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# L2 processing facilitation by constructional similarity: beyond word order correspondence

## *Facilitação por similaridade construcional no processamento da L2: para além da correspondência palavra a palavra*

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**ABSTRACT**

Structural similarity between a bilingual's two languages, defined by word order correspondence, reflects the surprisal levels (inverse-frequency effect) associated with sentence processing in the L2. Similarity is predicted to facilitate L2 processing due to the lower levels of surprisal of similar structures and the possibility of relying on existing mental representations and processing patterns from a bilingual's L1. As representations of argument structure constructions map both morphosyntactic structure and underlying meaning, this study investigates the trade-off in L2 processing facilitation by constructions that present equivalent word order in Brazilian Portuguese (BP) and English but differ in their underlying meaning. A self-paced reading task was used to compare processing of causative resultatives and middle voice constructions in English by L1 BP L2 English bilinguals of varying proficiency levels, as these constructions find word order equivalents in BP that fail to convey the intended meaning due to differences in event role assignment of the adjective in resultatives and differences in lexical restrictions on verbs in the middle construction. The analyses of critical words and spillover areas through mixed-effects linear models showed significantly higher RTs for middle voice sentences in comparison to resultative sentences, with L2 proficiency showing interaction with processing of the middle construction only. The results suggest that facilitation comes from overall constructional similarity rather than from word order correspondence alone, since the lexical selection differences in the middle sentences posed higher levels of surprisal to bilinguals than the novel event role assignment of the adjective in the resultative construction.

**KEYWORDS:** Linguistic similarity. Bilingual sentence processing. Surprisal. Middle voice. Causative resultative.

**RESUMO**

A similaridade estrutural entre as línguas de um bilíngue, definida pela correspondência da ordem de palavras, reflete os níveis de *surprisal* (efeito de frequência inverso) associados ao processamento de sentenças na L2. Similaridade tem efeitos de facilitação no processamento da L2 devido aos baixos níveis de *surprisal* de estruturas similares e ao acesso às representações mentais e padrões processuais disponíveis na L1. Dado que representações de estrutura argumental mapeiam estrutura morfossintática e sentido subjacente, este estudo investiga o contrabalanceamento na facilitação do processamento da L2 por construções que apresentam ordem de palavras equivalente no português brasileiro (PB) e no inglês mas diferem em seu sentido subjacente. Uma tarefa de leitura autocadenciada foi utilizada para comparar o processamento de resultativas e construções de voz média em inglês por bilíngues L1 PB L2 inglês de diferentes níveis de proficiência; estas construções encontram equivalentes estruturais no PB que não apresentam o mesmo sentido. As análises de palavras críticas e áreas de *spillover* feitas através de modelos lineares mistos mostraram RTs significativamente maiores para sentenças na voz média em relação às sentenças resultativas, com proficiência em L2 interagindo apenas com

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as sentenças de voz média. Os resultados sugerem que a facilitação é causada pela similaridade construcional como um todo e não apenas da correspondência palavra por palavra, dado que as diferenças na seleção lexical nas sentenças de voz média implicaram em maiores níveis de *surprisal* para os bilíngues do que a atribuição de papel de eventos ao adjetivo nas resultativas.
**PALAVRAS-CHAVE:** Similaridade linguística. Processamento de sentenças por bilíngues. *Surprisal*. Voz média. Causativa resultativa.

## Introduction

The influence of a bilingual's first language on the acquisition and processing of the second has been widely studied in the fields of bilingualism and second language acquisition. From an error-based perspective of late L2 acquisition and processing[2], the bilingual's L1 is understood to be the internal linguistic model to which the L2 input is compared and, in initial stages of L2 acquisition, the level of similarity between the L1 and the L2 determines the amount of information contained in the L2 input – that is, how predictable it is to the L2 learner (PERANI; ABUTALEBI, 2005; ZARCONE et al., 2016). Thus, the influence of L1 on L2 grammatical encoding has been observed to affect L2 speakers mostly in their early stages of acquisition, resulting in either positive or negative transfer[3] depending on the level of structural similarity between the two languages (TOLENTINO; TOKOWICZ, 2011). In general, similarity can be determined by the present state of a bilingual's linguistic system in relation to the L2 input to which they are exposed: L2 input presenting patterns already available in the learner's linguistic system contains a smaller informational load and is consequently more predictable, while input presenting conflicting or novel patterns is less predictable and imposes higher processing demands.

