festa da escola.
	Object Context	<u>Context:</u> Luiz é uma pessoa muito prestativa.
	Subject Parallelism	<u>Target:</u> O Luiz trouxe os doces para o piquenique e o Fábio para a festa da escola.
9	Subject Context	<u>Context:</u> Leda está desempregada há muito tempo.
	Neutral Parallelism	<u>Target:</u> Joice recomendou a Leda ao diretor e a Paula ao gerente no escritório.
	Object Context	<u>Context:</u> Leda e Paula estão desempregadas há muito tempo.
	Neutral Parallelism	<u>Target:</u> A Joice recomendou a Leda ao diretor e a Paula ao gerente no escritório.
	Subject Context	<u>Context:</u> Joice e Paula são amigas e adoram ler.
	Subject Parallelism	<u>Target:</u> A Joice recomendou um livro ao diretor e a Paula ao gerente no escritório.

	Object Context Subject Parallelism	<u>Context</u> : Paula está desempregada há algum tempo. <u>Target</u> : A Joice recomendou um livro ao diretor e a Paula ao gerente no escritório.
10	Subject Context Neutral Parallelism	<u>Context</u> : Denis e Igor são muito amigos de Heitor. <u>Target</u> : O Denis apresentou o Heitor aos pais e o Igor aos amigos na balada.
	Object Context Neutral Parallelism	<u>Context</u> : Denis é muito amigo de Heitor e de Igor. <u>Target</u> : O Denis apresentou o Heitor aos pais e o Igor aos amigos na balada.
	Subject Context Subject Parallelism	<u>Context</u> : Denis e Igor são amigos muito talentosos. <u>Target</u> : O Denis apresentou a música aos pais e o Igor aos amigos na balada.
	Object Context Subject Parallelism	<u>Context</u> : Denis e Igor são amigos e Denis é talentoso. <u>Target</u> : O Denis apresentou a música aos pais e o Igor aos amigos na balada.
	Subject Context Neutral Parallelism	<u>Context</u> : Sandra é uma excelente cozinheira. <u>Target</u> : A Taís elogiou a Sandra no jantar e a Júlia no almoço da família.
11	Object Context Neutral Parallelism	<u>Context</u> : Sandra e Júlia são excelentes cozinheiras. <u>Target</u> : A Taís elogiou a Sandra no jantar e a Júlia no almoço da família.
	Subject Context Subject Parallelism	<u>Context</u> : Taís e Júlia são pessoas muito gentis. <u>Target</u> : A Taís elogiou a comida no jantar e a Júlia no almoço da família.
	Object Context Subject Parallelism	<u>Context</u> : Taís é uma pessoa muito agradável. <u>Target</u> : A Taís elogiou a comida no jantar e a Júlia no almoço da família.
	Subject Context Neutral Parallelism	<u>Context</u> : Luiz e Hélio estavam com muitas dívidas. <u>Target</u> : O Luiz pagou o André com dinheiro e o Hélio com cheque na imobiliária.
12	Object Context Neutral Parallelism	<u>Context</u> : Luiz, apesar de responsável, estava com muitas dívidas. <u>Target</u> : O Luiz pagou o André com dinheiro e o Hélio com cheque na imobiliária.
	Subject Context Subject Parallelism	<u>Context</u> : Luiz e Hélio estavam com muitas dívidas. <u>Target</u> : O Luiz pagou a conta com dinheiro e o Hélio com cheque na imobiliária.

	Object Context Subject Parallelism	<u>Context</u> : Luiz, apesar de responsável, estava com muitas dívidas. <u>Target</u> : O Luiz pagou a conta com dinheiro e o Hélio com cheque na imobiliária.
13	Subject Context Neutral Parallelism	<u>Context</u> : Délia e Flávia foram à festa na casa da Lúcia. <u>Target</u> : A Délia viu a Lúcia na cozinha e a Flávia na varanda do casarão.
	Object Context Neutral Parallelism	<u>Context</u> : Délia foi à festa na casa da Lúcia e da Flávia. <u>Target</u> : A Délia viu a Lúcia na cozinha e a Flávia na varanda do casarão.
	Subject Context Subject Parallelism	<u>Context</u> : Délia entrou no casarão para procurar Flávia. <u>Target</u> : A Délia viu a planta na cozinha e a Flávia na varanda do casarão.
	Object Context Subject Parallelism	<u>Context</u> : Délia e Flávia gostam muito de plantas e jardinagem. <u>Target</u> : A Délia viu a planta na cozinha e a Flávia na varanda do casarão.
14	Subject Context Neutral Parallelism	<u>Context</u> : Júlio e Miguel são pessoas muito polêmicas. <u>Target</u> : O Júlio questionou o Tales na classe e o Miguel no corredor da escola.
	Object Context Neutral Parallelism	<u>Context</u> : Júlio é uma pessoa muito polêmica. <u>Target</u> : O Júlio questionou o Tales na classe e o Miguel no corredor da escola.
	Subject Context Subject Parallelism	<u>Context</u> : Júlio e Miguel são pessoas muito polêmicas. <u>Target</u> : O Júlio questionou a nota na classe e o Miguel no corredor da escola.
	Object Context Subject Parallelism	<u>Context</u> : Júlio é uma pessoa muito polêmica. <u>Target</u> : O Júlio questionou a nota na classe e o Miguel no corredor da escola.
15	Subject Context Neutral Parallelism	<u>Context</u> : Lara é uma garota muito levada. <u>Target</u> : A Kelly corrigiu a Lara na sala de aula e a Ester na sala da diretoria.
	Object Context Neutral Parallelism	<u>Context</u> : Lara e Ester são garotas muito levadas. <u>Target</u> : A Kelly corrigiu a Lara na sala de aula e a Ester na sala da diretoria.
	Subject Context Subject	<u>Context</u> : Kelly e Ester são professoras muito rígidas. <u>Target</u> : A Kelly corrigiu a prova na sala de aula e a Ester na sala da

	Parallelism	diretoria.
	Object Context Subject Parallelism	<u>Context:</u> Kelly é uma professora muito rígida. <u>Target:</u> A Kelly corrigiu a prova na sala de aula e a Ester na sala da diretoria.
16	Subject Context Neutral Parallelism	<u>Context:</u> Diogo e José são pessoas muito barulhentas. <u>Target:</u> O Diogo acordou o Paulo com gritos e o José com música muito alta.
	Object Context Neutral Parallelism	<u>Context:</u> Diogo é uma pessoa muito barulhenta. <u>Target:</u> O Diogo acordou o Paulo com gritos e o José com música muito alta.
	Subject Context Subject Parallelism	<u>Context:</u> Diogo e José são pessoas muito barulhentas. <u>Target:</u> O Diogo acordou o prédio com gritos e o José com música muito alta.
	Object Context Subject Parallelism	<u>Context:</u> Diogo é uma pessoa muito barulhenta. <u>Target:</u> O Diogo acordou o prédio com gritos e o José com música muito alta.
17	Subject Context Neutral Parallelism	<u>Context:</u> Maria é uma pessoa muito distraída. <u>Target:</u> A Joana lembrou a Maria da reunião e a Carla da entrevista na firma.
	Object Context Neutral Parallelism	<u>Context:</u> Maria e Carla são muito distraídas. <u>Target:</u> A Joana lembrou a Maria da reunião e a Carla da entrevista na firma.
	Subject Context Subject Parallelism	<u>Context:</u> Joana e Carla são funcionárias muito dedicadas. <u>Target:</u> A Joana lembrou a equipe da reunião e a Carla da entrevista na firma.
	Object Context Subject Parallelism	<u>Context:</u> Joana é uma funcionária muito dedicada. <u>Target:</u> A Joana lembrou a equipe da reunião e a Carla da entrevista na firma.
18	Subject Context Neutral Parallelism	<u>Context:</u> Jonas e Caio são pessoas corajosas. <u>Target:</u> O Jonas salvou o Bruno do incêndio e o Caio da enchente da cidade.
	Object Context Neutral	<u>Context:</u> Jonas é uma pessoa muito corajosa. <u>Target:</u> O Jonas salvou o Bruno do incêndio e o Caio da enchente da

