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WHAT CAN CROSS-LINGUISTIC PRIMING EFFECTS TELL US ABOUT BILINGUAL LANGUAGE PROCESSING? A STUDY WITH LATE BRAZILIAN PORTUGUESE-ENGLISH BILINGUALS

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Dissertação submetida ao Programa de Pós-Graduação em Inglês: Estudos Linguísticos e Literários da Universidade Federal de Santa Catarina para a obtenção do grau de Mestre em Inglês: Estudos Linguísticos e Literários.

Orientadora: Prof.ª Dra. Mailce Borges Mota.

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O presente trabalho em nível de mestrado foi
avaliado e aprovado por banca examinadora composta pelos
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Certificamos que esta é a versão original e final do trabalho de conclusão que foi julgado
adequado para obtenção do título de Mestre em Inglês: Estudos Linguísticos e Literários.

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Coordenação do Programa de Pós-Graduação

_____

Profa., Dra. Mailce Borges Mota
Orientadora

Florianópolis, 2022.

To my father,
Carlos De Angeli (*in memorian*),
I wish you were here.

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Pursuing an MA during a global pandemic was definitely not something I could have anticipated. After so much time looking forward to study at the graduate level, having to juggle around the clock motherhood with readings on bilingual language processing has left me feeling like I was losing something. What about the long talks over lunch? What about the trips to the coffee shop after a thought-provoking morning? How could I possibly investigate language processing when the only voice I heard was my own? Perhaps I did lose something. Didn't we all? However, even during the most difficult moments of the past two years I have never really thought about giving up. This thesis is dedicated to everyone who lent me their strength when I felt like mine was fading away. Thank you.

My advisor, professor Mailce Borges Mota, thank you for continuing to guide and inspire me. I look forward to the next chapter of our story.

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Finally, I would like to extend my gratitude to all members of LabLing. Thank you for the support during this past two years.

E ainda que as janelas se fechem, meu pai,
é certo que amanhece.
— Hilda Hilst

ABSTRACT

One fascinating aspect of the bilingual mind is its ability to effectively represent and process the structure of two, or more, languages. This acknowledgment has led researchers to wonder about the nature of the bilingual syntactic system. One way of investigating how bilinguals process their languages is by means of a structural priming study. If processing a syntactic structure in one language influences the processing of the same structure in another language, then both languages must share some level of representation. In the present thesis, I investigated cross-linguistic structural priming effects from L1 to L2 during the comprehension of the passive voice in a group of 35 BP-EN late bilinguals. A 4 x 2 experimental design was implemented and it included a four levels within-subjects Condition variable and a between-subjects Proficiency variable (Intermediate vs. Advanced). Results show that, regardless of proficiency, participants read target sentences faster in both experimental conditions when compared to the control conditions. Noticeably, cross-linguistic structural priming effects were observed even in the absence of translation equivalents. That is, both abstract and lexically mediated structural cross-linguistic effects were observed. These findings indicate that late bilinguals with intermediate and advanced levels of proficiency have already developed a shared syntactic system.
Keywords: psycholinguistics; structural priming; bilingual language processing; comprehension; passive voice; Brazilian-Portuguese; late bilinguals; residual activation.

RESUMO

Um aspecto fascinante da mente bilíngue é a sua habilidade de eficientemente representar e processar a estrutura de duas ou mais línguas. Essa situação levou pesquisadores a se perguntarem sobre a natureza do sistema sintático bilíngue. Uma maneira de investigar como bilíngues processam ambas as línguas é realizar um estudo de *priming* sintático. Se processar uma estrutura sintática em uma língua influencia o processamento da mesma estrutura em outra língua, então ambas as línguas devem compartilhar algum nível de representação. Nesta dissertação, eu investiguei efeitos de *priming* estrutural entre línguas da L1 para a L2 durante a compreensão de voz passiva em um grupo de 35 bilíngues tardios de PB-IN. Um desenho experimental 4 x 2 foi implementado, o qual incluiu uma variável intraparticipantes denominada Condição com quatro níveis e uma variável entre participantes denominada Proficiência (Intermediário x Avançado). Os resultados mostram que, independentemente de proficiência, os participantes leram as frases-alvo mais rápido nas duas condições experimentais em comparação com as condições controle. Notavelmente, os efeitos de *priming* estrutural entre línguas foram observados mesmo na ausência de equivalentes de tradução. Isto é, efeitos estruturais entre línguas foram observados com e sem equivalentes de tradução. Esses achados indicam que bilíngues tardios de níveis de proficiência intermediária e avançada de proficiência já desenvolveram um sistema sintático compartilhado.

Palavras-chave: psicolinguística; *priming* estrutural; processamento de língua bilíngue; compreensão; voz passiva; português brasileiro; bilíngues tardios; ativação residual.

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1 INTRODUCTION

Learning a language after puberty is neither a trivial nor a simple task. One of the many challenges they might face, late L2 learners must overcome the crucial matter of how and where to accommodate newly acquired L2 knowledge. As explained by Jackendoff (1990), information stored in the human brain is often conceived as mental representations while the operations they are subjected to are known as mental processes. In the case of language use, a plethora of mental representations and processes should be at place for it to be effective. The present thesis hinges on the fact that, to function in their second language late bilinguals must represent and process its syntactic dimension.

Assuming the co-occurrence of similar syntactic structures in two or more languages what principle would be prioritized: specificity or economy? In other words, do bilinguals have a shared or a separate syntactic system for each of their languages? When addressing this question, researchers often turn to the use of a well-established experimental paradigm in their studies: the structural priming paradigm. Broadly speaking, in a structural priming study, researchers look for facilitation effects that processing a prime sentence may have on the later processing of a target sentence (BRANIGAN; GIBB, 2018).

In 2003, Loebell and Bock conducted the first structural priming study across languages. They observed that fluent German-English bilinguals were more likely to use an English prepositional sentence to describe a picture (*e.g.,* The girl bought a newspaper for the blind woman) after having listened to and repeated a prepositional sentence in German than after having listened and repeated a double-object sentence in German. That is, German prepositional sentences were able to prime the production of English prepositional sentences. They interpreted this finding as evidence that both languages shared common procedures for building, at least some, sentence structures.

Since then, many other studies on cross-linguistic priming have also shown that processing a determined syntactic structure in one language influences the processing of the same structure in another language (BERNOLET *et al*., 2009; GÁMEZ; VASILYEVA, 2019; HARTSUIKER *e*t al., 2016; LOEBELL; BOCK, 2003; SON, 2020; VASILYEVA *et al*, 2010, *inter alia*). This influence appeared to be even greater when lexical repetition was also at play. That is, when prime and target sentences had translation equivalents.

That was the case in Weber and Indefrey's (2009) study. They found structural priming effects during the comprehension of the passive voice in a study with German-English late-acquisition bilinguals when prime and target sentences shared the same main verb. The effects

were observed both between languages (from L1 to L2) as well as within the L2. The results were interpreted as indicative of an interaction between the syntactic systems of participants' L1 and L2.

The occurrence of structural priming effects between languages are in line with two important models of shared bilingual syntactic representation. The first of those models was proposed by Hartsuiker, Pickering and Veltkamp in 2004. They propose that the bilingual representational system consists of an integrated network in which L1 and L2 lexical entries can be connected to the same combinatorial nodes. Cross-linguistic structural priming effects are explained as the result of a mechanism of residual activation. Assuming that the nodes activation threshold is lower when the traces of residual activation remain in the network, the processing of a recently experienced structure would be facilitated by the processing of the same structure shortly before. In a shared network, priming effects would happen regardless of language: processing the passive voice in one language could facilitate the processing of the passive voice in another language.

While Hartsuiker and colleagues' (2004) model focuses on a final picture of the bilingual syntactic system, Bernolet and Hartsuiker's (2018) model addresses the issue of how this shared syntactic system is constructed. They propose a series of stages that late bilinguals go through when developing an L2 syntactic system.

Interested in late BP-EN bilinguals, the present study had the objective of investigating the presence of structural priming effects during the comprehension of the passive voice. The research questions that guided this work were the following:

RQ1) Do reading times of late BP-EN bilinguals show cross-linguistic structural priming effects (from BP to EN) during the comprehension of the passive voice?

RQ2) Does L2 proficiency predict cross-linguistic structural priming effects?

RQ3) Is there an interaction between structural priming effects, lexical repetition (via translation equivalents) and L2 proficiency?

1.2 SIGNIFICANCE OF THE STUDY

By 2011, English was considered the most common second language in the world with outstanding 978,209,920 non-native speakers (EBERHARD, SIMONS; FENNIG, 2020). In fact, the idea that bilingualism is the rule rather than the exception is not new. Perhaps the most well-known proponent of this idea is François Grosjean who in 1982 published the book "Life

with Two Languages: An Introduction to Bilingualism". Accurately, more than half of the world population lives with two or more languages (GROSJEAN, 2008, 2010, 2013).

Somewhat naturally given its preponderance, the study of bilingualism is instrumental in our understanding of how our minds acquire, represent and process language. On this note, the present study can offer important contributions to the areas of psycholinguistics and of second language learning. Indeed, Mota (2019) explains that priming studies have the potential to enlighten theoretical issues of keen importance to the research on L2 learning, such as the influence of learners' L1 during L2 development. The on-going debate regarding the nature of the bilingual syntactic system will also be benefited by the results presented here.

Cautiously, implications of the present study to the field of L2 teaching can be suggested. For instance, knowing that students' L1 can affect the development of their L2 syntactic system can guide teachers and curriculum designers towards a new way of thinking about the use of the L1 in a L2 learning environment. More than that, the possibility of using the syntactic priming paradigm as a teaching approach was already addressed by McDonough, and Chaikitmongkol (2010).

Additionally, the study provides cross-linguistic data from a population still underrepresented in the literature: learners of English that speak Brazilian Portuguese as their first language. In this sense, it will also contribute to a family of priming studies that are being conducted at LabLing[1] (UFSC). Together, these studies show that language processing is affected by lexical and structural repetition. Finally, the present study continues the debate initiated by Felício (2018) by including both proficiency and lexical repetition via translation equivalents in its experimental design.

1.3 ORGANIZATION OF THE THESIS

The present thesis is motivated by a sincere curiosity about bilingualism. Chapter 1 was an introduction to bilingual language processing with a special focus on cross-linguistic priming studies and the models that support them. More than that, chapter 1 also presented the general objective of the present study, my research questions, the significance of study and the organization of this thesis.

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[1] The present study is part of the project "Frequência e repetição: efeitos no processamento de estruturas morfológicas e sintáticas complexas", coordinated by Dr. Mailce Borges Mota, funded by CNPq (Bolsa de Produtividade em Pesquisa- Processo 310729/2016-5).

Chapter 2 presents the theoretical and empirical foundation of the study. Section 2.1 explains the experimental paradigm of structural priming and its importance in the psycholinguistic literature. Section 2.2 addresses syntactic representation and processing in two ways. First, subsection 2.2.1 introduces the notion of levels of explanation. Subsection 2.2.3 defines syntactic representation and processing. In subsection 2.2.3 Pickering and Branigan's (1998) model of L1 syntactic representation is presented. Moving towards the main topic of the present study, structural priming effects during comprehension are discussed on section 2.3. Bilingual language representation and processing are the topics of section 2.4: in subsection 2.4.1 Hartsuiker and colleagues' (2004) model of bilingual grammatical representation is addressed followed by Bernolet and Hartsuiker's (2018) developmental model of L2 syntactic representation in subsection 2.4.1. Cross-linguistic structural priming effects are discussed in section 2.5 and cross-linguistic structural priming effects during comprehension are addressed in detail in subsection 2.5.1. Finally, proficiency is operationalized in section 2.6, the passive voice is described in section 2.7, and the importance of frequency control is briefly address in section 2.8.

Chapter 3 presents the method of the study conducted. First, in subsection 3.1 I present my research questions, hypotheses, and rationale. Then, in subsection 3.2 the experimental design is presented followed by the experimental stimulus on subsection 3.3. The participants are introduced in section 3.4. The instruments are presented in section 3.5. In section 3.6 the procedures of the study are described. Pre-pilot and pilot studies are explained in section 3.7.

Chapter 4 contains the results of the study conducted. First, I explain the data organization procedures in subsection 4.1 The descriptive statistic is presented in section 4.2 and the inferential statistic is approached in section 4.3. Chapter 5 discusses the results. The research questions are answered in subsection 5.1.

Chapter 6 concludes the present thesis with an answer to the question that opened it in section 6.1 and some limitations and implications for further research in section 6.2.

2 REVIEW OF LITERATURE

The objective of the present chapter is to introduce the theoretical and empirical foundation on which the present study was built. With this objective in mind, I will first explain the experimental paradigm of structural priming. Then, I will discuss issues pertaining to syntactic representation and processing using Marr's levels of explanation as a starting point. Pickering and Branigan's model (1998) of L1 syntactic representation will be presented next. Afterwards, I will present a working definition of comprehension and discuss structural priming effects during comprehension. Bilingual representation and processing will be addressed next. Following that, I will present studies that dealt with cross-linguistic structural priming effects. Due to its importance in the present proposal, I will also define proficiency. Finally, the passive voice in English and Brazilian Portuguese will be described and its use will be justified.

2.1 THE STRUCTURAL PRIMING PARADIGM

In 1986, Kathryn Bock published a paper in which she investigated language users' tendency to repeat the same syntactic structures across multiple sentences. This seminal study showed that participants were more likely to use a given syntactic structure when describing an unrelated picture if they had just encountered that structure. For example, after hearing and repeating a passive sentence, participants were more likely to use the passive structure to describe a picture. Bock (1986) interpreted this tendency to reuse the structure as indicative of a biased sentence formulator. That is, the probability of producing a passive sentence was increased by having just heard and repeated the passive structure. The effect of facilitation that the first sentence, the prime, had upon the other, the target, was referred to as syntactic or structural priming effect. In the case of Bock (1986) priming effects were operationalized as the increase in the production of a less preferred syntactic structure.

Throughout the present thesis I will use the term structural priming instead of syntactic priming. I will follow Ziegler and colleagues' (2019) understanding that structural priming is a more neutral term than syntactic priming. They explain that the latter would only refer to the priming of purely syntactic and abstract structures, while the former would also be influenced by aspects such as semantic roles and lexical repetition. Pickering and Ferreira (2008) also support this distinction. When addressing purely syntactic priming effects I will use the term abstract structural priming.

As pointed out by De Jesus (2018) and Tooley and Traxler (2010), structural priming effects have been observed in many different studies. The phenomenon was found in different languages like English (BOCK, 1986; TOOLEY; BOCK, 2014), Dutch (VAN DE CAVEY; HARTSUIKER, 2016), German (SCHEEPERS, 2003), Spanish (TRAVIS *et al*, 2017) and Brazilian Portuguese (DE JESUS, 2018; KRAMER, 2017; KUERTEN, 2017; TEIXEIRA; BUCHWEITZ, 2019; ANGELI, 2019). Structural priming effects were observed during both production (BERNOLET *et al*, 2009) and comprehension (TOOLEY *et al*, 2019), in different populations (e.g. in children in Vasilyeva *et al*., 2010, in aphasics in Shin and Sung, 2020, and in bilinguals in Vasilyeva *et al*., 2010) as well as in oral corpora (GRIES; KOOTSTRA, 2017).

The benefits of investigating language processing and representation with priming are numerous. At first, priming provides a window into both language processing and representation. Branigan and colleagues (1995) explain that priming can attest whether or not the cognitive system acknowledges a relationship between two stimuli. Importantly, in order to be processed linguistic information has to be mentally represented. By looking at the effects that one stimulus has on the processing of another it is possible to draw considerations about the representations that are being evoked during language processing.

Another important benefit of conducting priming studies is that the variety of populations that can be probed is quite large. A priming task may be designed with stimulus of different modalities (e.g. images, audios or written sentences). Thus, it can be used with illiterate people, like small children or illiterate adults. Moreover, unlike other tasks (e.g. grammaticality judgments) a priming task is able to provide online implicit behavioral measures and thus overcome limitations such as participants' decision-making biases (BRANIGAN; PICKERING, 2017). More than that, Berkovitch and Dehaene (2019) were able to find subliminal syntactic priming effects in conditions in which the prime stimulus was masked. In this sense, priming studies not only can tap into implicit operations, but also attest to processes happening below the threshold for conscious identification.

Acknowledging the dependence of the human language upon the human brain, Branigan and Pickering (2017) argue that structural priming studies are able to inform the development of psychologically motivated accounts of syntax. These accounts would be able to address the topic both at epiphenomenal and functional levels (PICKERING; FERREIRA, 2008). Indeed, models of both L1 and L2 syntactic processing and representation have been developed based upon results found on priming studies. One of the first models was Pickering and Branigan's (1998). Since its publication, the model has been widely supported by experimental evidence and has served as the basis for models of L2 syntactic processing, such as the one proposed by

Hartsuiker and colleague's (2004) and its later extension to L2 syntactic acquisition (HARTSUIKER; BERNOLET, 2015). The three models will be addressed in the following subsections, but first syntactic representation and processing will be defined.

2.2 SYNTACTIC REPRESENTATION AND PROCESSING

It is not a mere accident that words used in many theories of syntactic processing and representation are also present in computer science textbooks. Indeed, syntax merely refers to the set of rules that determine the possible operations in a language. That language may be a natural human language like English or Brazilian Portuguese or an artificial programming language as Python or C++. Apart from the more obvious differences between the two groups (for example, no human baby is being raised as a native speaker of Python), the fundamental aspect that sets them apart is the hardware in which they are operated. Regardless of how modern a computer is, it is no match for the biological hardware of the human brain.

2.2.1 Marr's three levels of explanation

The analogy of the human brain as a computer was addressed by Marr (1982) when he stated that "the essence of the brain is not simply that it is a computer but that it is a computer which is in the habit of performing some rather particular computation" (p. 5). Marr's posthumously published book *Vision* presented in detail his framework for the study of the human visual system (for the first account of the levels of explanation referred to in *Vision* see MARR; POGGIO, 1976). Albeit the differences between vision and language, Marr's ideas on how information-processing tasks should be described are applicable to language studies.

According to him, understanding how a device performs an information-processing task entails three main levels of explanations: computational theory, representation/algorithm and hardware implementation (MARR, 1982, p. 25). In other words, the computational level of explanation is a description of a given phenomenon and it is not necessarily concerned with how the phenomenon is implemented nor where[2]. Following Marr's well-known flying analogy: one cannot understand flying only by looking at feathers or by observing one particular

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[2] In 2012, Tomaso Poggio revised his and Marr's earlier work and proposed that "it is time to look again at the levels of understanding framework -- now emphasizing the connections between levels and their synergies" (POGGIO, 2012).

bird. Instead, it is also necessary to provide an explanation in terms of aerodynamics, in other words, a computational theory of flying. A theory would be a theoretical description and may not be constrained by issues related to representation, processing and implementation (i.e. issues described on other levels). For example, an operation may not find correlates on other levels of explanation due to the fact that on each level the phenomenon is addressed with different conceptual granularity (for a discussion of the *granularity mismatch problem* see Poeppel and Embick, 2017).

The second level of explanation accounts for the processes and representations involved in the implementation of the computational theory. That is, at this level we should be able to explain (1) the representations for input and output, (2) what is the algorithm[3] that acts upon them and (3) how the processing is carried out. For example, in the earlier example of flying, an explanation of what kind of movement the wings of a given bird does in order to create lift should be given (DUFFIELD, 2018). The distinction between the first and second level mirrors the distinction between formal linguistics and cognitive psychology. According to Boland (2005), formal linguistics describes speakers' knowledge about language while cognitive psychology focuses on mental representations and operations in order to describe a processing system.