The input's informational load and related predictability levels constitute the input's surprisal, whose effects are modulated by the distributional features of structures in the speaker's linguistic system (JAEGER; SNIDER, 2008; ZARCONE et al., 2016). In bilingualism studies, this comparison between existing/conflicting patterns translates as similarity between L1 and L2. Structures successfully processed using strategies already available in the speaker's linguistic system (which, in the case of speakers in early stages of L2 development, largely correspond to those from their L1) present low levels of surprisal and a likewise low need for systematic adaptation to accommodate the information present in the input. It is the case, for example, of a L1 Brazilian Portuguese (BP) speaker upon encountering a passive structure in L2 English. Because it is morphosyntactically and semantic-pragmatically equivalent in both languages, the form-meaning mappings from L1 BP will result in the target interpretation in L2 English. Conversely, structures whose processing strategies are not already available present high levels of surprisal, resulting in higher processing costs and a higher need for adaptation in the bilingual's linguistic system. That same L1 BP L2 English bilingual

[2] Late bilingualism is defined as the acquisition of the L2 after childhood and, consequently, the development of the L1 (DE GROOT, 2011).

[3] In this paper, the term "transfer" is used to denote the application of processing strategies of a language on the other.

is expected to present higher processing costs upon encountering, for example, an induced action causative structure such as (1), realized in L1 BP only with the overt causative verb (2):

1. *The jockey jumped the horse over the fence.*

2. *O jockey fez o cavalo pular sobre a cerca.*
   *"The jockey made the horse jump over the fence."*

It follows that similarity correlates negatively with surprisal, and decreasing surprisal levels are among the causes behind the well-established positive correlation between proficiency and ease of processing of the L2. Proficiency reflects the late bilingual's knowledge of L2 lexical items and the rules that govern their sequencing, acquired both explicitly from the abstraction and automation of formal instruction and implicitly from exposure to distributional information in the input. Thus, facilitation in L2 processing tends to rely less on linguistic similarity as the bilingual becomes more proficient, since surprisal levels of dissimilar structures are bound to decrease based on continuous exposure to L2 input and on L2 processing in general. Under the notion that the linguistic system is under constant adaptation from surprisal levels in the linguistic input, processing becomes a continuous learning process: speakers update their linguistic system at every episode of linguistic processing (CHANG; DELL; BOCK, 2006; ZHAO; LI, 2014).

Given the role of similarity in bilingual language processing, it is necessary to determine what defines a structure as being similar in a given pair of languages. In their review of the role of L1-L2 similarity on L2 processing and representation, Tolentino and Tokowicz (2011) adopted an operational definition of similarity as "the correspondence (or lack thereof) between specific L1 and L2 linguistic structures based on word-by-word translation" (p. 93). This restriction is in agreement with findings on bilingual structural representational sharing, which predict that structures in a bilingual's two languages presenting corresponding word order are mapped onto one single mental/neural representation (HARTSUIKER; BERNOLET, 2017; LOEBELL; BOCK, 2003). Differences in morphosyntactic restrictions in word-by-word corresponding structures, on the other hand, represent a form of structural dissimilarity that are not considered to result in language-specific representations (HARTSUIKER; BERNOLET, 2017; KOTZOCHAMPOU; CHONDROGIANNI, 2022; TOKOWICZ; MACWHINNEY, 2005).

## 1. The role of constructional meaning

It seems to be less complex to predict facilitation effects on the processing of structures whose translations are either clearly successful (e.g., the passive in BP and English) or distinctly unlicensed (e.g., the induced action causative from English to BP). There is, however, an intermediate level of similarity concerning the trade-off between word order patterns and underlying meaning, which requires us to look at syntactic structures as argument structure constructions (ASCs): independent

linguistic entities that code the relationship between event participants, information structure, morphosyntactic requirements and lexical restrictions (GOLDBERG, 2019).

Direct translation of an ASC may result in a licensed structure that carries a different meaning due to non-matching event role assignment. It is the case of the English causative property resultative construction[4] (GOLDBERG; JACKENDOFF, 2004), in (3), and its BP translation, in (4):

3. *The man kicked the door shut.*

4. *O homem chutou a porta fechada.*

In (3), the underlying meaning is that of x made z become y by doing w. The adjective *shut* denotes the state of the NP *the door* as a result of the event described by the verb *kicked* performed by the subject NP *The man*: the man shut the door by kicking it. Although (3) directly translates in BP as the licensed structure (4), it fails to carry over the resultative reading, as the adjective *fechada* (shut) in (4) is a modifier of the head noun *porta* (door) and is unrelated to the event described by the verb *chutou* (kicked): it represents the state of the door prior to the event of kicking. The underlying meaning of (4) is that the man kicked a door that was already shut. A resultative reading equivalent to that in (3) that maintains the level of specificity of the original sentence can be achieved in BP by changing the verb to one relative to the result adjective and adding a PP indicating manner:

5. *O homem fechou a porta com um chute.*
   *"The man shut the door with a kick."*

It is a fact that the sentences in (3) and (4) represent different ASCs: one is a resultative and the other is a general transitive. However, if facilitation by linguistic similarity is based on word order correspondence, it is unclear whether L1 BP speakers of L2 English would present facilitation effects independently from the discrepancy in the intended meaning, since a successful outcome of processing a resultative relies on the accurate event role assignment to the adjective as an indicator of result.