	Parallelism	cidade.
	Subject Context Subject Parallelism	<u>Context:</u> Jonas e Caio são pessoas corajosas. <u>Target:</u> O Jonas salvou os livros do incêndio e o Caio da enchente da cidade.
	Object Context Subject Parallelism	<u>Context:</u> Jonas é uma pessoa muito corajosa. <u>Target:</u> O Jonas salvou os livros do incêndio e o Caio da enchente da cidade.
19	Subject Context Neutral Parallelism	<u>Context:</u> Meire e Laura são muito distraídas. <u>Target:</u> A Meire perdeu a Ana na praia e a Laura no cinema da galeria.
	Object Context Neutral Parallelism	<u>Context:</u> Meire é uma pessoa muito distraída. <u>Target:</u> A Meire perdeu a Ana na praia e a Laura no cinema da galeria.
	Subject Context Subject Parallelism	<u>Context:</u> Meire e Laura são muito distraídas. <u>Target:</u> A Meire perdeu as chaves na praia e a Laura no cinema da galeria.
	Object Context Subject Parallelism	<u>Context:</u> Meire é uma pessoa muito distraída. <u>Target:</u> A Meire perdeu as chaves na praia e a Laura no cinema da galeria.
20	Subject Context Neutral Parallelism	<u>Context:</u> Marcos e Júlio são meninos muito levados. <u>Target:</u> O Marcos acertou o Lucas com os tomates e o Júlio com os ovos na feira.
	Object Context Neutral Parallelism	<u>Context:</u> Marcos é um menino bastante levado. <u>Target:</u> O Marcos acertou o Lucas com os tomates e o Júlio com os ovos na feira.
	Subject Context Subject Parallelism	<u>Context:</u> Marcos e Júlio são meninos muito levados. <u>Target:</u> O Marcos acertou o carro com os tomates e o Júlio com os ovos na feira.
	Object Context Subject Parallelism	<u>Context:</u> Marcos é um menino bastante levado. <u>Target:</u> O Marcos acertou o carro com os tomates e o Júlio com os ovos na feira.
21	Subject Context Neutral Parallelism	<u>Context:</u> Jade e Carol são pessoas prestativas. <u>Target:</u> A Jade ajudou a Telma na mudança e a Carol na pintura do sobrado.
	Object Context	<u>Context:</u> Jade é uma pessoa muito prestativa.

	Neutral Parallelism	<u>Target:</u> A Jade ajudou a Telma na mudança e a Carol na pintura do sobrado.
	Subject Context Subject Parallelism	<u>Context:</u> Jade e Carol são pessoas prestativas. <u>Target:</u> A Jade ajudou a empresa na mudança e a Carol na pintura do sobrado.
	Object Context Subject Parallelism	<u>Context:</u> Carol é uma pessoa muito prestativa. <u>Target:</u> A Jade ajudou a empresa na mudança e a Carol na pintura do sobrado.
22	Subject Context Neutral Parallelism	<u>Context:</u> Lucas é uma pessoa muito talentosa. <u>Target:</u> O Fábio ouviu o Lucas no rádio e o José no teatro municipal.
	Object Context Neutral Parallelism	<u>Context:</u> Fábio tem amigos que são muito talentosos. <u>Target:</u> O Fábio ouviu o Lucas no rádio e o José no teatro municipal.
	Subject Context Subject Parallelism	<u>Context:</u> Fábio e José gostam muito de política. <u>Target:</u> O Fábio ouviu o comício no rádio e o José no teatro municipal.
	Object Context Subject Parallelism	<u>Context:</u> Fábio gosta de política e é amigo de José. <u>Target:</u> O Fábio ouviu o comício no rádio e o José no teatro municipal.
23	Subject Context Neutral Parallelism	<u>Context:</u> Jaime é uma pessoa muito esquecida. <u>Target:</u> O Paulo avisou o Jaime da festa e o Cláudio da reunião do condomínio.
	Object Context Neutral Parallelism	<u>Context:</u> Jaime e Cláudio são pessoas muito esquecidas. <u>Target:</u> O Paulo avisou o Jaime da festa e o Claudio da reunião do condomínio.
	Subject Context Subject Parallelism	<u>Context:</u> Paulo e Cláudio são responsáveis e organizados. <u>Target:</u> O Paulo avisou a portaria da festa e o Cláudio da reunião do condomínio.
	Object Context Subject Parallelism	<u>Context:</u> Paulo é responsável e organizado. <u>Target:</u> O Paulo avisou a portaria da festa e o Cláudio da reunião do condomínio.
24	Subject Context Neutral Parallelism	<u>Context:</u> Dalva é uma pessoa envolvida na corrupção. <u>Target:</u> A Tânia denunciou a Dalva na polícia e a Sheila no tribunal de justiça.
	Object	<u>Context:</u> Dalva e Sheila estão envolvidas na corrupção.

Context Neutral Parallelism	<u>Target:</u> A Tânia denunciou a Dalva na polícia e a Sheila no tribunal de justiça.
Subject Context Subject Parallelism	<u>Context:</u> Tânia e Sheila são cidadãs muito corretas. <u>Target:</u> A Tânia denunciou o roubo na polícia e a Sheila no tribunal de justiça.
Object Context Subject Parallelism	<u>Context:</u> Tânia é uma cidadã muito correta. <u>Target:</u> A Tânia denunciou o roubo na polícia e a Sheila no tribunal de justiça.

Appendix 4 – Materials for Experiment 4**Sentences**

- 1 O Pedro levou a Júlia na festa e o Bruno no churrasco da empresa.
- 2 A Bia criticou o Mário no colégio e a Kátia no escritório da firma.
- 3 O Diogo encontrou a Cláudia na praça e o Lúcio no calçadão da cidade.
- 4 A Lara ajudou o Douglas com o cartaz e a Márcia com o dever de português.
- 5 O Cássio buscou a Leda em casa e o Tiago na fábrica de calçados.
- 6 A Lúcia esqueceu o Sérgio no shopping e a Nádia na escola de música.
- 7 O Leandro trouxe a Bruna pra reunião e o Jaime pra festa da escola.
- 8 O Danilo apresentou a Sônia aos pais e o Túlio aos amigos da escola.
- 9 A Deise viu o Lucas na cozinha e a Flávia na varanda do casarão.
- 10 O Júlio questionou a Laura na classe e o Vítor no corredor da escola.
- 11 A Dani conheceu o Márcio no clube e a Brenda na lanchonete do bairro.
- 12 O Jonas acordou a Paula com gritos e o Fábio com música muito alta.
- 13 O César salvou a Bruna do incêndio e o Caio da enchente da cidade.
- 14 A Sônia acertou o Paulo com os ovos e a Júlia com os tomates da feira.
- 15 A Lurdes ajudou o Beto na mudança e a Marta na pintura dos cômodos.
- 16 O Fábio assistiu a Vera no TV e o Mauro no teatro municipal.
- 17 A Sandra denunciou o Denis na polícia e a Sheila no tribunal de justiça.
- 18 O Tales pagou a Carla com cheque e o Rubem com dinheiro da herança.
- 19 A Kelly corrigiu o Sávio na sala e o Breno no corredor da escola.
- 20 A Rita visitou o Juca no trabalho e a Carmem no hospital da cidade.

Appendix 5 – Materials for Experiment 4: Prosodic Features

- F0 (Hz) means

Prosodic structure: Subject Accent (SA)						
	<i>Subject</i>	<i>f0 (Hz)</i>	<i>Object</i>	<i>f0 (Hz)</i>	<i>Conjunction + Ambiguous Noun</i>	<i>f0 (Hz)</i>
1	o Pedro	383	a Júlia	266	e o Bruno	399
2	a Selma	383	o Mário	278	e a Kátia	398
3	o Diogo	412	a Cláudia	231	e o Lúcio	385
4	a Lara	353	o Douglas	258	e a Márcia	382
5	o Cássio	354	a Leda	288	e o Tiago	389
6	a Lúcia	434	o Sérgio	266	e a Nádia	339
7	o César	370	a Bruna	278	e o Jaime	367
8	o Danilo	413	a Sônia	307	e o Túlio	442
9	a Deise	411	o Lucas	273	e a Flávia	352
10	o Júlio	382	a Laura	259	e o Vítor	396
11	a Dani	391	o Márcio	298	e a Brenda	391
12	o Jonas	376	a Paula	252	e o Fábio	387
13	o Tiago	387	a Bruna	283	e o Caio	364
14	a Sônia	358	o Paulo	236	e a Júlia	410
15	a Lurdes	408	o Beto	257	e a Marta	398
16	o Fábio	376	a Vera	262	e o Mauro	440
17	a Sandra	400	o Denis	230	e a Sheila	415
18	o Tales	381	a Carla	230	e o Rubem	428
19	a Kelly	338	o Sávio	295	e a Bruna	392
20	a Rita	425	o Juca	283	e a Carmem	372

Prosodic structure: Object Accent (OA)						
	<i>Subject</i>	<i>f0 (Hz)</i>	<i>Object</i>	<i>f0 (Hz)</i>	<i>Conjunction + Ambiguous Noun</i>	<i>f0 (Hz)</i>
1	o Pedro	284	a Júlia	362	e o Bruno	384
2	a Selma	277	o Mário	436	e a Kátia	351
3	o Diogo	270	a Cláudia	377	e o Lúcio	389
4	a Lara	262	o Douglas	394	e a Márcia	359
5	o Cássio	292	a Leda	431	e o Tiago	376
6	a Lúcia	321	o Sérgio	406	e a Nádia	357
7	o César	307	a Bruna	386	e o Jaime	356
8	o Danilo	296	a Sônia	359	e o Túlio	404
9	a Deise	311	o Lucas	385	e a Flávia	354
10	o Júlio	329	a Laura	362	e o Vítor	393
11	a Dani	318	o Márcio	453	e a Brenda	344
12	o Jonas	324	a Paula	375	e o Fábio	371
13	o Tiago	271	a Bruna	394	e o Caio	335
14	a Sônia	300	o Paulo	386	e a Júlia	424
15	a Lurdes	310	o Beto	382	e a Marta	342

