Analyzing Lexical Boost Effects in Priming of the Passive in Brazilian Portuguese

Analisando os efeitos de identidade lexical no priming *da passiva no português brasileiro*

Mara Passos Guimarães

Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, Minas Gerais/Brasil
maraguimaraes@ufmg.br
http://orcid.org/0000-0003-0251-3013

Gabriela Araújo Silva

Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, Minas Gerais/Brasil
gabyhmar50@gmail.com
http://orcid.org/0000-0003-1732-5701

Abstract: The lexical boost effect is an increase in the magnitude of structural priming effects when prime and target verbs are identical. This study investigates the connection of lexical boost to priming effects of the passive construction in Brazilian Portuguese (BP) in an image description task to contribute to the debate about whether lexical boost effects are a result of surface word repetition or a connection between the lexical item in the working memory and the structure in long-term memory. The task measured subjects' working memory (WM) capacity and manipulated task protocol by adding a matching cover task to the picture description task. Data collected indicate that structural priming effects in the image description task were contingent on lexical identity, presenting a positive correlation with choice of structure in the description. WM capacity did not influence priming effects, nor did subjects' performance in the cover task. Results provide evidence in favor of lexical boost effects being a result of residual activation of the connection between lexical item and structure. They also provide insight about the task and its applicability to priming effects of the passive construction in BP.

Keywords: lexical boost; structural priming; passive construction; image description task.

Resumo: O efeito de identidade lexical é definido como um aumento na magnitude dos efeitos de *priming* estrutural quando há identidade entre verbo prime e verbo alvo. Este estudo investiga a conexão entre efeitos de identidade lexical e *priming* estrutural da construção passiva no português brasileiro em uma tarefa de descrição de imagens, de modo a contribuir para o debate acerca da natureza destes efeitos – se resultado de repetição de palavras ou de conexão entre o item lexical na memória de trabalho e a estrutura na memória de longo prazo. A tarefa mediu a capacidade da memória de trabalho dos sujeitos e manipulou os protocolos experimentais, adicionando uma tarefa de associação como disfarce. Os dados coletados indicam que efeitos de *priming* estrutural na tarefa de descrição de imagens dependem da identidade lexical, apresentando uma correlação positiva com a escolha da estrutura das descrições. Não houve efeitos de capacidade de memória de trabalho ou do desempenho dos sujeitos na tarefa de disfarce sobre os efeitos de *priming*. Os resultados corroboram a visão dos efeitos de identidade lexical como resultado de ativação residual da conexão entre o item lexical e a estrutura, e oferecem novas perspectivas sobre a tarefa e sua aplicabilidade ao estudo de efeitos de *priming* estrutural da construção passiva no português brasileiro.

Palavras-chave: efeitos de identidade lexical; *priming* estrutural; construção passiva; tarefa de descrição de imagens.

1. Introduction

Studies about structural priming effects have offered valuable insights for research on first and second language acquisition and processing (for an overview, see BERNOLET *et al*., 2016). This phenomenon, defined as the increased likelihood of a speaker using a given argument structure construction after having processed it beforehand, can be explained under theories of both implicit learning and residual activation (BOCK; GRIFFIN, 2000; CHANG *et al*., 2006; JAEGER; SNIDER, 2013; PICKERING AND BRANIGAN, 1998; MALHOTRA *et al*., 2008). Analyzing priming phenomena under one or the other perspective has implications for the assumptions to be made about speakers' overall linguistic architecture, as these theories differ fundamentally on the mechanism underlying linguistic learning.

Structural priming can be considered a form of implicit learning inasmuch as it reflects distributional adjustments in the linguistic system originating from each and every episode of linguistic processing. As the

speaker processes language, they use sequence-meaning combinations to adjust connection weights between sequencing patterns and event-related elements, independently of lexical items (CHANG et al., 2006). These adjustments, which take place during processing by comparing predicted and observed linguistic occurrences (i.e., supervised learning), are thought to be long-lasting and to result in long-term changes to the speaker's linguistic system. In fact, structural priming has been observed to persist over longer periods of time than it would be possible for residual activations (BOCK; GRIFFIN, 2000; CHANG *et al.*, 2000).