A more delicate issue of word order correspondence in the analysis of facilitation based on linguistic similarity concerns the middle construction in English and BP when they occur with transitive accusative verbs[5]:

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[4] Henceforth referred to only as "resultative," as other types of constructions in the resultative family will not be analyzed in this study.

[5] The middle voice in Brazilian Portuguese has been extensively described, especially in terms of its occurrence with the clitic *se* and how it differs from reflexives, reciprocals and passives (e.g., CAMACHO, 2003; LIMA, 2021b, among others). However, these types of middle constructions are beyond the scope of this study and will not be described in detail. Henceforth, all mentions of the middle construction will refer to those presenting verbs denoting transitive events and prototypically found in transitive constructions.

6. *This book sells well.*
   *Este livro vende bem.*

This type of middle construction is similarly characterized in both languages: it presents the affected entity as primary topic in subject position, demotes the agent or cause, presents a verb predominantly used transitively, and relates to a corresponding active structure conveying the same event role assignment (HUNDT, 2007; LIMA, 2021a). Because it is morphosyntactically correspondent to actives, the middle construction has additional restrictions of semantic-pragmatic nature. First, the subject must present an inherent quality or property that is responsible for the action expressed in the verb (GOLDBERG, 1995): for instance, one can sell books, but not bake them. Second, the middle construction is often used to describe generic contexts, not referring to specific points in time, and is often described as presenting propositions of disposition (ALEXIADOU; DORON, 2012), similarly to constructions denoting state. Finally, as the agent is implicit and not possible to be inserted (opposed to what can be done in passives), most middle constructions require modification by adverb (as in 6 above), modal, or negative (HUNDT, 2007; LIMA, 2021b; SILVA; ARAÚJO, 2017):

7. *This book may sell.*
   *Este livro deve vender.*

8. *This book does not sell.*
   *Este livro não vende*.

The verb *sell* in sentences 6-8 was intentionally chosen because it successfully illustrates the direct correspondence of the middle constructions between English and BP, as the latter language seems to present restrictions in the occurrence of verbs that have yet to be systematically explained. The middle construction in BP does not occur with some transitive verbs that are otherwise frequently used in English:

9. *This wine drinks nicely with a steak.*
   ** Este vinho bebe bem com um filé.*

10. *The car drives smoothly in the rain.*
    ** O carro dirige suavemente na chuva.*

Examples 9 and 10 do not violate semantic-pragmatic restrictions, as they are licensed by the inherent properties of the subject in relation to the event expressed by the verb: books can be sold just as wine can be drunk and cars can be driven. It does not seem to be motivated by lexical aspect either, as both activity and accomplishment verbs can occur in the middle construction in BP (CIRÍACO, 2009).

One possibility for this discrepancy is that the non-agentive interpretation could be coded in the verb *vender* (sell) but not in *beber* (drink) or *dirigir* (drive). In fact, one of the entries for the verb *vender* is "to be sellable with ease; to be well accepted in the market" (VENDER, 2023), while there is no such meaning in the dictionary entries for the other two verbs. If this is the case, the middle construction in BP would be restricted to verbs akin to ergatives such as *break* or *open*. This is a conjecture that requires empirical investigation that is beyond the scope of this study; the relevant point is that there is a distinction in lexical selection in the middle construction between English and BP despite meeting the above-mentioned requirements, and that the construction seems to be more productive in the former language.

The available descriptions of the middle construction in BP and English lead us to believe that it is similar in the two languages, despite the verb licensing issue discussed. Although this similarity is expected to facilitate L2 processing by the L1 BP L2 English bilingual, it is unclear whether the limitation on BP verbs poses a significant processing cost based on the implausibility of the agentive reading, the interpretation alternative to the middle one in BP for verbs such as the ones in sentences 9 and 10.

Given the consensus on similarity being based on word order correspondence, the meaning differences in the direct translation of the resultative and middle construction from English to BP raises the issue of the extent to which processing facilitation takes place in structurally equivalent but semantically distinct constructions. This study then focuses on the aspects of linguistic similarity that facilitate (or hinder) L2 processing by L1 BP L2 English late bilinguals of different levels of proficiency, analyzing the trade-off between word order patterns and meaning under two different perspectives. On the one hand is the resultative construction, whose direct translation to BP results in licensed sentences that lack the intended meaning due to different event role assignment. The result of direct translation from English to BP is an active construction in which the adjective originally functioning as the result state functions as a post-head modifier. On the other hand is the middle construction, whose direct translation to BP carries the original event role assignment but results in unlicensed sentences due to BP restrictions that are not present in English. Facilitation effects for these constructions with intermediate levels of similarity are contrasted with those of the passive, entirely correspondent, and the induced action causative, unique to English. L2 proficiency is controlled to be contrasted with similarity effects, as both factors influence ease of L2 processing caused by distributional learning of the constructions under investigation.