16	o Fábio	280	a Vera	402	e o Mauro	377
17	a Sandra	319	o Denis	389	e a Sheila	384
18	o Tales	315	a Carla	385	e o Rubem	365
19	a Kelly	276	o Sávio	373	e a Bruna	438
20	a Rita	362	o Juca	436	e a Carmem	376

- Duration (ms) means

Prosodic structure: Subject Accent (SA)								
	<i>Subject</i>	<i>Duration (ms)</i>	<i>Object</i>	<i>Duration (ms)</i>	<i>Boundary IP_1 in (ms)</i>	<i>Conjunction + Ambiguous Noun</i>	<i>Duration (ms)</i>	<i>Boundary IP_2 in (ms)</i>
1	o Pedro	701	a Júlia	365	340	e o Bruno	849	395
2	a Selma	907	o Mário	362	336	e a Kátia	1009	346
3	o Diogo	796	a Cláudia	406	315	e o Lúcio	816	288
4	a Lara	787	o Douglas	565	307	e a Márcia	1050	332
5	o Cássio	797	a Leda	326	334	e o Tiago	976	333
6	a Lúcia	848	o Sérgio	492	318	e a Nádia	867	308
7	o César	984	a Bruna	363	365	e o Jaime	855	302
8	o Danilo	854	a Sônia	406	323	e o Túlio	777	291
9	a Deise	872	o Lucas	389	328	e a Flávia	1022	313
10	o Júlio	798	a Laura	383	354	e o Vítor	1061	312
11	a Dani	794	o Márcio	460	297	e a Brenda	1059	301
12	o Jonas	1071	a Paula	421	351	e o Fábio	990	323
13	o Tiago	856	a Bruna	393	339	e o Caio	919	269
14	a Sônia	934	o Paulo	377	289	e a Júlia	934	316
15	a Lurdes	1072	o Beto	311	309	e a Marta	1027	284
16	o Fábio	1012	a Vera	404	345	e o Mauro	995	339
17	a Sandra	1030	o Denis	376	334	e a Sheila	999	350
18	o Tales	942	a Carla	392	307	e o Rubem	947	307
19	a Kelly	848	o Sávio	457	304	e a Bruna	895	324
20	a Rita	816	o Juca	413	342	e a Carmem	949	276

Prosodic structure: Object Accent (OA)								
	<i>Subject</i>	<i>Duration (ms)</i>	<i>Object</i>	<i>Duration (ms)</i>	<i>Boundary IP_1 in (ms)</i>	<i>Conjunction + Ambiguous Noun</i>	<i>Duration (ms)</i>	<i>Boundary IP_2 in (ms)</i>
1	o Pedro	568	a Júlia	663	296	e o Bruno	885	---
2	a Selma	641	o Mário	706	357	e a Kátia	876	---
3	o Diogo	483	a Cláudia	744	326	e o Lúcio	789	---
4	a Lara	563	o Douglas	843	343	e a Márcia	891	---
5	o Cássio	664	a Leda	760	332	e o Tiago	939	---
6	a Lúcia	521	o Sérgio	958	338	e a Nádia	851	---
7	o César	643	a Bruna	805	309	e o Jaime	859	---

8	o Danilo	579	a Sônia	815	350	e o Túlio	894	---
9	a Deise	589	o Lucas	806	311	e a Flávia	1001	---
10	o Júlio	493	a Laura	645	318	e o Vítor	872	---
11	a Dani	576	o Márcio	723	324	e a Brenda	813	---
12	o Jonas	492	a Paula	741	303	e o Fábio	841	---
13	o Tiago	507	a Bruna	794	313	e o Caio	811	---
14	a Sônia	550	o Paulo	819	296	e a Júlia	779	---
15	a Lurdes	655	o Beto	724	276	e a Marta	838	---
16	o Fábio	619	a Vera	686	309	e o Mauro	778	---
17	a Sandra	586	o Denis	886	302	e a Sheila	934	---
18	o Tales	626	a Carla	747	328	e o Rubem	750	---
19	a Kelly	520	o Sávio	912	313	e a Bruna	800	---
20	a Rita	533	o Juca	733	314	e a Carmem	967	---

Appendix 6 – Materials for Experiment 5**Sentences**

- 1 No fim de semana, o Danilo levou a Camila na festa e o Fernando no churrasco da empresa.
 - 2 Infelizmente, a Carina criticou o Rodrigo na escola e a Marcela no escritório da firma.
 - 3 Antes de ontem, o Geraldo encontrou a Fernanda na praça e o Leandro no calçadão da cidade.
 - 4 Na aula da manhã, o Camilo intimidou a Larissa na classe e o Guilherme no corredor da escola.
 - 5 Durante o feriado, o Diogo apresentou a Sabrina aos primos e o Murilo aos amigos da escola.
 - 6 No mês passado, a Marina conheceu o Marcelo no clube e a Lorena na lanchonete do bairro.
 - 7 Na confusão da feira, a Simone acertou o Renato com os tomates e a Vanessa com os ovos da quitanda.
 - 8 Durante a semana, a Gisele ajudou o Nicolas na mudança e a Milena na pintura dos cômodos.
 - 9 De forma corajosa, a Solange denunciou o Rodrigo na polícia e a Talita no tribunal de justiça.
 - 10 Ontem à tarde, o Bernardo pagou a Cristina com o cheque e o Ricardo com o dinheiro da herança.
 - 11 Durante as férias, a Samanta visitou o Francisco na casa de praia e a Renata na fazenda da família.
 - 12 Naquela semana, a Suzana elogiou o Felipe na reunião e a Clarissa no almoço da firma.
 - 13 De bom grado, a Priscila recomendou o Ronaldo para o chefe e a Tamires para o gerente do escritório.
 - 14 Na saída da escola, a Denise flagrou o Roberto com cigarros e a Rebeca com bebidas alcólicas.
 - 15 No fim de semana, o Gilberto convidou a Silvana para um jantar e o Laerte para um cinema.
 - 16 Durante as férias, a Paloma ensinou o Fabrício sobre culinária e a Michele sobre costura.
 - 17 Na sexta-feira, o Gustavo insultou a Roberta durante a aula e o Leandro durante o intervalo.
 - 18 No Natal, o Diego presenteou a Nicole com um livro e o Rodolfo com um celular novo.
-

Appendix 7 – Materials for Experiment 5: Prosodic Features

- F0 (Hz)

Prosodic structure: Subject Accent (SA)						
	<i>Subject</i>	<i>f0 (Hz)</i>	<i>Object</i>	<i>f0 (Hz)</i>	<i>Ambiguous Noun</i>	<i>f0 (Hz)</i>
1	Danilo	329	Camila	235	Fernando	290
2	Carina	330	Rodrigo	252	Marcela	318
3	Geraldo	307	Fernanda	228	Leandro	313
4	Camilo	332	Larissa	237	Guilherme	315
5	Diogo	289	Sabrina	243	Murilo	292
6	Marina	311	Marcelo	243	Lorena	280
7	Simone	334	Renato	234	Vanessa	294
8	Gisele	320	Nicolas	249	Milena	338
9	Solange	297	Rodrigo	240	Talita	296
10	Bernardo	334	Cristina	255	Ricardo	323
11	Samanta	316	Francisco	249	Renata	291
12	Suzana	341	Felipe	271	Clarissa	294
13	Priscila	349	Ronaldo	247	Tamires	323
14	Denise	333	Roberto	241	Rebeca	303
15	Gilberto	332	Silvana	252	Laerte	298
16	Paloma	317	Fabrcio	270	Michele	337
17	Gustavo	407	Roberta	247	Leandro	336
18	Diego	309	Nicole	286	Rodolfo	330