Last, an explanation at the third level accounts for the physical implementation of the representations and algorithms described at level two. In other words, after having described flying both in aerodynamics terms (level 1) and representational/algorithmic terms (level 2) we can pay close attention to the physical characteristics of the feathers (level 3). Finally, applying the explanatory levels to language processing, we would have:

Level 1: Computational theory → an abstract theory/description of grammar

Level 2: Representation and algorithm → a description of the syntactic processing system and the representations used by it

Level 3: Biological implementation → an account of how linguistic representations and the processing system are implemented in the human brain

In the next subsection, I will delve into theories and models that address language at the second level. That is, how linguistic knowledge is represented and processed.

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[3] Rescorla (2020) defines algorithm as "an explicit, step-by-step procedure for answering some question or solving some problem".

2.2.2 Syntactic representation and processing

Psycholinguistic research focuses on understanding language processing and representation. Processing, or parsing, refers to the retrieval and implementation of the combinatorial operations required to produce and comprehend language. In other words, processing is what the human sentence processor, or parser, does when it applies structural knowledge to the input. At a more abstract level, the knowledge available to the parser needs is represented. Syntactic representation refers to the mental representation of the operations used to combine words into sentences (JACKENDOFF, 1987). For example, the operations used to build a passive sentence are mentally represented and will provide the parser with the *how-to* process a passive structure.

How sentence processing unfolds in time and how syntactic representations are organized in our mental architecture are to this day object of important inquiry. Some of the earlier approaches to sentence processing advocated in favor of a universal, modular, and serial parser would carry out purely syntactic operations (e.g.: the transformational grammar: Chomsky, 1973; the Garden Path Model: Frazier, 1978). Roberts (2016) explains that due to its serial and modular nature, the parser in a syntax-first account would be unable to incorporate any non-syntactic information during its analyses. In other words, syntactic processing would be informationally encapsulated. Only after completing the required syntactic operations the processor would move on to the incorporation of lexico-semantic information. This two-level understanding of sentence processing further entails a purely syntactic level of representation. That is, syntactic information would not be represented in the lexicon. Instead, every rule and operation would be part of a genetically determined system.

Although pervasive, the syntax-first approach is not unanimous. Some of its main postulations may be disputed. For instance, any model of language processing has to account for the fact that people process language incrementally (ROBERTS, 2016). That is, people attempt to interpret the input as soon as they can. Thus, the idea of a parser that fully builds the syntactic structure of a sentence and only after that incorporates lexical-semantic knowledge needs to be revised. Indeed, more contemporary approaches that go against the isolability of syntax take into consideration the interaction between syntactic parsing and other cognitive systems (TRAXLER *et al*, 2018).

A lexicalist model, for example, proposes that syntactic information is represented in the lexicon[4]. An example of a lexicalist model is Levelt's (1989) model of L1 speech production. It proposes the existence of four processing components: a conceptualizer, a formulator, an articulator, and a speech-comprehension system. Figure 1 shows these components and how they relate with each other.

Figure 1: Levelt's model of L1 speech production
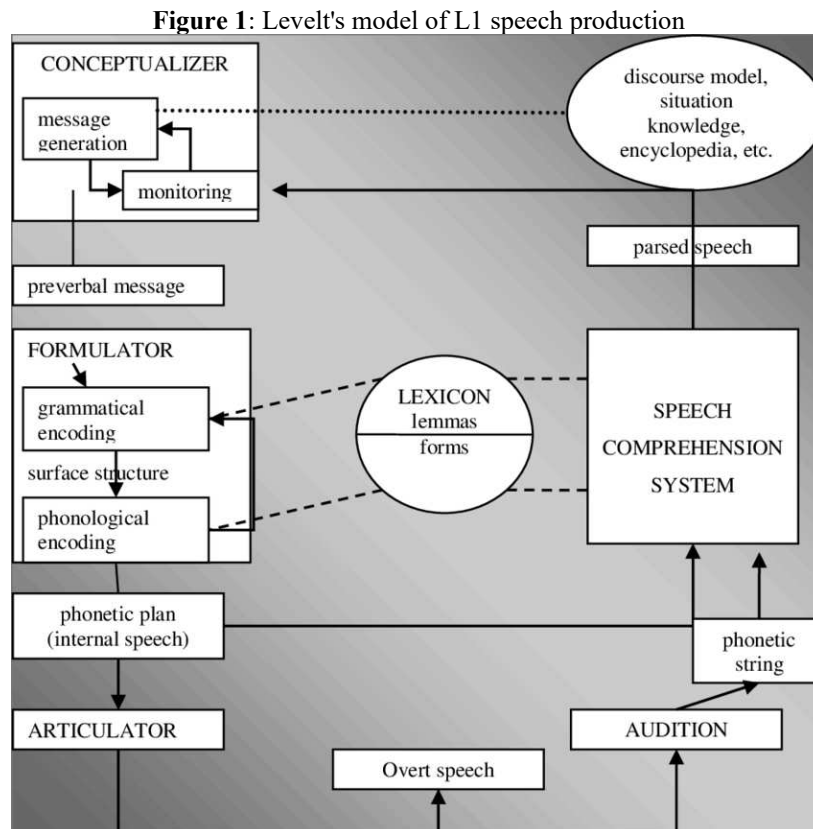
Source: Levelt (1989).

In the first component, the conceptualizer, a preverbal message is generated and sent as input to the formulator. It is within the formulator that the message will be encoded. At first, the grammatical encoder is responsible for accessing lemmas[5] and syntactic building procedures. Both meaning related and purely syntactic information are represented in the mental lexicon. However, the actual procedures used to construct phrases are stored in the grammatical encoder.

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[4] This is not to say that the only models that attribute syntactic information to the lexicon are the lexicalists.

2.2.3 Pickering and Branigan's (1998) model of L1 syntactic representation

Pickering and Branigan (1998) propose a model of the lemma stratum. A lemma is defined by Levelt and colleagues (1991) as a "semantically specified lexical item with its syntactic constraints" (p. 122). Pickering and Branigan (1998) propose three types of information to be represented in relation to each lemma. Category information would encode the syntactic category of a word (e.g. the lemma *sleeps* as a verb). Then, featural information would denote aspects such as number, person, tense and aspect (e.g. *sleeps* would be associated with the present tense, imperfective aspect, third person and singular). Finally, combinatorial information would encode the possible combinatorial information of each lemma (e.g. *sleeps* can be combined with an external argument that will correspond to the entity doing the action as in *the cat sleeps*). Thus, the authors proposed an extension of Roelofs' (1993) network model that would also incorporate syntactic aspects.

In both Roelofs' (1993) and Pickering and Branigan's (1998) models the lemma stratum is composed of lemma nodes that are connected to other nodes that are activated during language use. Differently than Roelofs' model that only included gender and category nodes, Pickering and Branigan's model included nodes for each of the aforementioned types of information (category, featural and combinatorial). Figure 2 shows a partial model of the syntactic representation at the lemma stratum.

Figure 2: Partial model of the syntactic representation at the lemma stratum
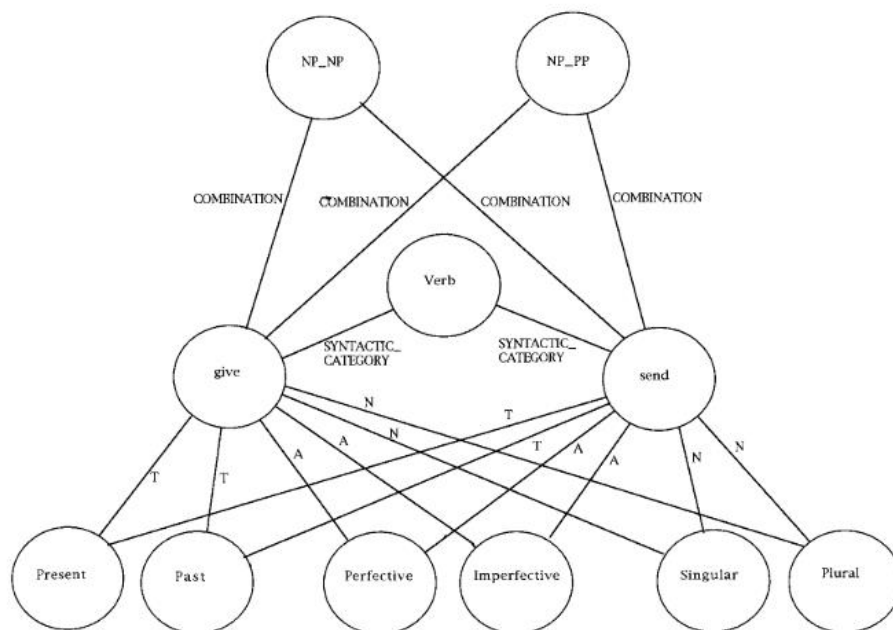
Source: Pickering and Branigan (1998, p. 635).

In order to better explain how Pickering and Branigan's model accounts for language use let us assume the lemma *give* in the sentence *The professor gives informative lessons to the students*. Naturally, the lemma node of *give* would be activated. However, this node is associated with different nodes present in the representational network. In the case of the sentence at hand, the node representing tense (T in the figure) to be activated is the *present*, the *imperfective* for aspect (A in the figure) and the *singular* for number (N in the figure). In relation to its syntactic category, the *verb* node is activated as well. Finally, regarding combinatorial aspects the activated node would be the *NP, PP* that denotes the use of the verb in a prepositional object (PO) construction.

Considering the spreading of activation that takes place within the representational network each time a sentence is uttered, Pickering and Branigan (1998) further argue that syntactic, or structural, priming effects take place due to a process of residual activation (for an alternative account see Dell and Chang, 2014). In other words, when processing a prime sentence a speaker activates the nodes relevant to that prime sentence. If a speaker encounters a prime sentence with the passive voice, for instance, the passive structure is activated. Then, when the same speaker is asked to describe a picture that suits both active and passive structures he/she is more likely to use the recently activated passive structure. The same would also hold during comprehension, but instead of producing a target sentence the speaker would, for example, spend less time processing the target passive structure. The issue of priming effects during comprehension will be explained in detail next.

2.3 STRUCTUAL PRIMING EFFECTS DURING COMPREHENSION

When producing a sentence a person goes from conceptualization to articulation (LEVELT, 1989). What about its interlocutor? What is the path they follow? At first, it is safe to assume that the path to comprehension differs from the production regarding its order: when comprehending a sentence, we go from the uttered sentence to its message. Also important is the fact that listeners do not have the same liberty to choose between two alternative structures. This fact, indeed, makes studies on priming effects during comprehension much more delicate.

One common strategy to overcome this particularity is to investigate ambiguous sentences. Indeed, one of the first structural priming studies to address the phenomenon during comprehension did exactly that. Branigan, Pickering and McLean (2005) investigated readers' parsing preferences when reading sentences that were ambiguous between high and low attachment. They discovered that after reading a prime sentence matched a picture that entailed

a high-attached interpretation, readers were more likely to interpret the ambiguous sentence also as high-attached.

However, priming studies during comprehension that deal with ambiguity resolution may be operationalizing comprehension differently than the present study will. In light of possible conceptual differences, the present study will operationalize comprehension as parsing and index structural priming effects during comprehension as effects of facilitation during the processing of a target structure. More specifically, we will assume that if a participant processes a structure faster after being primed, the priming effect has occurred.

As mentioned in the first chapter, a family of priming studies have been conducted at LabLing and the present study is one of them. Most of these studies investigated priming effects during comprehension. Of keen importance to the present chapter, I will now review three of LabLing's studies: Kuerten (2017), De Jesus (2018) and Angeli (2019).

 Kuerten (2017) adopted the same operationalization of syntactic priming during comprehension. She investigated whether or not people with developmental dyslexia were susceptible to syntactic priming effects. Three studies were carried out: studies 1 and 2 dealt with children with dyslexia that were native speakers of BP, while study 3 dealt with adults with dyslexia that were native speakers of EN. A self-paced reading task with active and passive sentences was administrated to all participants. Studies 1 and 3 were behavioral while study 2 used the fMRI technique. Her results showed that not only children with dyslexia show syntactic priming effects, but also that those effects were long lasting and cumulative. That is, as the experiment progressed participants' reaction times to the main verb of the experimental condition (the passive voice) decreased. Finally, Kuerten (2017) interprets her findings as an indication of the functionality of priming as an implicit learning mechanism (as proposed by Chang, Dell and Bock, 2006).

Addressing a different population, De Jesus (2018) investigated the neural correlates of syntactic priming during comprehension. Adult native speakers of BP had their neural electrical activity recorded while reading active and passive sentences. Since L1 language acquisition is completed in adults, the presence of priming effects could be harder to explain in terms of an implicit learning mechanism. Differently than Kuerten (2017), De Jesus experimental design did not include prime repetition. Syntactic priming effects were not found. She argued that the null results could have been due to the absence of lexical repetition in her experimental design.

Addressing this possibility Angeli (2019) conducted a behavioral study based on De Jesus (2018). Adaptations were made in order to include lexical repetition at the main verb. That is, in Angeli's study prime and target sentences shared the same verb in both experimental

and control conditions. If present, priming effects would be due to the repetition of the syntactic structure, namely the passive voice. Indeed, participants benefited from the structural repetition: syntactic priming effects were found. Although preliminary, the results suggest that lexical repetition plays an important role during comprehension. Finally, in order to investigate whether or not syntactic priming effects during comprehension only occur in the presence of lexical repetition, Adamczyk (in preparation) will conduct a behavioral priming study without lexical repetition.

In the next section, I will take a closer look at the specific topic of the present study and discuss bilingual syntactic processing.

2.4 BILINGUAL SYNTACTIC PROCESSING AND REPRESENTATION

It is often assumed that half of the planet deals with two or more languages on a daily basis (GROSJEAN, 2008). Regardless of the language, syntax allows them to combine known words into unique utterances. Of course, these operations do not happen at random. Instead, speakers have their choices constrained by a limited set of syntactic rules. With that in mind, the issue of how these syntactic operations take place in a bilingual brain comes to light.

In relation to L2 syntactic processing, researchers often investigate whether or not L2 and L1 processing are qualitatively different. For instance, the Shallow Structure Hypothesis (SSH) proposed by Clahsen and Felser (2006) is built upon the assumption that "the syntactic representations adult L2 learners compute for comprehension are shallower and less detailed than those of native speakers" (p.32). They argue that while L1 syntactic processing is conducted by a purely syntactic parser (as proposed by the syntax-first approaches mentioned earlier), L2 syntactic processing is lexically driven. That is, while L1 speakers construct hierarchical syntactic representations, L2 learners process the input linearly with a parser that takes lexical, pragmatic and world knowledge into account. So, according to the SSH not only L1 and L2 processing are indeed qualitatively different, but L2 grammar is also impaired (ROBERTS, 2016).

Some other separate syntax accounts (e.g. PARADIS, 2009; ULLMAN, 2001) are built upon the assumption that L1 and L2 processing are subserved by different memory systems such as the declarative memory system and procedural memory system. First, it is important to distinguish implicit and explicit knowledge. Paradis (2009) explains that implicit knowledge subserves our ability to generate novel sentences. In this sense, syntactic processing would be an implicit competence. On the other hand, explicit knowledge is related to metalinguistic and

lexical knowledge. One important aspect that should be of interest to bilingual language researchers is that while explicit knowledge results from conscious learning, implicit knowledge results from automatic acquisition. Regarding the declarative/procedural distinction, Paradis (2009) argues that implicit processes are sustained by procedural memory while explicit knowledge is sustained the declarative memory. Importantly, the declarative/procedural distinction is not only theoretical. Brain imaging research has shown that different neural networks subserves the two memory systems. Ullman (2001) explains that procedural memory is mainly related to specific frontal, basal ganglia, parietal, and cerebellar structures. On the other hand, declarative knowledge such as words largely depends on temporal-lobe structures.

Explaining how declarative and procedural memory interact during L2 acquisition, both Ullman (2001) and Paradis (2009) take a similar, but not equal stance. For Ullman (2001) both lexical and grammatical knowledge are subserved by declarative memory during L2 acquisition due to limitation in adults' procedural memory capacity. However, as proficiency enhances some declarative knowledge may go through a process of proceduralization and, as at outcome, it can change into procedural knowledge. Differently, Paradis (2009) goes against this shift from declarative to procedural memory. That is, what is learned via declarative memory will always be declarative memory. However, he does accept that some L2 acquisition may be carried out my procedural memory, specifically when learned implicitly.

Differently, researchers who defend shared-syntax accounts go against the impaired grammar assumption. For instance, Hartsuiker, Pickering and Veltkamp (2004)[6] argue that the syntactic rules that are common to the two languages are represented only once. In this sense even if there is a declarative/procedural distinction, both L1 and L2 syntax would rely upon the same substrates.

Many models of L2 processing seem to consider monolinguals as the norm. This assumption comes at a great cost because it can support the illusion that monolinguals are superior to bilinguals. More than that, the idea of a monolingual-bilingual dichotomy often creates the false belief that bilinguals are part of a homogenous group. Cook (2016) explains that the monolingual perspective assumes that an L2 is added on to speakers' L1 and that L2 proficiency is measured in terms of how close L2 speakers' performance is to native speakers' performance. Differently, the bilingual perspective does not compare L2 speakers to native speakers. Instead, it sees the L2 speaker as someone who speaks two or more languages and

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[6] Hartsuiker and colleagues' model (2004) will be described later in the present proposal.

tries to determine issues regarding how the two languages are used. This perspective also goes in line with the idea that bilinguals are not a homogenous group. As such, if a comparison is to be made it should be made between bilinguals. For instance, research could investigate how speakers go from low to high proficiency in their L2. Also, the differences between bilinguals who learned their L2 in a foreign environment and the ones who acquired it in an immersive setting should be addressed.

However, there might exist an intermediate perspective between the monolingual and the bilingual perspectives that may also contribute to our understanding of how we learn languages. While it is crucial that we know more about how an L2 grammar is constructed, the extent to which L1 grammar interacts with L2 grammar development can also be addressed. For instance, MacWhinney (2013) defends the idea that a unified model is more parsimonious since L1 and L2 learning share many commonalities. Indeed, his Unified Competition Model (UCM) pays great attention to how L1 affects L2 learning.

Differently than approaches that see L1 and L2 acquisition as two fundamentally different processes, the UCM proposes that L1 and L2 acquisition differ only in the extent that different risk generating and protective processes surpass both processes, as explained by MacWhinney (2013; p.211). To put it more straightforwardly, five risk factors and five protective processes are available to both children acquiring an L1 and adults learning an L2. Then, the main difference between L1 and L2 acquisition is how the protective and risk processes are configured. For instance, L2 learning is carried out by an already highly language committed brain. This risk factor is known as entrenchment. Taking a highly L1 entrenched brain L1 related knowledge may compete with the new L2 knowledge whenever the mapping from L1 to L2 is not transparent. For example, if L1 and L2 have different word order configurations the word order cue for subject assignment in L1 will not work on L2. The protective process that can potentially surpass entrenchment is resonance. It provides new encoding dimensions to old neuronal territory thus enabling the correct L2 patterns to be encoded as well (p.216). In other words, a new cue may be learned.

After having discussed L2 syntactic processing and representation as well as some core aspects of structural priming studies, the next two subsections will present models for L2 representation and development that are of keen importance to our study.