## 2. Methods

In order to assess facilitation effects in L2 processing given different levels of constructional similarity and proficiency, a moving window self-paced reading (SPR) task was employed to obtain reading times for critical words in each type of construction – passive, resultative, middle, and induced action. Due to the social distancing enforced by the World Health Organization in the year 2020 as an effort to contain the spread of Covid-19, the data was collected remotely.

## 2.1. Participants

Twenty-nine volunteers (16 women and 13 men) aged between 19 and 51 years old (mean = 30.62; sd = 8) participated in the experiment. All were L1 BP L2 English late bilinguals who either had obtained or were in the process of obtaining an undergraduate degree. Participants' proficiency was measured through their scores on an updated version of the VLT - Vocabulary Levels Test (NATION, 1990), proposed by Webb and colleagues (2017) and validated as a measure of L2 grammatical knowledge in psycholinguistic experiments by Souza and Soares-Silva (2015). The VLT presupposes knowledge of L2 English based on vocabulary range; participants may score up to 90 points by matching words and their definitions in five different levels of word frequency. Proficiency scores ranged from 36 to 88 points (mean = 72.9; sd = 13.07).

## 2.2. Materials

The SPR task was hosted on Ibex Farm (DRUMMOND et al., 2016), and participants performed the task remotely using their own computers[6]. Subjects read 30 sentences word by word, on a moving window paradigm. Experimental items consisted of 24 sentences in English, equally divided between four structures: passive (PA), middle voice (MV), resultative (RA), and induced action (IA), illustrated in sentences 11-14, below. Filler items consisted of 6 unlicensed causatives, as in sentence 15 below.

11. *The thief was chased by the police.*

12. *The book reads easily when you concentrate on it.*

13. *The waiter wiped the table clean using a rag.*

14. *The jockey jumped the horse over the hurdle.*

15. * *The detective appeared the evidence after the crime.*

Within the same type of structure, all sentences presented the same number of words and the same position of the critical word. Additionally, critical words appeared at least before the second-to-last word of the sentence to avoid wrap-up effects (JEGERSKI, 2014).

The comparison between the four types of structures in this SPR task is based on the reading times (RT) of the critical word in each sentence; that is, the word that unequivocally defines a construction as so and dismisses all other possibilities. For passives, the critical word is the verb in the participle; note that, up until that word, there are still other possible constructions presenting a subject followed by the verb *be*. In addition to the participle in passives (16-a), complements may be prepositional, verb, noun, or adjective phrases (sentences 16b-e):

[6] It was therefore not possible to control the type of hardware used by each participant. The only requirement was that the task should be performed on a computer, and not on a mobile device.

16. (a) The thief was *arrested by the police.*
    (b) The thief was *in the tunnel.*
    (c) The thief was *feeling lucky.*
    (d) The thief was *a disgruntled professor.*
    (e) The thief was *tired from running.*

The critical word in middle voice sentences is the verb immediately following the head noun in the subject noun phrase, as the active reading results in an unplausible sentence:

17. ? The book reads *text messages on the phone*.

Resultatives are defined as so based on the occurrence of the adjective indicating the result obtained from the action described by the verb; without the adjective, the structure would be considered an active:

18. The waiter wiped the table *using a rag.*

Finally, the critical word in induced action sentences is the head noun of the internal agent, that is, the sentence participant who performs the action despite not inciting it (FOLLI; HARLEY, 2006; LEVIN; RAPPAPORT HOVAV, 2005). Note that the manner of movement verbs present in induced action sentences could take an object referencing an inanimate entity, which would render the structure a simple active in which the subject is both the agent and the inciter:

19. The jockey jumped the *fence*.

## 2.3. Procedure

Volunteers received the link to the platform hosting the experiment and performed the task using their personal computers. First, participants took the VLT with the explicit purpose of assessing their L2 proficiency levels. Each of the vocabulary matching items was presented individually for a time limit of 8 seconds. The option “I don’t know” was added to the options present in the original configuration of the VLT to prevent subjects from guessing and, consequently, adding noise to the proficiency assessment.

After taking the VLT, participants proceeded to the SPR task itself. They were instructed to press the space bar to read the sentence word by word and to pay close attention to the contents of the sentence. They subsequently performed a training session to get acquainted with the dynamics of the task, after which the experimental trials began. Items were pseudorandomized so that no two sentences of the same structure type appeared in a row. A yes/no comprehension question followed each trial, both to serve as a cover task and to ensure subjects read the sentences attentively.

