Implicit linguistic processing of inflection morphemes: a self-paced reading task with Brazilian Portuguese-English learners

Processamento linguístico implícito de morfemas flexionais: uma tarefa de leitura autocadenciada com brasileiros aprendizes de inglês

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Abstract: This study investigated implicit knowledge of inflectional morphemes by Brazilian English learners as a second language (L2). Specifically, we examined whether they could detect the omission of third-person singular (-s) and simple past (-ed) morphemes; using a self-paced reading task that required automated knowledge of the L2. Additionally, we administered an English proficiency test to classify participants into higher and lower proficiency groups. The results indicate that both higher and lower proficiency participants were not sensitive to the lack of -s and -ed morphemes, as their reaction times were similar in grammatical and ungrammatical sentences involving both morphemes.

Keywords: Second Language Processing. Implicit Knowledge. Inflectional Morphology. Self-Paced Reading.

Resumo: Este estudo investigou o conhecimento implícito de morfemas flexionais de brasileiros aprendizes de inglês como segunda língua (L2). Especificamente, examinamos se eles conseguiam detectar a omissão dos morfemas de terceira pessoa do singular (-s) e passado simples (-ed) da língua inglesa; usando uma tarefa de leitura autocadenciada que exigia conhecimento automatizado da L2. Além disso, aplicamos um teste de proficiência em inglês para classificar os participantes em grupos de maior e menor proficiência. Os resultados indicam que os participantes de maior e menor proficiência não foram sensíveis à falta de morfemas -s e -ed, pois seus tempos de reação foram semelhantes em frases gramaticais e agramaticais com ambos os morfemas.

Palavras-chave: Processamento de segunda língua. Conhecimento implícito. Morfologia flexional. Leitura autocadenciada.

Introduction

Mastering morphological knowledge can be problematic during second language acquisition, regardless of the native language (L1) (cf. Jiang (2004, 2007) with Chinese-English learners, Carneiro (2011) and Oliveira, Fontoura e Souza (2020) with Brazilian Portuguese-English (BPE), Jensen *et al.* (2019) with Norwegian-English learners, among others). In fact, it is one of the hardest challenges that second language (L2) learners may face. The high cognitive load demanded from functional morphology led Slabakova (2013, 2014) to formulate the bottleneck hypothesis, according to which functional morphology is the most arduous property

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for L2 learners.

L2 learners struggle to access functional morphology knowledge, but this issue may have diverse outcomes in different types of tasks. When it comes to morphological processing implicitly, Jiang (2004, 2007) claims that English L1 speakers display sensitivity to ungrammatical sentences, whereas English L2 learners do not exhibit the same sensitivity level. L2 learners need automatized knowledge to succeed in this task type, which many of them lack in their representation. Thus, their competence does not have morphological specifications under control to use subconsciously (JIANG, 2004).

The absence of morphological knowledge integration may be the result of the different lexical development stages (JIANG, 2000) that L2 learners must go through before automatizing it. In the first stages, they rely on the links between the native language and L2 to suppress grammatical information they do not have. At the latest stage of lexical development, these learners can retrieve and access morphological knowledge without relying on their L1. During L2 acquisition, L2 learners have difficulty detecting in which context a given morpheme is instantiated, such as the third-person singular (-s) in (1) and where it is not, as in (2).

(1) The lazy boy usually cause**s** trouble in the classroom.

(2) The smart kid often solve the puzzle without any help.

Considering L2 learners' morphological knowledge, we decided to further investigate whether Brazilian Portuguese-English (BPE) can detect when the third-person singular (-s), as in (3), and regular past tense (-ed), as in (4), morphemes are missing in the course of implicit processing. Recent evidence shows that L2 learners display morphological sensitivity in acceptability judgment tasks (OLIVEIRA; FONTOURA; SOUZA, 2020), which rely mostly on explicit knowledge. By using an online methodology, we aim to investigate if this behavior is related to the processing of these morphemes.

(3) The smiling waiter always serve**s** the clients.

(4) The funny patient recover**ed** from the anesthesia.

We organized this study by examining the dichotomy between competence deficit and performance deficiency, exploring the role of L2 lexical development, and then discussing the difference between offline and online tasks. Afterward, we describe the task used to implement the study – including the materials, procedures, and results. Finally, we discuss our findings and the most likely indications of the problems L2 learners have in implicit inflectional morphology processing.

1 Competence deficit vs. Performance deficiency

Mastering functional morphology is a burdensome task, but this task seems more demanding for late L2 learners. Many authors tried to find the underlying cause for this difficulty, and Jiang (2004) advocates that there may be two approaches that help explain why the morphological acquisition is very problematic for adult L2 learners: the competence deficit approach (CDA) or the performance deficiency approach (PDA). For the former, the difficulty lies in the representation, and for the latter, in the processing and retrieving. Jiang's (2000) study corroborates the CDA because it proposes that morphological specifications are usually language-specific; therefore, it is unlikely that a piece of knowledge can be transferred from one language to the other. In Jiang's (2000) L2 lexical development model, inflectional morphology is not integrated into L2 vocabulary until the last stage. To use morphological information, L2 learners use explicit knowledge to mediate their output before they have access to morphological knowledge implicitly (KRASHEN, 2002, 2009).

On the other hand, Sharwood Smith's (1986) work aligns with the PDA because he claims that L2 learners have already internalized inflectional morphology but have problems accessing it. It takes time until one has control over compe-

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tence. Sorace (1985) defends that procedural knowledge is responsible for retrieving and using internalized knowledge. This view assumes that metalinguistic knowledge (learning) can be the starting point for performance, which is different from Krashen's Monitor Theory; the latter supports that just the acquired system can be used in active communication. However, Sorace (1985) admits that procedural knowledge takes longer to be mastered than internalized knowledge in formal learning environments. Having mental representation does not equal production abilities.