Prosodic structure: Object Accent (OA)						
	<i>Subject</i>	<i>f0 (Hz)</i>	<i>Object</i>	<i>f0 (Hz)</i>	<i>Ambiguous Noun</i>	<i>f0 (Hz)</i>
1	Danilo	233	Camila	333	Fernando	311
2	Carina	237	Rodrigo	322	Marcela	331
3	Geraldo	228	Fernanda	352	Leandro	289
4	Camilo	257	Larissa	331	Guilherme	326
5	Diogo	223	Sabrina	318	Murilo	306
6	Marina	238	Marcelo	308	Lorena	303
7	Simone	240	Renato	339	Vanessa	298
8	Gisele	212	Nicolas	305	Milena	311
9	Solange	224	Rodrigo	293	Talita	293
10	Bernardo	224	Cristina	340	Ricardo	312
11	Samanta	240	Francisco	342	Renata	298
12	Suzana	233	Felipe	314	Clarissa	323
13	Priscila	235	Ronaldo	335	Tamires	312
14	Denise	215	Roberto	300	Rebeca	290
15	Gilberto	224	Silvana	356	Laerte	274
16	Paloma	237	Fabrcio	322	Michele	305
17	Gustavo	235	Roberta	300	Leandro	380
18	Diego	219	Nicole	337	Rodolfo	366

Prosodic structure: Baseline						
	<i>Subject</i>	<i>f0 (Hz)</i>	<i>Object</i>	<i>f0 (Hz)</i>	<i>Ambiguous Noun</i>	<i>f0 (Hz)</i>
1	Danilo	220	Camila	248	Fernando	237
2	Carina	226	Rodrigo	228	Marcela	271
3	Geraldo	211	Fernanda	242	Leandro	240
4	Camilo	254	Larissa	240	Guilherme	241
5	Diogo	229	Sabrina	248	Murilo	236
6	Marina	227	Marcelo	229	Lorena	243
7	Simone	246	Renato	236	Vanessa	238
8	Gisele	225	Nicolas	234	Milena	258
9	Solange	235	Rodrigo	233	Talita	236
10	Bernardo	224	Cristina	246	Ricardo	261
11	Samanta	238	Francisco	236	Renata	243
12	Suzana	251	Felipe	250	Clarissa	250
13	Priscila	230	Ronaldo	240	Tamires	251
14	Denise	244	Roberto	256	Rebeca	258
15	Gilberto	245	Silvana	252	Laerte	245
16	Paloma	264	Fabrcio	253	Michele	240
17	Gustavo	229	Roberta	248	Leandro	246
18	Diego	260	Nicole	258	Rodolfo	300

- Duration (ms)

Prosodic structure: Subject Accent (SA)								
	<i>Subject</i>	<i>Duration (ms)</i>	<i>Object</i>	<i>Duration (ms)</i>	<i>Boundary IP_1 in (ms)</i>	<i>Ambiguous Noun</i>	<i>Duration (ms)</i>	<i>Boundary IP_2 in (ms)</i>
1	Danilo	868	Camila	469	259	Fernando	858	348
2	Carina	814	Rodrigo	436	286	Marcela	902	317
3	Geraldo	871	Fernanda	476	310	Leandro	793	312
4	Camilo	822	Larissa	432	261	Guilherme	868	386
5	Diogo	852	Sabrina	514	401	Murilo	819	292
6	Marina	854	Marcelo	513	312	Lorena	871	326
7	Simone	846	Renato	521	207	Vanessa	912	333
8	Gisele	942	Nicolas	624	424	Milena	952	338
9	Solange	770	Rodrigo	448	355	Talita	920	364
10	Bernardo	864	Cristina	534	349	Ricardo	871	304
11	Samanta	796	Francisco	546	359	Renata	824	337
12	Suzana	898	Felipe	376	244	Clarissa	875	357
13	Priscila	934	Ronaldo	451	367	Tamires	931	297
14	Denise	963	Roberto	455	358	Rebeca	831	280
15	Gilberto	842	Silvana	514	294	Laerte	897	225
16	Paloma	753	Fabrcio	613	382	Michele	871	321
17	Gustavo	829	Roberta	536	375	Leandro	906	344
18	Diego	691	Nicole	427	325	Rodolfo	787	324

Prosodic structure: Object Accent (OA)								
	<i>Subject</i>	<i>Duration (ms)</i>	<i>Object</i>	<i>Duration (ms)</i>	<i>Boundary IP_1 in (ms)</i>	<i>Ambiguous Noun</i>	<i>Duration (ms)</i>	<i>Boundary IP_2 in (ms)</i>
1	Danilo	515	Camila	433	333	Fernando	634	---
2	Carina	467	Rodrigo	392	322	Marcela	645	---
3	Geraldo	464	Fernanda	493	352	Leandro	427	---
4	Camilo	551	Larissa	584	331	Guilherme	572	---
5	Diogo	442	Sabrina	504	318	Murilo	428	---
6	Marina	591	Marcelo	483	308	Lorena	553	---
7	Simone	430	Renato	399	339	Vanessa	457	---
8	Gisele	427	Nicolas	505	305	Milena	535	---
9	Solange	468	Rodrigo	402	293	Talita	588	---
10	Bernardo	539	Cristina	546	340	Ricardo	535	---
11	Samanta	488	Francisco	568	342	Renata	578	---
12	Suzana	512	Felipe	458	314	Clarissa	604	---
13	Priscila	547	Ronaldo	523	335	Tamires	654	---
14	Denise	507	Roberto	398	300	Rebeca	461	---
15	Gilberto	518	Silvana	477	356	Laerte	450	---
16	Paloma	444	Fabrcio	498	322	Michele	497	---
17	Gustavo	514	Roberta	584	300	Leandro	557	---
18	Diego	444	Nicole	467	337	Rodolfo	509	---

Prosodic structure: Baseline								
	<i>Subject</i>	<i>Duration (ms)</i>	<i>Object</i>	<i>Duration (ms)</i>	<i>Boundary IP_1 in (ms)</i>	<i>Ambiguous Noun</i>	<i>Duration (ms)</i>	<i>Boundary IP_2 in (ms)</i>
1	Danilo	524	Camila	782	333	Fernando	825	---
2	Carina	575	Rodrigo	768	322	Marcela	786	---
3	Geraldo	447	Fernanda	778	352	Leandro	689	---
4	Camilo	393	Larissa	562	331	Guilherme	705	---
5	Diogo	376	Sabrina	927	318	Murilo	779	---
6	Marina	496	Marcelo	746	308	Lorena	883	---
7	Simone	555	Renato	746	339	Vanessa	933	---
8	Gisele	553	Nicolas	785	305	Milena	845	---
9	Solange	532	Rodrigo	742	293	Talita	912	---
10	Bernardo	614	Cristina	874	340	Ricardo	813	---
11	Samanta	488	Francisco	904	342	Renata	933	---
12	Suzana	485	Felipe	752	314	Clarissa	938	---
13	Priscila	493	Ronaldo	805	335	Tamires	886	---
14	Denise	418	Roberto	662	300	Rebeca	854	---
15	Gilberto	541	Silvana	848	356	Laerte	726	---
16	Paloma	495	Fabrcio	834	322	Michele	881	---
17	Gustavo	490	Roberta	794	300	Leandro	809	---
18	Diego	391	Nicole	846	337	Rodolfo	847	---

Appendix 8 – Materials for Experiment 6

Set	Introduction + Context + Target Sentence
1	<p><u>Introduction:</u> Esses são o Pedro, a Júlia e o Bruno.</p> <p><u>Subject Context:</u> Fazia tempo que o Pedro e o Bruno não viam a Júlia. <u>Object Context:</u> Fazia tempo que o Pedro não via a Júlia e o Bruno.</p> <p><u>Target:</u> No fim de semana, o Pedro levou a Júlia na festa e o Bruno no churrasco da empresa.</p>
2	<p><u>Introduction:</u> Esses são a Selma, o Mário e a Kátia.</p> <p><u>Subject Context:</u> A Selma e a Kátia foram rígidias com o Mário. <u>Object Context:</u> A Selma foi rígida com o Mário e com a Kátia.</p> <p><u>Target:</u> Infelizmente, a Selma criticou o Mário na escola e a Kátia no escritório da firma.</p>
3	<p><u>Introduction:</u> Esses são o Jairo, a Cláudia e o Lúcio.</p> <p><u>Subject Context:</u> O Jairo e o Lúcio viram a amiga Cláudia por acaso. <u>Object Context:</u> O Jairo viu os amigos Cláudia e Lúcio por acaso.</p> <p><u>Target:</u> Antes de ontem, o Jairo encontrou a Cláudia na praça e o Lúcio no calçadão da cidade.</p>
4	<p><u>Introduction:</u> Esses são a Lara, o Douglas e a Márcia.</p> <p><u>Subject Context:</u> A Lara e a Márcia foram prestativas com o Douglas. <u>Object Context:</u> A Lara foi prestativa com o Douglas e com a Márcia.</p> <p><u>Target:</u> Durante a tarde, A Lara ajudou o Douglas com o cartaz e a Márcia com o dever de português.</p>
5	<p><u>Introduction:</u> Esses são o Sílvio, a Leda e o Cássio.</p> <p><u>Subject Context:</u> O Sílvio e o Cássio costumam dar carona para a Leda. <u>Object Context:</u> O Sílvio costuma dar carona para a Leda e o Cássio.</p> <p><u>Target:</u> Nessa semana, o Sílvio buscou a Leda em casa e o Cássio na fábrica de calçados.</p>
6	<p><u>Introduction:</u> Esses são a Lúcia, o Sérgio e a Nádia.</p> <p><u>Subject Context:</u> A Lúcia e a Nádia foram distraídas no encontro com o Sérgio. <u>Object Context:</u> A Lúcia foi distraída no encontro com o Sérgio e a</p>