# 3. Results

## 3.1. Data validation

There was an initial total of 696 observations of interest areas and their respective 696 observations of spillover areas (i.e., words following critical words in each sentence type). All trials of one experimental item from the induced action type were eliminated because answers to the item's comprehension question were wrong in more than 50% of the trials, therefore suggesting that the question may have been ill conceived. The impossibility of including the answers to this particular question prevented us from attesting participants' comprehension of that experimental item (n = 29). Additionally, individual trials were eliminated if participants provided wrong answers to their comprehension questions (n = 59).

RTs higher than 2000ms and lower than 200ms were considered outliers and, therefore, were also eliminated (n = 14 for interest areas and n = 5 for spillover areas). It is assumed that these outliers indicate a lack of attention or engagement from the participants, as RTs higher than 2000ms suggest disengagement or timeout (i.e., the stimulus presentation reached its time limit), while RTs lower than 200ms suggest mindless or accidental button pressing.

After validation, there was a total of 594 observations of interest areas and 603 observations of spillover areas for all sentence types, each observation providing its own reaction time. Table 1 presents the number of observations per structure type:

**Table 1:** number of observations per sentence type.

| *# observations* | *passive* | *middle voice* | *resultative* | *induced action* | *total* |
|---|---|---|---|---|---|
| interest area | 157 | 154 | 154 | 129 | 594 |
| spillover area | 161 | 154 | 154 | 134 | 603 |

**Source:** the author

Table 2 shows the means of RTs for each of the structure types (in ms):

**Table 2**: means and standard deviations of RTs per sentence type (in ms).

| *type* | *interest* | | *spillover* | |
|---|---|---|---|---|
| | *mean* | *sd* | *mean* | *sd* |
| passive | 685 | 329 | 531 | 235 |
| middle voice | 650 | 295 | 771 | 358 |
| resultative | 610 | 273 | 612 | 265 |
| induced action | 692 | 337 | 579 | 260 |

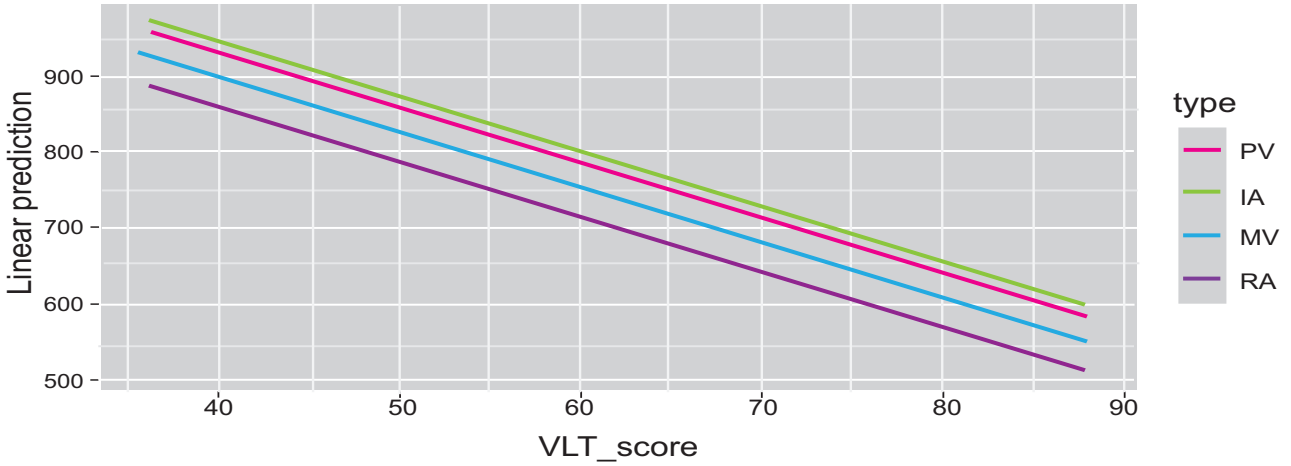
**Source:** the author

### 3.2. Analysis

This experiment was designed to observe possible differences in RTs for disambiguating words for sentences presenting structures with different levels of constructional similarity between BP and English (participants' L1 and L2, respectively). Three predictions were made for this experiment: first, that RTs for critical words of RA, MV, and IA would be higher compared to those of the PV; second, that RTs would be negatively correlated with proficiency levels; and third, that there would be an interaction between proficiency and sentence type, in that the expected proficiency effect would be higher for RA, MV, and IA.

