

Linear distance and markedness effects in variable subject-verb agreement processing in BP

Efeitos de distância linear e marcação no processamento da concordância verbal variável no PB

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Abstract: This paper investigates the role of linear distance between subject and verb and of morphological number marking for the processing of variable subject-verb agreement in Brazilian Portuguese (e.g. *Policiais Militares, após denúncia, prendeØ/ prendem traficante*). On the basis of

studies regarding agreement processing – based on the comprehension and production of the so-called attraction errors (E.g. *O tecido das cortinas rasgaram*) – and the findings from research on Variationist Sociolinguistics, we conducted a reading experiment by means of a maze task. The results suggest that distance has an impact on the computation of the number features in the verb: significantly shorter reaction times were registered under long distance conditions. In addition, subject (singular/plural) and verb number marking also proved to be relevant. Plural subjects appear to be more robustly maintained in the speaker's memory and to impose greater restrictions on agreement computation, as compared to singular subjects, even in the context of speakers exposed to linguistic variation in which non-redundant marking is found.

Keywords: variable agreement; agreement processing; linear distance; markedness.

Resumo: Este artigo investiga o papel de distância linear entre sujeito e verbo e de marcação morfológica de número no sujeito e no verbo no processamento da concordância verbal variável no português brasileiro (Ex.: *Policiais Militares, após denúncia, prendeØ/ prendem traficante*). Tomando como ponto de partida estudos sobre o processamento da concordância – baseados em dados de compreensão e de produção dos denominados erros de atração (Ex.: *O tecido das cortinas rasgaram*) – e resultados de pesquisas sobre a concordância variável realizadas no contexto da Sociolinguística Variacionista, foi elaborado um experimento de leitura conduzido por meio de uma *maze task*. Os resultados obtidos sugerem que a distância tem impacto na computação dos traços de número no verbo: tempos de reação significativamente menores foram registrados nas condições de distância longa. Além disso, a marcação de número do sujeito (singular/plural) e do verbo também se mostrou relevante. Sujeitos plurais parecem ser mantidos na memória de forma mais robusta e estabelecer restrições mais pesadas na computação da concordância do que sujeitos singulares, mesmo no contexto de falantes expostos à variação linguística em que marcas não redundantes são atestadas.

Palavras-chave: concordância variável; processamento da concordância; distância linear; marcação morfológica.

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1 Introduction

Studies about agreement processing in both production and comprehension have focused heavily on the investigation of the so-called attraction errors. In the realm of this type of literature, a series of factors have been assessed which could potentially interfere in the computation of subject-verb agreement. It is thus known that the attraction errors, or attraction lapses, are favored in situations in which the head of the subject is singular and there is a linear or hierarchical distance between this head and the verb, as in the case of (1) (RODRIGUES, 2006, p. 15):

- (1) A análise dos **resultados** experimentais **indicaram** um efeito principal de número do núcleo interveniente no processamento da concordância.

The **analysis**_{sing} of the experimental **results**_{pl} **indicated**_{pl} a main effect of the number of the intervenient head in the agreement processing.

(The analysis of the experimental **results indicated** a main effect of the number of the intervenient head in the agreement processing.)

It should be noted that the errors consist of disruptions in processing, which are not associated with an unawareness of the rules of a language's grammatical structure, and in this sense, reflect a question of performance and not of linguistic competence. They are, thus, as Fromkin (1973, p.217) claims: "unintentional linguistic innovations", "deviations in the performance as regards the [spoken] phonological, grammatical, or lexical intention of the speaker."¹

¹ In the realm of Psycholinguistics, lapses in speech are characterized as utterances stemming from disruptions in some of the typical linguistic processing stages (i.e. in individuals with no linguistic impairment). This type of occurrence was first investigated by Meringer and Mayer (1885), leading to the publication of a list of speech and writing errors in German. In the same time period, Freud, in his **Psychopathology of Everyday Life**, analyzes lapses in speech from a psychoanalytical perspective (FREUD, 1901). It is worth noting that Freud himself makes a reference – in chapter V of this work – to the aforementioned work of Meringer and Mayer. In the 1970s, the investigation of the lapses will be taken up again by Fromkin (1971, 1973) and Garrett (1975, 1976), who proposed models that sought to establish the means of thinking for articulated speech