Residual (or trailing) activation accounts, on the other hand, consider structural priming to be a result of residual activation of the combinatorial nodes between the lexical item and its structural possibilities. In this view, structural priming occurs because the structural representation is more salient due to recent processing and, therefore, more readily available for subsequent use. The Trailing Activation Model (MALHOTRA *et al.*, 2008), developed as a formalization of the residual activation account, assumes that syntactic and lexical processing are two cognitively independent processes, so that selection of structures and lexical items is a result of activation competition between representational nodes in syntactic and lexical layers. In such a "winner-take-all" system[1], a more salient representation (i.e., one presenting higher levels of residual activation) is one that is more likely to be chosen subsequently. Given the short-lived nature of neural activations, priming itself is expected to be rather short-lived. In this perspective, persistence effects of priming observed in the literature (reflecting incremental adjustments to the linguistic system as a whole) are attributed to processes analogous to Hebbian (rather than implicit) learning: "when an input frequently contributes to the firing of a particular neuron, then synapses from the input to the neuron should be strengthened" (MALHOTRA *et al.*, 2008, p. 658). Accounts based on residual activation find theoretical support in lexical access theories of language production that present a layered feedforward system composed of a concept, a lemma, and an articulation stratum (LEVELT *et al.*, 1999). Concept formulation influences lemma selection, which in turn provides input for articulation processes.

Since the residual activation account of structural priming was proposed, there have been findings concerning the persistence of priming

---

[1] Activation of a representation means not activating the competing ones.

effects and the influence of cumulative experiences (KASCHAK *et al*., 2011), for which this activation-based view has not been able to account. The impossibility for residual activation to account for long-lasting priming effects has resulted in a fairly solid consensus in the priming literature that priming as a result of learning rather than residual activation (TOOLEY, 2020).

2. Lexical boost effects on structural priming

The debate concerning the implicit learning versus the residual activation accounts of structural priming encompasses the lexical boost effect: the increase in the magnitude of structural priming effects when prime and target structures present the same lexical item. Although lexical overlap is not necessary for the occurrence of priming effects (BOCK, 1986), it has been so systematically observed in the priming literature (BERNOLET *et al*., 2016) that any theory attempting to define the nature of structural priming must also provide a satisfactory account for this boost. Although structural priming has been considered a type of learning, only the model formalizing the residual activation account was able to successfully mirror the lexical boost effects reported in the large body of work on structural priming. Malhotra *et al*. (2008) defend that the likelihood of reusing a structure presenting the same verb as the prime increases in conditions of lexical overlap due to the existence of not only the residual activation of the structure itself (i.e., residual activation from the syntax layer), but also the residual activation of the connection between the lexical item and the prime structure.

Conversely, the dual-path model proposed by Chang and colleagues (2006) explains lexical boost effects as a result of explicit memory of the wording of the prime structure. Although the authors justify this post-hoc analysis of lexical boost as explicit memory based on its short duration, they acknowledged the dire need for a deeper analysis of the phenomenon within the model. It would not be too far-fetched, then, to say that the implicit learning account attributes lexical boost effects to the same residual activation processes that account for structural priming in the competing theory. This may seem a controversial assertion, but Chang and colleagues (2006) themselves understand the existence of effects of lexical overlap as "orthogonal, rather than contrary to the model" (p. 256). Both the implicit learning and residual activation

models differ considerably in their accounts of structural priming, but agree that lexical boost effects do not constitute a form of learning.

The underlying mechanism of this effect, however, is still a point of contention. Tooley (2020) has offered valuable insight on the debate over the nature of the lexical boost from observing the facilitation effects of structural priming in reading comprehension using data from two eye-tracking experiments. In the first, the author investigated the assumption that the lexical boost effect is not the result of a learning mechanism by analyzing its occurrence in adjacent reduced-relative clause (RRC) prime-target pairs, with prime sentences varying in length. Reading times for targets following short RRC primes were smaller than for those following longer RRC primes, suggesting that lexical boost effects decayed over time. These results offer support to the assumption that effects of lexical overlap on priming are not caused by a learning mechanism; had it been a result of learning, these effects would not have decreased as a function of time.