2.4.1 Hartsuiker and colleagues' (2004) model of bilingual grammatical representation

Setting itself apart from the earlier mentioned separate-syntax accounts, Hartsuiker and colleagues (2004) proposed a spread activation bilingual model that incorporates language specific nodes. Based on Pickering and Branigan's (1998) model, they propose that lemma nodes are linked to combinatorial nodes (e.g. active v. passive), categorical nodes (e.g. verb v. noun) as well language nodes. In other words, every grammatical structure that can fit into the nodes will be activated: the same combinatorial nodes will be activated regardless of language. Figure 3 shows an example of how this organization would take place. Similar to Pickering and Branigan's (1998) model the figure depicts different nodes present in the representational network. The main difference between the two models is the presence of nodes representing the languages spoken by the bilingual. This addition entails that a sentence would not only activate nodes related to tense, aspect, number, syntactic, category and combinatorial aspects, but it would also activate a language node (in the case of Figure 3 the language nodes represent English and Spanish). Thus, structural priming effects are expected to occur between languages. However, within language priming effects would be more robust because even if the sentence is kept identical, only when the prime and target share the same language they would activate the same language node.

**Figure 3:** Hartsuiker, Pickering and Veltkamp's (2004) spread activation model
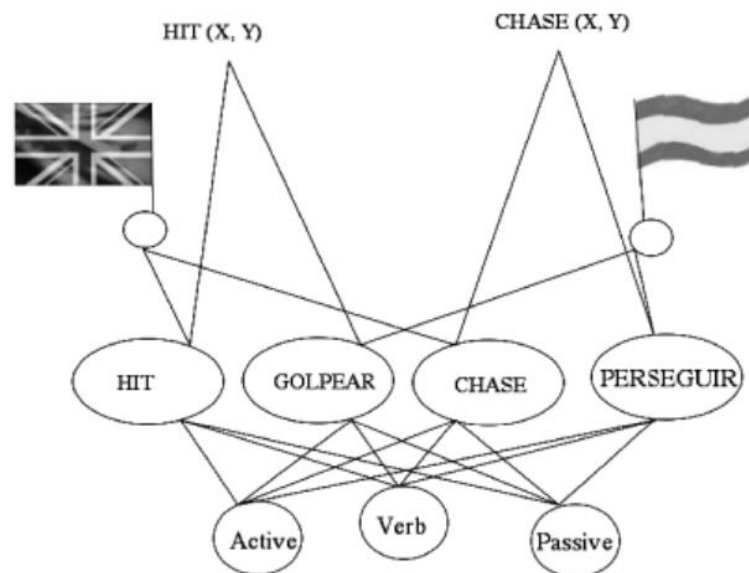
Source: Hartsuiker, Pickering and Veltkamp (2004).

2.4.2 Bernolet and Hartsuiker's (2018) developmental model of L2 syntactic representation

A revised model was later proposed by Bernolet and Hartsuiker (2018) as to account for late bilinguals and the issue of how they develop their L2 syntax. Since the present study will

deal with the same population, the model and its predictions are crucial. While the former lexical-syntactic model for bilingual sentence production proposed by Hartsuiker and colleagues (2004) deals with a stage in which L1 and L2 syntactic systems are totally shared, Bernolet and Harstuiker (2018) model tries to explain how learners get there. Figure 4 depicts the different stages proposed in their model.

Figure 4: Bernolet and Hartsuiker (2018) developmental model
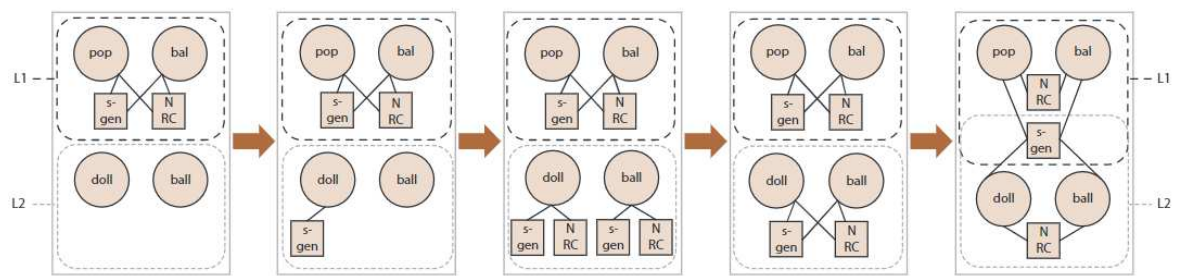
Source: Bernolet and Hartsuiker (2018).

At first, the new L2 structures are not mapped into the existent L1 nodes. After some exposure to the L2, learners began forming item-specific representations for L2 syntactic structures. As learning continues, a process of abstraction transforms these item-specific representations into proper syntactic nodes. Only after that, an additional language node is formed and all the abstract L2 syntactic representations are collapsed into the L1 nodes.

Importantly, important predictions can be made regarding how cross-linguistic syntactic priming effects may be predicted by both L2 proficiency and translation between prime and target. If the stages proposed are indeed accurate, low proficient L2 participants should show greater effects in the presence of translation since at early stages the syntactic representations are only item-specific. Differently, abstract priming effects should only appear at later stages, that is, only highly proficiently L2 participants should benefit from the structural repetition in the absence of translation equivalents. During the years, many studies were conducted to test both aforementioned bilingual models. In the next subsection some of its results will be presented.

2.5 CROSS-LINGUISTIC SYNTACTIC PRIMING EFFECTS

What could we tell about bilingual language processing if we were to find that L1 plays a role during L2 language processing? In a cross-linguistic syntactic priming study, that is exactly what researchers want to test. To put it briefly, if syntactic priming effects occur

between languages one might argue that these languages share at least some levels of syntactic representation and processing. Durgunoglu and Roediger (1987) conducted a study that can be seen as a forerunner of a cross-linguistic priming study. Participants were told to study English and Spanish words in five different conditions. Later, in a recognition memory test, they were given a list of 138 English words and asked to circle the words they had just saw in the study phase. Importantly, they should circle the English words even if they recall having seen them only in Spanish. Note that the first phrase of the study can be seen as a priming phase. Even though they were not interested in syntactic priming, their study shows that researchers have been looking for possible effects that processing one language might have on the processing of another language at least since the late 80s.

Focus of the present study, cross-linguistic syntactic priming refers to the effects that processing a syntactic structure in one language have on the processing of the same structure in another language (LOEBELL; BOCK, 2003; BERNOLET *et* al, 2009; VASILYEVA *et* al, 2010; for a review see VAN GOMPEL; ARAI, 2017). With a cross-language syntactic study, we are able to test some of the already mentioned models of L2 syntactic processing and representation. In light of that, the following subsections aim at presenting a non-exhaustive review of studies that dealt with cross-linguistic syntactic priming effects during production and comprehension.

Mirroring the scenery of L1 priming research, the first cross-linguistic priming studies were focused on production. Loebell and Bock (2003) investigated cross-linguistic priming effects in fluent German-English bilinguals. Their study was an adaptation of Bock (1986) and the structures they were interested in were datives (double-object and prepositional) and transitive (active and passive) sentences. Participants listened and repeated to an English or a German sentence in the prime phase. Then, they were asked to describe an unrelated image. The results showed that syntactic priming effects could indeed happen between languages: the production of German dative sentences primed the production of English datives, and the production of English datives primed German datives. However, passive sentences did not yield the same results in either direction. One possible explanation is that even tough priming between language exists, it only occurs when the structure in both languages share the same word order. This is not the case for English and German passive sentences. To further test this hypothesis, Loebell and Bock (2003) conducted the same transitive portion of the study, but prime and target sentences were both in German, that is, they shared the same word order. Their findings showed a tendency, although not significant, towards a greater production of passive sentences after the passive primes.

In a series of studies with Spanish-English bilinguals with moderate or high proficiency, Hartsuiker and colleagues (2004) found similar results. Participants were asked to describe pictures after having heard a confederate, disguised as a participant, do the same. The confederate, while pretending to be describing a picture, provided the prime sentence. The structures investigated were active, passive, intransitive and OVS. Priming effects were only found for the passive structure. Importantly, the authors explain that these results may be due to the fact that only in the passive structure do English and Spanish share the same word order.

Naturally, the results yielded in those studies shed light on what might be an important moderator of cross-linguistic syntactic priming effects: word order repetition. Accordingly, Bernolet and colleagues (2007) found both intra and cross-linguistic syntactic priming effects. However, cross-linguistic priming effects during production were found to be dependent upon word order repetition. Indeed, as to increase the likeliness of finding cross-linguistics priming effects the present study will use a syntactic structure that has the same word order in both BP and EN: the passive voice. At the method chapter of the present study this decision will go through further scrutiny.

Also investigating how bilinguals process the passive voice, Gámez and Vasilyeva (2019) conducted a cross-linguistics priming study with balanced bilinguals[7]. Participants were six-year-old Spanish-English bilinguals. With a design similar to Hartsuiker and colleagues (2004), the children were asked to describe a picture after having heard an adult describe another picture. The researchers were also interested in a possible lexical boost effect that word repetition – via translation equivalents – might have upon the priming effects. They found bi-directional, from L1 to L2 as well as from L2 to L1, and within languages priming effects. Importantly, the within language effects were greater than the between languages effects, thus corroborating models of bilingual processing such as the one proposed by Hartsuiker and colleagues (2014) and by Hartsuiker and Bernolet (2015). However, differently than proposed by the same models, their study did not find an effect of lexical boost. The authors point that the absence of a lexical boost effect may be related to the fact that they were working with balanced bilingual children. That is, even if in adults an early stage of acquisition entails lexically dependent representations, thus creating the lexical boost effects, this may not be the case for children. Noticeable, most bilingual models of processing address an adult population and that could explain the different results.

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[7] Edwards (2004) explains that "the term balanced bilingual is reserved for those whose mastery of both languages is more roughly equivalent" (p. 9).

Moving closer to the population that will be investigated in the present study, late bilinguals, Bernolet and colleagues (2013) conducted a series of studies that aimed at investigating how L2 syntactic representations go from lexical-specific to abstract. They were interested in both between and within language priming. Participants were Dutch-English bilinguals with at least 5 years of experience with English. For the between-language priming study, they were interested in the impact of proficiency and lexical overlap upon the priming effects. The rationale behind these goals is in line with Hartsuiker and Bernolet's (2015) later proposed model. They expected that lexical-specific representations would be present at the earlier stages of L2 acquisition. That is, participants with the lower levels of proficiency would benefit the most from lexical overlap between prime and target sentences. As proficiency enhances the lexical-specific representations would go through a process of abstraction. That is, participants with the higher levels of proficiency would show priming effects in the absence of lexical overlap. Indeed, the results were partially in line with that. Significant between-language priming occurred and was boosted by translation equivalents. Regarding the different proficiency levels, low proficient participants showed almost no between-language priming whatsoever.

The lack of priming effects at the lowest levels of proficiency might be explained with the results of the within-language priming study. While shared representations between L1 and L2 do occur once L2 learning reaches a certain level, at a first moment they might indeed not be present. Bernolet and colleagues' (2013) within-language priming study showed that low proficient L2 speakers already benefited from priming effects within their L2. Thus, a three-way interaction between prime type, meaning overlap and L2 proficiency was found. The scenario behind their results is one in which, at first, language and lexical dependent representations are build. As proficiency enhances a process of abstraction takes place and repetition is not a *sine qua non* of the priming effects anymore. Then, once L2 representations are fully built, they begin to be shared with the L1 syntactic system.

Finally, before moving on to the topic of cross-linguistic priming effects during comprehension it is worth noting that LabLing's family of priming studies also includes a study on syntactic priming effects during production within English as an L2. Santos (2019) investigated the possibility that participants' tendency to use the passive structure to describe an image would be increased by having just used the same passive structure to describe a different picture. Importantly, participants' first description (in the prime phase) should follow a color-coded logic: entities depicted in green should always be placed in the beginning of the sentence. The results indicated that using the passive voice to describe an image increased the

probability of re-using the same structure to describe a different image. That is, syntactic priming effects were observed in the production of English as L2.

2.5.2 Cross-linguistic priming effects during comprehension

Even in L1 studies, syntactic priming effects during comprehension are still less studied than during production (DE JESUS, 2018). An important particularity of comprehension studies is that they tend to differ in their operationalization of comprehension, as mentioned earlier. In fact, studies dealing with cross-linguistic priming effects during comprehension also tend to focus a lot on ambiguity resolution.

Fukuta and colleagues (2018) used a self-paced reading task to investigate priming effects during comprehension. They investigated how natives and non-native speakers, 20 Japanese learners of English and 18 English native speakers, dealt with ambiguous sentences. They primed participants with high and low-attachment PP sentences and found priming effects: participants showed faster reaction times in target sentences that had the same structure as its prime. However, native speakers showed greater priming effects. The authors interpreted these findings as evidence that nonnative speakers can also rely on algorithmic processing (as opposed to heuristic processing) when dealing with ambiguity resolution. Finally, the possibility that L2 syntactic processing and representation is somewhat deficient was not supported.

As mentioned in chapter 1, despite being a relatively new field of research in Brazil, experiments investigating cross-linguistic syntactic priming effects were already conducted at LabLing. Santos and Mota (2018) investigated the presence of syntactic priming effects during comprehension in a population of Brazilian Portuguese- French bilinguals. Their experimental design allowed them to address both within language priming (with prime and target sentences in French) as well as the impact of lexical repetition via translation equivalents (with prime and target sentences sharing the same main verb). Syntactic priming effects were indexed by shorter reaction times. The results showed priming effects only at the condition in which prime and target sentences shared the same language (French) as well as the same main verb. It is important to mention that the passive structure in Brazilian Portuguese has 6 words while its counterpart in French has 8 words. With this is mind, the lack of between language priming effects might be due to those differences (just as in Bock and Loebell, 2003). Finally, the authors argue that future research should control for participants' L2 history.

Working with the same language combination as the present intended study will, Felicio (2018) investigated cross-linguistic priming effects in a population of Brazilian Portuguese-English bilinguals by means of a self-paced reading task. She found priming effects, indexed by shorter reaction times, only in one experimental condition. Participants only benefited from syntactic priming effects when prime and target sentence shared the same structure (the passive voice) as well as the same verb (via translation equivalents). Importantly, the author acknowledges that the lack of a between group analysis based on participants' L2 proficiency prevented her study from addressing issues regarding L2 syntactic development.

The present research proposal will address exactly this issue. In the next subsection L2 proficiency will be operationalized.

2.6 L2 PROFICIENCY

Being able to measure and assess speakers' level of mastery of a language is crucial to anyone interested in bilingualism. Although a layperson would probably be satisfied with a straightforward dictionary definition, researchers keep revisiting what does proficiency mean. First, we should be able to explain what exactly knowing a language means. The theoretical division of languages into the dimensions of phonology, morphology, syntax and semantic may guide our understanding of what someone has to know in order to know a language. Naturally, this knowledge is most likely not metalinguistic, but when speaking a language people have to know its sounds, forms, structures and meanings. In this sense to define proficiency is also a task that should be done by dividing it into different parts: speaking, writing, reading and listening.

Hulstijn (2015, p. 22) argues that language proficiency or, in his terms language cognition[8], has two dimensions: basic language cognition (BLC) and higher language cognition (HLC). On the one hand, BLC refers to the knowledge that every native speaker of a language shares. That is, individual differences are not at play in BLC. Upon a closer look, BLC comprises day-to-day language, that is, high-frequency lexical items and morpho-syntactic structures. Also, it is restricted to speech perception and production. On the other hand, HLC extends BLC. It comprises low-frequency lexical items and morpho-syntactic structures. Utterances at the HLC are usually longer and can be also written. Since HLC is mediated by literacy and instructional levels, even L1 HLC is likely to show individual differences. To put

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[8] Hulstijn (2015) defines cognition as "a neural network, comprising both the representation and use of information, both knowledge and skill" (p.20).

it differently, while talking to a family member a person would rely upon BLC proficiency whereas while giving an academic lecture HLC would be highly recruited.

In the present proposal, proficiency is operationalized following Hulstijn's (2015) view. That is, as a "construct uniting the dichotomy of basic and higher language cognition" (p.20). The modality that the intended study will employ (participants will perform a self-paced reading task) as well as the syntactic structure of interest (the passive voice) will allow us to probe into participants' higher language cognition. A justification of why the passive voice was chosen will be given next.

2.7 THE PASSIVE VOICE: AN EXPLANATION AND SOME IMPORTANT CONSIDERATIONS

Before properly beginning an explanation of the passive voice is it paramount to define voice. From the Latin word *vox*, voice can be associated with the act of speaking or, to be more neutral, conveying some message. In fact, the syntactic use of the term does not fall far from that: voice is related to the perspective from which something is being reported. Shibatani (1988) explains that "voice is to be understood as a mechanism that selects a grammatically prominent syntactic constituent – subject – from the underlying semantic functions (case or thematic roles) of a clause" (p.3). To put it differently, voice refers to the assignment of the grammatical subject of a sentence. In accusative languages, for instance, the active voice selects an agent as the grammatical subject as seen below:

a) The woman cut the bread.

The grammatical subject of the sentence above is also the agent of the action (*the woman*). The active voice is also considered the unmarked voice. Differently, if a patient is selected as the grammatical subject of a sentence we will have a marked voice: the passive. Somewhere between active and passive voices, English also presents the middle voice. According to Grady (1969) the middle voice occurs with intransitive verbs which he calls middle verbs. One characteristic of these verbs is that they cannot be part of a passive structure. Actually, the fact that some verbs cannot be part of a passive structure is argued by Pinker, Lebeaux and Frost (1987) to be evidence of the existence of semantic constraints on the passive voice. An example of a verb like this is given below:

b) The meat costs ten dollars.

c) Ten dollars is cost by the meat.*

The passive voice differs from the active voice regarding its rendering of perspective. That is, while in the active voice the perspective is constrained by the entity with the external thematic role, in the passive voice such perspective accompanies the entity with the internal thematic role. Now the grammatical subject is a patient, rather than an agent. Accordingly, a shift of perspective implicates different pragmatic and semantic functions to actives and passives with the same constituents (CORRÊA *et al*., 2017). The object of interest of the present study, the syntactic passive can be described in terms of how it relates to its corresponding active:

d) The mother hugged the baby. (Active)

e) The baby was hugged by the mother. (Passive)

Notice that in sentence (d) the subject is also the agent, that is, the entity doing the action. Differently, in sentence (e) the subject is on the receiving end of the action portrayed by the verb, it suffers the action. In fact, Miller (2002) explains that the term passive is derived from the Latin verb *patior* (I suffer). Indeed, a passive structure is the one in which the focus is given to who or whatever suffers the action. According to Goldberg (2006), the passive is a learned pairing of form and function.

Important to the present proposal, the syntactic passive voice in EN and in BP share the same word order. In both languages the passive is a syntactic construction with an auxiliary verb and a passive participle. An example of a BP syntactic passive and its corresponding active is given below:

f) A mãe abraçou o bebê. (Active)

g) O bebê foi abraçado pela mãe. (Passive)

Another way to describe the passive voice is to categorize it as a syntactically marked construction (BRESNAN *et al*, 2001). That is, passives have patients marked as subjects. To illustrate, let us consider the previous example given in (g): the patient (the baby) is marked as subject, whereas the agent (the mother) has peripheral status (marked by a preposition). The patient could also be marked as Subject via verbal agreement as in:

h) The babies were hugged by the mother.

Importantly, the grammatical operation that promotes the patient to subject does not imply changes in grammatical roles: the patient remains the patient.