In languages that contain a linguistic variation regarding agreement, as is the case of Brazilian Portuguese (BP), it is not always easy to distinguish between a typical occurrence of an attraction error and contexts in which the occurrence of a non-standard variant would be possible, as illustrated in (2), in which the head of the subject is plural, and there is a potential attractor element between the subject and the verb.

- (2) **Contas vazias** do Estado **deixa**Ø pagamento de servidores, pela Justiça, sem prazo para acabar. (*Jornal Extra* online, 13/09/2016).

Empty_{pl} **accounts**_{pl} of the **State**_{sing} **leave**_{sing} the public servants' salary, determined by the Courts, with no a clear deadline.

(The State's **empty** accounts **leave** the public servants' salary, determined by the Courts, with no a clear deadline.)

The question at hand, therefore, is if the absence of the verb's plural number marking corresponds to an attraction error or, by contrast, if it reflects the existence of variable agreement rules within the language itself.

Since the 1970s, descriptive studies in the realm of Variationist Sociolinguistics have pointed to the systematic form through which number agreement in BP constitutes a variable phenomenon (LEMLE; NARO, 1977; NICOLAU, 1984; GRACIOSA, 1991; SCHERRE; NARO; 1993, 1997, 1998a, 1998b, among others; BRANDÃO; VIEIRA, 2012; VIEIRA, 2015; MENDES; OUSHIRO; 2015).

Two general rules of subject-verb number agreement can be identified in the language: (i) morphologically redundant marking, with the reiteration of the plural information in all of the relevant items involved; (ii) morphologically non-redundant marking, with plural marking exclusively on the subject, but omitted on the verb. Rule (ii) is exemplified in (3) as follows:

through speech error data. In the site of the Max Planck Institute (https://www.mpi.nl/dbmpi/sedb/sperco_form4.pl) it is possible to access a database of lapses of speech that include the *corpora* of many languages (English, French, Italian, and German). Lapses can be categorized according to the linguistic units involved in each case (phonological features, phonemes, syllable, morpheme, word, phrase, or sentence) and the type of mechanism involved in the error (fusion, substitution, addition, erasing of units, etc.).

- (3) [...] as criançaØ iráØ aprender os relacionados ao ambiente
 [...].²
 [...] the_{pl} child_{sing} will_{sing} learn that related to the environment
 [...].
 (The children will learn that related to the environment.)

The variation between the two presented rules would not be free, but rather conditioned by the actions of linguistic and extralinguistic factors. In the specific case of subject/verb agreement, among the external variables that seem to play a role in the occurrence of variable verbal agreement, age, origin, and gender are some of the previously investigated factors. However, the education level is, among the sociolinguistic factors explored in the literature, what has been most commonly identified as relevant (VIEIRA, 1994; VOTRE, 2013).

As regards the linguistic variables considered relevant by corpora studies, we can highlight: (i) the position of the subject (pre-verbal or post-verbal subject); (ii) the semantic features of the subject (especially the contrast between animate/inanimate subjects); and (iii) the distance between the subject and the verb (COSTA, 1994; SILVA, 2005; SANTOS, 2010; SCHERRE; NARO; 1998b, 1997).

It can also be observed that one factor, the linear distance between the subject and the verb, seems to be relevant both to predict the occurrence of attraction errors and to favor the occurrence of non-redundant agreement in the case of BP.

It is important to emphasize that, while studies on agreement errors are quite rich, including studies that investigate writing production (BOCK; MILLER, 1991; BOCK; CUTTING, 1992; BOCK; EBERHARD, 1993; FAYOL *et al.*, 1994; VIGLIOCCO; NICOL, 1998; FRANCK *et al.*, 2002; for BP RODRIGUES, 2005a, 2005b, 2006, COSTA, 2013; ALMEIDA, 2016; errors in writing, FAYOL *et al.*, 1994; among others),³ works involving the processing of variable

² Example taken from a group of randomly chosen sentence fragments, collected by the authors in an anecdotal manner by means of written works produced by university students in the context of diverse subjects between 2014 and 2016.