Having ruled out lexical boost as a type of learning, Tooley (2020) conducted a second experiment investigating the exact nature of the explicit memory involved in the phenomenon. The author tested predictions from the implicit learning and residual activation accounts: the first states that lexical boost effects are based either on prime wording stored in the explicit memory, while the second claims these effects are based on a temporary link between the lexical item stored in explicit memory and the structural representation stored in long-term memory[2]. The experiment observed whether surface-level repetition without structural overlap would produce lexical boost effects using locative by-phrases as primes and RRC agent by-phrases as targets. No facilitation effects were observed; rather, the locative prime caused the participants to wrongly interpret RRC targets as locatives first, which forced them to reanalyze the sentences and, consequently, take longer to read them. These findings argue against the interpretation of lexical boost effects as a result of wording from the prime structure retrieved from explicit memory, as proposed by Chang *et al*. (2006); rather, they provide strong evidence that the repeated lexical item serves as a connection to the representation of the structure stored

---

[2] Tooley (2020) makes a further distinction between the residual activation account and the "deep explicit memory account". As predictions from both accounts are based on the connection between the lexical item and the structure in long-term memory, the distinction was omitted in this paper.

in long-term memory. Based on findings from these two experiments, Tooley (2020) argues in favor of a dual-mechanism account of structural priming and lexical boost effects: while the first is a form of implicit learning, the second is a result of lexically mediated access to the structural representation stored in long-term memory.

Although Tooley's (2020) findings help bridge a gap that has existed in the literature for over thirty years, Guimarães (2018) raised an issue regarding image description tasks, an experimental paradigm widely used in studies about structural priming and, consequently, lexical boost effects. This paradigm, most notoriously used by Bock in her 1986 paper, consists on showing participants a prime sentence presenting the structure of interest, then eliciting descriptions of images depicting events that are likely to be expressed using the prime structure – all under the disguise of a cover task, such as a matching or memory activity.

Based on Bock (1986), Guimarães (2018) conducted an image description task as part of a research project investigating distributional learning in L1 Brazilian Portuguese (BP) L2 English bilinguals. The author played audio recordings of sentences in the active and passive constructions in the participants' L1 PB, then elicited oral descriptions of images depicting transitive events, also in their L1. As in Bock's (1986) third experiment, the cover task was to determine whether or not a sentence or image had already been shown during the experiment. This cover task served both to hide the purpose of the experiment and to ensure that participants fully processed the prime sentences. The results were in line with the literature on priming: speakers produced more descriptions in the passive construction following passive primes than following active primes. Results also showed that priming effects on BP monolinguals tended to be stronger than on bilinguals (as predicted by surprisal rates of the construction in BP and English), suggesting that the linguistic system as whole is influenced by episodes of language processing both in the L1 and the L2. However, the findings that motivated the present study concerned participants' behavior in experimental items presenting lexical overlap between the prime verb and the event depicted in the image (e.g., the sentence presented the verb "carry" and the image showed a man carrying a fainting woman).

Guimarães (2018) did not find significant effects of the prime verb repetition on either the choice of structure or the choice of verb in the image descriptions. In other words, participants did not produce more descriptions

in the passive when the prime verb and the image expressed the same event (in comparison to prime-target pairs expressing different events), nor did they show a tendency to use the prime verb in their descriptions. More interestingly, lexical overlap had a negative effect on high-proficiency bilinguals' choice of structure in experimental items: for images with passive primes, they only produced descriptions using the passive when the prime verb and the event in the picture were different (p = .014).

It could be argued that the absence of lexical boost effects could be interpreted as evidence against the phenomenon; however, it would not explain bilinguals' apparent resistance in choosing the passive in descriptions following passive primes. Another possible explanation could be that there were flaws in the task protocol, which made these participants misunderstand the task instructions and deliberately avoid using the construction heard in the prime sentence. However, this would not satisfactorily explain why this was the case only for the high-proficiency bilingual participants.

The odd behavior of this specific group put into question the tendency observed among monolinguals: if high-proficiency bilinguals appeared to deliberately avoid repeating either verb or structure, would it be possible that monolinguals deliberately *chose* to repeat both verb and structure? In fact, reanalysis of the raw data from Guimarães (2018) done prior to the beginning of this study showed that monolinguals reused the prime verb in the totality of the valid descriptions with passive primes; however, priming effects within this group did not increase as a function of lexical overlap. It is therefore not possible to interpret the data from monolinguals as evidence of lexical boost being based on wording available in explicit memory, as lexical identity between prime and target motivated the choice of verb, but not of structure.