As can be seen, the main feature that differentiate a passive from its active counterpart is located within the predicate or verb phrase (KEENAN; DRYER, 2007). That is, in terms of its' NPs the passive does not display any unusual word order (as is the case for topicalizations). Instead, the passive is marked at the predicate. We should also acknowledge the existence of a basic, or short, passive that lacks an agent phrase:

i) The baby was hugged. (Simple passive)

Focusing on the English passive, it is important to mention that the syntactic *be-passive* is not the only subcategory within the passive voice. Indeed, *get-passives* also form a category. Examples of both constructions are given below:

j) The baby was hugged by the mother. *(Be-passive)*
k) The baby got hugged by the mother. *(Get-passive)*

Thompson, Ferreira and Scheepers (2018) explain that *get-passives* are generally less studied than *be-passives*. Moreover, the *get-passive* appears to be a recent addition to both American and British English. In terms of syntax and semantic, the debate about the possible equivalence of both structures remains opened. Thompson and colleagues (2018) point that, even if similar, get and be passives are used differently. Finally, it is important to mention that some researchers (e.g, Arce-Arenales, Axelrod and Fox (1999) argue that sentences such as *Manuel got dressed* are not passives, but active sentences exhibiting middle diathesis.

Another way of characterizing the passive voice is to divide them into three categories: reversible, non-reversible and agentless. In the reversible passive subject and object can be interchanged. On the other hand, in the irreversible passive this is not allowed. Finally, the agentless passive lacks an agent, that is, a passive object. Examples of the three sub-categories are given below:

l) The daughter was carried by the mother → The mother was carried by the daughter (*Reversible passive*)

m) The bag was carried by the mother. → The mother was carried by the bag.* (*Non-reversible passive*)

n) The bag was carried. *(Agentless passive).*

The acknowledgment of these sub-categories is of keen importance to the present project. What makes a non-reversible passive different from a reversible passive when both sentences share the same main verb? Let us take a look at some thematic roles requirements of a specific verb. Assume the main verb of the three examples above: to carry. The act of carrying something depicted in sentence (l) involves an agent and a patient. In this particular case, both agent and patient are animated and human. Since patient and agent both present identical thematic relations interchanging them does not harm the semantic plausibility of the sentence. Differently, the non-reversible passive in sentence (m) has agent and theme that are deeply different. Note that the verb to carry in its active form entails an agent. Griffiths (2006) explains that an agent must be consciously responsible for what happens (p. 71). Naturally, if sentence (m) were to be reversible, the patient (the bag) would not fulfill such requirement. In addition, this non-syntactic constraint on the passive voice is argued to be evidence that the distinction between active and passive cannot be fully explained at the syntactic level. Instead, an explanation should be given at the interface between syntax and other levels such as semantics and argument structure (CULICOVER; JACKENDOFF, 2005 p.61). Indeed, another possible way of conceiving the passive voice that may go in line with these requirements is to see it as an construction in the likes of Goldberg's (1992; 2006) proposal.

Finally, research on the neural basis of thematic role assignment has been growing. Vercesi and colleagues (2020) wanted to determine if syntactic cues (word order), semantic cues (reversibility) or a combination of both were responsible for the processing load attributed to the passive voice. They delivered transcranial magnetic stimulation (rTMS) over the left inferior intraparietal sulcus (I-IPS) of participants while they performed a self-paced reading task. During the task, participants had their ability of assigning thematic roles tested. That is, they had to identify who was doing the action versus who was receiving the action. Participants' performance, measured by their reaction time, was significantly different for reversible passives when compared to reversible actives and non-reversible passives. More specifically, only when comprehending reversible passives participants' reaction time was increased when receiving

the rTMS over the I-IPS. The authors thus suggest that the I-IPS is highly involved in the assignment of thematic roles in reversible sentences.

Many more considerations can be made regarding how thematic roles may interact with the plausibility of a passive sentence. As noted, experimental research has already shed some light on how people process different types of passive sentences. Ambridge and colleagues (2015) investigated a possible semantic constraint on the passive voice. They investigated whether or not the level of semantic affectedness of a verb constrains its likeliness of being used in a passive construction. They operationalized semantic affectedness as the extent to which a verb denotes an action where a patient is affected of acted upon. They wanted to know if, for instance, a highly affecting agent-patient passive (e.g. Wendy was kicked by Bob) would be more acceptable than a non-actional experiencer theme passive (e.g. Wendy was heard by Bob). Their results indicated that a semantic constrained on the passive voice is indeed psychologically real. For instance, in their third study participants were more likely to give high ratings in a grammatical acceptability judgment test to passive sentences in which the verbs denoted highly affected semantic transactions (e.g. Homer was kicked by Marge). Moreover, in a forced-choice comprehension task with RT measures the results remained the same thus providing an online measure of the phenomenon as well.

Another non-syntactic feature that may play a role during the processing of the passive voice is animacy. Kittila *et al* (2011) explain that animacy can be understood within two main scopes: biological and linguistic. For the biological sense, animacy refers to all living entities. That is, people and animals are equally animated. For the linguistic sense, however, the label is used in a more nuanced way. For linguistics, animacy is seen as one's ability of instigating an action. In THIS sense, the entities with the higher possible rank in the animacy continuum are humans, followed by higher animals such as dogs and horses. Importantly, even among humans animacy can vary. Croft (2003, p.131) explains that the animacy hierarchy involves three functional dimensions:

Person: first, second < third
Referentiality: pronoun < proper name < common noun
Animacy: human < animate < inanimate

Since one of the keen features of the passive voice is that the grammatical subject becomes the patient of the action animacy has to be accounted for. The higher an entity's status in the animacy hierarchy the more accepted it would be as an agent? In other words, does

animacy affect the assignment of grammatical functions? Branigan, Pickering and Tanaka (2008) explain that animacy is known to be associated with syntactic variations. When the choice between active and passive sentences is present people's bias towards the active voice is decreased when patient is animated and/or human while agent is not.

In light of the above, the present study will counterbalance the animacy of agents and patients as to minimize the possibility of a co-variable to occur. In other words, even if a passive sentence that has as human acting upon a non-animated entity were to show an ease of processing this animacy effect will not interfere with the results. A detailed explanation of how the counterbalancing was carried out will be given at the methods chapter.

Even though the target sentences of the present study will always be in English, some considerations regarding the passive voice in Brazilian Portuguese should also be made. BP passive voice is subdivided into two main groups: verbal, or *eventiva*, and adjectival passives. Lima Júnior (2018) explains that the latter group is further divided into *resultativas* and *estativas*. The main difference between the verbal and adjectival passives is related to the different auxiliary verbs they use: *ser* (verbal passive), *ficar* (*resultativa*) and *estar* (*estativa*). In the present study the syntactic structure that will be used in the prime sentences will be the verbal passive. Since the sentences were counterbalanced for animacy effects, the types of verbs vary.

Having described the passive voice, the choice for this particular syntactic structure for the present study remains unaddressed. Priming studies often focus on different syntactic structures, such as the double object and the prepositional object (e.g. BRANIGAN; PICKERING; MCLEAN, 2005). Even during language compression many studies investigate priming effects during the processing of ambiguous sentences (e.g. KIDD; TENNANT; NITSCHKE, 2015). In order to situate the reader, the next section will present a justification for the use of the passive voice in the present syntactic priming study.

2.7.1 Why the passive voice?

> And we rejoin: Does not the soul know? And is not 'being' known? And are not 'knowing' and 'being known' active and passive? That which is known is affected by knowledge, and therefore is in motion.
>
> Sophist, Plato

At least since the teachings of Plato, people have been in some way thinking about prototypes of active and passive structures. Indeed, the notion of acting and being acted upon

is pervasive to our mental lives. Acknowledging the centrality of the verb in linguistic studies, it comes without surprise that linguists have been paying attention to verbal voices for a long time. The passive voice, specifically, assumes an important role in these studies due to some keen characteristics.

From a language development standpoint, the passive voice is known to be a structure that children acquire later than, for instance, the active voice. Fraser, Bellugi and Brown (1963) pursue the possibility that children were able to comprehend some grammatical features, like the passive voice, before being able to produce it. They observed that even tough children are able to imitate (I) before comprehending (C), they cannot produce (P) before comprehending. Also acknowledging a difference between imitating and producing, Baldie (1976) wanted to know exactly when children began to imitate, produce and comprehend passive constructions. He observed the same (I > C > P) pattern, but children's results differed as a function of age. In the group of children with ages ranging from 7 to 11 years old, 80% could produce a passive structure while 100% could imitate and comprehend it. They observed that the production was the last skill to be acquired and it began at the mean age of 3 years old. Similarly, Brooks and Tomasello (1999) reported that 3-year-old children are already susceptible to priming effects in the production of the passive voice.

From a language processing standpoint, the passive voice receives great attention mainly because it is a complex structure. First, it is deemed as complex due to its aforementioned syntactic markedness. Indeed, given that the word order in languages such as English and Brazilian Portuguese follows the default Subject Verb Object (SVO) a structure that changes that entails a processing load. In other words, noncanonical sentences are more complex than canonical sentences (MACK *et al.*, 2013). Another important aspect that distinguishes the passive voice from its active counterpart is that in the passive the patient comes before the (sometimes-optional) agent. Since people tend to assume that the first noun in a sentence is not only the grammatical subject but also the agent, to subvert this expectation creates the need for a syntactic reanalysis (BEVER, 1970, p.299). For instance, in a study with aphasic and nonaphasic subjects Brookshire and Nicholas (1980) observed that both groups showed greater reaction times measures as well as lower accuracy for passive sentences when compared to active sentences. Haverkort (2005) further explains that, when speaking, aphasic patients tend to restrict their sentences to the canonical word order (SVO).

Additionally, the passive voice being less frequent than the active voice also contributes to its position as a complex structure. The sole fact that a structure is less frequent is not enough to classify it as a complex structure, as observed by Ferreira (2003). Nevertheless, it is enough

to assume that, from a frequency-based perspective, people have less contact with the passive. However, this statement is not equally true in EN and BP. Guimarães (2021) explain that while the passive voice is less frequent than the active voice in both English and Brazilian Portuguese, in English it is significantly more frequent than in Brazilian Portuguese. In fact, they argue that English passive sentences are almost twice more frequent than BP passive sentences.

At last, the final choice for the use of the passive voice also relates to the fact that this is a cross-linguistic study that will deal with both English and Brazilian Portuguese. Since we do not aim at addressing the specific issue of whether or not cross-linguistic priming effects are dependent upon word order overlap we had to select a structure that shares the same word order in both English and Brazilian-Portuguese. That is the case for the passive voice.

In the next section I will close chapter 2 with a brief discussion on why and how one should pay attention to word frequency.

2.8 SOME WORDS ON THE IMPORTANCE OF FREQUENCY CONTROL

In the present study, structural priming effects during comprehension are being operationalized as a decrease in participants' reaction times to the main verb of the experimental conditions when compared with the control conditions. Thereby, changes in participants' speed rates will be at the core of the future statistical analysis and close attention should be paid to extraneous factors known to influence participants' behavior. The present section will briefly present the rationale for the methodological decision of controlling the frequency of stimulus words.

In 1973, Forster and Chambers conducted one of the first studies to observe that people process words differently depending on how frequent the word is in their language (similar results were also found by Oldfied and Wingfield, 1965; Berry, 1971; Carrol and White, 1973). Their study consisted of a naming task in which participants had to name words as fast as possible. The results showed that the more frequent a word was, the faster it was named. More recently, Harley (2014) further explained that during visual word recognition differences in frequency can influence the amount of time people take to react to a word (p.172).

In view of the interplay between word frequency and language processing, close attention must be paid to the ruling out of frequency as a covariate. That is, researchers should make sure that stimulus words are matched for frequency so that differences in participants' reaction times will not be due to one word being more frequent than another. Relevant to the present study, frequency effects were also observed between languages. Kootstra and Doedens

(2016) investigated how the frequency of a determined structure in participants' L1 might influence cross-linguistic priming effects. They found that the frequency of the prime structure in one language interacted with the priming effects in another language.

Having briefly defended the importance of frequency control, I will now explain the procedures carried out by researchers when controlling the frequency of their stimulus words. The main strategy used is to look for the occurrence of a word in a corpus. A corpus consists of a collection of real texts organized into a database from each researchers can look into patterns of language use (REPPEN; SIMPSON-VLACH, 2019). The main assumption behind using a corpus as a research toll is that the collection of texts, taken from different sources such as newspapers, books, essays and documents, is representative of how people use a language. Thus, when examining how frequent a word is the number of occurrences of the word within a corpus would be representative of how frequent the word is in a language.

The choice of which corpus to use may vary depending on the population that will be investigated. For instance, one often used corpus of American English with data gathered from adult speakers is the Contemporary American English (COCA). Differently, when dealing with language learners, an alternative option is to consult a specialized learners' corpus. A learner corpus consists of samples of speech or texts taken from non-native speakers. Granger, Gaëtanelle and Meunier (2015) define learner corpus as "electronic collections of natural or near-natural data produced by foreign or second language (L2) learners and assembled according to explicit design criteria". Currently the most prestigious learner corpora are the International Corpus of Learner English (ICLE) and the Cambrigde Learner Corpus (CLC).

In the next chapter the procedures of the word frequency control will be explained in detail.

3 METHOD

Having presented the relevant theoretical basis, I will now address the study conducted. I will present its (i) research questions, hypotheses and *rationale*, (ii) experimental and control conditions, (iii) experimental stimulus, (iv) criteria for the selection of participants, (v) the instruments that were used to attest for participants' language background and measure their proficiency, (v) the procedures carried out during the data collection, (vi) the pre pilot study, (vii) the pilot study and, finally, (viii) the main study.

3.1 RESEARCH QUESTIONS, HYPOTHESES AND *RATIONALE*

The main objective of the present study was to investigate bilingual syntactic processing and representation. Specifically, the occurrence of cross-linguistic syntactic priming effects from L1 to L2 as well as its possible predictors were investigated. Pursuing these objectives, our research questions were the following:

RQ1) Do reading times of late BP-EN bilinguals show cross-linguistic syntactic priming effects (from BP to EN) during the comprehension of the passive voice?

H1) Reading times of late bilinguals will demonstrate cross-linguistic syntactic priming effects (from BP to EN) during the comprehension of the passive voice.

Following the findings of previous studies, the occurrence of between language priming effects is expected. Also taken into consideration the predictions made by Hartsuiker and Bernolet's (2015; 2018) model participants should benefit from structural and lexical repetition from prime to target sentences. The effects would be characterized by a decrease in reading times in the first experimental condition when compared with the first control condition. Prime sentences, in Brazilian-Portuguese, are expected to facilitate the processing of target sentences, in English, when both sentences share the same structure, the passive voice. Differently than Santos and Mota (2018) who did not find cross-linguistic priming effects, both sentences will have the same number of words. Importantly, prime and target will also have the same main verb. That is, lexical repetition will be included in the design via translation at the main verb. This inclusion was made in light of Bernolet's and colleagues (2013) results of finding cross-linguistic priming effects to be boosted by lexical repetition. More than that, due to the exploratory nature of the study a condition in which the likeliness of occurrence of the phenomenon being investigated is increased appeared to be suitable.

RQ2) Does L2 proficiency predict cross-linguistic syntactic priming effects?

H2) Cross-linguistic syntactic priming effects (from BP to EN) will be predicted by participants' proficiency level. The most proficient participants will demonstrate more robust syntactic priming effects.

Hartsuiker and Bernolet's (2015) model proposes that as L2 proficiency enhances the L2 syntactic representations go through a series of changes, from lexical specific to abstract. Based on that, cross-linguistic syntactic priming effects (from BP to EN) are expected to be predicted by proficiency level in both experimental conditions. The likeliness of weaker priming effects is greater at the lowest levels of proficiency since L2 learners may not have yet reached the first stage in which L2 and L1 nodes are connected.

RQ3) Is there an interaction between syntactic priming effects, lexical repetition (via translation equivalents) and L2 proficiency?

H3) Cross-linguistic syntactic priming effects (from BP to EN) will interact with lexical repetition (via translation equivalents) and proficiency level. Participants with the lowest proficiency levels will only demonstrate priming effects in the presence of translation equivalents.

Hartsuiker and Bernolet's (2015) model proposes a series of steps to be taken by L2 learners while they evolve towards a fully shared syntax. By including a between-group factor of proficiency in the present study, we will be able to make same inferences about that. At the lowest stages of L2 proficiency participants are expected to only show priming effects when there is lexical repetition between prime and target sentences, that is, at Experimental Condition 1. The reason behind this is that, at first, syntactic representations are lexically bounded. Learners form nodes for each specific lexical unit and not yet for the syntactic structure. In this sense, the nodes for *kissed* and *beijado* would be mutually activated since they are linked to the same conceptual node. However, no activation would yet occur in relation to a node for the passive voice. Even though learners already have one in their native language, they still do not have one in their L2. As proficiency enhances, this will change. So, at the higher stages of L2 proficiency a new structural node will be added to the available L2 nodes. More than that the L1 and L2 nodes representing the same structure will have being collapsed together. Structures such as *was kissed by* and *foi comprado por* will activate the same passive syntactic node. Thus, at the highest stage of L2 proficiency participants will show priming effects in the absence of lexical repetition. That is, at Experimental Condition 2.

3.2 THE PARTICIPANTS

Participants were 35 BP-EN late bilinguals (21 females) with ages ranging from 19 to 48 years (M_{age}=30, -SD=6). The choice for this population was not made lightly. First, due to its status as an international language, English is currently the most common second language in the world (EBERHARD, SIMONS; FENNIG, 2020). More than that, learning a language after puberty appears to be common due to work and academic demands. Indeed, information gathered with the language experience questionnaire showed that participants' mean age of acquisition (AoA) was 11 (SD=7).

Regarding their education, all participants reported having finished high school. Twelve participants (34%) reported having finished an undergraduate program, while five (14%) were reported they were still taking classes. The majority of the participants (51%) were either pursuing or already held graduate degrees and/or PhDs. The abundance of highly educated participants was not surprising, but it should not be left unnoted since this appears to be a common trend in behavioral sciences (HENRICH *et al.*, 2010; HENRICH, 2020). Perhaps following the same trend, 29 participants (82%) reported having attended an English course.

Given that in both BP and EN the passive voice tends to be more frequent in writing than in spoken language knowing participants' reading and writing habits may be informative. Reading in English appears to be a common activity for this study's sample since 82% of the participants reported doing so regularly. Regarding writing in English, 68% of the participants reported doing so in their daily lives. From this, I assume that participants have had some experience with the passive voice in English.

Participants were instructed to partake in two of DIALANG's tests: vocabulary and structure. After having done that, they went back to the study website and reported their results. DIALANG provides scores in accordance with the Common European Framework of Reference (CEFR). Table 8 shows participants' proficiency levels:

Table 1 – Participants' proficiency levels

CEFR BROAD LEVEL	CEFR LEVEL	PARTICIPANTS
Proficient user	C2	6
	C1	13
Independent user	B2	11
	B1	5

Source: the author.

The small number of participants at levels B1 and C2 lead me to broaden my initial grouping strategy: instead of working with four levels of proficiency I decided to work with two. That is, proficiency was defined as a factor with two levels. For the sake of clarity, from now on I will refer to proficient users as advanced and independent users as intermediate.