³ In the case of research in language processing conducted with BP speakers, concerning the dialog between Psycholinguistics and Linguistic Variation Studies, it is important to highlight the works of Costa (2014) and Almeida (2016), who, though they do not

agreement are still scarce and very recent (for BP, MARCILESE *et al.*, 2015; HENRIQUE, 2016; AZALIM, 2016; AZALIM *et al.*, submitted for publication; for English, SQUIRES, 2014).

The present paper explores – through experimental methodology – to what extent linear distance is a relevant factor in the processing of variable agreement by university speakers.⁴ Bearing in mind the initial presupposition that non-redundant agreement can be the most frequent variant of this group – due to the education level, which broadens the possibilities of contact with a redundant variant of agreement – we sought to verify if the larger distance between the subject and verb could improve the acceptance of the sentence in which the subject is marked in the plural, while the verb appears in the singular.

As this is a practically unexplored issue in psycholinguistics literature, there is very little literature directly connected to it. Nevertheless, studies focusing on the role of distance (linear and hierarchical) and morphophonological marking (singular/plural) in the subject when agreement errors occur are of interest. Also interesting to this debate is the more recent discussion on the fallibility of the *parser* in relation to the linguistic phenomena that can induce grammatical illusions (PHILLIPS; WAGERS; LAU, 2011). Research conducted in the realm of Variationist Sociolinguistics still provides the fundamental

focus on variable agreement as a topic of investigation, bring a level of discussion regarding the possible effect of linguistic variation in the agreement process. Costa analyzes structure in which meteorological verbs inserted in relative clauses agree in number with the antecedent of the relative pronoun (Ex. *Essa roupa é perfeita para locais que ventam muito/ This clothing is perfect for places_{pl} that win_{pl} a lot/This clothing is perfect for places with strong winds.*) and discuss the frontiers between error and innovative structure in BP. Almeida, by contrast, upon examining agreement in predicative structures, in production and comprehension, discusses the effects of morphological marking in the processing of these configurations, observing a possible effect of unmarked forms (singular and masculine) in predicative structures.

⁴The present article stems from a study conducted in the realm of the project *Interfaces internas e externas na aquisição e no processamento adulto de L1 e L2: concordância e tópico/ foco no PB (Internal and external interfaces in the acquisition and adult processing of L1 and L2: agreement and topic/focus in BP)*, funded by FAPEMIG (Grant announcement 1/2015, Universal Demand – Protocol number APQ-00988-15). The referred project also received approval from the Ethics Committee at Universidade Federal de Juiz de Fora (CAAE: 44123015.6.0000.5147).

background information for the development of the research from which this article arises.

In §2, some of these studies will be presented. Studies on agreement processing that assess both production and comprehension are discussed in §3. In §4, the experiment conducted in this study is reported, and the final considerations are presented in §5.

2. Variable verbal agreement in BP and the distance between the subject and the verb

In the Variationist Sociolinguistics, various studies have pointed to the importance of the linear distance factor in verbal agreement in BP (BRANDÃO; VIEIRA, 2009; SCHERRE; NARO, 1997; GRACIOSA, 1991; among others). According to Naro (1981), the clearer the subject/verb relationship and the closer the subject is to the verb to which it refers, the greater the chance of the verb receiving the morphophonological marking of a plural form. In writing, including contexts understood as being more monitored – as is the case with journalistic texts – the occurrences of non-redundant verbal agreement is more common when the subject is distant from the verb (4-5).