The analysis of RTs of critical words was carried out through a mixed-effects linear model fitted in R (R CORE TEAM, 2020), using the lmer() function (BATES et al., 2015), with RTs as the response variable; proficiency level, sentence type, and their interaction as predictor variables; and participants as random variables[7]. A nested models comparison showed effects of proficiency level ($\chi2 = 7.2886$, $p < .01$) and sentence type ($\chi2 = 10.999$, $p < .05$), but not of their interaction ($\chi2 = 3.5332$, $p = .3165$). Graph 1 illustrates the model of RT variance of critical words of all sentence types across the proficiency scores:

**Graph 1:** model of RTs of critical words as a function of proficiency score for all sentence types.




**Source:** the author

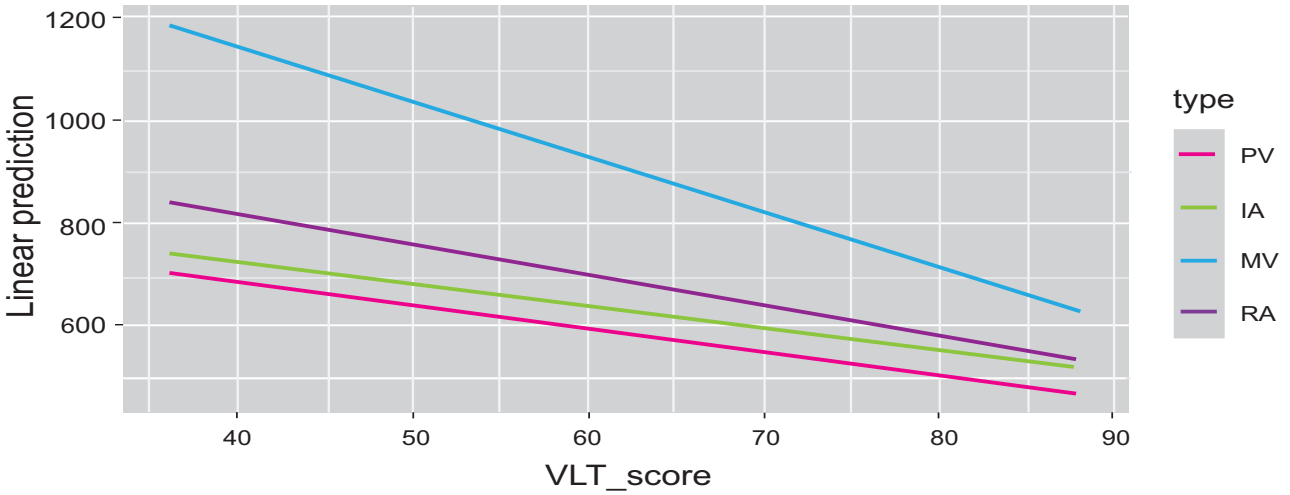
Post hoc paired comparisons using the Tukey HSD test indicated that the mean RTs for RA were marginally significantly lower than those for PA ($t = 2.635$, $p = .0428$) and significantly lower than those for IA ($t = 2.635$, $p < .05$), but did not differ significantly from those for MV ($t = 1.487$, $p = .4463$). RTs for PA did not vary significantly in relation to IA ($t = 0.499$, $p = .9593$) or MV ($t = -1.142$, $p = .6637$).

An analysis of the spillover area was likewise conducted. A mixed-effects linear model was fitted in R (R CORE TEAM, 2020) using the lmer() function (BATES et al., 2015), with RTs of spillover words as the response variable; proficiency level, sentence type, and their interaction as predictor

[7] Items were initially included as random variables, but were later removed as they did not significantly affect the total variance of random effects ($\chi^2 = 0.0341$, $p = .8535$).

variables; and both participants and items as random variables[8]. A nested models comparison showed significant effects of proficiency level ($\chi2 = 21.486$, $p < .001$), sentence type ($\chi2 = 85.563$, $p < .001$), and their interaction ($\chi2 = 9.3463$, $p < .05$). The linear regression analysis showed that proficiency interacted only with spillover words from the MV structure ($t = -2.645$, $p < .01$). Graph 2 illustrates the model of RT variance of spillover words of all sentence types across the proficiency scores:

**Graph 2:** model of RTs of spillover words as a function of proficiency score for all sentence types.




**Source:** the author

Post hoc paired comparisons using the Tukey HSD test indicated that mean RTs of spillover words in MV were significantly higher than those in all the other three sentence types: PV ($t = 8.638$, $p < .0001$), IA ($t = 6.613$, $p < .0001$), and RA ($t = 5.605$, $p < .0001$). Mean RTs for spillover words in RA were significantly higher than those in PV ($t = 2.973$, $p < .05$), while there was no significant difference between PV and IA ($t = -1.641$, $p = .3567$).