3.3 THE EXPERIMENTAL DESIGN: CONDITIONS

The present cross-linguistic priming study was designed as to answer the research questions presented in the previous section. In a nutshell, a priming study consists of prime and target sentences that are arranged in a way that allows researchers look for any effects that processing the prime sentence may have in the later processing of the target sentence. In this sense, a priming study will count with at least one control condition and one experimental condition. Take. for instance, the operationalization of priming effects in the present study. Here, priming effects were operationalized as a decrease in response time which, in turn, is taken as an index of the time the participants took to process a word within a sentence. When control and experimental conditions differ only in relation to one aspect any differences in participants performance can be attributed in this particular aspect.

The two within-subjects factors to be investigated here are prime type and lexical repetition. The first pair of experimental and control conditions manipulate the structural repetition between prime and target sentences. In the experimental condition 1 (EC1) prime and target sentences are always in the passive voice and share the same main verb. In the control condition 1 (CC1) prime sentences are in the active voice while target sentences are in the passive voice, but the same main verb is used in both prime and target sentences as in EC1. This arrangement of conditions allowed me to tackle research question 1. Importantly, in a priming study the main concern of the analysis is the target sentence. That is, we will compare the reaction time measures of the target sentences in both EC1 and CC1. If reaction times in the target sentences of at EC1 are significantly shorter than those in the target sentences of CC1, this difference is attributed to the type of prime sentence, that differ between conditions, and can be interpreted as a priming effect.

The second within-subject factor is lexical repetition. In experimental condition 2 (EC2) prime and target sentences do not share the same main verb, but share the same passive structure. In control condition 2 (CC2) sentences will not share the main verb nor the syntactic structure. Thus, if reaction times in the target sentences of EC2 are significantly shorter than those in the target sentence of CC2, this difference can be interpreted as evidence of cross-

linguistic priming effects in the absence of lexical repetition. This will be of great significance because it will provide evidence for a fully shared and abstract bilingual syntax. Table 1 shows examples of prime and target sentences from each condition.

Table 2: Experimental and control conditions

Condition	Prime	Target
Experimental Condition 1 (EC1)	A máquina foi carregada pelo homem alto.	The piano was carried by the pianist.
Control Condition 1 (CC1)	O homem alto carregou a máquina.	The piano was carried by the pianist.
Experimental Condition 2 (EC2)	A máquina foi usada pelo homem alto.	The piano was carried by the pianist.
Control Condition 2 (CC2)	O homem alto mostrou a máquina.	The piano was carried by the pianist.

Source: the author.

3.4 THE EXPERIMENTAL STIMULUS

The stimuli for the priming task consist of BP and EN sentences (see Appendix E for all sentences). In each language, each sentence has 7 words. The experimental design of the priming task involves a Prime Type variable (Active vs. Passive) and a Translation Equivalent variable (Translation Equivalent vs. No Translation). The creation of the stimulus was carried out during the months of April, May and June of 2021 and involved the phase and task displayed in Table 2.

Table 3 - Making of the experimental stimulus

PHASE	Tasks
Phase 1	Writing of the sentences' first draft while counterbalancing for animacy.
Phase 2	Control the frequency of the main verb.
Phase 3	Rewriting of the sentences.
Phase 4	Design and application of acceptability judgments tests.
Phase 5	Rewriting of the sentences.
Phase 6	Final revision of the experimental sentences.

Source: the author.

At phase 1, 240 experimental sentences were written. More specifically, 80 target sentences in English and 160 prime sentences in Brazilian-Portuguese were created. The option for the use of two prime sentences was based on Weber and Indrefey (2009) and Thothathiri and Snedeker (2008), among other studies, and on the fact that the experimental literature shows that priming effects during comprehension may be harder to find than during production since in production priming studies require comprehension at the prime and production at the target

thus possibly leading to a deeper processing demand. Thus, by adding two prime sentences I expected to increase the likelihood of priming effects to occur

Also at phase 1, the making of the sentences was guided by an informed decision to counterbalance the sentences for animacy. Experimental research has shown the existence of semantic constraints on the passive voice (*c.f.* AMBRIDGE; BIDGOOD, 2016; ARYAWIBAWA; AMBRIDGE, 2018; BIDGOOD *et al*, 2020). Among the possible semantic constrains great attention has been paid to issues related to animacy. For instance, is it harder to process a passive sentence in which both agent and patient are not animated? Would it be even harder to process a passive in which the agent is not animated while the patient is? If a semantic constraint of animacy is indeed psychologically real, the answer would be positive. Since the present study does not aim at addressing whether or not passive constructions are entirely syntactic or semantically structured a methodological decision for counterbalancing the sentences for animacy was made. The table below shows how this control took place:

Table 4 – Counterbalancing the animacy

| Agent	Animated	Not animated	Animated	Not animated
Patient	Not animated	Animated	Animated	Not animated
Experimental condition 1	15 sentences	15 sentences	15 sentences	15 sentences
Experimental condition 2	15 sentences	15 sentences	15 sentences	15 sentences
Control condition 1	15 sentences	15 sentences	15 sentences	15 sentences
Control condition 2	15 sentences	15 sentences	15 sentences	15 sentences

Source: the author.

As presented above every experimental and control condition has equal amounts of animacy features. The four possible combinations are (1) + animacy agents and – animacy patients, (2) - animacy agents and + animacy patients, (3) + animacy agents and patients and (4) – animacy agents and patients. Examples of each sentence are given below:

(1) The room was illuminated by the lady.

(2) Our father was surprised by the noise.

(3) The author was published by her agent.

(4) The car was constructed by the machines.

At phase 2, every main verb went through a frequency check. Based on the literature on frequency control reviewed in chapter 2, I decided to control the frequency of BP and EN verbs. Even tough prime sentences will not be statistically analyzed, a possible interference that processing a more or less frequent prime word may have in the subsequent processing of a target word cannot be disregarded. So, using the normalized frequency measures taken from the CLC and the Brazilian Portuguese Corpus (both available at SketchEngine) I made a cut at the 250 occurrences per million mark. That is to say that both BP and EN main verb have similar frequency as it can be seen in the following figure:

Figure 5: Scatter plot of the verbs per frequency and language
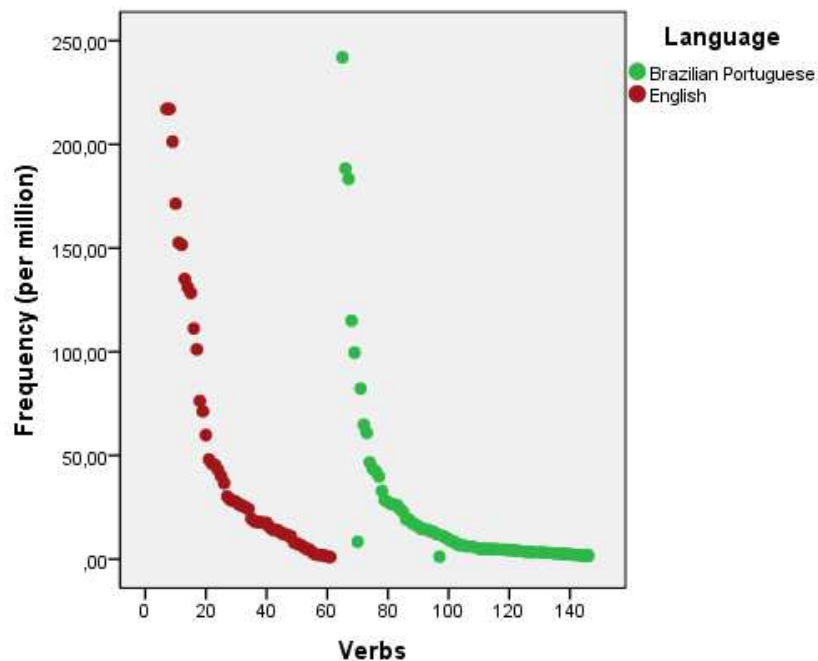
Source: the author.

After rewriting the sentences which had verbs that did not made the frequency cut, at phase 3, I move on to the grammaticality judgment test, at phase 4. Both BP and EN sentences were analyzed by native speakers as to determine whether or not they are acceptable. The sentences were divided in lists. Each list was graded by 6 to 15 people. The test consisted of a Likert scale adapted from De Jesus (2018) that showed the following options:

1 - Totally unnatural. No one would write this.

2 - Weird. Acceptable, but it could be better.

3 - Good, but it could be more natural.

4 - Very good and natural.

Tables 5 and 6 shows examples of the sentences with the mean for their acceptability.

Table 5 and 6 – BP and EN sentences and their mean for the grammaticality judgment test

Sentence	Mean
O atleta foi lançado pela cama elástica.	3
A árvore foi plantada pela sua avô.	4
A roseira foi quebrada pela chuva forte.	4

Sentence	Mean
The surfer was lifted by the wave.	3,5
The ball was thrown by the player.	4
The mother was surprised by her daughter.	4

Source: the author.

At phase 5 the sentences with the mean acceptability grade of 2 and 1 were revised and went through a new acceptability test. Finally, at phase 6, a final revision for typos was made and the final version of the sentences was ready. After having the final 240 experimental sentences, 240 filler sentences were selected from two of LabLing's earlier studies: De Jesus (2018) and Felício (2019). The sentences are intransitives and are in both BP and EN. These filler sentences have already gone through grammaticality judgment tests.

3.5 THE INSTRUMENTS

The instruments used in the study will be presented next. First, I will present the biographical and language experience questionnaire. Then, I will discuss the proficiency test selected for the present study. Then, every methodological procedure involved in the making of the experimental stimuli will be discussed in the following section.

3.5.1 The biographical and language experience questionnaire

As already mentioned in the significance of study section, participants of the study were late bilinguals of BP-EN. Following previous studies conducted at LabLing (e.g. DOS SANTOS, 2019; FELICIO, 2018) the questionnaire administered to participants was divided

into 2 sections (see Appendix D). While the first section focused on more general information (*e.g.* age, sex, level of schooling), the second addressed issues regarding participants L2 experience. Importantly, knowing that the syntactic structure that will used in the present study, the passive, tends to occur more in written language, I decided to include questions regarding participants' reading and writing habits. That is, I included questions such as "*Você costuma escrever em inglês (e-mails, trabalhos, relatórios etc.)?*".

3.5.2 The proficiency test

The test selected to measure participants' L2 proficiency was the DIALANG (ALDERSON, 2005; ALDERSON; HUHTA, 2005). It rates proficiency according to the Common European Framework of References for Languages (CEFRL). The choice for this particular proficiency test is threefold. First, DIALANG is an on-line diagnostic language assessment system designed so that students could take it without the presence of an instructor. Since the data collection was conducted remotely this feature was definitely important. Second, DIALANG has specific tests for the skills of reading, listening, writing, vocabulary and structures. For the purpose of the present study, participants performed the placement and structures tests. The placement test establishes the level of difficulty of the later structure test. It is composed of a list of words and non-words and participant should mark the ones that they consider to be real English words. At last, DIALANG has received positive critique regarding its efficiency (KEKTSIDOU; TSAGARI, 2019) and I judged it to be more thorough than other free proficiency measures.

Although simple, DIALANG's interface is user friendly, and participants were expected to be able to navigate the website without major setbacks. However, since there are many options of tests to take within DIALANG guidelines were included as shown in Figure 6. Figure 7 shows an example of a question from the structures test.

Figure 6: Guidelines for the proficiency exam

Agora precisamos saber qual é o seu nível de proficiência na língua inglesa. Para isso, precisamos que você faça um teste no aplicativo DIALANG, mantido pela Lancaster University, Inglaterra.

Antes de ir para o site, certifique-se de que entendeu bem a sequência abaixo:

1. acesse o link em uma nova aba https://dialangweb.lancaster.ac.uk;
2. escolha a língua na qual você prefere ler as instruções;
3. leia as instruções;
4. escolha o teste de estrutura (você será encaminhado para o teste de nivelamento);
5. faça o teste de nivelamento;
6. faça o teste de estruturas;
7. ao final, seu nível de proficiência será informado pelo DIALANG. Volte para essa aba e responda a questão abaixo.

Qual o seu nível de proficiência medido pelo DIALANG?

○ C2

○ C1

○ B2

○ B1

○ A2

○ A1

Source: own authorship.

Figure 7: Example of a DIALANG question

Escolha uma das opções abaixo apresentadas e clique com o rato no botão correspondente.

Choose the best word for the gap (...) in the following sentence:

I've nearly finished. There's very ... left to do.

○ little
○ less
○ least

Source: DIALANG

### 3.5.3 The self-paced task

The main task of the present study was a self-paced task which aimed at investigating how processing the passive voice in BP would influence the subsequent processing of the passive voice in EN. Following Just and colleagues (1982) recommendations regarding possible paradigms to present text in an experimental setting I decided to conduct a self-paced sentence

reading task with a moving window presentation. Just *et al* (1982) explains that in a moving window condition participants read a sentence one word at a time by pressing a button. The moving window term refers to the fact that the words are presented at their own natural location, differently than in a word-by-word condition in which every word appears at the center of the screen. The benefit of the moving window is that it more accurately mimics the natural process of reading.

As it will be explained in the next section, the one-word moving-window self-paced reading task was conducted remotely. Before each sentence, a fixation cross appeared for 1 second so participants could fixate their eye gaze in the initial point of the upcoming sentence. The words were masked with hyphens (-) and to read them participants pressed the space bar. Once a new word was revealed the previous word was re-masked. An example of a sentence presentation is displayed in figure 8.
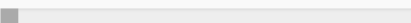
Figure 8: Example of a sentence presentation

Progresso:

```
The ----- --- ------- -- --- ----
```

Progresso:

```
--- apple --- ------- -- --- ----
```
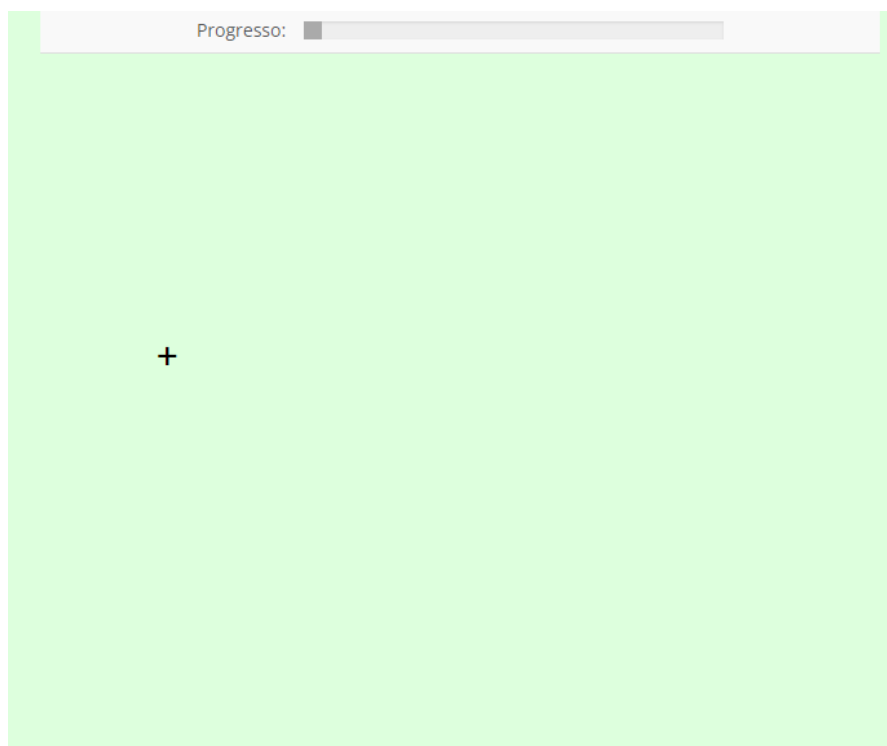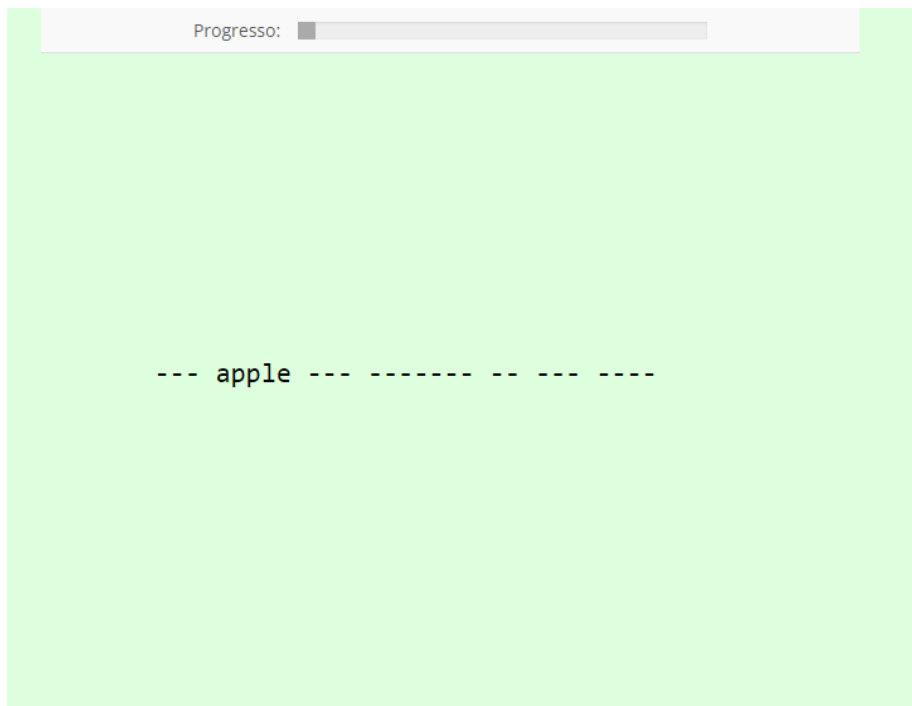
Progresso:

```
--- ----- was ------- -- --- ----
```

Progresso:

```
--- ----- --- knocked -- --- ----
```

Progresso: ▮

--- ----- --- ------- by --- ----

Progresso: ▮

--- ----- --- ------- -- the ----

Source: the author.

The words were presented in black font (Monospace, font size 22) on a light green background. One experimental trial consisted of two prime sentences, one target sentence and one to four filler sentences. A block consisted of three trials. After each block participants answered a memory question by pressing S (for yes) or N (for no) on their keyboard. The task was divided into two parts, each consisting of 40 trials. An 180ms pause was included between parts. The order of trial presentation was randomized to each participant. Two blocks of practice trials were included in the beginning of the experiment so participants could get familiar with the dynamic of the study.

3.6 PROCEDURES

On 11 March 2020, the World Health Organization (WHO) officially declared COVID-19 a pandemic. It was during this unusual time that the current MA thesis was conducted. The first and perhaps most urgent demand created by the need for social distancing was to develop a remote study. At first, regarding the experimental task *per se* using any lab-based software, such as the E-prime, was no longer an option. After careful consideration, I decided to develop the task myself with the aid of other LabLing researchers using the JsPsych library (DE LEEUW, 2015).

Participants used their own computers or laptops to access the study. The data collection session lasted from 40 to 70 minutes, and it was composed of three parts. Right after clicking on the link provided in the invitation, participants saw the following welcome page:

Figure 9: Welcome message and instructions for participants

Source: the author.

From this moment on participants were aware that the study consisted of four parts. The need for such a straightforward list was noted after having received the feedback from the pilot study. According to *Resolução 510* from Conselho Nacional de Saúde no data collection can take place before participants have read and signed the consent form. The first part of the study, as can be seen in Figure 8, consisted of reading and signing the consent form (see Appendix C for the TCLE). After that, in part two, participants answered the biographical and language experience questionnaire mentioned on subsection 3.4.1. Part three consisted of going to the DIALANG website, doing the relevant tests and reporting the proficiency level achieved. Finally, on part four, participants performed the self-paced reading task aimed at assessing structural priming effects.