- (4) Os policiais militares, Sargento Souza e Sargento Ottoni (na foto acima), sob o comando do capitão Flávio, **realizou**Ø nessa quarta-feira, 20/01, duas ocorrências que **resultou**Ø em prisões dos autores (dados retirados de HENRIQUE, 2016)

The policemen_{pl}, Sargent Souza and Sargent Ottoni (in the photo above), under the command of Captain Flávio, **conducted**_{sing} Ø this Friday, 01/20, two police actions that **resulted**_{sing} Ø in the arrest of the culprits (data taken from HENRIQUE, 2016)

- (5) Policiais Militares, após denúncia, **prende**Ø traficante do bairro Boa União. (dados retirados de HENRIQUE, 2016)

The Policemen, after the denouncement, **arrested**Ø the trafficker in the Boa União neighborhood (data taken from HENRIQUE, 2016)

Regarding the written modality, Motta (2011) investigated the occurrence of variable verbal agreement in compositions written by

students who attend EJA courses⁵ and students enrolled in regular courses in elementary and high schools in public and private schools located in the city of Rio de Janeiro. The study sought to analyze the linguistic factors that most commonly influenced the marking of the 3rd person plural in their compositions, in addition to assessing extralinguistic factors, such as education level (EJA, elementary, and high school education), the participant's gender, and the age range. The collected data were divided into three groups: group 1, consisting of compositions from students from a private school; and group 2, consisting of the writing production of students from a state public school from the state of Rio de Janeiro. The conducted analysis suggested that, in the written modality, the phonic saliency⁶ would be a decisive linguistic factor for the presence or absence of the marking of the 3rd person plural form of verbs. By contrast, the relevance of the distance of the verb in relation to the subject was found in some compositions, but in a limited number of occurrences (19 data, with 12 occurrences with the marking of the plural form, totaling 63% of the total). The fact that the subject precedes the verb also proved to be a determining factor for redundant agreement. According to the author, the position of the subject preceding the verb considerably favors the use of the standard variation in verbal agreement. In general, the data analyzed by Motta (2011) is inconclusive regarding the relevance of the linear distance due to the small volume of examples of subjects that are distant from the verbs in the analyzed sample. Nonetheless, many prior studies (BRANDÃO; VIEIRA, 2009; SCHERRE; NARO, 1997; GRACIOSA, 1991) report that the linear distance would be one of the determining

⁵ EJA is a program of the Brazilian government that aims to offer Elementary and Secondary Education to young people and adults who did not have the opportunity to study at the appropriate time.

⁶ Phonic saliency is associated with the fact that singular and plural forms have a greater or lesser phonic identity when compared to each other. In this sense, the singular and plural forms of verbs, such as *ser* (to be), in the third person of the present tense (*é/são*), would have a greater degree of phonic saliency than would verbs such as *comer* (to eat – *come/comem* in the present tense), in which the singular and plural forms are more phonetically and morphologically similar to one another. Analyses of corpora suggest that the lower the degree of phonic saliency of an item, the more favorable the context would be to the non-redundant marking of the plural form (LEMLE; NARO, 1977, among others).

factors to explain the variable occurrence of the morphological marking of verbs in the plural form.

According to Scherre and Naro (1997), the more intervening material there is between the head of the subject and the verb, the lesser the probability of producing a redundant agreement marking between the two elements. One of the explanations put forth for this phenomenon would be restrictions in the capacity of an individual's work memory, which would have greater difficulty to recover the information regarding the number of the head of the DP subject.

Graciosa (1991), upon analyzing the alternation in the morphological marking of the verb in the speech of well-educated people from Rio de Janeiro, verified that: "when there is a linear proximity between the noun phrase (NP) and the verb phrase VP, there is a greater guarantee of the rule being applied" (GRACIOSA, 1991, p.69). Santos (2010, p. 98), by contrast, observes that the non-redundant verbal agreement is conditioned by the factor of "the presence of elements", while redundant verbal agreement is conditioned by the factor of "the absence of elements" between the subject and the verb. It is important to emphasize that, while the study conducted by Graciosa (1991) investigated the phenomenon of variable verbal agreement in the oral production of adult speakers, the study conducted by Santos (2010) analyzed the cancelling of the marking of the verb in the plural form in narratives from children who attend philanthropic institutions in Maceió, Brazil.