	<p>Nádia.</p> <p><u>Target:</u> Na semana passada, a Lúcia esqueceu o Sérgio no shopping e a Nádia na escola de música.</p>
7	<p><u>Introduction:</u> Esses são o César, a Bruna e o Jaime.</p> <p><u>Subject Context:</u> O César e o Jaime levaram a amiga Bruna para sair. <u>Object Context:</u> O César levou os amigos Bruna e Jaime para sair.</p> <p><u>Target:</u> No fim de semana, o César trouxe a Bruna para a reunião e o Jaime para a festa da escola.</p>
8	<p><u>Introduction:</u> Esses são o Décio, a Sônia e o Túlio.</p> <p><u>Subject Context:</u> O Décio e o Túlio conheceram a Sônia há pouco tempo. <u>Object Context:</u> O Décio conheceu a Sônia e o Túlio há pouco tempo.</p> <p><u>Target:</u> Durante o feriado, o Décio apresentou a Sônia aos pais e o Túlio aos amigos da escola.</p>
9	<p><u>Introduction:</u> Esses são a Deise, o Lucas e a Flávia.</p> <p><u>Subject Context:</u> A Deise e Flávia estavam procurando o Lucas. <u>Object Context:</u> A Deise estava procurando o Lucas e a Flávia.</p> <p><u>Target:</u> Felizmente, a Deise viu o Lucas na cozinha e a Flávia na varanda do casarão.</p>
10	<p><u>Introduction:</u> Esses são o Júlio, a Laura e o Victor.</p> <p><u>Subject Context:</u> O Júlio e o Victor gostam de fazer bullying com a Laura. <u>Object Context:</u> O Júlio gosta de fazer bullying com a Laura e com o Victor.</p> <p><u>Target:</u> Nessa manhã, o Júlio intimidou a Laura na classe e o Victor no corredor da escola.</p>
11	<p><u>Introduction:</u> Esses são a Cássia, o Márcio e a Brenda.</p> <p><u>Subject Context:</u> A Cássia e a Brenda se tornaram amigas do Márcio recentemente. <u>Object Context:</u> A Cássia se tornou amiga do Márcio e da Brenda recentemente.</p> <p><u>Target:</u> No mês passado, a Cássia conheceu o Márcio no clube e a Brenda na lanchonete do bairro.</p>

- 12 Introduction: Esses são o Jonas, a Paula e o Fábio.
Subject Context: O Jonas e o Fábio gostam de perturbar a Paula.
Object Context: O Jonas gosta de perturbar a Paula e o Fábio.
Target: Nessa manhã, o Jonas acordou a Paula com o sino e o Fábio com música muito alta.
- 13 Introduction: Esses são o Carlos, a Rita e o Tales.
Subject Context: O Carlos e o Tales são heróis para a Rita.
Object Context: O Carlos é um herói para a Rita e para o Tales.
Target: Corajosamente, o Carlos salvou a Rita do incêndio e o Tales da enchente da cidade.
- 14 Introduction: Esses são a Nara, o Paulo e a Vera.
Subject Context: A Nara e a Vera foram malvadas com o Paulo.
Object Context: A Nara foi malvada com o Paulo e com a Vera.
Target: Rapidamente, a Nara acertou o Paulo com os tomates e a Vera com os ovos da quitanda.
- 15 Introduction: Esses são a Lurdes, o Cláudio e a Marta.
Subject Context: A Lurdes e a Marta foram prestativas com o Cláudio.
Object Context: A Lurdes foi prestativa com o Cláudio e com a Marta.
Target: Durante a semana, a Lurdes ajudou o Cláudio na mudança e a Marta na pintura dos cômodos.
- 16 Introduction: Esses são o Mauro, a Vânia e o Denis.
Subject Context: O Mauro e o Denis acham que a Vânia é talentosa.
Object Context: O Mauro acha que o Denis e a Vânia são talentosos.
Target: No mês passado, o Mauro assistiu a Vânia na TV e o Denis no teatro municipal.
- 17 Introduction: Esses são a Sandra, o Marcos e a Livia.
Subject Context: A Sandra e a Livia descobriram que o Marcos é corrupto.
Object Context: A Sandra descobriu que o Marcos e a Livia são corruptos.
Target: De forma corajosa, a Sandra denunciou o Marcos na polícia e a Livia no tribunal de justiça.

- 18** Introduction: Esses são o Breno, a Carla e o Rubens.
Subject Context: O Breno e o Rubens deviam a Carla.
Object Context: O Breno devia a Carla e o Rubens.
Target: Ontem à tarde, o Breno pagou a Carla com o cheque e o Rubens com o dinheiro da herança.
-
- 19** Introduction: Esses são a Kelly, o Sávio e a Mara.
Subject Context: A Kelly e a Mara foram rígidas com o Sávio.
Object Context: A Kelly foi rígida com o Sávio e com a Mara.
Target: Depois da aula, a Kelly corrigiu o Sávio em casa e a Mara no mercadinho do bairro.
-
- 20** Introduction: Esses são a Sheila, o Juca e a Carmem.
Subject Context: Fazia tempo que a Sheila e a Carmem não viam o Juca.
Object Context: Fazia tempo que a Sheila não via o Juca e a Carmem.
Target: Durante as férias, a Sheila visitou o Juca no trabalho e a Carmem no hospital de cidade.
-
- 21** Introduction: Esses são a Jade, o Nelson e a Cíntia.
Subject Context: A Jade e a Cíntia foram gentis com o Nelson.
Object Context: A Jade foi gentil com o Nelson e com a Cíntia.
Target: Naquela semana, a Jade elogiou o Nelson na reunião e a Cíntia no almoço da família.
-
- 22** Introduction: Esses são a Célia, o Fausto e a Tânia.
Subject Context: A Célia e a Tânia ajudaram o Fausto.
Object Context: A Célia ajudou o Fausto e a Tânia.
Target: De bom grado, a Célia recomendou o Fausto para o chefe e a Tânia para o gerente do escritório.
-
- 23** Introduction: Esses são o Bento, a Clara e o Jorge.
Subject Context: O Bento e o Jorge gostam de implicar com a Clara.
Object Context: O Bento gosta de implicar com a Clara e com o Jorge.
Target: Ontem, o Bento perturbou a Clara na escola e o Jorge na festa de aniversário.

- 24** Introduction: Esses são o Caio, a Joice e o Flávio.
Subject Context: O Caio e o Flávio trataram mal a Joice.
Object Context: O Caio tratou mal a Joice e o Flávio.

Target: Ontem de manhã, o Caio desprezou a Joice na classe e o Flávio na cantina da escola.
-
- 25** Introduction: Esses são a Keila, o Celso e a Rubia.

Subject Context: A Keila e a Rubia suspeitavam do Celso.
Object Context: A Keila suspeitava do Celso e da Rubia.

Target: Na saída da escola, a Keila flagrou o Celso com cigarros e a Rubia com bebidas alcólicas.
-
- 26** Introduction: Esses são o Kleber, a Rute e o Valter.

Subject Context: Fazia tempo que o Kleber e o Valter não viam a Rute.
Object Context: Fazia tempo que o Kleber não via a Rute e o Valter.

Target: No fim de semana, o Kleber convidou a Sara para um jantar e o Valter para um cinema.
-
- 27** Introduction: Esses são a Dalva, o Sandro e a Leila.

Subject Context: A Dalva e a Leila ajudaram o Sandro.
Object Context: A Dalva ajudou o Sandro e a Leila.

Target: Com paciência, a Dalva ensinou o Sandro sobre culinária e a Leila sobre costura.
-
- 28** Introduction: Esses são o Guto, a Dani e o Beto.

Subject Context: O Guto e o Beto foram rudes com a Dani.
Object Context: O Guto foi rude com a Dani e com o Beto.

Target: Infelizmente, o Guto insultou a Dani durante a aula e o Beto durante o intervalo.
-
- 29** Introduction: Esses são a Tati, o Cadu e a Duda.

Subject Context: Fazia tempo que a Tati e a Duda não viam o Cadu.
Object Context: Fazia tempo que a Tati não via o Cadu e a Duda.

Target: Por acaso, a Tati encontrou o Cadu no shopping e a Duda no restaurante do centro.
-
- 30** Introduction: Esses são o Chico, a Manu e o Nando.

Subject Context: O Chico e o Nando compraram presentes para a

Malu.

Object Context: O Chico comprou presentes para a Malu e para o Nando.