Consequently, these approaches conceive L2 competence differently. The CDA argues that an individual will have competence in the language if this person can use the language automatically and accurately. However, the internalized linguistic representation is crucial for the PDA, regardless of the accuracy level in communication. Jiang (2004) sustains that L2 competence is a sort of knowledge that can be subconsciously accessed and used. His view slips a little away from the CDA because he believes this knowledge can be integrated into competence arising from contexts where both formal and informal learning takes place.

In order to test if adult L2 learners can automatically activate morphological knowledge, Jiang (2004) conducted a word-by-word self-paced reading task (SPRT) with Chinese-English learners and English native speakers. He tested their sensitivity in sentences where the plural morpheme was missing, as exemplified in (5), compared to sentences where the morpheme was instantiated, as in (6). Moreover, pronoun/*be* agreement, as observable in (7) and (8), and subcategorization were also investigated, such as in (9) and (10).

(5) *The bridge to the island were about ten miles away.

(6) The bridge**s** to the island were about ten miles away (JIANG, 2004, p. 615).

(7) I told you **I** am a professor of psychology.

(8) I told you **she** am a professor of psychology.

(9) The teacher **encouraged** the children to mail the letter to the president.

(10) *The teacher **insisted** the children to mail the letter to the president (JIANG, 2004, p. 617).

The author chose this method to minimize participants' explicit knowledge use. The focus is on meaning rather than on grammar, and the quick appearance of each word leaves no room for participants to check for errors. This receptive method confers advantages over the production method because of the visual cue. Should participants display no sensitivity to the morpheme omission, there are good chances that their problem has nothing to do with control and retrieval abilities; instead, it is a competence impairment.

His results reveal that although native speakers were sensitive to pronoun/*be,* agreement, subcategorization, and number agreement, L2 learners did not exhibit sensitivity to number agreement. This L2 sensitivity could indicate that L2 learners do not have automatized morphological information since they had significant reaction times (RT) differences in the other phenomena under investigation. L2 participants also completed a written test regarding the subject-verb agreement and demonstrated good performance. The results suggest that they could use their explicit knowledge but failed to use implicit knowledge.

Carneiro (2011) conducted an SPRT in the moving window condition to compel participants to see each sentence fragment once. The author analyzed participants' RT concerning the third-person singular agreement (-s) and regular simple past tense (-ed) morphemes. Both BPE with higher and lower proficiency and English natives performed the task. Carneiro found results suggesting that English L2 learners do not present a significant delay in their RT in sentences where there is an omission of the morphemes -ed and -s compared to sentences where the morpheme is present. Nevertheless, she did not find substantial sensitivity in her English L1 speakers when she contrasted their RT in grammatical and ungrammatical sentences regarding the morpheme -s. She attributes this finding to conducting

her study in Brazil and having natives that experienced Brazilians failing to place morphological agreement all the time. This finding could be the reason they were insensitive to the morphological omission of the morpheme -s.

It seems that tasks that require implicit morphological knowledge can be demanding to L2 learners, but natives can also exhibit optionality when facing morpheme omission. Different task paradigms can yield different results, especially the ones that tap into explicit and implicit knowledge. In the next section, we will discuss evidence showing that linguistic performance regarding L2 morphology is also dependent on the linguistic task.

2 L2 lexical development

Accounts of the persistence of accuracy variability in inflectional morphology in L2 performance that rely on assumptions of overall representational failures in L2 grammars have been influential in bilingualism research. A remarkable exception is the hypothesis put forward by Jiang (2000). Instead of relying on descriptions of a general grammatical mechanism that would grant systematic suppliance of accurate inflectional morphemes, or lack, thereof, under circumstances of L2 acquisition, Jiang's (2000) account renders a lexically-oriented interpretation of the issue of L2 inflectional morphology.

Jiang's hypothesis is based upon tenets of the Revised Hierarchical Model (KROLL; STEWART, 1994) for the architecture of the bilingual lexicon. This model suggests that bilinguals have separate memory repositories for L1 and L2 word forms or lexical pointers. The model also proposes, however, that bilinguals possess a shared conceptual system, which bestows semantic load to either L1 or L2 lexical pointers. The Revised Hierarchical Model predicts that in early L2 acquisition or among bilinguals with lesser L2 proficiency, access to the conceptual repository will be mediated by the L1 forms linked correspondents of the available L2 forms. Such prediction is underpinned by the assumption that links between L2 forms and L1 forms are stronger than links

between L1 forms and L2 forms; as a consequence of the L1's usual status as the stronger language of the early L2 acquirers and strongly L1-dominant bilinguals. Furthermore, the model predicts that L1 form mediation to conceptual information stems from the L1 having stronger links to conceptual references than L2 forms, at least when L2 proficiency is low. Therefore, the model proposes that L1 forms bridge the recognition of meanings when L2 forms are encountered. It is only as proficiency grows, according to Kroll and Stewart (1994), that conceptual information is directly accessed by L2 forms, indicating that L1 dependence for meaning recognition may be overruled by the gradual strengthening of links between L2 forms and the conceptual system as higher L2 proficiency is achieved.

Although its assumptions of separate repositories for L1 and L2 forms and the assumption of a fully integrated conceptual system serving both L1 and L2 lexical items have been challenged (BRYSBAERT; DUYCK, 2010), the Revised Hierarchical Model has some descriptive adequacy. It correctly describes observable behavior that L2 to L1 translations are less cognitively demanding than L1 to L2 translations, which can be explained within the model by following its assumption that L2 forms have stronger links to L1 forms than the other way around as it is the L1 that first mediates access to conceptual representations. This asymmetry in translations' cognitive cost was part of Kroll and Stewart's (1994) actual empirical base for their model. The Revised Hierarchical Model also accurately describes pervasive L1-to-L2 lexical transfer in L2 acquisition.

It is precisely the L1 mediational role for lexical access suggested by the Revised Hierarchical Model that is at the core, with some adaptations, of Jiang's (2000) proposal to account for difficulties in L2 inflectional morphology. Such adaptations are based on the author's reliance on the conceptualization of the representation of lexical entries in Levelt (1989). In this conceptualization, the lexical entry is divided into lexeme and lemma information. Lexemic information specifies phonological/orthographic details as well as

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morphological details of a given lexical entry, whereas lemma information specifies semantic/pragmatic details and combinatorial (syntactic and/or collocational) details of the lexical entry.