3.7 THE ETHICS REVIEW BOARD

In accordance with Brazilian law, the study went through the analysis of the *Conselho de Ética em Pesquisas com Seres Humanos* at the Federal University of Santa Catarina *(CEPSH-UFSC)* and received permission to be conducted[9].

3.8 PRE- AND PILOT STUDIES

The pre pilot study was carried out on June 18th and 19th 2021 and it counted with five participants (4 female; M_{age}: 25.6; -SD: 4.8). The main of the pre pilot study was to test the instruments, receive feedback from participants and gather some information about the design and procedures of the study (for instance, how long people took to carry out the entire task). Participants reported having spent from 40 minutes to an hour to finish the experiment. Going through the language experience questionnaire and comparing the self-rated proficiency level with the DIALANG's level a possibility arose that participants self-rated levels were not always in line with their DIALANG's result.

The pilot study was conducted in September of 2021 with 10 participants. The main difference between the pilot study and the pre-pilot study was that, by the pilot study, the experimental sentences have been changed. Based on the sentences used in the pre-pilot study, primes were adapted with the objective of creating sentences that differed from each other only regarding syntactic structure and repetition at the main verb. Examples of the new prime sentences are given below:

Table 7 – Examples of prime sentences

Condition	Prime sentence
Experimental Condition 1	O prédio foi construído pela engenheira chefe.
Experimental Condition 2	O prédio foi derrubado pela engenheira chefe.
Control Condition 1	A engenheira chefe construiu o prédio alto.
Control Condition 2	A engenheira chefe desenhou o prédio alto.

Source: the author.

The reason behind the decision of editing the sentences was that only by doing so I would be able to include items as random factors in the linear mixed model that would be used for the inferential statistical analysis. Including both items and participants as random factors

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[9] CAAE: 46880521.8.0000.0121

is beneficial when analyzing priming data (BAAYEN; DAVIDSON, 2008; HESSELMANN, 2018).

4 RESULTS

The main goal of the present study was to investigate the processing of bilingual syntax. More specifically, I aimed at assessing the occurrence of cross-linguistic syntactic priming effects during the processing of the passive voice in English by a group of BP-EN late bilinguals. The cross-linguistic priming effects that I was interested in were from L1 to L2. That is, I assessed the occurrence of priming effects by observing whether a participant processed an English passive target sentence faster after having been exposed to a Brazilian-Portuguese passive prime sentence when compared to a control sentence. More than that, I was also interested in the role played by translation equivalents upon the priming effects. At last, the issue of how proficiency interacted with priming effects and with lexical repetition (via translation equivalents) was also investigated.

4.1 THE DATA ORGANIZATION

Garcia (2021) explains that any data frame that will be analyzed with R should be organized into multiple same size columns with one observation per row (p.32). As such, the data organization stage focused on making sure that this procedure was followed. As mentioned in the third chapter, the experimental task was hosted on the LabLing website. The resulting data was in .json format as can be seen in the following extract:

```
{"words": "The pizza was purchased by the teenager",
 "rt":
"[1204.5999999940395,1126.199999988079,870.2999999970198,1125.
 8999999910593,845.5999999940395,785.5999999940395,2402.5]",
 "condition": "filler",
 "test_part": "prac",
 "trial_type": "moving-window",
 "trial_index": 48,
 "time_elapsed": 2127017,
 "internal_node_id": "0.0-32.0-1.7"}
```

In order to extract words and RTs from the experimental sentences I developed a tool that was able to do it automatically. Figure 10 shows its interface.

Figure 10: Tool interface

```
Cole aqui o conteúdo completo de um arquivo JSON
(CTRL+A, CTRL+C no arquivo JSON e CTRL+V na caixa de texto)
e pressione OK:

                    "internal_node_id": "0.0-36.0-1.192"
            },
            {
                    "rt": 2139.3999999910593,
                    "stimulus": "<p>Muito obrigada! Você terminou a tarefa.</p>
<p>Por favor, aperte <strong>ESPAÇO</strong> para finalizar.</p>",
                    "response": 32,
                    "trial_type": "html-keyboard-response",
                    "trial_index": 880,
                    "time_elapsed": 4294595,
                    "internal_node_id": "0.0-37.0"
            }
]

                            OK

experimental,CC2
1121.9000000059605
1030.6000000089407
875.2999999970198
1005.7999999970198
885.2000000029802
915.5
1145.5999999940395

experimental,CC2
1413.2999999970198
930.3999999910593
925.4000000059605
```

Source: the author.

The resulting raw data consisted of 62111 observations from 35 participants. Two .xlsx files were created: one with the memory questions together with their answers and one with sentences and RTs. Accuracy on the memory questions was interpreted as an indicator that participants were actually reading the sentences as opposed to just pressing the space bar randomly. I stipulated that participants whose accuracy was below 70% would have their data discarded. Fortunately, no participant had an error rate greater that 30% so all data was maintained and moved on to the next stage: removing impossible values (>100ms and <1500ms). After having done that, I further removed all values that were not clustered inside the +- 3,5SD region. Those values were considered outliers. Figure 9 shows the data distribution for the main verb (region 4).

Figure 11: Frequency distribution of the reaction times in ms for the main verb
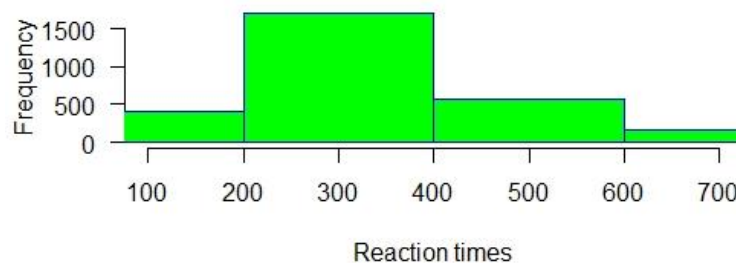
Source: the author.

4.2 THE DESCRIPTIVE STATISTIC

For the purposes of the present study only two regions of the target sentences were analyzed: the main verb (region 4) and the by preposition (region 5). The main source of the possible priming effects was expected to be region 4. However, Kaser (2013) explains that reaction time measures may suffer from the spill-over effect, that is, the impact of processing one word may appear a word later (p. 141). With that mind, I also analyzed region 5 to for delayed priming effects.

4.2.1 Descriptive analysis of the main verb (region 4)

All data was analyzed using R (version 4.1.2; R CORE TEAM, 2019) with the R packages lme4 (BATES *et al*., 2015) and jsPlot (LÜDECKE, 2021). Table 9 shows means and standard deviations from each condition.

Table 9 - Means and standard deviations from each condition

Condition	Mean	SD
CE1	345.53	162.14
CC1	363.37	186.38
CE2	340.04	165.23
CC2	356.76	178.35

Source: the author.

As expected, participants read the experimental conditions (CE1 and CE2) faster than the control conditions (CC1 and CC2). That is, a preliminary descriptive analysis seems to indicate the presence of cross-linguistic syntactic priming effects. Figure 10 shows a chart with RT means at each condition.

Figure 12: RT means at each condition
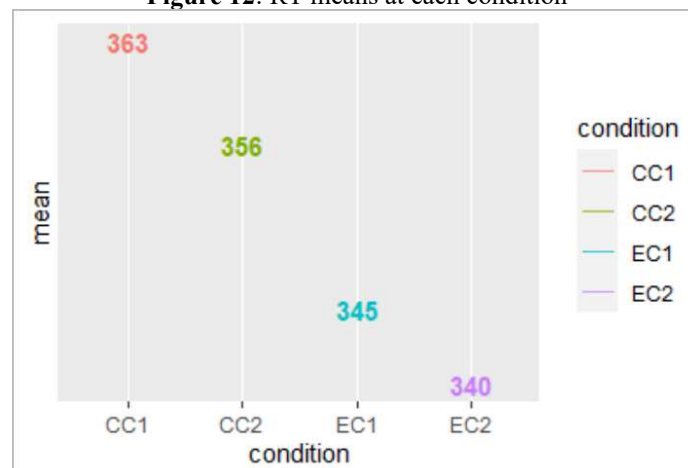
Noticeable, means of both experimental conditions were lower than means of both control conditions. Interesting enough, the smaller mean was found in experimental condition 2 (M=340). Among control conditions, differently than expected, the highest mean was found in control condition 1 (M=363). Figure 11 shows mean reaction times for each word in all conditions:

Figure 13: mean reaction times for each word in all conditions
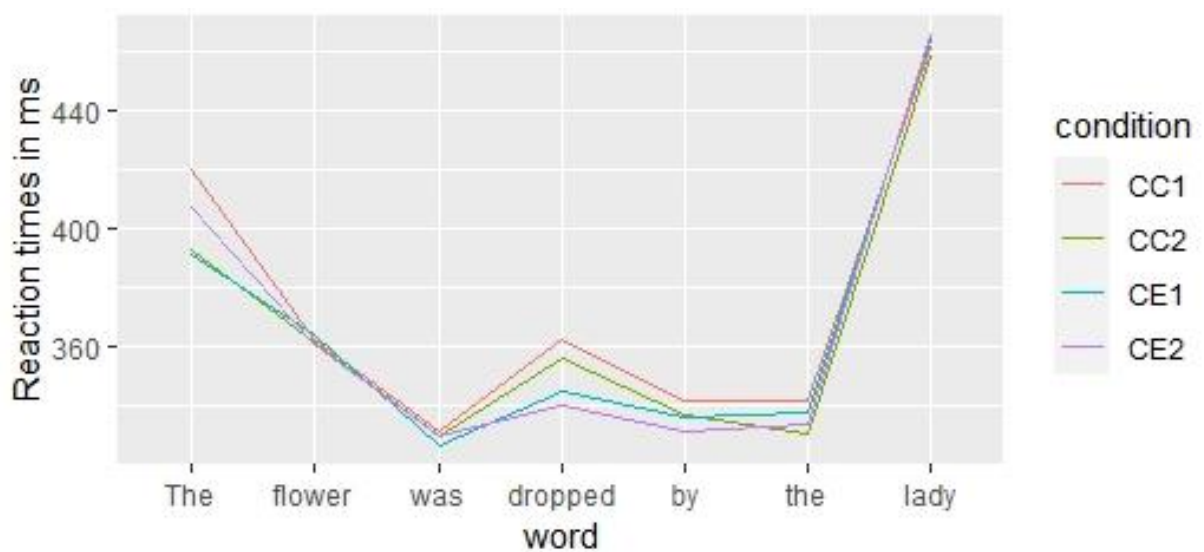
Source: own authorship.

4.2.2 Descriptive analysis of the by preposition (region 5)

All data was analyzed using R (version 4.1.2; R CORE TEAM, 2019) with the R packages lme4 (BATES *et al*., 2015) and jsPlot (LÜDECKE, 2021). Table 10 shows means and standard deviations for region 5, that is, the by preposition.

Table 10 - Means and standard deviations for region 5

Condition	Mean	SD
CE1	336.88	129.54
CC1	342.58	145.43
CE2	332.46	125.40
CC2	337.61	173.66

Source: the author.

Differently than in region 4, region 5 does not show the same pattern of shorter RTs on experimental conditions when compared to control conditions. That is, there is no indication of the occurrence of a spill-over effect.

4.3 THE INFERENTIAL STATISTICS

Just as in the descriptive statistical analysis, regions 4 and 5 were the focus of the inferential statistical analyses. Mixed-effects modeling was used to assess if RTs significantly decreased as a function of prime type and/or verb repetition. Condition and proficiency were included as fixed factors while participants and items were random factors. Since I also wanted to test whether or not verb repetition would enhance priming effects differently depending on proficiency, interaction terms for condition and proficiency were also included.

4.3.1 Inferential analysis of the main verb (region 4)

Figure 14 shows the summary of the model for region 4.

Figure 14 - Summary of the model for region 4

Predictors	Estimates	CI	p
		rt	
(Intercept)	377.93	297.10 – 458.76	**<0.001**
condition [CC1]	0.80	-19.63 – 21.23	0.939
condition [CE1]	-28.92	-50.25 – -7.58	**0.008**
condition [CE2]	-29.87	-51.41 – -8.34	**0.007**
proficiency [2]	-36.93	-146.60 – 72.73	0.509
condition [CC1] * proficiency [2]	9.43	-18.32 – 37.19	0.505
condition [CE1] * proficiency [2]	27.02	-2.03 – 56.08	0.068
condition [CE2] * proficiency [2]	22.76	-6.68 – 52.20	0.130
Random Effects			
σ^2	17870.54		
τ_{00} participant	28900.36		
τ_{11} participant.item	0.29		
ρ_{01} participant	-0.32		
ICC	0.62		
N participant	35		
Observations	2937		
Marginal R^2 / Conditional R^2	0.005 / 0.620		

Source: the author.

The results showed a significant main effect of condition for both EC1 (β: -28.92, $p <$ .01) and EC2 (β: -29.874, $p <$ .01). Contrary to expectations, there was no significant main effect for proficiency nor for the interaction between fixed factors (namely, proficiency and condition). Interestingly enough, a comparison between marginal and conditional R^2 values

indicates that the full model (*i.e.*, the model with both fixed and random factors) explained better the variability than the model with only fixed factors.

4.3.2 Inferential analysis of the by preposition (region 5)

Finally, the same model was constructed with RTs from region 5 (the by preposition). Figure 13 shows the summary of the model for region 5.

Figure 15 - Summary of the model for region 5

Predictors	Estimates	CI	p
		rt	
(Intercept)	370.17	322.50 – 417.84	**<0.001**
condition [CC1]	-1.57	-17.88 – 14.74	0.850
condition [CE1]	1.18	-15.31 – 17.66	0.889
condition [CE2]	-8.72	-25.35 – 7.91	0.304
proficiency [2]	-46.61	-111.25 – 18.03	0.158
condition [CC1] * proficiency [2]	8.49	-13.68 – 30.66	0.453
condition [CE1] * proficiency [2]	-6.18	-28.59 – 16.24	0.589
condition [CE2] * proficiency [2]	3.28	-19.37 – 25.94	0.776
Random Effects			
σ^2	11834.63		
τ_{00} participant	10737.89		
τ_{11} participant.item	0.02		
ρ_{01} participant	-0.84		
ICC	0.48		
N participant	35		
Observations	2945		
Marginal R^2 / Conditional R^2	0.023 / 0.488		

Source: the author

As expected, based on the descriptive analysis, the results showed no significant main effects. Based on that it is possible to state that no spill-over effect was found in the present study.

5 DISCUSSION

The presence of cross-linguistic priming effects from L1 to L2 during the comprehension of the passive voice by BP-EN late bilinguals is the main finding of the present study. Participants were consistently faster to process the main verb of the target sentences after having just processed the prime sentences in both experimental conditions. Differently than expected, all participants – regardless of proficiency level – showed both lexically dependent and abstract priming effects.

To reiterate, the experiment consisted of two experimental and two control conditions. In experimental condition 1 (EC1) prime and target sentences shared the same syntactic structure and translation equivalents were included (e.g., visto – seen). In control condition 1 (CC1) the same verb was repeated between prime and target sentences, but the syntactic structure was not the same (e.g., viu – seen). In experimental condition 2 (EC2) prime and target sentences shared the same syntactic structure, but no translation equivalents were included (e.g., visto – hugged). Finally, in control condition 2 (CC2) prime and target syntactic structures differed and no translation equivalents were included (e.g. comeu – kissed).

The comparison of experimental condition 1 (EC1) to control condition 1 (CC1) allowed me to observe that structural and lexical repetition via translation equivalents negatively impacted participants reaction times (RTs) to the main verb of the target sentence. That is, RTs were lower in EC1 when compared to CC1. Given that the main difference between control and experimental conditions was the presence of structural repetition it is tempting to infer that the nature of the observed facilitation was structural. However, the possibility that participants simply benefited from the word-by-word translation present in EC1 can only be ruled out with the results found in EC2 and CC2.

Differently than in EC1, EC2 did not include any translation at the main verb. Thus, the fact that participants were faster to process the main verb in EC2 when compared to CC2 cannot be explained in terms of a translation benefit. Here the only possible source of the observed facilitation effect is the syntactic repetition between prime and target sentences. In other words, the cross-linguistic priming effects found were abstract in nature since they occurred in the absence of translation equivalents. This finding goes against Clahsen and Felser's (2006) proposal that L2 syntactic processing is lexically driven and in favor of Hartsuiker and colleagues' (2004) shared syntax position.

As explained in the review of literature chapter, structural priming effects can be explained as the results of the residual activation left by the processing of a prime sentence

(TOOLEY, 2020). The fact that in the present study the processing of a BP passive sentence facilitated the later processing of an EN passive sentence can only be conceived in a scenario in which BP and EN syntactic representations are shared. Importantly, that is not to say that structural priming can only be explained as the results of residual activation. In fact, much attention is being drawn to the possibility that an implicit learning mechanism might be responsible for priming effects. However, in the present study the claim that syntactic representations are shared is better supported by a residual activation mechanism.

Regardless of condition (EC1 or EC2) the following figure depicts what may have happened during the experiment reported here:

Figure 16 – Bilingual representational network during an experimental trial
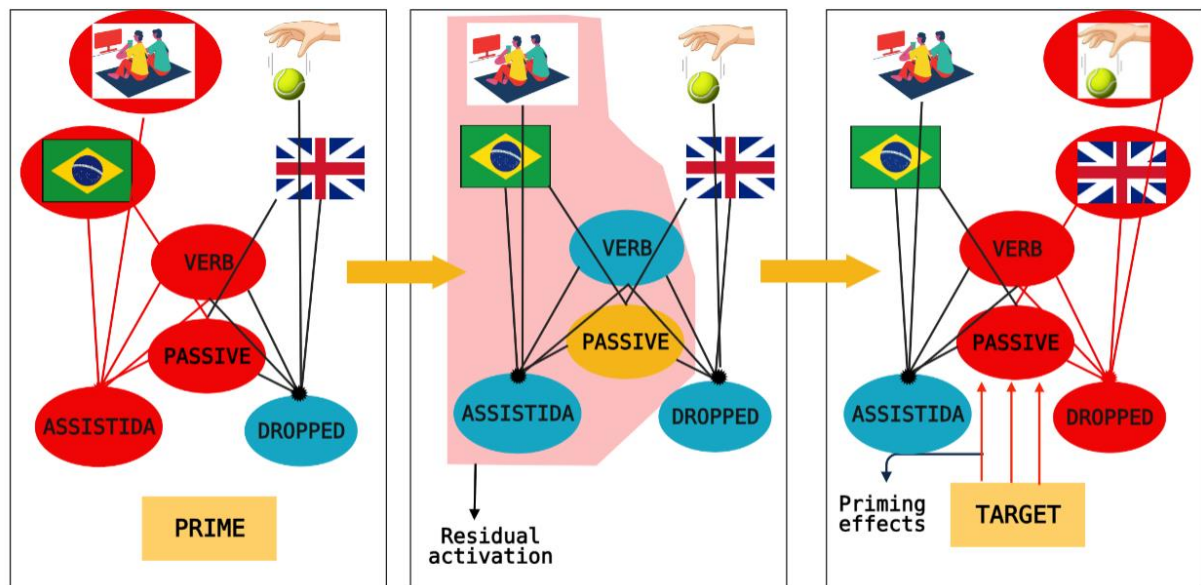
Source: the author.