Target: No Natal, o Chico presenteou a Manu com um livro e o Nando com um celular moderno.

Appendix 9 – Materials for Experiment 6: Prosodic Features

- F0 (Hz)

Prosodic structure: Subject Accent (SA)						
	<i>Subject</i>	<i>f0 (Hz)</i>	<i>Object</i>	<i>f0 (Hz)</i>	<i>Ambiguous Noun</i>	<i>f0 (Hz)</i>
1	Pedro	301	Júlia	218	Bruno	318
2	Selma	285	Mário	238	Kátia	270
3	Jairo	309	Cláudia	242	Lúcio	348
4	Lara	277	Douglas	236	Márcia	270
5	Sílvio	314	Leda	241	Cássio	311
6	Lúcia	320	Sérgio	246	Nádia	374
7	César	297	Bruna	232	Jaime	313
8	Décio	318	Sônia	235	Túlio	302
9	Deise	289	Lucas	242	Flávia	289
10	Júlio	295	Laura	222	Victor	334
11	Cássia	321	Márcio	265	Brenda	298
12	Jonas	276	Paula	238	Fábio	254
13	Carlos	316	Rita	251	Tales	288
14	Nara	324	Paulo	227	Vera	342
15	Lurdes	383	Cláudio	257	Marta	355
16	Mauro	345	Vânia	236	Denis	303
17	Sandra	313	Marcos	264	Lívia	308
18	Breno	323	Carla	234	Rubens	316
19	Kelly	307	Sávio	245	Mara	285
20	Sheila	301	Juca	236	Carmem	315
21	Jade	284	Nelson	234	Cíntia	343
22	Célia	281	Fausto	238	Tânia	334
23	Bento	325	Clara	246	Jorge	299
24	Caio	322	Joice	239	Flávio	294
25	Keila	317	Celso	242	Rubia	297
26	Kleber	342	Sara	222	Valter	357
27	Dalva	296	Sandro	239	Leila	308
28	Guto	300	Dani	223	Beto	322
29	Tati	284	Lucas	234	Duda	304
30	Chico	395	Bete	222	Nando	336

Prosodic structure: Object Accent (OA)						
	<i>Subject</i>	<i>f0 (Hz)</i>	<i>Object</i>	<i>f0 (Hz)</i>	<i>Ambiguous Noun</i>	<i>f0 (Hz)</i>
1	Pedro	257	Júlia	312	Bruno	316
2	Selma	241	Mário	279	Kátia	282
3	Jairo	229	Cláudia	298	Lúcio	319
4	Lara	258	Douglas	316	Márcia	353
5	Sílvio	272	Leda	317	Cássio	380
6	Lúcia	272	Sérgio	383	Nádia	355
7	César	244	Bruna	331	Jaime	293

8	Décio	259	Sônia	332	Túlio	344
9	Deise	233	Lucas	344	Flávia	310
10	Júlio	261	Laura	291	Victor	320
11	Cássia	283	Márcio	289	Brenda	332
12	Jonas	239	Paula	298	Fábio	324
13	Carlos	263	Rita	326	Tales	297
14	Nara	223	Paulo	335	Vera	278
15	Lurdes	253	Cláudio	346	Marta	347
16	Mauro	256	Vânia	305	Denis	319
17	Sandra	254	Marcos	365	Lívia	348
18	Breno	259	Carla	336	Rubens	325
19	Kelly	248	Sávio	313	Mara	337
20	Sheila	232	Juca	322	Carmem	320
21	Jade	238	Nelson	329	Cíntia	338
22	Célia	220	Fausto	368	Tânia	337
23	Bento	264	Clara	290	Jorge	306
24	Caio	231	Joice	294	Flávio	276
25	Keila	227	Celso	338	Rubia	325
26	Kleber	252	Sara	378	Valter	405
27	Dalva	233	Sandro	367	Leila	365
28	Guto	264	Dani	353	Beto	287
29	Tati	243	Lucas	333	Duda	308
30	Chico	253	Bete	323	Nando	315

- Duration (ms)

Prosodic structure: Subject Accent (SA)								
	<i>Subject</i>	<i>Duration (ms)</i>	<i>Object</i>	<i>Duration (ms)</i>	<i>Boundary IP_1 in (ms)</i>	<i>Ambiguous Noun</i>	<i>Duration (ms)</i>	<i>Boundary IP_2 in (ms)</i>
1	Pedro	776	Júlia	273	332	Bruno	755	350
2	Selma	667	Mário	404	327	Kátia	852	298
3	Jairo	619	Cláudia	419	477	Lúcio	712	370
4	Lara	509	Douglas	479	337	Márcia	761	299
5	Sílvio	612	Leda	304	360	Cássio	933	365
6	Lúcia	606	Sérgio	433	308	Nádia	804	286
7	César	905	Bruna	292	335	Jaime	819	335
8	Décio	863	Sônia	373	344	Túlio	746	366
9	Deise	589	Lucas	329	374	Flávia	833	437
10	Júlio	559	Laura	314	315	Victor	740	322
11	Cássia	730	Márcio	400	337	Brenda	660	372
12	Jonas	705	Paula	322	385	Fábio	760	370
13	Carlos	774	Rita	323	431	Tales	942	314
14	Nara	602	Paulo	292	353	Vera	642	354
15	Lurdes	778	Cláudio	390	389	Marta	675	523
16	Mauro	544	Vânia	365	404	Denis	726	337

17	Sandra	672	Marcos	426	316	Lívia	720	303
18	Breno	690	Carla	372	321	Rubens	769	346
19	Kelly	604	Sávio	370	353	Mara	655	415
20	Sheila	720	Juca	312	264	Carmem	722	331
21	Jade	707	Nelson	416	340	Cíntia	755	374
22	Célia	577	Fausto	430	312	Tânia	730	372
23	Bento	676	Clara	365	310	Jorge	819	355
24	Caio	737	Joice	362	289	Flávio	692	346
25	Keila	642	Celso	380	300	Rubia	585	410
26	Kleber	776	Sara	302	507	Valter	810	479
27	Dalva	614	Sandro	434	322	Leila	585	361
28	Guto	655	Dani	306	389	Beto	763	439
29	Tati	773	Lucas	341	328	Duda	676	349
30	Chico	683	Bete	325	470	Nando	690	483

Prosodic structure: Object Accent (OA)								
	<i>Subject</i>	<i>Duration (ms)</i>	<i>Object</i>	<i>Duration (ms)</i>	<i>Boundary IP_1 in (ms)</i>	<i>Ambiguous Noun</i>	<i>Duration (ms)</i>	<i>Boundary IP_2 in (ms)</i>
1	Pedro	389	Júlia	516	365	Bruno	669	---
2	Selma	338	Mário	501	418	Kátia	627	---
3	Jairo	254	Cláudia	584	357	Lúcio	616	---
4	Lara	354	Douglas	564	372	Márcia	626	---
5	Sílvio	343	Leda	479	418	Cássio	774	---
6	Lúcia	249	Sérgio	558	473	Nádia	686	---
7	César	439	Bruna	439	397	Jaime	525	---
8	Décio	313	Sônia	570	414	Túlio	543	---
9	Deise	434	Lucas	601	448	Flávia	701	---
10	Júlio	348	Laura	467	407	Victor	613	---
11	Cássia	416	Márcio	422	386	Brenda	522	---
12	Jonas	394	Paula	534	369	Fábio	685	---
13	Carlos	541	Rita	519	417	Tales	608	---
14	Nara	324	Paulo	515	548	Vera	555	---
15	Lurdes	337	Cláudio	620	350	Marta	549	---
16	Mauro	291	Vânia	447	304	Denis	597	---
17	Sandra	392	Marcos	647	374	Lívia	564	---
18	Breno	326	Carla	517	373	Rubens	671	---
19	Kelly	268	Sávio	638	481	Mara	579	---
20	Sheila	422	Juca	512	461	Carmem	668	---
21	Jade	284	Nelson	606	411	Cíntia	732	---
22	Célia	343	Fausto	584	451	Tânia	638	---
23	Bento	321	Clara	616	433	Jorge	644	---
24	Caio	322	Joice	670	453	Flávio	668	---
25	Keila	339	Celso	671	402	Rubia	652	---
26	Kleber	394	Sara	516	671	Valter	775	---
27	Dalva	316	Sandro	590	383	Leila	492	---
28	Guto	264	Dani	564	414	Beto	601	---