These puzzling results concerning lexical boost motivated the present study in two main ways. First, task protocol: although it is highly unlikely that linguistic profile (bilingual or monolingual) influenced the interpretation of standard written instructions, there is nevertheless a need to reassess the experimental paradigm of the image description task with speakers of BP as L1. Second, the nature of lexical boost effects: the flagrant lexical repetition without effects on priming requires further research.

This second motivation for the experimental designed required that one last factor be added: working memory capacity. Baddeley (2003) summarizes some available approaches to working memory (WM)

and defines it as "a limited capacity system, which temporarily stores information, [and] supports human thought processes by providing an interface between perception, long-term memory, and action" (p. 829). We hypothesize that the behavior shown by high-proficiency bilinguals and monolinguals in Guimarães (2018) was directly related to the surface information present in prime sentences, either by deliberate avoidance or deliberate choice of repetition, contradicting Tooley's (2020) findings that facilitation effects do not rely solely on wording. Either way, storage of wording in WM seemed to have influenced these subjects' descriptions, and the question raised concerned whether subjects' performance (given the deliberate choice or avoidance of prime structure use) would vary according to their WM capacity. Additionally, as lexical boost is understood to reflect a connection between short-term storage and long-term memory, it can be argued that WM capacity may correlate positively with the magnitude of lexical boost effects. For this reason, this study included a WM capacity measure as well as the image description task in an attempt to identify possible correlations.

3. Methodology

The experimental part of this study consisted of two tasks: an adaptation of the Reading Span Test (KLAUS; SCHRIEFERS, 2016), to measure subjects' WM capacity, and a picture description task in subjects' L1 BP disguised as a sentence-image matching task. These experiments were designed to observe two main aspects. First, to observe whether or to what extent the wording (as opposed to the structure[3]) of the prime sentence influences the choice of structure and lexical item (i.e., the verb) in subjects' production in an image description task. In order to address this protocol issue, the cover task for the experiment was a memory activity in which subjects indicated whether the prime sentence appropriately described the image shown subsequently. We predict that subjects who rely on prime sentence wording to produce image descriptions will provide a positive (and incorrect) answer to the matching question. The second purpose in this experimental design is to assess lexical overlap effects on structural priming in general. Based

---

[3] Note that the same wording may result in different structures (see experiment 2 from Tooley, 2020).

on the literature of priming effects, we predict that subjects will produce more descriptions in the passive following passive primes than following active primes; lexical boost effects will increase the magnitude of priming effects for experimental items with lexical identity (i.e., the verb in the prime sentence matches the event depicted by the image), which would validate the image description task as a paradigm for analyzing priming effects on the passive in BP. Finally, we predict that subjects with higher working memory capacity will be more susceptible to priming effects in the lexical identity condition.

3.1. Participants

Thirty-one volunteers (21 female) aged between 21 and 40 years old participated in the experiment. All subjects were native speakers of BP and had a high school degree.

3.2. Materials

The experiment was hosted on Ibex Farm (DRUMMOND, 2016), and subjects performed the tasks remotely. Ibex Farm provides free hosting for online behavioral experiments, which can be shared with volunteers via direct link. Because the experiment was conducted remotely, it was not possible to control the type of hardware (e.g., screen resolution, frames per second, keyboard) used by each subject to perform the tasks. The only restriction was that volunteers could only participate via computer, not mobile devices.

3.2.1. Reading Span Test

A fraction of the Reading Span Test (KLAUS; SCHRIEFERS, 2016) was used to measure subjects' WM capacity. As it is available only in English, Dutch, and German, the test was adapted to BP by translating the sentences and adapting specific lexical items where direct translation did not produce natural sentences in BP. The extract of the test used in this study was comprised of 10 blocks of random words interspersed with both well- and ill-formed sentences.

Just as in the original task, each of the blocks exhibited a sentence, followed by a yes/no judgment question in BP ("Is this sentence correct?"),

and the word for subsequent recollection. The blocks differed in the number of sentence-word pairs and, consequently, on their demand on subjects' WM: they presented 2, 3, 4, 5, or 6 pairs, and each block length occurred twice during the experiment. The complexity of this test lies on the fact that it demands the employment of both storage and linguistic processing resources from WM, also requiring subjects to keep track not only of *which* but also of *how many* words should be recalled in each of the blocks.