In one recent comparative study conducted by Rubio (2012), 67.9% of the cancelling of redundant marking were found in data written in sentences in which the distance between the subject and the verb was between six and ten syllables. According to the author, these results: "*illustrate that the widening of the distance between the verb and its subject promotes, according to aforementioned premises, a weakening of verbal agreement*" (p.280).

The role of linear distance in variable agreement has also been perceived in other varieties of Portuguese. Lopes and Baxter (2010), considering in this case the Portuguese spoken in Tonga, point out the interference of the distance factor for agreement. According to the authors, the complexity of the NP and the distance between the subject and the verb would affect agreement rules in this variety of Portuguese. According to Lopes and Baxter (2010), in cognitive and pragmatic terms, adjacency

between these elements corroborates the implementation of the rule. By contrast, Rubio (2015), analyzing European Portuguese, reports that the position of the verb in relation to the subject (pre- or post-verbal) would heavily influence the occurrence of variable agreement in this variety. In particular, pre-verbal subjects, coupled with a greater distance (more than 10 syllables) configure a context that hinders redundant marking.

3. Studies on agreement processing: attraction errors and variable agreement

As previously mentioned, in psycholinguistic literature, subject-verb agreement has been explored mainly in association with “attraction errors” (CLAHSEN; HANSEN, 1993; VIGLIOCCO; BUTTERWORTH; GARRET, 1996; VIGLIOCCO; NICOL, 1998). Attraction errors occur when a verb agrees with a noun other than its subject. It is frequently associated with complex NPs, and the verb does not agree with the head of the subject, but rather with another intervening element inside the complex NP. Sentence (6) below illustrates an attraction error:

(6) O álbum das fotos rasgaram.

O_{sing} album_{sing} das_{pl} fotos_{pl} tore_{pl}

(The photo album tore.) (RODRIGUES, 2005a, p. 146)

Many studies have reported an asymmetry between the singular and plural forms in attracting errors (BOCK; EBERHARD, 1993; EBERHARD, 1999; in BP, RODRIGUES, 2005a). Thus, the condition in which N1 is singular and N2 is plural (7) shows a greater number of attraction errors than the condition in which N1 is plural and N2 is singular (8). It is important to remember that the configuration in (8), but not in (7), is that involved in the cases of variable agreement (i.e., plural subject + singular verb).

(7) A caixa_{N1} das canetas_{N2} ... sujou/sujaram.

(The box_{N1} of pens_{N2} ... has/have gotten dirty.)

(8) As contas_{N1} do estado_{N2} ... fechou/fecharam.

(The bills_{N1} of the state_{N2} ... has/have balanced.)

The effect of linear distance in agreement attraction errors was initially investigated by Bock and Miller (1991), in an experiment in which they manipulated, among other factors, the size of the preambles that worked as subjects of the sentences by placing an average of two pre-nominal adjectives in the modifier (Ex.: *The key to the cabinets* vs. *The key to the ornate Victorian cabinets*). In this same experiment, the authors also varied the type of modifier of the head of the subject – prepositioned phrase (PP) and relative clause – and the number, both of the head of the subject and of the nominal head of the modifier. No main effect of the size of the modifier was observed. No interaction between these variables was reported.

Bock and Cutting (1992), in a later experiment, also involving prepositional and clausal modifiers, obtained an effect of the number of the local noun as well as of the type and size of the modifier. There was an interaction between the number of the local noun and type of modifier and between the type and the size of the modifier. As far as distance is concerned, an effect of the size of the modifier was obtained only for PPs. These results were taken as evidence favoring the “clausal packaging” hypothesis, according to which a clausal boundary would reduce the probability of an agreement error by insulating the head noun from the number feature of the local noun

As far as comprehension is concerned, results from a reading experiment, which employed the eye-tracking technique, conducted with Hebrew speakers (DEUTSCH, 1998), suggest that linear distance between the subject head noun and the verb is a factor that affects the detection of agreement errors in number and gender in a verb (the verb agrees in number and gender with the subject in Hebrew). In this study, what was more commonly identified were errors in short rather than long distance.