Figure 16 represents a mechanistic account of cross-linguistic structural priming effects based on Hartsuiker, Pickering and Veltkamp's (2004) proposal (reviewed in Chapter 2). The following representational nodes are depicted: two lemma nodes ("assistida" and "dropped"), one category node (verb), one combinatorial node (passive), two language nodes (Brazilian-Portuguese and English), and two conceptual nodes (to watch and to drop).

From left to right, the first image accounts for the processing of the main verb of a BP prime sentence in experimental condition 2 (EC2). For example, when a participant processed the verb "assitida" in the prime sentence "A novela foi assistida pela moça loira" the following nodes were activated: the lemma node of "assistida", the passive voice combinatorial node, the verb categorical node, the BP language node, and the conceptual node. Node activation is

represented by the color red. The activation is spread trough the links between nodes that are also colored in red when recruited.

Note that the passive node is shared by both language nodes since the passive voice exists in both BP and EN. In other words, the passive node is not language specific. Following Bernolet and Hartsuiker's (2018) trajectory model, the sharing of combinatorial nodes only happens at the final stage of L2 syntactic development. Thus, the representational network depicted in figure 14 might not be suitable for the representation of the earlier stages of L2 acquisition.

The central image shows the state of the representational network right after the processing of the prime sentence. The residual activation left in the nodes is pivotal to the occurrence of the priming effects represented in the last image. As explained by Muylle, Bernolet and Hartsuiker (2020) the residual activation retained by the nodes makes subsequent activation easier: given a residually activated and a resting state node the residually activated node will reach the activation threshold faster thus giving rise to the priming effects.

The last image represents the state of the network during the processing of the main verb of an EN target sentence in EC1. Since both prime and target sentences share the same syntactic structure, the passive node had to be activated twice. Crucially, in the second time around, the activation happened faster due to the residual activation left in the network. The red arrows represent the structural priming effects.

The fact that priming effects were found in both experimental conditions regardless of proficiency level is also an important finding of the present study. According to Bernolet and Hartsuiker's (2018) model L2 syntactic representations go from lexically dependent to fully abstract. In other words, at lower levels of proficiency L2 learners are expected to establish lexically bounded syntactic representations. That is, once they encounter a new L2 verb occurring in a given syntactic structure they would develop a new representation node for that particular verb in that particular syntactic structure. At this stage, syntactic representations are neither abstract nor non-language specific. Regarding cross-linguistic priming effects, low proficient L2 users would only be susceptible to them when prime and target sentence share the same main verb. In the case of the present study, participants with the lower level of proficiency were expected to only show cross-linguistic priming effects at EC1. Admittedly, that was not the case.

Two possible explanations for the presence of abstract cross-linguistic priming effects regardless of proficiency are proposed. At first, the small and uneven number of participants at each proficiency level may have hindered the model's ability to find a significant interaction

between priming effects and proficiency. Conversely, assuming that sample size was not the issue, it is also possible that at the intermediate level of proficiency L2 users have already reached the stage in which the passive node is abstract and shared between languages. In other words, regarding the passive voice they may have already reached the last stage of the bilingual syntax and, as such, the representations and processing procedures that they go through are the same that advanced L2 users rely upon.

Of keen importance to the results found here is the fact that, unlike other studies that dealt with cross-linguistic priming effects during comprehension (*e.g.* FELÍCIO, 2018), the experimental design implemented included a 2:1 prime and target proportion. That is, participants processed the EN target sentence after having processed two BP prime sentences. Taking a closer look at the methodological procedures of priming studies such as Bock (1986) one interesting characteristic came to light: even though the authors reported having used only one prime, participants seem to have at least two instances of contact with each prime sentence.

Bock's (1986) seminal priming study participants not only listen to the prime sentences, but also repeat them. Even in a more recent cross-linguistic priming study a similar trend can be noted. In the prime portion of Kidd *et al*'s (2015) study participants not only read a prime sentence, but also indicated which picture better represented its meaning. What if having two instances of contact with each prime increases its depth of processing? Craik and Lockhart (1972) argued that a greater depth of processing implies "a greater degree of semantic or cognitive analysis" (p. 675). Perhaps having processed each prime sentence twice, participants were more likely to retain some of its aspects in memory thus enabling the occurrence of priming effects. Of course, the relation between double primes, depth of processing and priming effects during comprehension is only a possibility. However, considering the findings reported here, further research may benefit from investigating this possibility.

Finally, a surprising finding should be addressed. Participants spent more time processing the main verb of CC1 than they did in any other condition. That is surprising since CC2 is the one in which neither syntactic structure nor lexical content are repeated between prime and target sentences; thus, it was expected that the higher RTs measures found would be on CC2. However, repeating the same verb (e.g., *to kiss*) but not the same syntactic structure (beijou – was kissed) taxed participants' performance more than having no repetition at all (comeu – was hugged). This finding warrants further research, but it is possible that an inhibitory process was triggered: having processed a verb in a determined syntactic structure participants might have to inhibit the following processing of the same verb in the same

syntactic structure. In other words, the residual activation left on the passive node had to be suppressed thus giving rise to some processing load.

5.1 READRESSING THE RESEARCH QUESTIONS AND HYPOTHESES

Having reached the end of the discussion, I will now readdress my research questions and hypotheses.

RQ1) Do reading times of late BP-EN bilinguals show cross-linguistic syntactic priming effects (from BP to EN) during the comprehension of the passive voice?

H1) Reading times of late bilinguals will demonstrate cross-linguistic syntactic priming effects (from BP to EN) during the comprehension of the passive voice.

Cross-linguistic syntactic priming effects were found in both experimental conditions. That is, BP-EN late bilinguals were susceptible to between-language syntactic priming effects both with and without lexical repetition at the main verb. These results can be interpreted as evidence in favor of hypothesis 1. These results are in line with previous studies that also found cross-linguistic syntactic priming effects during comprehension (*e.g.* WEBER; INDEFREY, 2009, KIDD *et al.*, 2015; HSIEH, 2017).

RQ2) Does L2 proficiency predict cross-linguistic syntactic priming effects?

H2) Cross-linguistic syntactic priming effects (from BP to EN) will be predicted by participants' proficiency level. The most proficient participants will demonstrate more robust syntactic priming effects.

No interaction between proficiency and cross-linguistic syntactic priming was found. Thus, hypothesis 2 was not confirmed. This null result can be explained in two different ways. Firstly, it is possible that participants with intermediate proficiency are already at a developmental stage in which, at least for the passive voice, L1 and L2 syntactic representations are shared and abstract. Secondly, the small number of participants may have hindered the model's ability to detect a group difference.

RQ3) Is there an interaction between syntactic priming effects, lexical repetition (via translation equivalents) and L2 proficiency?

H3) Cross-linguistic syntactic priming effects (from BP to EN) will interact with lexical repetition (via translation equivalents) and proficiency level. Participants with the lowest proficiency levels will only demonstrate priming effects in the presence of translation equivalents.

All participants, regardless of proficiency level, demonstrated cross-linguistic priming effects in both experimental conditions. Participants with the lowest level of proficiency demonstrated priming effects with or without translation equivalents. Hypothesis 3 was not confirmed. The null results found here might also be due to the size of our sample. Alternatively, it is also possible that participants' syntactic representations simply did not differ as a function of proficiency. That is, participants with intermediate and advanced levels of proficiency may represent L2 syntactic information the same way.

6   CONCLUSION AND FINAL REMARKS

This final chapter presents the main conclusions that arose from this thesis as well as some of its limitations and implications for further research. First, I will provide an answer to the question that opened this thesis. Then, I will present the limitations of the study alongside with some suggestions for future research.

6.1 WHAT CAN CROSS-LINGUISTIC PRIMING EFFECTS TELL US ABOUT BILINGUAL LANGUAGE PROCESSING?

Based on the results of the experiment carried out the following proposal is put forward: BP-EN late bilinguals with intermediate and advanced levels of proficiency have already reached a developmental stage in which the passive voice node is fully shared between their two languages. In other words, intermediate and advanced L2 speakers of English whose L1 is Brazilian Portuguese have only one shared syntactic representation for the passive voice.

Answering the question that initiated the present thesis – what can cross-linguistic priming effects tell us about bilingual language processing? – it is my contention that, most importantly, the priming effects found in the present study indicate that late BP-EN bilinguals have a shared syntactic system for at least some of the syntactic structures present in both languages. Besides that, when considering bilinguals with intermediate and advanced levels of proficiency, their susceptibility to both lexically dependent and abstract cross-linguistic priming effects seems to be the same. That is, proficiency, as assessed in the present study, did not interact with the observed priming effects. Objectively, the following main findings are put forward:

1. BP-EN late bilinguals are susceptible to cross-linguistic syntactic priming effects from BP to EN during the comprehension of the passive voice when prime and target sentences share the same main verb.

2. BP-EN late bilinguals are susceptible to cross-linguistic syntactic priming effects from BP to EN during the comprehension of the passive voice even in the absence of translation equivalents. In other words, they are susceptible to abstract cross-linguistic syntactic priming effects.

3. When dealing with intermediate and advanced L2 speakers, there is no interaction between proficiency and the occurrence of cross-linguistic syntactic priming effects from BP to EN during the comprehension of the passive voice.

6.1 LIMITATIONS AND IMPLICATIONS FOR FURTHER RESEARCH

Although having fulfilled its objectives, the study reported here has some limitations. Perhaps the most important one is that it was not a longitudinal study. The fact that proficiency was not a within-subject factor may have contributed to the unexpected lack of interaction between proficiency and cross-linguistic priming effects. More than that, the comparison of r square values indicated that the variability found in the model was deeply related with its random factors, that is, participants and items. Further research on L2 syntactic development may consider implementing a longitudinal study.

The small number of participants in each proficiency level may also be considered a limitation. Jiang (2012) explains that there is no ideal number of participants for a RT study. Instead, she posits that an informed decision should be made based on features of each particular experimental design. For instance, having participant-related independent variables with different levels may entail the need for a larger sample size. As mentioned in the method section, due to the small number of participants I had to abandon my initial idea of having proficiency as an independent variable with four layers. However, even after having done so I still worked with a two layered independent variable of proficiency that perhaps called for more participants.

Another consideration pointed by Jiang (2012) regarding the number of participants refers to the specific effect under investigation. Perhaps, the nuanced nature of cross-linguistic priming effects during comprehension would be more thoroughly observed with a larger sample. That is, the behavioral manifestation of the difference between abstract cross-linguistic priming effects and lexically bounded cross-linguistic priming effects may warrant more observations.

Also possible, although more speculative, is that only more fine-grained methods are able to measure a difference that does not translate to behavioral measures such as RTs. In light of that, further research may consider replicating the present study with hemodynamic and/or electrophysiological measures of brain activity.

Finally, including participants with even lower levels of proficiency would be of great benefit for future studies. In fact, most of the participants of the present study were at neighboring levels of proficiency (namely, B2 and C1). This alone may indicate that the results found here are not able to produce a comprehensive picture of L2 syntactic representation at different proficiency levels thus creating the need for further scrutiny.

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APPENDIX A – Instagram Post

APPENDIX B – Study email invitation

Natália Pinheiro. <nataliapinheirod@gmail.com>
para pginews ▾

qua., 3 de nov. de 2021 11:38

Caríssimos colegas,

sou aluna de mestrado no PPGI e estou, sob orientação da professora Mailce, conduzindo um estudo sobre o processamento sintático bilíngue. Veio por meio dessa mensagem convidá-los a participar do meu estudo e/ou divulgá-lo. Segue abaixo o convite:

O Laboratorio da Linguagem e Processos Cognitivos, da Universidade Federal de Santa Catarina (UFSC), convida você para participar de uma pesquisa sobre a leitura de frases em português e inglês.
O objetivo da pesquisa é investigar como brasileiros, falantes de inglês como segunda língua, leem frases em português e inglês. Caso aceite participar do estudo, você fará um teste de proficiência na língua inglesa para que saibamos o seu nível de domínio da língua. Nós estamos procurando por participantes com diferentes níveis de inglês, então não se preocupe com o seu resultado!
🖥 Para participar você realizará um experimento online de leitura de frases com duração de aproximadamente 1 hora. Esse estudo deverá ser feito através do seu computador. Celulares, smartphones e tablets não podem ser usados.

Perfil desejado:
1. Ser maior de 18 anos;
2. Ser falante nativo de português brasileiro; 🇧🇷
3. Ter nível básico, intermediário ou avançado de inglês; 🇺🇸

Link para participar do estudo: https://labling.ufsc.br/estudos/natalia/

A participação é voluntária, portanto, não há compensação financeira. Essa pesquisa foi aprovada pelo CEPSH/UFSC (CAAE: 46880521.8.0000.0121).

APPENDIX C – Termo de consentimento livre e esclarecido (TCLE)

Termo de Consentimento Livre e Esclarecido
Se desejar, use a função "imprimir" do seu navegador
para gerar uma cópia desse documento.

Caro(a) participante,

Eu, Natália Pinheiro De Angeli, aluna de mestrado do Programa de Pós-graduação em Inglês (PPGI) da Universidade Federal de Santa Catarina, orientada pela Professora Dra. Mailce Borges Mota, tenho como objetivo desenvolver um estudo sobre o processamento de frases em inglês e português.

Gostaria de convidá-lo(a) a participar desta pesquisa, intitulada *O que os efeitos de priming translinguístico podem nos dizer sobre a sintaxe bilíngue? Um estudo com bilíngues tardios de Português Brasileiro - Inglês*, que busca investigar como lemos sentenças em uma segunda língua, neste caso o inglês. Os estudos nessa área visam não só compreender o processamento de uma língua, mas também desenvolver meios de aperfeiçoar o seu ensino e aprendizagem. Peço que você leia este formulário de consentimento e tire todas as dúvidas que possam surgir antes de concordar em participar do estudo.

Os experimentos aplicados serão realizados remotamente, de forma online. Se você concorda em participar deste estudo, você será solicitado(a) a preencher um questionário biográfico e de experiência linguística, realizar uma tarefa de leitura silenciosa de sentenças em português e inglês e realizar um teste de proficiência em inglês. Você preencherá o questionário biográfico com alguns dados pessoais (por exemplo, idade, sexo, etc.). O teste de proficiência será realizado em uma plataforma online.

Em decorrência da participação nesta pesquisa, você pode estar exposto(a) a eventuais riscos, mesmo que baixos, tais como nervosismo, constrangimento, cansaço ou aborrecimento inerentes a qualquer situação de avaliação, assim como a quebra de sigilo mesmo que de maneira involuntária e não intencional. Para minimizar a possibilidade de desconforto, sessões de prática serão feitas antes da aplicação do experimento para que você possa se familiarizar com os procedimentos. Como o experimento será realizado remotamente, orientamos que busque um local em sua residência que seja confortável, silencioso e propício para a realização da coleta de dados. Recomendamos cadeiras confortáveis, iluminação e temperatura adequadas e posicionamento adequado do monitor do computador, de acordo com a sua altura. Outro risco possível advindo de sua participação nessa pesquisa é o de quebra, mesmo que involuntária, de sigilo. Para diminuir tal risco os dados serão armazenados em um pen drive privado de acesso restrito às pesquisadoras.

De acordo com a legislação brasileira, sua participação é voluntária e não remunerada. As pesquisadoras estarão à disposição para esclarecimentos antes, durante e depois da pesquisa. Você tem assegurada a liberdade de desistir da participação a qualquer momento do estudo, sem nenhuma penalização.

A data e horário do envio desse formulário ficarão registrados automaticamente. Sua via será encaminhada por e-mail em até 48 horas. Guarde cuidadosamente a sua via, pois é um documento que traz importantes informações de contato e garante os seus direitos como participante de pesquisa. Caso a sua participação nessa pesquisa lhe traga alguma despesa, você tem direito a ressarcimento. Caso venha sofrer qualquer prejuízo, material ou imaterial, comprovadamente decorrente de sua participação nesta pesquisa, você será indenizado de acordo com a legislação vigente.

Os dados pessoais sensíveis obtidos neste estudo serão mantidos em total sigilo. Ou seja, seu nome não será reportado em lugar algum. Os dados serão acessados apenas pelos pesquisadores responsáveis. Os dados não sensíveis, ou seja, os resultados do estudo, serão disponibilizados em plataforma de ciência aberta. Os resultados desta pesquisa serão divulgados em eventos ou publicações científicas sem qualquer identificação dos participantes. Você pode ter acesso aos resultados da pesquisa a qualquer momento entrando em contato com os pesquisadores.

Os procedimentos metodológicos adotados obedecem aos preceitos éticos implicados em pesquisas envolvendo seres humanos, conforme normatizado pela Resolução do Conselho Nacional de Saúde nº 510 de 07 de abril de 2016, que dispõe sobre as normas aplicáveis a pesquisas em Ciências Humanas e Sociais. As pesquisadoras também aderem a esse documento e comprometem-se a conduzir a pesquisa de acordo com o que preconiza a referida Resolução.

Tendo qualquer dúvida sobre a pesquisa, você pode entrar em contato com Natália Pinheiro De Angeli, pelo e-mail nataliapinheirod@gmail.com ou pelo telefone (48) 99985-2061, ou com a professora Dra. Mailce Borges Mota através do e-mail mailce.mota@ufsc.br, telefone (48) 3721-3792, ou no prédio do Centro de Comunicação e Expressão – CCE, bloco B, sala 513, Universidade Federal de Santa Catarina, UFSC.

A pesquisa, da qual faz parte esse questionário, foi avaliada e aprovada pelo Comitê de Ética em Pesquisa com Seres Humanos (CEPSH) da UFSC. O CEPSH é um órgão colegiado interdisciplinar, deliberativo, consultivo e educativo, vinculado à Universidade Federal de Santa Catarina, mas independente na tomada de decisões, criado para defender os interesses dos participantes da pesquisa em sua integridade e dignidade e para contribuir no desenvolvimento da pesquisa dentro de padrões éticos. Caso você tenha alguma dúvida ou reclamação quanto à condução ética dessa pesquisa, você pode entrar em contato com o CEPSH – UFSC. Endereço: Prédio da Reitoria II, 4º andar, sala 401, Rua Desembargador Vitor Lima, nº222, Trindade, CEP 88040-400, Florianópolis-SC. Telefone: (48) 3721-6094. E-mail: cep.propesq@contato.ufsc.br.

○ Concordo com os termos do TCLE e tenho mais de 18 anos.
○ Não quero participar da pesquisa.

[próximo]

APPENDIX D – Info biographical and language experience questionnaire

Qual a sua idade (anos completos)?

próximo

Qual a sua nacionalidade?

próximo

Sexo:

○ masculino

○ feminino

○ outro

próximo

Qual a sua escolaridade:

○ Ensino Médio completo
○ Ensino Médio incompleto
○ Ensino Superior completo
○ Ensino Superior incompleto
○ PG/Especialização (completo ou incompleto)
○ PG/Mestrado (completo ou incompleto)
○ PG/Doutorado (completo ou incompleto)

próximo

Além do português, quantos idiomas você fala?

○ 0
○ 1
○ 2
○ 3
○ 4+

próximo

Além do português, quais idiomas você fala?

☐ Nenhum
☐ Alemão
☐ Árabe
☐ Espanhol
☐ Francês
☐ Hindi
☐ Inglês
☐ Italiano
☐ Japonês
☐ Mandarim
☐ Polonês
☐ Russo
☐ Outro

próximo

Você se considera fluente na língua inglesa? (É considerado fluente aquele que consegue se comunicar na segunda língua sem precisar recorrer à língua materna)

○ Sim

○ Não

próximo

Com que idade você começou a aprender Inglês?

próximo

Você tem o costume de ler em Inglês (livros de ficção, por exemplo)?