3.2.2. Image description task

Experimental items in the image description task consisted of 36 sentences in BP, equally divided between active primes, passive primes, and intransitive fillers. The sentences were presented in written form on the screen, after which a yes/no comprehension question appeared. Experimental sentences ranged from 15 to 17 syllables in length and presented high frequency words, so that there was no additional load on subjects' WM. All sentential subjects and objects were [+ animate], ensuring that preferential agent features were equally distributed across actives and passives (LOWDER; GORDON, 2015). The yes/no comprehension questions shown following the prime sentences served as a way to ensure subjects actually read the sentences, rather than just clicking mindlessly.

Materials also included 36 images, of which 24 depicted events that could be appropriately described using either the active or the passive, with the remaining 12 depicting events likely to be described using an intransitive construction. The images were all colored illustrations created using the free version of the animation software Animaker[4], which offers illustrations of humans in varied body positions (or performing different kinds of activities) as well as different scenarios (e.g., hospital, airport, office) and "props" (i.e., objects to be used in the composition of scene). The images were designed by selecting the scenes and adding the participants and the props (when necessary), based on the events to be described. Figure 1 below, for example, shows a woman dressed in uniform pushing a man on a wheel chair in an airport:

---

[4]   Available at http://animaker.com. Accessed on March 1st, 2021.

Figure 1 - Image used to depict the verb "push"
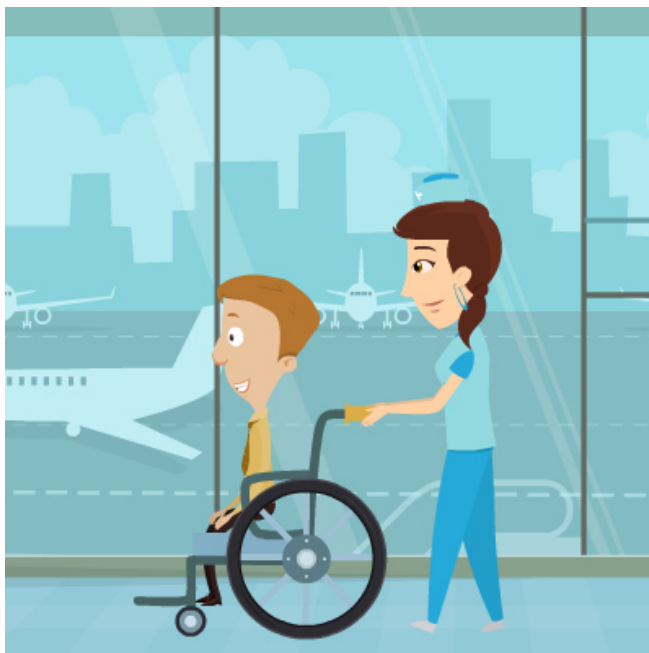
Source: ANIMAKER, c2021.

Half the prime-target pairs presented lexical overlap, that is, the images presented events that could be described using the verb from their prime sentences (e.g., the verb in sentence (6) above matches the event depicted by figure 1). The participants in the illustrations were positioned so that they could be clearly distinguishable as either the agent or the patient of the event shown. Their occurrence in the left or right side of the image was not controlled, as it has not influenced the choice of structure in similar picture description tasks in Guimarães (2018; 2021).

3.3. Procedures

Volunteers received the link to the experiment on Ibex Farm (DRUMMOND, 2016), and accessed the experiment using their personal computers. They were instructed to dedicate 30 minutes to the execution of both tasks and to avoid interruptions of any kind, especially those that configure human interaction (texting, talking to others, etc.)

3.3.1. Reading Span Test

Subjects were informed that they would read a sentence, answer a question about it, then see a random word on the screen. They were instructed to try to remember the word without any help (e.g., writing it down, getting help from other people), as they were supposed to write these words later on in the task. The sentences were shown on the screen for 10 seconds or until subjects clicked the "continue" button, whichever happened first. Then, a comprehension question appeared, to which they were also given 10 seconds to answer. Following the comprehension question, the word was shown for 1 second and disappeared automatically. After seeing all the sentence-word pairings in each block, subjects were directed to the answer page, where they wrote in the text boxes displayed the words they were able to recall. All answer pages presented six slots to write the words, regardless of how many words were shown in the block (there could be from two to six words in each block). After the end of the Reading Span Test, subjects had the option to take a break and return whenever they felt ready to continue the experiment.