29	Tati	327	Lucas	427	488	Duda	575	---
30	Chico	318	Bete	535	549	Nando	627	---

Appendix 10 – Materials for Experiment 7

Set	Introduction + Context + Target Sentence
1	<p><u>Introduction</u>: This is Peter, Julia and Brian.</p> <p><u>Subject Context</u>: It's been a long time since Peter and Brian had seen their friend Julia.</p> <p><u>Object Context</u>: It's been a long time since Peter had seen with his friends Julia and Brian.</p> <p><u>Target</u>: On the weekend, Peter took Julia to the party and Brian to the company barbecue.</p>
2	<p><u>Introduction</u>: This is Betsy, Michael and Katy.</p> <p><u>Subject Context</u>: Betsy and Katy are very judgmental of Michael.</p> <p><u>Object Context</u>: Betsy is very judgmental of Michael and Katy.</p> <p><u>Target</u>: In fact, Betsy criticized Michael at school and Katy at the firm office.</p>
3	<p><u>Introduction</u>: This is Daniel, Grace and James.</p> <p><u>Subject Context</u>: It's been a long time since Daniel and James had seen Grace.</p> <p><u>Object Context</u>: It's been a long time since Daniel had seen James and Grace.</p> <p><u>Target</u>: Yesterday, Daniel met Grace at the square and James at the city boardwalk.</p>
4	<p><u>Introduction</u>: This is Laura, Donald and Mary.</p> <p><u>Subject Context</u>: Laura and Mary are very kind to Donald.</p> <p><u>Object Context</u>: Laura is very kind to Mary and Donald.</p> <p><u>Target</u>: In the afternoon, Laura helped Donald with the poster and Mary with English homework.</p>
5	<p><u>Introduction</u>: This is Craig, Lisa and Thomas.</p> <p><u>Subject Context</u>: Craig and Thomas like to give Lisa rides around town.</p> <p><u>Object Context</u>: Craig likes to give Lisa and Thomas rides around town.</p> <p><u>Target</u>: Last week, Craig picked up Lisa at home and Thomas at the shoe store.</p>
6	<p><u>Introduction</u>: This is Lucy, Samuel and Emma.</p> <p><u>Subject Context</u>: Lucy and Emma are often losing track of Samuel.</p>

	<p><u>Object Context</u>: Lucy is often losing track of Samuel and Emma.</p> <p><u>Target</u>: Indeed, Lucy forgot Samuel at the shopping mall and Emma at the music school.</p>
7	<p><u>Introduction</u>: This is Lucas, Brenda and Jacob.</p> <p><u>Subject Context</u>: It's been a long time since Lucas and Jacob had gone out with their friend Brenda.</p> <p><u>Object Context</u>: It's been a long time since Lucas had gone out with his friends Brenda and Jacob.</p> <p><u>Target</u>: Last weekend, Lucas brought Brenda to the meeting and Jacob to the school party.</p>
8	<p><u>Introduction</u>: This is Ethan, Dylan and Susan.</p> <p><u>Subject Context</u>: Ethan and Dylan have just become friends with Susan.</p> <p><u>Object Context</u>: Ethan has just become friends with Susan and Dylan.</p> <p><u>Target</u>: During the holiday, Ethan introduced Susan to his parents and Dylan to his school friends.</p>
9	<p><u>Introduction</u>: This is Daisy, Luke and Sally.</p> <p><u>Subject Context</u>: Daisy and Sally were looking for Luke.</p> <p><u>Object Context</u>: Daisy was looking for Sally and Luke.</p> <p><u>Target</u>: Fortunately, Daisy saw Luke in the kitchen and Sally on the balcony.</p>
10	<p><u>Introduction</u>: This is Julio, Laura and Victor.</p> <p><u>Subject Context</u>: Julio and Victor often bully Laura.</p> <p><u>Object Context</u>: Julio often bullies Laura and Victor.</p> <p><u>Target</u>: This afternoon, Julio threatened Laura in the classroom and Victor in the school hall.</p>
11	<p><u>Introduction</u>: This is Janet, Marcus and Claire.</p> <p><u>Subject Context</u>: Janet and Claire have recently become friends with Marcus.</p> <p><u>Object Context</u>: Janet has recently become friends with Marcus and Claire.</p> <p><u>Target</u>: Two weeks ago, Janet met Marcus at the club and Claire at the local diner.</p>
12	<p><u>Introduction</u>: This is John, Peggy and Fred.</p>

	<p><u>Subject Context</u>: John and Fred like to bother Peggy in the morning. <u>Object Context</u>: John likes to bother Peggy and Fred in the morning.</p> <p><u>Target</u>: This morning, John woke up Peggy with the bell and Fred with loud music.</p>
13	<p><u>Introduction</u>: This is Connor, Bridget and Chase.</p> <p><u>Subject Context</u>: Connor and Chase are both heroes to Bridget. <u>Object Context</u>: Connor is a hero to both Bridget and Chase.</p> <p><u>Target</u>: Bravely, Connor saved Bridget from the fire and Chase from the city flood.</p>
14	<p><u>Introduction</u>: This is Sandy, Paul and Jenny.</p> <p><u>Subject Context</u>: Sandy and Jenny are very mean to Paul. <u>Object Context</u>: Sandy is very mean to Paul and Jenny.</p> <p><u>Target</u>: In fact, Sandy hit Paul with eggs and Jenny with tomatoes.</p>
15	<p><u>Introduction</u>: This is Lila, Roger and Martha</p> <p><u>Subject Context</u>: Lila and Martha are very kind to Roger. <u>Object Context</u>: Lila is very kind to Roger and Martha.</p> <p><u>Target</u>: During the week, Lila helped Roger with moving and Martha with room painting.</p>
16	<p><u>Introduction</u>: This is Frank, Sofia and Henry.</p> <p><u>Subject Context</u>: Frank and Henry think Sofia is a talented singer. <u>Object Context</u>: Frank thinks Sofia and Henry are talented singers.</p> <p><u>Target</u>: Last month, Frank saw Sofia on TV and Henry at the theater.</p>
17	<p><u>Introduction</u>: This is Sheila, Dennis and Sandra.</p> <p><u>Subject Context</u>: Sheila and Sandra think Dennis is involved in corruption. <u>Object Context</u>: Sheila think Dennis and Sandra are involved in corruption.</p> <p><u>Target</u>: Later, Sheila reported Dennis to the police and Sandra to the court.</p>
18	<p><u>Introduction</u>: This is Tate, Sharon and Robert.</p> <p><u>Subject Context</u>: Tate and Robert owed some money to Sharon. <u>Object Context</u>: Tate owed some money to Robert and Sharon.</p> <p><u>Target</u>: Yesterday, Tate paid Sharon with a check and Robert with cash.</p>

- 19** Introduction: This is Kelly, Parker and Rachel.
Subject Context: Kelly and Rachel often annoy Parker.
Object Context: Kelly often annoys Parker and Rachel.
Target: After school, Kelly pestered Parker at home and Rachel at the grocery store.
-
- 20** Introduction: This is Rita, Charles and Carmen.
Subject Context: It's been a long time since Rita and Carmen had seen Charles.
Object Context: It's been a long time since Rita had seen Carmen and Charles.
Target: During vacation, Rita visited Charles at work and Carmen at the city hospital.
-
- 21** Introduction: This is Joanna, Eric and Tina.
Subject Context: Joanna and Tina were very kind to Eric.
Object Context: Joanna was very kind to Eric.
Target: In fact, Joanna complimented Eric at the meeting and Tina at the family lunch.
-
- 22** Introduction: This is Chloe, Oliver and Zoey.
Subject Context: Chloe and Zoey were very helpful to Oliver.
Object Context: Chloe was very helpful to Oliver and Zoey.
Target: Indeed, Chloe recommended Oliver to the boss and Zoey to the office manager.
-
- 23** Introduction: This is Noah, Evelyn and William.
Subject Context: Noah and William like to pester Evelyn.
Object Context: Noah likes to pester Evelyn and William.
Target: Yesterday, Noah annoyed Evelyn at school and William at the birthday party.
-
- 24** Introduction: This is Andrew, Leah and Nathan.
Subject Context: Andrew and Nathan like to tease Leah.
Object Context: Andrew likes to tease Leah and Nathan.
Target: In the morning, Andrew mocked Leah in the classroom and Nathan in the school cafeteria.

- 25** Introduction: This is Maya, Jordan and Ruby.
Subject Context: Maya and Ruby were suspicious of Jordan.
Object Context: Maya was suspicious of Jordan and Ruby.
Target: Yesterday, Maya caught Jordan with cigarettes and Ruby with alcoholic beverages.
-
- 26** Introduction: This is Kevin, Rose and George.
Subject Context: It's been a while since Kevin and George had seen their friend Rose.
Object Context: It's been a while since Kevin had seen his friends Rose and George.
Target: Last weekend, Kevin invited Rose to the dinner and George to the cinema.
-
- 27** Introduction: This is Emily, Joshua and Avery.
Subject Context: Emily and Avery were very helpful to Joshua.
Object Context: Emily was very helpful to Joshua and Avery.
Target: Patiently, Emily taught Joshua about cooking and Avery about sewing.
-
- 28** Introduction: This is Gabriel, Layla and David.
Subject Context: Gabriel and David are often rude towards Layla.
Object Context: Gabriel is often rude towards Layla and David.
Target: Unfortunately, Gabriel insulted Layla during class and David during break.
-
- 29** Introduction: This Nora, Christian and Anna.
Subject Context: Nora and Anna ran into Christian on the weekend.
Object Context: Nora ran into Christian and Anna on the weekend.
Target: By chance, Nora met Christian at the mall and Anna at the restaurant.
-
- 30** Introduction: This is Nolan, Hannah and Adam.
Subject Context: Nolan and Adam had presents for Hannah.
Object Context: Nolan had presents for Hannah and Adam.
Target: At the birthday party, Nolan gave Hannah a book and Adam a cellphone.