## 3. 3. Results

Analysis of interest and spillover areas provided different answers to the predictions made prior to the experiment, with the exception of the significant negative correlation of this variable with the RTs. Unsurprisingly, RTs were smaller for more proficient speakers than for less proficient ones, regardless of sentence type.

The passive was expected to show smaller RTs in comparison to the other three types of sentences due to its overall correspondence between English and BP, and this prediction was only partially confirmed. While analysis of interest areas showed no significant differences in RTs for passives, data from the spillover areas showed RTs for passives were significantly smaller than those

[8] Unlike in the analysis of critical words, items contributed significantly to the total variance of random effects ($\chi^2 = 11.454$, $p < .001$) in the analysis of spillover words and were therefore included in the model.

of the middle and resultative sentences, and not significantly smaller than those of the induced action sentences. Additionally, middle and resultative sentences – the ones with potential interference of meaning distinctions between L1 and L2 – showed significant differences in the spillover area, with resultatives being read faster than middles.

The final prediction made for this experiment was also partially confirmed: proficiency correlated significantly only with the spillover area in middle sentences, but not with the other sentence types.

### 3.4. Discussion

At first, the results from the analysis of critical words seem to indicate that processing of resultatives is less costly than that of induced action sentences, with no significant differences from the processing of the middle construction. This would suggest that parsing prioritizes syntactic information which, in turn, would mean that facilitation by word order correspondence alone would reduce the cost of processing of constructions whose L1 counterparts do not represent a syntactic violation. In that sense, word-by-word correspondents of both the resultative (though depleted of its actual resultative meaning) and the middle voice (despite its implausible interpretation) result in syntactically licensed structures in L1 BP, as they are both instances of the active construction (sentences 20 and 21). Word-by-word correspondents of the induced action construction do not (sentence 22):

20. *The driver filled the tank full before going on vacation.*
*O motorista encheu o tanque cheio antes de sair de férias.*

21. The bed sleeps comfortably after a couple of weeks.
*?A cama dorme confortavelmente após algumas semanas.*

22. The captain marched the soldiers to the tent.
** O capitão marchou os soldados para a barraca.*

A syntax-first account of sentence parsing, however, does not offer an explanation as to why resultatives showed smaller RTs than passives, which are similar in L1 BP and L2 English in both morphosyntactic structure and meaning, as processing of an entirely correspondent construction between L1 and L2 is expected to be less costly than that of a construction that does not share underlying meaning given the same structure. Frequency-based accounts of linguistic processing are equally unable to provide an explanation for these results based on the frequency discrepancy between actives and passives (GUIMARÃES; SOUZA, 2016), as the critical word in resultative sentences was not the verb, but the adjective following the verb's direct object.

Caution is required when attributing SPR results to modular and serial approaches to syntactic parsing (e.g., FRAZIER; RAYNER, 1987) because of the widely observed spillover effect present in SPR tasks: processing difficulty of the critical segment is observed on subsequent segments

of the experimental sentence (LIVERSEDGE; PATERSON; PICKERING, 1998; OLIVEIRA; MARCILESE; LEITÃO, 2022). Spillover words in each sentence type were: the head of the agent by-phrase in passives; the adverb of manner following the main verb in middle sentences; the head of the directional prepositional phrase in induced action sentences; and adverb modification in resultative sentences.

The middle and resultative sentence types showed higher RTs in comparison to passives, following the prediction that structures relative to equivalent constructions are more easily processed. However, RTs for middle sentences were also significantly higher than those for resultatives, indicating that these two constructions stand in different levels of similarity between BP and English. In essence, these constructions differ in their word-by-word translation possibilities: direct translation of English resultatives yields licensed sentences in BP (with the result-indicating adjective functioning as the direct object's post-head noun modifier), while translation of the English middle voice sentences in this experiment results in sentences that are semantically implausible based on the verb licensing discrepancy.

Finally, the comparison between passive and induced action sentences showed somewhat unexpected results. Based on an analysis of acceptability judgments by Author (2014), RTs for the induced action construction were expected to correlate negatively with proficiency level, as were the acceptability rates reported by the authors. Although RTs for induced action tended to be higher than those for passives, the difference was not statistically robust and there was no effect of proficiency associated with this slight increase in RTs for induced action sentences. From this data, it is only possible to offer conjectures that require further empirical investigation. It could be argued that critical words in induced action sentences presented high levels of surprisal for speakers of different levels of proficiency, and two different conjectures can be made to accommodate the high across participant profiles. A type of Goldilocks effect (ZARCONE et al., 2016) may have taken place for low-proficiency bilinguals, in which the surprisal levels were so high that these speakers may have considered the sentence ungrammatical and thus undeserving of further interpretation attempts by the time they encountered the head of the directional PP. Higher RTs among high-proficiency speakers may have shown a frequency effect (LEVY, 2008), which is to be expected due to it being exclusive to English.