3.3.2. Image description task

This second task was presented to subjects as a memory task. At each trial, they were instructed to read the sentence in BP on the screen, answer a yes/no comprehension question about it, describe an image in writing in BP, then indicate whether the sentence they had read corresponded to the image they had just described.

Subjects were instructed to press the spacebar on their keyboard when they believed they had finished reading the sentence; they were also informed that it would be displayed for a maximum of 4 seconds, after which the comprehension question would appear automatically. To answer the comprehension question, they used the mouse or trackpad on their computers to click the "yes" or "no" buttons displayed, with a time limit of 10 seconds. The image description was typed in a textbox below the image, using their keyboard, and submitted by clicking the "next" button; there was no time limit for this part of the trial. Prior to the beginning of this task, subjects were informed that they should not worry about grammar or orthography rules when writing the descriptions, and to write whatever came to mind first. Also, they were advised to avoid describing the images with only a single word. Finally, as in the comprehension question, subjects also used the mouse or trackpad to answer "yes" or "no" in the sentence-image correspondence task, also

with a time limit of 10 seconds. Only filler items (intransitives) showed correspondence; experimental primes and targets (actives and passives) always expressed two different situations, even in the lexical identity condition – e.g., the prime sentence read *the singer was chased by fans*, while the image showed a mummy chasing a woman.

4. Analysis

4.1. Reading Span Test

Scores for each of the subjects were calculated as the sum of the correct words recalled in the appropriate blocks. The maximum score possible was 40. Table 1 shows the maximum, minimum, mean, and median of the scores in the Reading Span Test:

Table 1 - Scores in the Reading Span Test

Maximum	Minimum	Mean	Median
40	15	31.1935	31

Source: Created by the authors.

We fitted a linear model in R (R CORE TEAM, 2020) with score in the WM test as the response variable and age as the predictor variable, and concluded that score did not vary as a function of age ($t =$ -.904, $p = .3735$).

4.2. Image description task

4.2.1. Data validation

There was a total of 743 descriptions. Experimental items whose descriptions failed to express the intended event in more than 50% of cases were excluded so as to remove noise from the lexical boost analysis: subjects will not use the verb from the prime to describe the event in the image not because of a lack of lexical boost effects, but simply because they have apprehended a different event altogether. Therefore, a total of 126 descriptions of the images representing the verbs *fire, kick, pay,* and *serve* were excluded from the analysis.

The 29 descriptions of the images representing the verb *abduct* also had to be removed due to the abnormal frequency of the passive construction, which was present in 82% of descriptions – regardless of its prime sentence being in the active. Arguably, an item whose behavior contradicts the general tendency in the language may lead to a misinterpretation of results: as the number of unprimed passives increase, it approximates to that of primed passives and causes priming effects to appear milder. A similar result was found in Guimarães (2021) with the verb *baptize* ("batizar", in BP), with 80% of its descriptions presenting the passive in an unprimed (free production) task. These biases towards the passive are strong indicatives that these items are stored as chunks (ELLIS, 2003), though it is necessary to further examine this claim. Finally, data from 20 of the remaining trials were excluded for presenting wrong answers to comprehension questions; inability to correctly answer comprehension questions represents an impossibility to ensure subjects had interpreted the prime sentences correctly, rendering any analysis of structural priming or lexical boost effects unreliable.

We were left with 568 descriptions, categorized as actives, passives, intransitives, middle voice, noun phrases, and constructions with prepositional objects. A description was labeled "active" if it presented a verb with an overt NP object; "passive" if it presented the verb *be* ("ser") followed by the main verb in the participle, with or without the agentive by-phrase; "intransitive" if it presented a verb without a complement (regardless of its usual argument structure); "middle voice" if it expressed an agentless event with an affected subject (CAMACHO, 2003); "noun phrase" if it did not qualify as a clause; and "prepositional object" if it presented a verb followed by a participial phrase complement. Table 2 shows the distribution of the types of descriptions:

Table 2 - types of descriptions

type	frequency
active	429
passive	82
prepositional object	18
intransitive	17
noun phrase	15
middle voice	5

Source: Created by the authors.