Appendix 11 – Materials for Experiment 7: Prosodic Features

- F0 (Hz)

Prosodic structure: Subject Accent (SA)						
	<i>Subject</i>	<i>f0 (Hz)</i>	<i>Object</i>	<i>f0 (Hz)</i>	<i>Ambiguous Noun</i>	<i>f0 (Hz)</i>
1	Peter	429	Julia	248	Brian	316
2	Betsy	322	Michael	253	Katy	303
3	Daniel	286	Grace	257	James	312
4	Laura	303	Donald	251	Mary	316
5	Craig	299	Lisa	263	Thomas	281
6	Lucy	343	Samuel	262	Emma	313
7	Lucas	353	Brenda	258	Jacob	334
8	Ethan	311	Susan	263	Dylan	313
9	Daisy	305	Luke	269	Sally	324
10	Julio	322	Linda	258	Victor	325
11	Janet	303	Marcus	261	Claire	294
12	John	295	Peggy	320	Fred	333
13	Connor	332	Bridget	279	Chase	449
14	Sandy	348	Paul	456	Jenny	304
15	Lila	340	Roger	258	Martha	345
16	Frank	326	Sofia	287	Henry	335
17	Sheila	334	Dennis	250	Sandra	300
18	Tate	386	Sharon	266	Robert	290
19	Kelly	415	Parker	367	Rachel	359
20	Rita	355	Charles	257	Carmen	295
21	Joanna	396	Eric	302	Tina	330
22	Chloe	332	Oliver	265	Zoey	313
23	Noah	326	Evelyn	274	William	328
24	Andrew	318	Leah	258	Nathan	307
25	Maya	303	Jordan	271	Ruby	323
26	Kevin	337	Rose	270	George	326
27	Emily	379	Joshua	260	Avery	380
28	Gabriel	332	Layla	277	David	325
29	Nora	348	Christian	425	Anna	354
30	Nolan	338	Hannah	275	Adam	321

Prosodic structure: Object Accent (OA)						
	<i>Subject</i>	<i>f0 (Hz)</i>	<i>Object</i>	<i>f0 (Hz)</i>	<i>Ambiguous Noun</i>	<i>f0 (Hz)</i>
1	Peter	444	Julia	259	Brian	252
2	Betsy	285	Michael	275	Katy	266
3	Daniel	260	Grace	263	James	248
4	Laura	253	Donald	242	Mary	241
5	Craig	266	Lisa	283	Thomas	288
6	Lucy	272	Samuel	288	Emma	265
7	Lucas	260	Brenda	286	Jacob	281

8	Ethan	270	Susan	275	Dylan	291
9	Daisy	262	Luke	276	Sally	267
10	Julio	284	Linda	277	Victor	267
11	Janet	257	Marcus	265	Claire	457
12	John	265	Peggy	446	Fred	322
13	Connor	280	Bridget	314	Chase	329
14	Sandy	281	Paul	456	Jenny	302
15	Lila	270	Roger	279	Martha	301
16	Frank	296	Sofia	303	Henry	353
17	Sheila	404	Dennis	262	Sandra	264
18	Tate	406	Sharon	310	Robert	285
19	Kelly	266	Parker	383	Rachel	288
20	Rita	293	Charles	295	Carmen	331
21	Joanna	293	Eric	291	Tina	443
22	Chloe	274	Oliver	249	Zoey	252
23	Noah	263	Evelyn	306	William	266
24	Andrew	266	Leah	286	Nathan	248
25	Maya	266	Jordan	263	Ruby	241
26	Kevin	286	Rose	266	George	288
27	Emily	294	Joshua	297	Avery	265
28	Gabriel	271	Layla	302	David	281
29	Nora	289	Christian	300	Anna	291
30	Nolan	256	Hannah	280	Adam	267

- Duration (ms)

Prosodic structure: Subject Accent (SA)								
	<i>Subject</i>	<i>Duration (ms)</i>	<i>Object</i>	<i>Duration (ms)</i>	<i>Boundary IP_1 in (ms)</i>	<i>Ambiguous Noun</i>	<i>Duration (ms)</i>	<i>Boundary IP_2 in (ms)</i>
1	Peter	353	Julia	420	382	Brian	566	308
2	Betsy	402	Michael	449	447	Katy	523	347
3	Daniel	450	Grace	294	350	James	627	333
4	Laura	417	Donald	411	327	Mary	580	268
5	Craig	401	Lisa	384	348	Thomas	726	310
6	Lucy	434	Samuel	434	357	Emma	520	312
7	Lucas	464	Brenda	272	307	Jacob	634	300
8	Ethan	446	Susan	420	349	Dylan	572	291
9	Daisy	407	Luke	303	368	Sally	616	368
10	Julio	541	Linda	327	332	Victor	601	351
11	Janet	403	Marcus	362	359	Claire	604	348
12	John	420	Peggy	414	357	Fred	601	307
13	Connor	397	Bridget	363	351	Chase	692	258
14	Sandy	561	Paul	447	333	Jenny	708	360
15	Lila	486	Roger	440	384	Martha	670	322
16	Frank	441	Sofia	460	320	Henry	640	308

17	Sheila	540	Dennis	496	334	Sandra	757	340
18	Tate	337	Sharon	431	301	Robert	574	419
19	Kelly	498	Parker	484	323	Rachel	644	329
20	Rita	435	Charles	483	358	Carmen	697	390
21	Joanna	546	Eric	364	333	Tina	623	353
22	Chloe	435	Oliver	447	342	Zoey	618	390
23	Noah	398	Evelyn	421	384	William	650	298
24	Andrew	447	Leah	220	366	Nathan	667	391
25	Maya	494	Jordan	439	333	Ruby	604	288
26	Kevin	408	Rose	427	352	George	646	323
27	Emily	421	Joshua	597	377	Avery	610	407
28	Gabriel	523	Layla	504	332	David	573	284
29	Nora	453	Christian	481	323	Anna	571	295
30	Nolan	470	Hannah	457	334	Adam	675	348

Prosodic structure: Object Accent (OA)								
	<i>Subject</i>	<i>Duration (ms)</i>	<i>Object</i>	<i>Duration (ms)</i>	<i>Boundary IP_1 in (ms)</i>	<i>Ambiguous Noun</i>	<i>Duration (ms)</i>	<i>Boundary IP_2 in (ms)</i>
1	Peter	286	Julia	488	332	Brian	515	---
2	Betsy	322	Michael	481	349	Katy	467	---
3	Daniel	342	Grace	337	335	James	400	---
4	Laura	296	Donald	440	370	Mary	532	---
5	Craig	298	Lisa	436	343	Thomas	507	---
6	Lucy	306	Samuel	600	340	Emma	411	---
7	Lucas	394	Brenda	422	361	Jacob	550	---
8	Ethan	344	Susan	573	374	Dylan	532	---
9	Daisy	311	Luke	393	335	Sally	621	---
10	Julio	533	Linda	384	323	Victor	500	---
11	Janet	357	Marcus	541	324	Claire	420	---
12	John	308	Peggy	401	313	Fred	422	---
13	Connor	339	Bridget	435	298	Chase	538	---
14	Sandy	435	Paul	440	322	Jenny	430	---
15	Lila	360	Roger	496	294	Martha	508	---
16	Frank	301	Sofia	579	363	Henry	488	---
17	Sheila	393	Dennis	425	323	Sandra	582	---
18	Tate	306	Sharon	516	345	Robert	453	---
19	Kelly	335	Parker	558	377	Rachel	514	---
20	Rita	316	Charles	528	333	Carmen	479	---
21	Joanna	452	Eric	466	368	Tina	492	---
22	Chloe	383	Oliver	456	304	Zoey	467	---
23	Noah	343	Evelyn	519	355	William	503	---
24	Andrew	353	Leah	379	327	Nathan	506	---
25	Maya	377	Jordan	417	329	Ruby	441	---
26	Kevin	272	Rose	432	298	George	561	---
27	Emily	381	Joshua	547	386	Avery	458	---
28	Gabriel	514	Layla	508	344	David	568	---

29	Nora	381	Christian	472	356	Anna	478	---
30	Nolan	395	Hannah	468	307	Adam	356	---