Pearlmutter (2000) conducted two experiments of self-monitored reading⁷ aimed at assessing the impacts of distance in agreement

⁷ The paradigm of self-monitored reading was introduced independently by many different researchers (see also MITCHELL, 2004) and is characterized by the fact that the participant him/herself is allowed to control – by pressing a button – the time of exposure to each word, segment, or full phrase during the reading process. It is assumed that the time taken to press the button (passing from one segment, word, or phrase to the next) depends on the properties of that which is being read and is related to the course of the cognitive processes that occur while reading and understanding.

processing in comprehension. The author manipulated the distance between the intervening element and the head of the subject in order to contrast two hypotheses: (i) a hypothesis based on the idea of percolation (VIGLIOCCO; NICOL, 1997) and on a *hierarchical feature-passing system* and (ii) a hypothesis based on a *linear slot-based system*.

According to the hypothesis (i), hierarchical distance between the intervening element and the maximum projection of the head of the subject would be the determining factor of interference effects. Thus, the closer the element with an incongruent number was to the higher projection, the greater the chance of this element affecting agreement processing. Thus, upon contrasting the sentences (9) and (10), below, the first would generate more interference than would the second:

(9) The lamp near the paintings of the house was damaged in the flood.

(10) The lamp near the painting of the houses was damaged in the flood.

According to hypothesis (ii), on the other hand, the interference effects would be directly associated with the fading of information within the working memory. The idea is that there would be a slot in the memory reserved to track the number of the NP subject during parsing and that the information of the number of the head of the subject would tend to decline with time or distance.

Thus, an intervening element that is more distant from the head of the subject would have a better chance of generating an interference, since the representation of the number of the head would have undergone a fading process. Hence, a sentence like (10) would more likely suffer interference effects than would (9).

Pearlmutter (2000) observed an interference effect only in experiment 2, whose stimuli were all sentences with an N1 plural (Ex. *The lamps near the painting(s) of the house(s) were...*). In this experiment, when the number of N2 (painting) was incongruent in relation to the number of N1, the reading times for the verb were greater. The results from the second experiment are in accordance with the hypothesis that hierarchical distance is a relevant factor in agreement processing, as well as with the idea that the number marking of the head of the subject affects this process, and are in accordance with production studies

(VIGLIOCCO; NICOL, 1998, with English speakers and RODRIGUES, 2006, with BP speakers).

Pearlmutter observes, however, that one cannot fully discard a possible effect of linear distance. According to the author, if there were no interference of this factor, it would be expected that the plural subjects of experiment 2 would be as invulnerable to interference as plural subjects in constructions involving a single PP (Ex. *The keys to the cabinet*). One additional point raised by Pearlmutter concerns the nature of the intervening elements between the subject head and the verb. According to the author, what should possibly be considered is not only the number of intervening elements, but rather the need for these to be computed in a process of tracking the number features.

Wagers, Lau, and Phillips (2009) conducted a series of seven experiments, involving structures with intervening elements between the head of the subject and the verb, which could potentially cause a disruption in the computation of agreement.

Among the investigated structures, there were NPs modified by PPs and NPs modified by relative clauses. In the case of PP modifiers, N1 was always in the singular and the number of N2 and the number of the verb were manipulated (Ex. *The key to the cell(s) (unsurprisingly) was(were) rusty from many years of disuse*); in the case of clausal modifiers, both the number of the N1 and that of N2, as well as the number of the verb in the relative clause, were manipulated (Ex. *The musician(s) who the reviewer(s) praise(s)*).