4.2.2. Choice of structure

For the analysis of structural priming and lexical boost effects, only actives and passives that expressed the intended event and presented [+animate] agents and patients were included. From the 568 descriptions, 409 met these requirements. Table 3 presents the final number of descriptions per choice of structure, prime sentence type, and lexical identity condition:

Table 3 - descriptions by prime type and lexical identity

	active prime		passive prime		Total
	same verb	diff. verb	same verb	diff. verb	
active descriptions	33	97	114	92	**336**
passive descriptions	2	22	41	8	**73**
Total	**35**	**119**	**155**	**100**	**409**

Source: Created by the authors.

The predictor variables were prime type (active or passive), lexical identity (same or different verb as that in the prime sentence), WM capacity (score in the Reading Span Test), and performance in the cover task (correctly indicating the non-correspondence between prime sentence and target image). We ran a collinearity test to determine whether factors were orthogonal, and we found a strong correlation between prime type and lexical identity.

A logistic regression model was fitted to the data to observe whether prime type, lexical identity, and working memory capacity affected the choice of structure in the description. A nested model comparison showed that passive primes had a negative effect on choice of structure ($Z = -2.216$, $p = .0267$), while neither lexical identity nor WM capacity had significant effects ($Z = -1.715$, $p = .0834$; $Z = 0.734$, $p = .4628$, respectively). As predicted by the collinearity test, there was a strong positive effect of the interaction between passive primes and items with lexical identity ($Z = 3.156$, $p = .0016$).

We also analyzed the connection between lexical identity and performance in the cover task, which did not yield statistically significant results ($Z = -.018$, $p = .9855$). There was not an effect of the interaction between the performance in the cover task and WM capacity ($Z = -.633$, $p = .5267$). Finally, analysis of experimental items with lexical overlap

showed no connection between repeating the prime verb and providing a wrong answer to the cover task ($Z = -1.65$, $p = .0989$).

5. Results and discussion

The first motivation behind this experimental design was to validate the use of the image description task as an experimental paradigm to investigate priming and lexical boost effects. The negative correlation found between prime type and choice of structure suggested that, overall, subjects tended to avoid using the passive on their descriptions unless they could employ the verb encountered in the prime sentence. Although the fact that facilitation from reading the prime sentences as conditioned to lexical repetition could favor an interpretation of priming effects being a result of residual activation, this is not a straightforward conclusion given the negative influence of passive primes in general on the descriptions. If analyzed together with the results presented in Guimarães (2018), these findings advise against using picture description tasks to elicit structural priming effects in the production of the passive construction in BP. Further analysis is necessary to identify whether the task itself fails to produce these facilitation effects in general in BP (which is highly unlikely, given the robust number of such tasks in the priming literature), or if it is just not sensitive to the peculiarities of the passive in BP. It is also important noting that this study and the one reported by Guimarães (2018) differ in the production method (spoken vs. written), a difference which influenced the occurrence of the passive in the image description tasks reported by Guimarães (2021).

The second motivation of this study was to investigate whether the absence of priming effects independently from lexical repetition reported by Guimarães (2018) stemmed from task misinterpretation and reliance on wording of the prime sentence. Interestingly, this study replicated the results from Guimarães (2018) in terms of the dependence of structural priming on lexical overlap, but dismissed task misinterpretation or word repetition by adding the correspondence task. The absence of a connection between verb repetition and cover task mistakes suggests that subjects did not reuse the prime verb as a result of equivocally understanding the events expressed by the prime sentence and depicted in the image as corresponding. Although our results do not provide support to the debate concerning the nature of structural priming, they provide valuable insight about the nature of the lexical boost effect: it is supported by explicit memory, but not by means of superficial word repetition. In accordance with the results reported by Tooley (2020), it appears to be

motivated by residual activation of the connection between the lexical item in explicit memory and the construction in long-term memory. It remains to be seen what aspects of both the picture description task and the passive construction in BP must be manipulated in order to replicate the structural priming effects vastly reported in the literature.