Jiang (2000) proposes that in learning L2 lexical items, the learner first learns the phonological form (in other words, a part of the lexemic information) of such items. Lemma information such as semantics and combinatorial restrictions may then obtain a massive L1 transfer, as lemma information relies on the conceptual system of which access, following Kroll and Stewart (1994), is initially mediated by the corresponding L1 forms. Such transfer may even support the early use of the L2 lexical items, even in non-nativelike usage. However, according to Jiang (2000), the other part of the lexeme information – L2 inflectional morphology forms – cannot rely on such support of corresponding L1 forms, as inflectional morphology forms tend to be too language specific. Such heavy language tagging, the author suggests, blocks L1 transfer of inflectional morphology.

Jiang's model allows for the prediction that progressive direct access of L2 forms to L2-specific lemma information may stem from L2 proficiency growth. But as L2 inflectional morphology is unaided by L1 mediation, suppliance of required forms may be far more cognitively demanding, thus competing for processing resources under the circumstance of the magnitude of demands imposed by certain language tasks, as well as the bilingual's depth of familiarity with specific L2 lexical entries. We find this lexically-oriented hypothesis for L2 morphology processing of interest because it may account for the task-dependent variation of accuracy in suppliance of L2 inflectional morphology, as well as itemized intra-individual variation, in other words, the observation that accurate inflectional morphology may occur with certain L2 lexical items but fail to occur with other L2 items of any given bilingual.

3 Offline vs. Online Tasks

A key question in the field of SLA is whether late bilinguals can develop target-like representations for L2 constructions, especially those that are not productive in their L1 (CHO, 2022; HOPP, 2010; OLIVEIRA, 2020). To investigate this issue, researchers have used both online and offline psycholinguistic techniques, which often produce different results. Some studies show target-like performance in online tasks but not in offline tasks, whereas other studies show the opposite picture. One of the possible reasons for these mixed results is the type of knowledge, implicit or explicit, that participants rely on the most when performing each task. We understand that implicit knowledge consists of procedural representations of which participants are unaware and are accessed through automatic processing, whereas explicit knowledge involves declarative representations of which participants are aware, and that can be accessed through controlled processing (GODFROID *et al.*, 2015).

Oliveira (2016), for instance, studied high proficiency Brazilian Portuguese (BP)-English bilinguals' sensitivity to adjective violations in the English resultative construction, which is not productive in BP, as compared to English native speakers (NS). The bilingual group was divided into immersed in the L1 and immersed in the L2, but since they behaved similarly, we will refer to them as the bilingual group. The author analyzed the behavior of participants towards sentences such as (11) and (12) in an acceptability judgment task (AJT) and in a maze task (MT), which is an alternative method for the SPRT. The results indicated that bilinguals differed from the native speakers in the AJT but not in the MT. More specifically, both bilinguals and NS displayed the same processing pattern, in which ungrammatical sentences had longer RT. However, NS assigned significantly lower acceptability ratings to the ungrammatical resultative sentences. Thus, bilinguals and native speakers exhibited the same sensitivity level to the violation in (12) in the online task, but native speakers showed higher sensitivity in the offline task. The author also used these two experimental methods to compare the behavior of BP monolinguals and high proficiency BP English bilinguals towards sentences that forced the resultative construction in BP (13)

to investigate possible bilingualism effects on bilinguals' L1 processing. In this case, bilinguals differed from native speakers in the MT, exhibiting shorter RT to sentences such as (13) but not in the AJT, in which both displayed lower acceptability ratings for this structure.

(11) Laura painted her nail and **blew it dry**.

(12) *Tara cut the nail and **painted it beautiful**.

(13) *O menino pintou a unha e **a soprou seca**.DET boy paint(PST) DET nail and it(ACC) blow(PST) dry. "The boy painted the nail and blew it dry" (OLIVEIRA, 2016).

This difference between online and offline tasks has also been observed in tasks that compare bilinguals and native speakers regarding functional morphology. Investigation concerning the behavior towards articles in an L2 by NS of an article-less language, such as Korean and Chinese, is one example. Cho (2022) analyzed the performance of Korean-English speakers towards felicitous (14) and infelicitous (15) uses of definite and indefinite English articles using an SPRT and an AJT. Similarly to Oliveira (2016), bilinguals did not differ from English NS in the online task but did in the offline task. Ionin, Choi e Liu (2019) also found this pattern of results investigating whether Mandarin-English bilinguals are sensitive to article omission errors and misuse. Both studies argue against the idea that bilinguals cannot represent a new morphological category put forth by Morphological Congruency Hypothesis (JIANG *et al.*, 2011). Moreover, they lend support to the claim that judgment tests demand increased processing resources (ORFITELLI; POLINKY, 2017), which may affect the bilinguals' performance even if they have native-like representation. Evidence about non-target performance in judgment tasks involving functional morphology abounds in the literature (DEKEYSER, 2000; JENSEN *et al.*, 2019; JOHNSON; NEWPORT, 1989).

(14) a. Sam bought a monitor and a keyboard. He broke **the keyboard** and became really upset. b. Sam sat in front of the computer. He broke **the keyboard** and became really upset. c. Sam works at a computer store. He broke **a keyboard** and became really upset.

(15) a. Sam bought a monitor and a keyboard. He broke **a keyboard** and became really upset. b. Sam sat in front of the computer. He broke **a keyboard** and became really upset. c. Sam works at a computer store. He broke **the keyboard** and became really upset (CHO, 2022 , p. 11).