As far as results are concerned, it is relevant to highlight that attraction effects were reported for relative clauses (in which the verb seems to agree with the subject of the main clause – *The musician who the reviewers praises*) and were only observed in ungrammatical sentences. Such results are taken as evidence for a mechanism to recover the features of the subject guided by cues (similar to the slot-based memory system, by Pearlmutter, 2000). The authors argue that, if the problem had been associated with the representation of the number of the subject (as seen in the hierarchical feature-passing model), an effect would also be expected in the case of grammatical sentences (Ex.: *The key to the cells (unsurprisingly) was rusty from many years of disuse*), since the modifier, upon impacting the number of the highest hierarchical projection, would be incongruent with the verb. Thus, in this example, the number feature of *cells*, through a percolation process, could end up

specifying the number of the DP as plural, which would be incompatible with the number of the verb, singular form – *was*. Rodrigues (2011) notes that the authors report an attraction effect in the position of the verb, in one of the comparisons between grammatical pairs: *The key to the cells unsurprisingly was rusty from many years of disuse* (with a plural form of N2) vs. *The key to the cell unsurprisingly was rusty from many years of disuse* (with a singular form of N2 / controlled condition), with longer reading times for the former. This result, which was not expected according to their hypothesis, is explained in terms of a spillover, which would extend to the next region, that of the adverb.

Rodrigues (2011), in an off-line experiment, an adaptation of the grammaticality judgement technique,⁸ verified that the presence of the plural form of an N2 in the position of a modifier of the head of the subject, significantly reduces the rejection of sentences in which the subject/verb agreement is ungrammatical –the average acceptance for the condition of the singular form of N2 + the plural form of V (Ex. *O pediatra da criança da creche receitaram o remédio / The child's pediatrician at the daycare center prescribed the medicine*) was 0.5 in a maximum score of 4, while the average for the condition of the plural form of N2 + the plural form of V (Ex. *O pediatra das crianças da creche receitaram o remédio / The children's pediatrician at the daycare center prescribed the medicine*) was 2.3. By contrast, in the case of grammatical conditions (singular form of N2 + singular form of V: *O pediatra da criança da creche receitou o remédio / The child's pediatrician at the daycare center prescribed the medicine*) vs. the plural form of N2 + the singular form of V: *O pediatra das crianças da creche receitou o remédio / The children's pediatrician at the daycare center prescribed the medicine*), there was no difference in terms of the rate of acceptance, as both presented results near the maximum score (3.8 and 3.7, respectively).

⁸ The adopted experimental procedure consisted of the presentation of sentences, word by word, in the center of a projection screen. The participants received the information that the sentences had been produced by foreign speakers and that the task to be carried out consisted of saying whether or not the foreigner dominated Portuguese. The judgments, recorded in an answer key, could be of two types: “D” for Dominates or “N” for does not dominate. There was a set time between the presentation of the stimuli, and the answer should be given as quickly as possible.

Rodrigues (2011) results are compatible with Wagers, Lau, and Phillips (2009) proposal, according to which, in comprehension, the attraction effect would occur as a re-access to information regarding the number of the subject upon the identification of the verb. An alternative analysis also considered by the authors is that the number of the verb could be anticipated through a predictive mechanism. Only in cases of ungrammaticality would there occur a re-analysis process. This explanation is, to a certain extent, compatible with the model of Parser Monitored Production (PMP), presented by Rodrigues (2006), to explain agreement errors caused by attraction in the production process.

One question that the experiments on agreement processing in comprehension raise is that of the selective fallibility of the *parser* and the so-called grammatical illusions (PHILLIPS; WAGERS; LAU, 2011). According to these authors, *grammatical illusions*, in general, constitute a set of grammatical constraints which appear to have a more delayed impact on language processing, such as: anaphora, agreement, case, and dependencies. According to the authors, although the human parser was highly efficient in the implementation of determined complex grammatical constraints, such as constraints in the use of reflexive pronouns, this would not be so efficient in relatively simple constraints, generating grammatical illusions.