This explanation is tentative at best for two main reasons. First, proficiency was included in the analysis as a continuous variable, making it impossible to establish a threshold between low- high-proficiency bilinguals to determine whether high RTs were due to interpretation of induced action sentences as ungrammatical or to the construction's low distribution. Although a number of previous studies employing the VLT as a measure of proficiency have established a score beyond which a participant is considered to show high L2 proficiency (e.g., GUIMARÃES, 2021; SOUZA et al., 2014), a theoretical framework of late L2 development that assumes acquisition of different constructions to be based on L2 input availability (either formal or natural) is not compatible with such a clear-cut distinction between high and low L2 proficiency.

Second, attesting such interpretation is not possible using the tools available in SPR tasks. The comprehension questions that follow experimental items serve as a strategy to ensure mindful reading, so much so that items whose answers were wrong were excluded from the analysis. Their methodological significance stops at attention, as comprehension questions cannot allude to the actual meaning of the structure under investigation at the risk of causing a learning effect that would skew results. Thus, any explanation as to why RTs of induced action sentences were not significantly higher than those of passive sentences has to undergo empirical investigation, ideally under linguistic production paradigms (GUIMARÃES, 2021).

## 4. General Discussion

Similarity is expected to offer facilitation in processing given the smaller informational load associated with similar structures. As L2 processing departs from representations available in the speaker's linguistic system – initially coming from the L1 and gradually built based on exposure to distributional information in the L2 input –, processing facilitation for less proficient speakers is expected to rely more on L1-L2 similarity than for more proficient speakers. The present study thus focused on the aspects of linguistic similarity (and its relation to L2 proficiency) that result in processing facilitation. Based on the definition of similarity as word order correspondence, it remained to be seen how differences in meaning resulting from direct translation would influence processing facilitation.

The ultimate distinction between the middle and the resultative constructions in English and BP is that, while the first presents different lexical restrictions in both languages, the latter presents a BP equivalent that fails to convey its English underlying meaning. Thus, successful and less costly processing of the resultative would in theory rely greatly on exposure to L2 input, both to assign the appropriate event role to the adjective and to prevent the post-head modifier interpretation, unlicensed in English. Conversely, successful processing of middle constructions presenting unlicensed verbs in L1 BP would require that the speaker apply the middle interpretation to a novel item, associating a new token with an existing type.

The findings in this study showed that differences in proficiency levels influenced processing of the middle construction, but not the resultative. This suggests that familiarity with middle constructions presenting verbs that do not occur in it in L1 BP increases based on exposure to distributional information in the L2 input and relies less on generalization of the middle construction to novel lexical items from the L2. Had it been the opposite, there would not be an interaction between proficiency level and the middle construction, as both high- and low-proficiency bilinguals would be able to process it based on the existing middle representation from the L1. It can be argued that the informational load of the middle construction was higher for lower-proficiency speakers based on the availability of distributional information of the construction in the L2, as it is not only infrequent but also highly lexically restricted in BP.

The difference in results between resultative and middle sentences indicate that processing facilitation from L1-L2 similarity is not structural, but constructional. Processing of the resultative was significantly more costly than that of the L1-L2 equivalent passive, suggesting that the resultative was not processed as an equivalent active with a noun-adjective order violation. Processing of the middle, on the other hand, was more costly than that of the English-exclusive induced action despite existing in both languages, indicating that the lexical restrictions on the construction did not allow for extrapolation of the existing middle onto the new lexical item. It is not enough to have licensed morphosyntax; the underlying constructional meaning must also be possible in both languages. The lexical restriction violation present in the English middles prevented speakers from processing it based on existing L1 patterns despite its correspondent morphosyntax and underlying constructional meaning. Although these results are do not provide sufficient data to categorically affirm that the middle maps onto distinct representations in BP and English, it is clear that the occurrence of verbs in the English middle that are not possible in BP presented high levels of surprisal that required error adaptation in the processing of a similar construction.

Note that these results do not challenge the definition of similarity as word order correspondence, as structures in a given pair or group of languages are analyzed in terms of their similarity when they serve the same function – passives are contrasted to passives, relative clause modification is compared to relative clause modification, and so on. The analysis of this study departed from word order correspondence in BP and English, and not on similar or equivalent structures in both languages, to investigate whether processing facilitation takes place regardless of semantic discrepancies of word-by-word equivalent structures. The passive in English translates as passive in BP; the resultative translates as active; the middle translates as an unlicensed middle due to semantic violation; the induced action translates as an unlicensed causative based on syntactic-semantic constraints. The point of interest was the possible trade-off between underlying meaning the word order correspondence between L1 and L2, which showed to be significant in face of a lexical violation whose BP correspondent resulted in implausible sentences as was the case of the middle construction.

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