○ Sim

○ Não

próximo

Você costuma escrever em inglês (e-mails, trabalhos, relatórios etc.)?

○ Sim

○ Não

próximo

Faça uma avaliação do seu desempenho em Inglês:

Fala

○ Muito bom   ○ Bom   ○ Regular   ○ Ruim

Compreende

○ Muito bom   ○ Bom   ○ Regular   ○ Ruim

Escreve

○ Muito bom   ○ Bom   ○ Regular   ○ Ruim

Lê

○ Muito bom   ○ Bom   ○ Regular   ○ Ruim

próximo

Você frequentou aulas de inglês em um curso de línguas?

○ Sim.

○ Não.

próximo

Se sim, por quanto tempo você frequentou as aulas?
(se não, prossiga)

próximo

Você continua tendo aulas de inglês? Qual o seu nível?

○ Não estou tendo aulas de inglês.

○ Sim, nível iniciante.

○ Sim, nível intermediário.

○ Sim, nível avançado.

próximo

Assinale a alternativa que mais combina com você atualmente:

○ Comunico-me somente em uma das línguas (por exemplo, português).

○ Comunico-me essencialmente em português, e em inglês raramente.

○ Comunico-me essencialmente em português, e em inglês ocasionalmente (Ex.: em sala de aula apenas).

○ Comunico-me tanto em português quanto em inglês, com a mesma regularidade nas duas línguas.

próximo

Com que frequência você se encontra num ambiente onde o português e inglês possam ser utilizados alternadamente?

○ O tempo todo.

○ Quase o tempo todo.

○ Em certas ocasiões.

○ Raramente.

○ Nunca.

próximo

Quais são os modos de contato com o inglês durante a semana?

☐ Não tenho contato com o inglês.

☐ Lendo (livros, revistas, internet etc.).

☐ Vendo vídeos (televisão, cinema, internet etc.).

☐ Escutando áudios (podcasts, aulas etc.).

☐ Conversando com familiares, amigos, colegas de trabalho.

☐ Assistindo aulas.

☐ Outros.

próximo

APPENDIX E – List of experimental sentences

Prime	O goleiro foi derrubado pelo jogador nervoso.	EC1
Prime	O jogador foi derrubado pelo goleiro nervoso.	EC1
Target	The flower was dropped by the lady.	EC1
Prime	O cantor foi visto pelo repórter atento.	EC1
Prime	A novela foi vista pela moça loira.	EC1
Target	The actor was seen by his mother	EC1
Prime	A aluna foi assustada pela prova dificil.	EC1
Prime	A irmã foi assustada pelo irmão fantaseado.	EC1
Target	The father was scared by a wave.	EC1
Prime	A concha foi lavada pelo irmão caçula.	EC1
Prime	A faca foi lavada pela cozinheira chefe.	EC1
Target	The girl was washed by the water.	EC1
Prime	O menino foi acordado pela mãe amorosa.	EC1
Prime	A titia foi acordada pelo sobrinho brincalhão.	EC1
Target	Our father was surprised by the noise.	EC1
Prime	O brinquedo foi atingido pelo chute dela.	EC1
Prime	O professor foi atingido pelo papel amassado.	EC1
Target	The door was hit by the teenager.	EC1
Prime	O ventilador foi carregado pela criança pequena.	EC1
Prime	A máquina foi carregada pelo homem alto.	EC1
Target	The piano was carried by the pianist.	EC1
Prime	A cozinheira foi incomodada pela cebola cortada.	EC1
Prime	O bebê foi incomodado pelo calor excessivo.	EC1
Target	The nurse was disturbed by the noise.	EC1
Prime	O copo foi derrubado pelo vento forte.	EC1
Prime	O menino foi derrubado pelo pai cuidadoso.	EC1
Target	The teacher was knocked by the boy.	EC1
Prime	O astronauta foi iluminado pela lâmpada interna.	EC1
Prime	A surfista foi iluminada pela luz solar.	EC1
Target	The room was illuminated by the lady.	EC1
Prime	O prédio foi construído pela engenheiro chefe.	EC1
Prime	O castelo foi construído pela família toda.	EC1

Target	The car was constructed by the machines.	EC1
Prime	A xícara foi quebrada pelo menino desastrado.	EC1
Prime	O quadro foi quebrado pelo avô furioso.	EC1
Target	The GPS was broken by your wife.	EC1
Prime	A encomenda foi recebida pela porta fechada.	EC1
Prime	A chuva foi recebida pela janela aberta.	EC1
Target	The grant was recieved by the account.	EC1
Prime	O jornalista foi surpreendido pelo plantão urgente.	EC1
Prime	A dentista foi surpreendida pela festa surpresa.	EC1
Target	My mother was surprised by the news.	EC1
Prime	O dinheiro foi escondido pelo livro jogado.	EC1
Prime	A ameixa foi escondida pela banana enorme.	EC1
Target	The key was hidden by the pillow.	EC1
Prime	A noiva foi acompanhada pela própria mãe.	EC1
Prime	O idoso foi acompanhado pelo guia turístico.	EC1
Target	The sandwich was accompanied by the potatos.	EC1
Prime	O cientista foi publicado pelo novo editor.	EC1
Prime	O livro foi publicado pela editora nova.	EC1
Target	The author was published by her agent.	EC1
Prime	A frase foi escrita pelo computador novo.	EC1
Prime	A piada foi escrita pelo palhaço hilário.	EC1
Target	The character was written by the computer.	EC1
Prime	A jóia foi roubada pelo cofre quebrado.	EC1
Prime	O sorvete foi roubado pela geladeira desligada.	EC1
Target	The owner was stolen by the girl.	EC1
Prime	O copo foi pintado pela menina cuidadosa.	EC1
Prime	O quadro foi pintado pela jovem artista.	EC1
Target	The boy was painted by the teacher.	EC1

Prime	**O goleiro foi chutado pelo jogador nervoso.**	**EC2**
Prime	O jogador foi confrontado pelo goleiro nervoso.	EC2
Target	The flower was dropped by the lady.	EC2
Prime	O cantor foi observado pelo repórter atento.	EC2
Prime	A novela foi assistida pela moça loira.	EC2
Target	The actor was seen by his mother	EC2

Prime	A aluna foi derrotada pela prova dificil.	EC2
Prime	A irmã foi olhada pelo irmão fantaseado.	EC2
Target	The father was scared by a wave.	EC2
Prime	A concha foi suja pelo irmão caçula.	EC2
Prime	A faca foi derrubada pela cozinheira chefe.	EC2
Target	The girl was washed by the water.	EC2
Prime	O menino foi abraçado pela mãe amorosa.	EC2
Prime	A titia foi molhada pelo sobrinho brincalhão.	EC2
Target	Our father was surprised by the noise.	EC2
Prime	O brinquedo foi quebrado pelo chute dela.	EC2
Prime	O professor foi machucado pelo papel amassado.	EC2
Target	The door was hit by the teenager.	EC2
Prime	O ventilador foi derrubado pela criança pequena.	EC2
Prime	A máquina foi comprada pelo homem alto.	EC2
Target	The piano was carried by the pianist.	EC2
Prime	A cozinheira foi atingida pela cebola cortada.	EC2
Prime	O bebê foi irritado pelo calor excessivo.	EC2
Target	The nurse was disturbed by the noise.	EC2
Prime	O copo foi atingido pelo vento forte.	EC2
Prime	O menino foi beijado pelo pai cuidadoso.	EC2
Target	The teacher was knocked by the boy.	EC2
Prime	O astronauta foi queimado pela lâmpada interna.	EC2
Prime	A surfista foi cegado pela luz solar.	EC2
Target	The room was illuminated by the lady.	EC2
Prime	O prédio foi derrubado pela engenheiro chefe.	EC2
Prime	O castelo foi destruído pela família toda.	EC2
Target	The car was constructed by the machines.	EC2
Prime	A xícara foi pintada pelo menino desastrado.	EC2
Prime	O quadro foi rasgado pelo avô furioso.	EC2
Target	The GPS was broken by your wife.	EC2
Prime	A encomenda foi amassada pela porta fechada.	EC2
Prime	A janela foi molhada pela chuva forte.	EC2
Target	The grant was recieved by the account.	EC2
Prime	O jornalista foi assustado pelo plantão urgente.	EC2
Prime	O dentista foi conquistado pela festa surpresa.	EC2

Target	My mother was surprised by the news.	EC2
Prime	O dinheiro foi amassado pelo livro jogado.	EC2
Prime	A ameixa foi coberta pela banana enorme.	EC2
Target	The key was hidden by the pillow.	EC2
Prime	A noiva foi maquiada pela própria mãe.	EC2
Prime	O idoso foi inscrito pelo guia turístico.	EC2
Target	The sandwich was accompanied by the potatos.	EC2
Prime	O cientista foi criticado pelo novo editor.	EC2
Prime	O livro foi rejeitado pela editora nova.	EC2
Target	The author was published by her agent.	EC2
Prime	A frase foi apagada pelo computador novo.	EC2
Prime	A piada foi rejeitada pelo palhaço hilário.	EC2
Target	The character was written by the computer.	EC2
Prime	A jóia foi guardada pelo cofre quebrado.	EC2
Prime	O sorvete foi estragado pela geladeira desligada.	EC2
Target	The owner was stolen by the girl.	EC2
Prime	O copo foi quebrado pela menina cuidadosa.	EC2
Prime	O quadro foi cortado pela jovem artista.	EC2
Target	The boy was painted by the teacher.	EC2

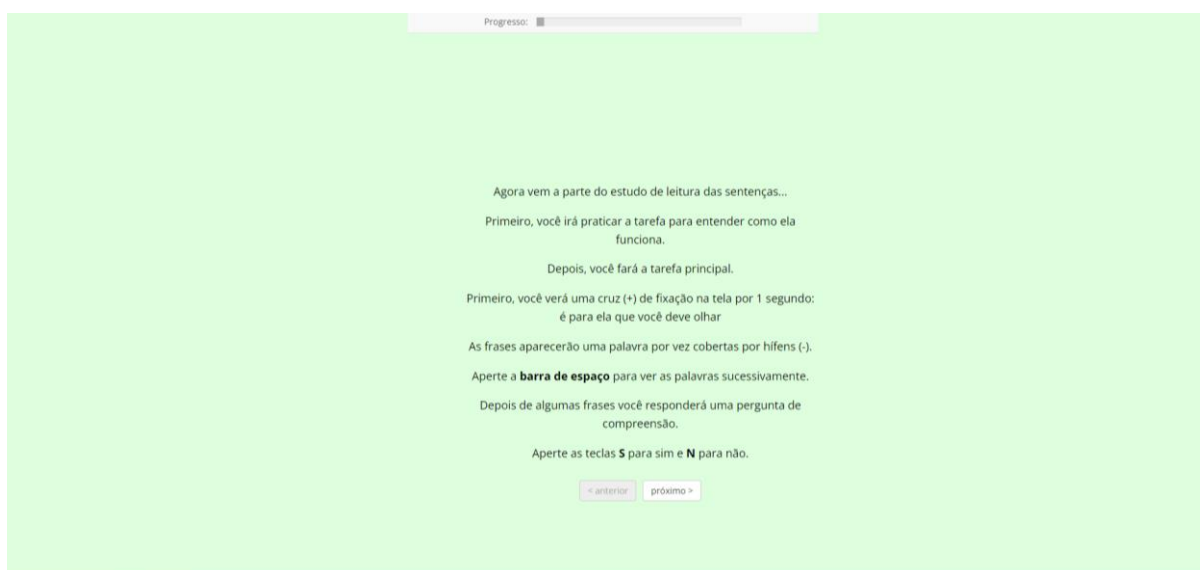|		
Prime	**O goleiro nervoso derrubou o jogador novo.**	**CC1**
Prime	O jogador novo derrubou o goleiro nervoso.	CC1
Target	The flower was dropped by the lady.	CC1
Prime	O cantor legal viu o repórter atento.	CC1
Prime	A moça loira viu a novela inteira.	CC1
Target	The actor was seen by his mother	CC1
Prime	A prova difícil assustou a aluna jovem.	CC1
Prime	O irmão fantaseado assustou a irmã distraída.	CC1
Target	The father was scared by a wave.	CC1
Prime	A irmão caçula lavou a concha suja.	CC1
Prime	A cozinheira chefe lavou a faca nova.	CC1
Target	The girl was washed by the water.	CC1
Prime	O mãe amorosa surpreendeu o menino triste.	CC1
Prime	O sobrinho brincalhão surpreendeu a tia morena.	CC1
Target	Our father was surprised by the noise.	CC1
Prime	O chute dela atingiu o brinquedo novo.	CC1

Prime	O papel amassado atingiu o professor bravo.	CC1
Target	The door was hit by the teenager.	CC1
Prime	A criança pequena carregou o ventilador grande.	CC1
Prime	O homem alto carregou a máquina pesada.	CC1
Target	The piano was carried by the pianist.	CC1
Prime	A cebola cortada incomodou a cozinheira nova.	CC1
Prime	O calor excessivo incomodou o bebê novo.	CC1
Target	The nurse was disturbed by the noise.	CC1
Prime	O vento forte derrubou o copo cheio.	CC1
Prime	O menino atento derrubou o pai cuidadoso.	CC1
Target	The teacher was knocked by the boy.	CC1
Prime	A lâmpada interna iluminou o astronauta jovem.	CC1
Prime	A luz solar iluminou o surfista brasileiro.	CC1
Target	The room was illuminated by the lady.	CC1
Prime	O engenheiro chefe construiu o prédio alto.	CC1
Prime	A família toda construiu o castelo juntos.	CC1
Target	The car was constructed by the machines.	CC1
Prime	O menino desastrado quebrou a xícara antiga.	CC1
Prime	O avô furioso quebrou o quadro bonito.	CC1
Target	The GPS was broken by your wife.	CC1
Prime	A porta fechada recebeu a encomenda atrasada.	CC1
Prime	A janela aberta recebeu a chuva forte.	CC1
Target	The grant was recieved by the account.	CC1
Prime	O plantão urgente surpreendeu o jornalista cansado.	CC1
Prime	A festa surpresa supreendeu o dentista dedicado.	CC1
Target	My mother was surprised by the news.	CC1
Prime	O livro jogado escondeu o dinheiro perdido.	CC1
Prime	A banana enorme escondeu a ameixada estragada.	CC1
Target	The key was hidden by the pillow.	CC1
Prime	A própria mãe acompanhou a noiva bonita.	CC1
Prime	O guia turístico acompanhou o idoso animado.	CC1
Target	The sandwich was accompanied by the potatos.	CC1
Prime	O novo editor publicou o cientista promissor.	CC1
Prime	A editora nova publicou o livro antigo.	CC1

Target	The author was published by her agent.	CC1
Prime	O computador novo escreveu a frase estranha.	CC1
Prime	O palhaço hilário escreveu a piada ruim.	CC1
Target	The character was written by the computer.	CC1
Prime	O cofre quebrado roubou a jóia preciosa.	CC1
Prime	A geladeira estragada roubou o sorvete caro.	CC1
Target	The owner was stolen by the girl.	CC1
Prime	A menina cuidadosa pintou o copo frágil	CC1
Prime	O jovem artista pintou o quadro pequeno.	CC1
Target	The boy was painted by the teacher.	CC1

Prime	**O goleiro nervoso empurrou o jogagor novo.**	**CC2**
Prime	O jogador novo gritou com o goleiro.	CC2
Target	The flower was dropped by the lady.	CC2
Prime	O cantor legal conversou com o repórter.	CC2
Prime	A moça loira odiou a novela inteira.	CC2
Target	The actor was seen by his mother	CC2
Prime	A prova difícil assustou a aluna jovem.	CC2
Prime	O irmão fantaseado assustou a irmã distraída.	CC2
Target	The father was scared by a wave.	CC2
Prime	O irmão caçula derrubou a concha suja.	CC2
Prime	A cozinheira chefe usou a faca nova.	CC2
Target	The girl was washed by the water.	CC2
Prime	O mãe amorosa beijou o menino triste.	CC2
Prime	A sobrinho brincalhão riu com a tia.	CC2
Target	Our father was surprised by the noise.	CC2
Prime	O chute dela quebrou o brinquedo novo.	CC2
Prime	O professor bravo pegou o papel amassado.	CC2
Target	The door was hit by the teenager.	CC2
Prime	A criança pequena quebrou o ventilador pesado.	CC2
Prime	O homem alto usou a máquina nova.	CC2
Target	The piano was carried by the pianist.	CC2
Prime	A cozinheira chefe jogou o cebola cortada.	CC2
Prime	O bebê novo chorou com o calor.	CC2
Target	The nurse was disturbed by the noise.	CC2
Prime	O copo leve voou com o vento.	CC2

Prime	O menino atento olhou para o pai.	CC2
Target	The teacher was knocked by the boy.	CC2
Prime	O astronauta novo passou pela lâmpada interna.	CC2
Prime	A surfista brasileiro gostou da luz solar.	CC2
Target	The room was illuminated by the lady.	CC2
Prime	O engenheiro chefe desenhou o prédio alto.	CC2
Prime	A família toda montou o castelo juntos.	CC2
Target	The car was constructed by the machines.	CC2
Prime	O menino desastrado mexeu na xícara antiga.	CC2
Prime	O avô furioso gostou do quadro bonito.	CC2
Target	The GPS was broken by your wife.	CC2
Prime	A porta fechada amassou a encomenda atrasada.	CC2
Prime	A chuva forte molhou a janela aberta.	CC2
Target	The grant was recieved by the account.	CC2
Prime	O plantão urgente assustou o jornalista cansado.	CC2
Prime	A festa surpresa conquistou o dentista dedicado.	CC2
Target	My mother was surprised by the news.	CC2
Prime	O livro jogado amassou o dinheiro perdido.	CC2
Prime	A banana enorme cobriu a ameixa estragada.	CC2
Target	The key was hidden by the pillow.	CC2
Prime	A própria mãe maquiou a noiva bonita.	CC2
Prime	O guia turístico inscreveu o idoso animado.	CC2
Target	The sandwich was accompanied by the potatos.	CC2
Prime	O novo editor criticou o cientista promissor.	CC2
Prime	A editora nova rejeitou o livro antiga.	CC2
Target	The author was published by her agent.	CC2
Prime	O computador novo apagou a frase estranha.	CC2
Prime	O palhaço hilário rejeitou a piada ruim.	CC2
Target	The character was written by the computer.	CC2
Prime	O cofre quebrado guardou a jóia roubada.	CC2
Prime	A geladeira desligada estragou o sorvete caro.	CC2
Target	The owner was stolen by the girl.	CC2
Prime	A menina cuidadosa quebrou o copo frágil.	CC2
Prime	O jovem artista cortou o quadro pequeno.	CC2
Target	The boy was painted by the teacher.	CC2

APPENDIX F – Instructions of the self-paced reading task

Progresso: ▮

Agora vem a parte do estudo de leitura das sentenças...

Primeiro, você irá praticar a tarefa para entender como ela funciona.

Depois, você fará a tarefa principal.

Primeiro, você verá uma cruz (+) de fixação na tela por 1 segundo: é para ela que você deve olhar

As frases aparecerão uma palavra por vez cobertas por hifens (-).

Aperte a **barra de espaço** para ver as palavras sucessivamente.

Depois de algumas frases você responderá uma pergunta de compreensão.

Aperte as teclas **S** para sim e **N** para não.

< anterior   próximo >