There are other studies, however, that show that bilinguals with high proficiency behave differently from native speakers regarding functional morphology also in online experiments (CARNEIRO, 2017; JIANG, 2004, 2007; SILVA; CLAHSEN, 2008;). Moreover, some of these studies also include evidence of target-like behavior in offline tasks (HOPP, 2010; ROBERTS; GULLBERG; INDEFREY, 2008). Hopp (2010), for instance, conducted a study that included an AJT[2] and an SPRT to investigate the behavior of speakers from different L1s towards case and subject-verb agreement in their L2 German. The results show that a group of Russian-German bilinguals were sensitive to these markings in the AJT but not in the SPRT. Thus, the literature has furnished mixed evidence as to the type of tasks, online or offline, that bilinguals with high proficiency are more likely to exhibit a behavior that is more similar to that of native speakers.

As we have mentioned earlier, our investigation about how BP-English bilinguals behave towards inflectional morphemes in the L2 started with a study that included two acceptability judgment tasks (OLIVEIRA; FONTOURA; SOUZA, 2020). The results indicated that bilinguals differentiated grammatical from ungrammatical sentences in the tasks regardless of their proficiency (lower and higher) or immersion status (immersed in the

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[2] He refers to the task as an offline grammaticality judgment task. In this paper, we will refer to all judgment tasks as Acceptability Judgment Tasks (AJT). To have more information about the differences between these types of judgment tasks read Schütze (2016) and Souza *et al.* (2015).

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L1 and immersed in the L2), but they were not as sensitive as native speakers to sentences with missing morphemes. In the present study, we will report the behavior of a similar bilingual group in an SPRT with similar structures and, hence, we aim to add to the discussion about bilinguals' performance in online and offline tasks in the L2.

It is important to stress that both AJTs we used in our first study were timed. In other words, we conducted a speeded AJT (SOUZA *et al.*, 2015), in which participants had only 6 seconds to rate each sentence. The imposition of time limits in judgment tasks has been widely used in L2 research (BIALYSTOK, 1979, 1982; GUIMARÃES, 2021; HOPP, 2010; OLIVEIRA; PENZIN, 2019; SOUZA *et al.*, 2014), but it is not clear whether this time ceiling manipulation results in measures of different constructs. On the one hand, we have studies that indicate that the presence of a time constraint results in a stronger association between an AJT and implicit knowledge (BOWLES, 2011; ELLIS, 2005; GODFROID *et al.*, 2015; HAN; ELLIS, 1998). On the other hand, recent studies challenge the validity of these previous findings (VAFAEE; KACHINSKE, 2019) and provide evidence that judgment tasks seem to rely mainly on explicit knowledge regardless of time limits (SUZUKI, 2017; VAFAEE; SUZUKI; KACHISNKE, 2016). Thus, the differences between the present study and Oliveira, Fontoura e Souza (2020) may also shed some light on the effects of time constraints in AJTs.

4 Tasks

To test our hypothesis that L2 learners have problems in implicit inflectional morphology processing, we conducted a Self-Paced Reading Task[3] (JUST; CARPENTER; WOOLLEY, 1982; OLIVEIRA; MARCILESE; LEITÃO, 2022) with BPE bilinguals at different proficiency levels.

4.1 Participants

Thirty-nine BPE bilinguals took part in the tasks. All of them lived in the metropolitan area of Belo Horizonte/MG. Most were university students, with a few having graduate degrees. We used the Vocabulary Levels Test (VLT)[4] to rank them into higher and lower proficiency. The individuals, who completed level 5, were considered higher proficiency, and levels 2, 3, and 4 were lower proficiency. After undergoing VLT, the higher proficiency group had twenty-four participants, and the lower proficiency had fifteen.

L2 proficiency can be estimated using different metrics, such as vocabulary size. One can correlate vocabulary size with language performance (ALDERSON, 2005). The Vocabulary Levels Test (VLT) organizes vocabulary knowledge into five levels following the Brown Corpus: level 1 encompasses the most usual 2,000 words, level 2 the most usual 3,000 words, level 3 the most usual 5,000 words, level 4 contains academic and scientific vocabulary, and level 10 the 10,000 most usual words. Furthermore, these levels depict lemmas rather than single words, which cover a larger amount of word formation. In order to be considered suitable for one level and go on to the next, participants needed to get 12 correct items out of 18 (NATION, 1990). In addition, Souza and Silva (2015) worked on the VLT validation compared to the Oxford Placement Test for the BPE university student population. Thus, we chose the VLT to classify our participants into higher and lower proficiency.

4.2 The Self-Paced Reading Task (SPRT)

We aimed to investigate whether the participants' proficiency level influenced their RT when they read ungrammatical sentences compared to grammatical sentences. We selected grammatical sentences with the third-person singular agreement (-s) and regular simple past tense (-ed) morphemes and ungrammatical sentences where these morphemes were omitted. Afterward, we contrasted the higher and lower proficiency participants' RT in the sentence fragments that contained the verb and the one immediately after it. We hypothesized that RT differences

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[3] We used the software PsychoPy to implement the SPRT.
[4] This test was performed on an online platform, in which each participant received a login and a password.

could appear in either the verb or the following fragment.

4.2.1 Procedures

We decided to pursue an examination of the same morphemes, the third-person singular agreement (-s) and regular simple past tense (-ed), that Carneiro (2011) analyzed because, in her study, no L2 learner group presented sensitivity to their omission and even L1 natives were insensitive to morpheme -s omission. BPE learners with higher and lower proficiency were selected. We adopted a similar format to the self-paced reading used by Carneiro (2011) with a moving window, but in ours, a question followed every sentence, including non-targets, as exemplified in (16) below, to ensure that participants were not simply pressing the button to move forward before reading the sentence fragment:

(16) Visual display of the self-paced reading task
The funny patient --------- ---- --- --- -------

--- ------ ------- recovered ---- --- --- -------
--- ------ ------- --------- from the anesthesia.
Did the patient recover?