References

ANIMAKER. Palo Alto: Animaker, c2021. Online software. Available at: http://animaker.com. Access on: Mar. 1st, 2021.

BADDELEY, A. Working Memory: Looking Back and Looking Forward. *Nature Reviews: Neuroscience*, 4, p. 829-839, 2003.

BERNOLET, S.; COLLINA, S.; HARTSUIKER, R. J. The persistence of structural priming revisited. *Journal of Memory and Language*, 91, 99-116, 2016.

BOCK, J. K. Syntactic persistence in language production. *Cognitive Psychology*, 18, 355-387, 1986.

BOCK, J. K.; GRIFFIN, Z. M. The Persistence of Structural Priming: Transient Activation or Implicit Learning? *Journal of Experimental Psychology: General*, 129(2), 177-192, 2000.

CAMACHO, R. G. Em Defesa da Categoria de Voz Média no Português. *D.E.L.T.A.*, 19(1), p. 91-122, 2003.

CHANG, F.; DELL, G. S.; BOCK, J. K. Becoming Syntactic. *Psychological Review*, 113(2), 234-272, 2006.

CHANG, F.; DELL, G. S.; BOCK, J. K.; GRIFFIN, Z. M. Structural Priming as Implicit Learning: A Comparison of Models of Sentence Production. *Journal of Psycholinguistic Research*, 29(2), 217-229, 2000.

DRUMMOND, A. *Ibex Farm*, 2016. Available at http://spellout.net/ibexfarm/. Accessed on March 1st, 2021.

ELLIS, N. C. Constructions, Chunking and Connectionism: The Emergence of Second Language Structure. In: DOWTY, C. J.; LONG, M. H. (Ed.). *The Handbook of Second Language Acquisition*. Malden, MA: Blackwell, 63-103, 2003.

GUIMARÃES, M. P. *Structural persistence and surprisal: implications for proficiency-modulated distributional learning in late bilinguals*. 2018.

92 p. Unpublished PhD dissertation (Linguistics) – Programa de Pós-Graduação em Estudos Linguísticos, Belo Horizonte, 2018.

GUIMARÃES, M. P. Frequency effects of L2 English on the processing of the passive in L1 Brazilian Portuguese. *Revista de Estudos da Linguagem*, v. 29, n. 1, p. 215-258, 2021.

JAEGER, T. F.; SNIDER, N. Alignment as a consequence of expectation adaptation: Structural priming is affected by the prime's prediction error given both prior and recent experience. *Cognition,* 127, 57-83, 2013.

KASCHAK, M. P.; KUTTA, T. J.; JONES, J. L. Structural priming as implicit learning: Cumulative priming effects and individual differences. *Psychonomic Bulletin and Review*, 18, p. 1133–1139, 2011.

KLAUS, J.; SCHRIEFERS, H. (2016). Measuring working memory capacity: A reading span task for laboratory and web-based use. Unpublished manuscript submitted for publication.

LEVELT, W. J. M.; ROELOFS, A.; MEYER, A. S. A theory of lexical access in speech production. *Behavioral and Brain Sciences*, 22, 1(75), 1999.

LOWDER, M. W.; GORDON, P. C. Natural Forces as Agents: Reconceptualizing the Animate-Inanimate Distinction. *Cognition*, 136, p. 85-90, 2015.

MALHOTRA, G.; PICKERING, M. J.; BRANIGAN, H., & BEDNAR, J. A. On the persistence of structural priming: Mechanisms of decay and influence of word-forms. In LOVE, B. C.; MCRAE, K.; SLOUTSKY, V. M. (Ed.). *Proceedings of the 30th annual conference of the cognitive science society*, 657-662. Austin: Cognitive Science Society, 2008.

R CORE TEAM. *R: A language and environment for statistical computing.* R Foundation for Statistical Computing, Vienna, Austria. Available at https://www.R-project.org/. Accessed on March 1st, 2021.

PICKERING, M. J.; BRANIGAN, H. P. The Representation of Verbs: Evidence from Structural priming in Language Production. *Journal of Memory and Language*, 39, 633-651, 1998.

TOOLEY, K. M. Contrasting mechanistic accounts of the lexical boost. *Memory and Cognition*, 48, p. 815-838, 2020.