4.2.2 Materials

Before the trial, participants got acquainted with the task and conducted training with four sentences followed by a question each. This task encompassed sixty-four sentences, from which fifteen were the targets[5] and the others were fillers. The fifteen targets were divided into sentences with grammatical morpheme -s, as observable in Table 1, ungrammatical morpheme -s, as in Table 2, grammatical morpheme -ed, exemplified in Table 3, and ungrammatical morpheme -ed, in Table 4. We divided the morpheme -s sentences into five fragments: fragment 1 contained the subject, fragment 2 had the frequency adverb, fragment 3 presented the verb, fragment 4 kept the complement, and fragment 5 held the accessory, as instantiated in Table 1 and Table 2:

TABLE 1 – Grammatical -s

fragment-1	fragment-2	fragment-3	fragment-4	fragment-5
subject	frequency adverb	verb	complement	accessory
a. The lazy boy	usually	**causes**	trouble	in the classroom
b. The smiling waiter	always	**serves**	the clients	
c. The Science teacher	usually	**starts**	the class	with a joke
d. The bread baker	frequently	**blends**	the mixture	

Source: Authors' own elaboration.

TABLE 2 – Ungrammatical -s

fragment-1	fragment-2	fragment-3	fragment-4	fragment-5
subject	frequency adverb	verb	complement	accessory
a. The political prisoner	constantly	**claim**	for support	
b. The smart kid	often	**solve**	the puzzle	without any help
c. The aspiring singer	generally	**blame**	the TV	
d. The language center	never	**offer**	an online course	

Source: Authors' own elaboration.

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[5] Based on the stimuli in Carneiro (2011).

The morpheme -ed sentences had four fragments – the subject filled fragment 1, the verb fragment 2, the complement fragment 3, and the accessory fragment 4, as in Table 3 and Table 4:

TABLE 3 – Grammatical -ed

fragment-1	fragment-2	fragment-3	fragment-4
subject	**verb**	**complement**	**accessory**
a. The funny patient	**recovered**	from the anesthesia	
b. The nice gardener	**filled**	the bucket	with enough water
c. The bad student	**kicked**	the radio	with great anger
d. The youngest sister	**poured**	juice	into the cup

Source: Authors' own elaboration.

TABLE 4 – Ungrammatical -ed[6]

fragment-1	fragment-2	fragment-3	fragment-4
subject	**verb**	**complement**	**accessory**
a. The brave firefighter	**help**	the victims	with severe burns
b. The talented maestro	**nod**	with his head	to the musicians
c. The modern TV	**show**	the picture	of a suspect

Source: Authors' own elaboration.

In the next section, we describe the results from implementing the procedures and materials to assemble this task for the morphemes -s and -ed in the fragment with the verb and the one immediately after it.

4.2.3 Results

In this study, we contrast the RT of higher and lower proficiency groups when they read grammatical and ungrammatical sentences with the third-person singular (-s) and the regular past tense (-ed) morphemes. Before starting the analysis, we filtered the RTs longer than 3,000 milliseconds (msec) because we attributed this unexpected long time to participants' lack of commitment to the task. Afterward, we divided the analysis for each morpheme separately and examined the groups' RT in the fragment containing the verb and the one immediately after it; thus, we analyzed fragments 3 and 4 of the sentences concerning the morpheme -s and fragments 2 and 3 of the sentences regarding the morpheme -ed. When we investigated their RT in fragment 3 of morpheme -s sentences, we can see, from Table 5 and Graph 1, that the median of the higher proficiency group RT is 0.572 msec and the lower proficiency is 0.563 msec in the grammatical sentences, and the median for the first is 0.512 msec and 0.566 msec for the second in the ungrammatical sentences.

**TABLE 5 – Median of the Reaction Times in Fragment 3 of Morpheme -s**

morpheme -s		
proficiency	**condition**	**RT – fragment 3**
higher	grammatical	0.572
higher	ungrammatical	0.512

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[6]   We had to remove one of the sentences because there was a mistake that was not positioned on the verb.

morpheme -s		
lower	grammatical	0.563
lower	ungrammatical	0.566

Source: Authors' own elaboration.

Graph 1 – Reaction Times in Fragment 3 of Morpheme -s
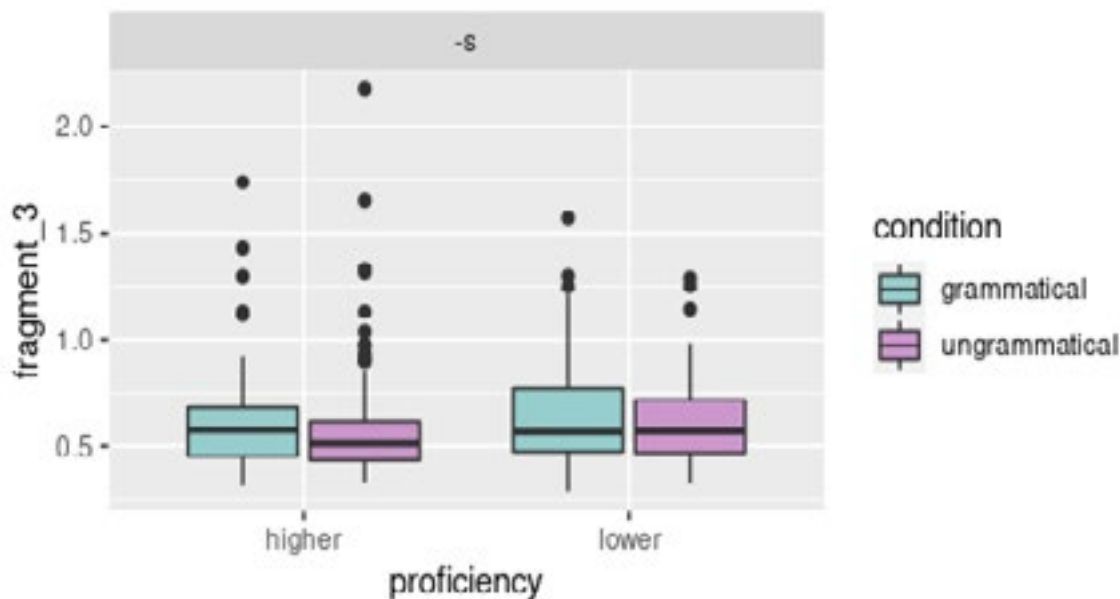
Source: Authors' own elaboration.

To test the difference between the groups' RT in grammatical and ungrammatical, we ran an adjusted linear mixed model with the fragment 3 RT as a response variable, the interaction between the type of condition (grammatical/ungrammatical) and proficiency (higher/lower) as fixed effects, and random slopes for items and participants. The nested model comparison revealed that the interaction between condition and proficiency was not significant ($\chi2 = 0.3006$, p= 0.5835), and neither were proficiency ($\chi2 = 1.639$, p= 0.4406) and condition ($\chi2 = 0.8148$, p= 0.6654)
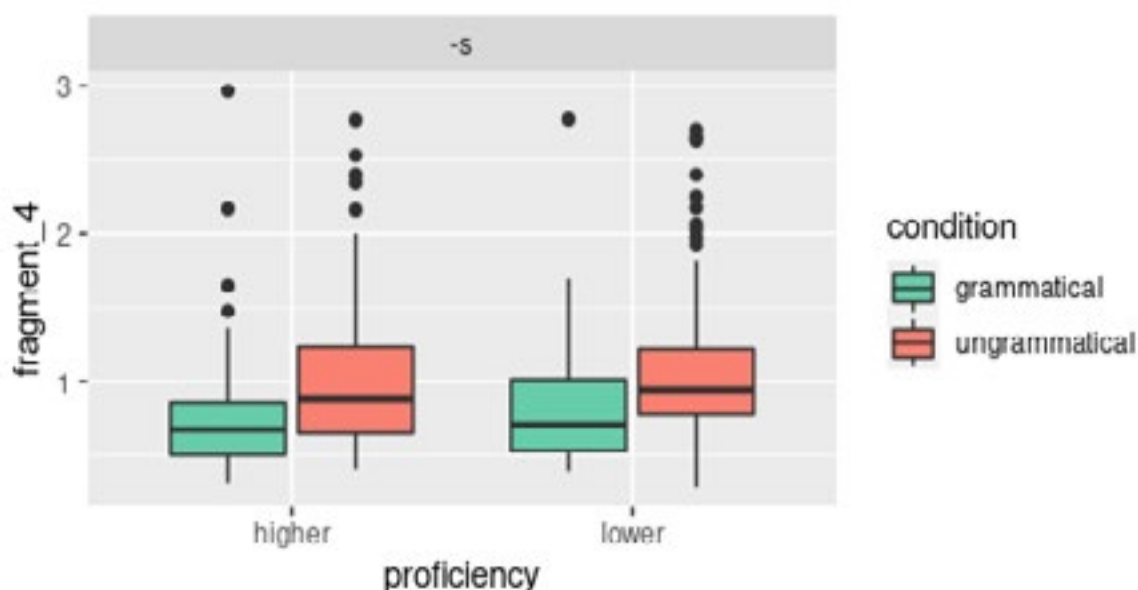
separately to the model.

We followed our analysis to fragment 4 of the morpheme -s sentences. We can observe in Table 6 and Graph 2 that the RT median of the higher proficiency group is 0.675, and the lower proficiency group is 0.708 in the grammatical sentences. There is not much difference in their RT in the ungrammatical sentences because the median of the higher proficiency group is 0.886, and the median of the lower proficiency group is 0.940.

TABLE 6 – Median of the Reaction Times in Fragment 4 of Morpheme -s

morpheme -s		
proficiency	**condition**	**RT – fragment 4**
higher	grammatical	0.675
higher	ungrammatical	0.886
lower	grammatical	0.708
lower	ungrammatical	0.940

Source: Authors' own elaboration.

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Graph 2 – Reaction Times in Fragment 4 of Morpheme -s

Source: Authors' own elaboration.

In order to confirm the similarity in the median of groups' RT, we adjusted a linear mixed model having the fragment 4 RT as a response variable and the interaction between type of condition (grammatical/ungrammatical) and proficiency (higher/lower) as fixed effects, and random slopes for items and participants. The results suggest that the interaction between condition and proficiency was not statistically significant (χ^2 = 0.0906, p= 0.7634), and proficiency (χ^2 = 1.8035, p= 0.4059) and condition (χ^2 = 3.8873, p= 0.1432) were not important to the model individually.

The results of fragments 3 and 4 indicate that both higher and lower proficiency groups are insensitive to the lack of morpheme -s. Failing to automatize L2 knowledge could lead to a pro-

cessing disruption whenever there is no time to access explicit knowledge (JIANG, 2004). Since the morpheme -s results seem to align with the findings of Carneiro (2011), we moved our investigation to the morpheme -ed to pursue whether it could also be a problem for our BPE group.

The analysis of fragment 2 RT of morpheme -ed shows, in Table 7 and Graph 3, that the median of the higher proficiency group's RT is 0.615, and the lower proficiency group's RT is 0.750 in the grammatical sentences. We can notice that they took, in general, longer to read grammatical than ungrammatical sentences because the higher proficiency group's RT in the ungrammatical sentences is 0.549, and the lower proficiency group's RT is 0.576.

TABLE 7 – Median of the Reaction Times in Fragment 2 of Morpheme -ed

morpheme -ed		
proficiency	**condition**	**RT – fragment 2**
higher	grammatical	0.615
higher	ungrammatical	0.549
lower	grammatical	0.750
lower	ungrammatical	0.576

Source: Authors' own elaboration.

Graph 3 – Reaction Times in Fragment 2 of Morpheme -ed
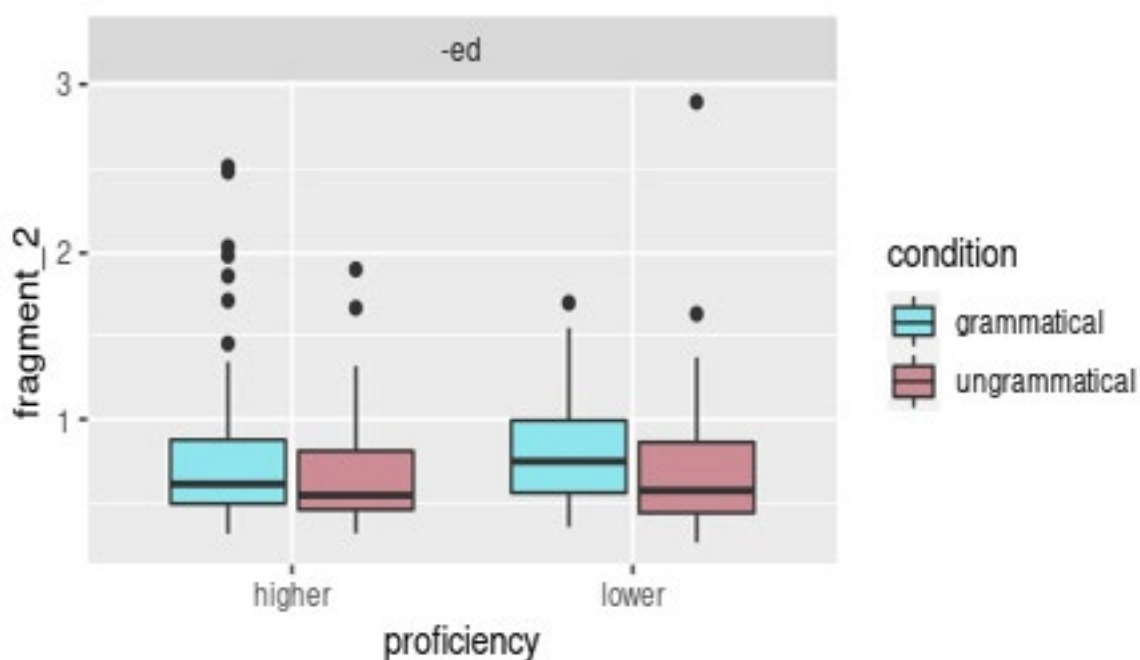
Source: Authors' own elaboration.

We adjusted a linear mixed model with the fragment 2 RT as a response variable, the interaction between type of condition (grammatical/ungrammatical) and proficiency (higher/lower) as fixed effects, and random slopes for items and participants. The results reveal that the interaction between condition and proficiency was not meaningful ($\chi2$ = 0.0995, p= 0.7524), and proficiency ($\chi2$ = 0.8324, p= 0.6595) and condition ($\chi2$ = 5.4641, p= 0.06509) were not expressive either to the model.

We can detect in Table 8 and Graph 4 that the RT medians of higher and lower proficiency groups were similar in fragment 3 of morpheme -ed. The higher proficiency group displays the RT median of 0.659 and the lower proficiency group of 0.785 in grammatical sentences. The median of the former is 0.698 and the latter 0.865 in the ungrammatical sentences.

TABLE 8 – Median of the Reaction Times in Fragment 3 of Morpheme -ed

morpheme -ed		
proficiency	condition	RT – fragment 3
higher	grammatical	0.659
higher	ungrammatical	0.698
lower	grammatical	0.785
lower	ungrammatical	0.865

Source: Authors' own elaboration.

Graph 4 – Reaction Times in Fragment 3 of Morpheme -ed
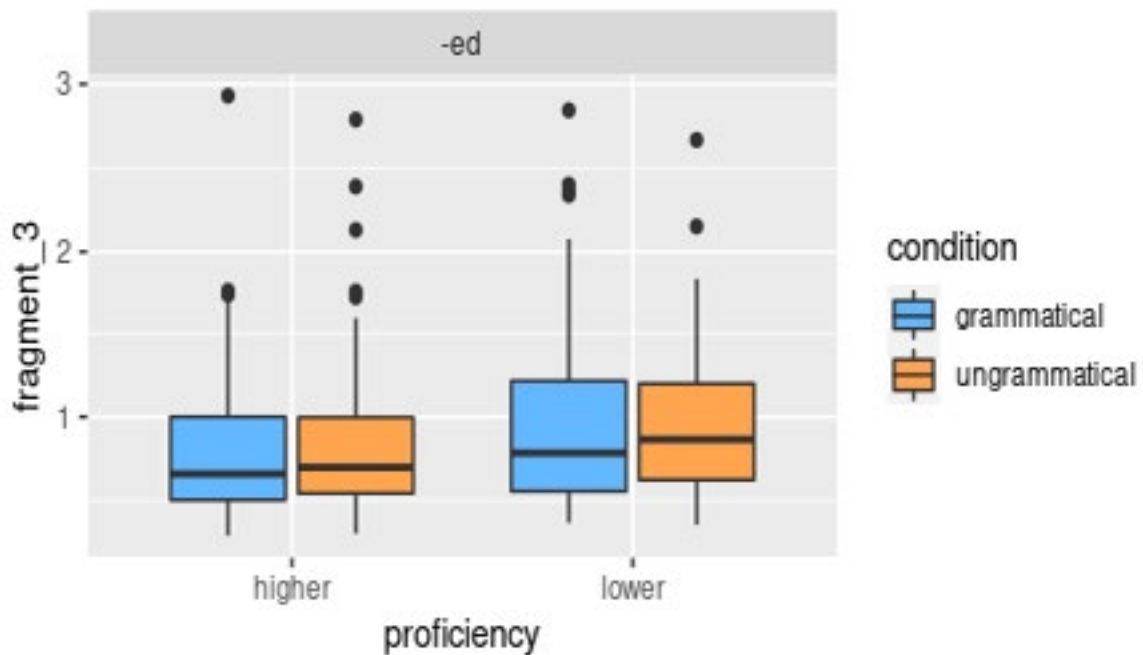
Source: Authors' own elaboration.

To verify if there was no difference in the groups' RT, we adjusted a linear mixed model of fragment 4. The RT was the response variable, the interaction between the type of condition (grammatical/ungrammatical) and proficiency (higher/lower) acted as fixed effects, and there were random slopes for items and participants. The interaction between condition and proficiency was not substantial ($\chi2$ = 0.3001, p= 0.5838), and proficiency ($\chi2$ = 4.9262, p= 0.08517) and condition ($\chi2$ = 0.3944, p= 0.821) were not significant to the model either.

Participants did not display sensitivity to the morpheme -ed omission in fragments 2 and 3. Competence impairment could explain why both higher and lower proficiency groups did not notice the absence of the morphemes, as they have no morphological information implicitly at their disposal (JIANG, 2004). Besides, these L2 learners seem to be developing their language skills since they have no access to morphological specifications yet (JIANG, 2000).

5 Discussion

The results from the SPRT suggest that higher and lower proficiency participants were not sensitive to the third-person singular (-s) and the regular past tense (-ed) morphemes omission. More specifically, these groups did not present substantial differences in their RT in the fragment containing the verb and the one following it when we contrasted sentences with these morphemes and the sentences without them. Neither their proficiency level (higher/lower) nor the kind of condition (grammatical/ungrammatical) played a substantial role in the task. Therefore, proficiency and condition had no significant role in their performance.

We aimed to measure the internalized morphological knowledge from these participants in the SPRT and adopted the moving window format to minimize their explicit knowledge reliance, such as done previously by Jiang (2004, 2007) and Carneiro (2011). If participants had unlimited time access to the whole sentence, they could use their explicit knowledge to monitor the input (KRASHEN, 2002, 2009), and the outcome could be different.

Morphological knowledge in the L2 can be problematic from an implicit point of view, but it may not be the case when one deals with

explicit knowledge. The goal of the task chosen by Jiang (2004, 2007) and Carneiro (2011) was to test implicit knowledge, but other studies that seem to tap into explicit knowledge, such as the speeded AJTs in Oliveira, Fontoura e Souza (2020), could attest that L2 learners could use explicit knowledge whenever they have time to retrieve it. Although the AJT in Oliveira, Fontoura e Souza (2020) was timed, the findings reported in this study suggest that an SPRT and an AJT estimate different types of morphological knowledge. Recent studies indicate that the time constraint in an AJT does not change the type of knowledge on which participants rely (VAFAEE; KACHINSKE, 2019).

Using offline and online tasks to measure functional morphology knowledge can yield different results for L2 learners as they appear to have target-like behavior in offline tasks (HOPP, 2010; OLIVEIRA; FONTOURA; SOUZA, 2020; ROBERTS; GULLBERG; INDEFREY, 2008) but not in online tasks (CARNEIRO, 2011, 2017; JIANG, 2004, 2007; SILVA; CLAHSEN, 2008). One of the reasons why this seems to be the case is competence impairment (JIANG, 2004). L2 learners, who lack subconscious morphological knowledge, do not have it in a ready state to be used automatically and fail to succeed in these types of tasks.

The competence impairment reported by Jiang (2004) concerning L2 morphological knowledge led us to Jiang's (2000) model for L2 lexical development. The latter can help explain the stages that L2 learners have to go through before having access to this sort of knowledge implicitly. According to this model, L2 learners will rely on the links between the L1-L2 before having L2 knowledge automatized. Therefore, morphological knowledge is only ready to be used at the last stage.

When we observe our data, we can see similarities to the morphological implicit knowledge findings that Jiang (2004, 2007) and Carneiro (2011) reported in their studies for L2 learners. Preventing L2 learners from using explicit knowledge seems to result in a processing breakdown in such a way that higher and lower proficiency groups did not notice the lack of the -s and -ed morphemes. Although higher proficiency participants are expected to have retained more stages of L2 lexical development compared to lower proficiency participants, our higher proficiency group did not seem to have mastered it to a point where they can access it subconsciously. Consequently, they still suffer from a competence deficit involving morphological knowledge. In addition, proficiency can vary within the group, and we cannot forget that there is an intra-individual variation concerning lexical items, meaning that each item can be at a different developing stage for each individual.

Final Remarks

Our purpose was to contribute to the area that investigates L2 learners' implicit morphological knowledge. Therefore, we conducted an SPRT in the moving window paradigm to minimize participants' access to implicit knowledge. We tested the third-person singular (-s) and regular past tense (-ed) morphemes in grammatical and ungrammatical sentences and ranked BPE participants into higher and lower proficiency. Our results suggest that no group was sensitive to the omission of morphemes independently from their proficiency level.

We can find similarities between our findings and the ones in Jiang (2004, 2007) and Carneiro (2011) because their L2 learners did not display sensitivity to morphological omission; nonetheless, the authors had native speakers to contrast the L2 learners' results, which deserves comparison between L1 speakers and L2 learners in the future. Overall, L2 learners seem to lack an underlying representation of morphological knowledge since they cannot use it implicitly (CARNEIRO, 2011, 2017; JIANG, 2004, 2007; SILVA; CLAHSEN, 2008), but they seem to perform well whenever they have time to monitor (KRASHEN, 2002, 2009) and use explicit knowledge (HOPP, 2010; OLIVEIRA; FONTOURA; SOUZA, 2020; RO-BERTS; GULLBERG; INDEFREY, 2008). The lexical development insufficiency could explain this morphological deficit (JIANG, 2000) in bilinguals.

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In addition, forthcoming studies using self-paced reading in the moving window should better control the characters and syllables in sentence fragments because we understand that participants can rely on their working memory to manipulate the presented information, and unbalanced conditions can impact the results.

The implicit morphological knowledge issue should be further explored because it seems to be a challenging topic that pervades learners from different L1s, and research in this area would benefit L2 classrooms. Intervention studies aligned with bilingual classes may be a productive prospect to observe how L2 learners evolve.

We expect this study foments investigations regarding implicit morphological knowledge since many questions are still unanswered. We analyzed L2 learners' implicit morphological knowledge in processing, but it is desirable to observe how these groups would behave in production to grasp how they would act in daily situations.

Acknowledgments

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