As mentioned previously, studies on variable agreement processing are quite rare in the literature. Squires (2014) constitutes an exploratory study that investigates the role of a set of social variables (social class, gender, and ethnicity) in the processing of agreement variation in American English. More specifically, the author was concerned with the means through which the agreement variation between the subject and the verb is processed during the comprehension of sentences. Three self-paced reading experiments were conducted, investigating three distinct patterns of agreement:

- a) Standard agreement (they don't/ he doesn't);
Plural: *After eating, the turtles don't walk very fast.*
Singular: *After eating, the turtle doesn't walk very fast.*
- b) Non-standard agreement (he/she don't);
After eating, the turtle don't walk very fast.

- c) “Uncommon” agreement, i.e., an option that was not recognized as a variation present in American English (they doesn’t).

*After eating, the turtles doesn’t walk very fast.

This study included 112 volunteers, undergraduate students who were aware of standard agreement. The participants answered a questionnaire and were grouped according to three categories: class (high or low), ethnicity (white, Afro-American, or other), and gender (male and female). Based on previous sociolinguistic studies, the author predicted that middle class, Afro-American, and male participants would be less affected by the variation in agreement, obtaining similar reaction times for both standard and non-standard conditions. It was also expected that upper class, white, and female participants would be more sensitive to these differences, presenting higher reaction times for non-standard and uncommon conditions.

We would like to highlight that, regardless of the social class, sentences with standard agreement were read more quickly, and sentences with uncommon agreement showed higher reading times, while the sentences with non-standard agreement demonstrated intermediate reading times. In an overall view, Squires’ (2014) results suggest differential processing for the non-standard pattern in comparison to the standard one.

As regards BP, Marcilese *et al.* (2015), Henrique (2016), Azalim 2016, Azalim *et al.* (submitted), and Marcilese *et al.* (in preparation) sought to investigate nominal and verbal variable agreement processing. Marcilese *et al.* (2015) conducted a self-monitored listening experiment with undergraduate students, whose results ran in line with that reported by Squires (2014) for English. Listening times were significantly higher for non-redundant agreement conditions, as compared to redundant agreement conditions (*Os esquilo desceu da árvore / The squirrel came down the tree.* vs. *Os esquilos desceram da árvore / The squirrels came down the tree.*). Similar results were obtained by Henrique (2016) in an elicited production by repetition experiment which showed higher reaction times for non-redundant conditions.

Azalim (2016), Azalim *et al.* (submitted), and Marcilese *et al.* (in preparation) investigated the roles of phonic saliency in nominal variable agreement processing in BP. Elicited production by repetition experiments were conducted with undergraduate students, EJA students, and 6-year-

old children. Once again, analyzed as a whole, the results indicate a differential processing of the standard and non-standard patterns, with reaction times that are significantly higher for non-redundant agreement conditions and lower averages of target responses for all the groups (i.e. regardless of education level and age).

Taking into account these previous studies, the present paper aims to extend the investigation on variable agreement processing in BP. The following research questions are addressed in relation to the experiment to be reported in the next section:

- (i) Considering that the participants are undergraduate students (and, therefore, with a greater exposure – at least in writing – to redundant agreement), would the presence of a non-redundant plural marking only in the subject (grammatical in non-standard variety in BP) have a less impact than an ungrammatical counterpart condition (ungrammatical in any variety of BP -singular form of the subject + plural form of the verb: **A menina dançaram / The girl danced*)?
- (ii) Would the linear distance, which can favor the occurrence of errors (in production) and its non-perception as lapses (in comprehension), interfere in the *parser's* verification process of the verbal features, making this more vulnerable to an effect of grammatical illusion?
- (iii) Can the distance contribute to a greater “acceptance” of a variant that is not necessarily part of our participants’ grammar?

4. Linear distance in variable verbal agreement processing

With the aim of investigating the roles of linear distance in the act of variable verbal agreement, a reading experiment was conducted using a maze task.⁹ In general terms, in experiments that employ this technique, the participant’s task consists of making choices about which of the two options is more appropriate to develop a sentence. Different from the traditional self-monitored reading experiments, the maze task requires the local incremental integration of each new word/segment

⁹ For further details on this technique, see Forster, Guerrera, and Elliot (2009) and the *site* <<http://www.u.arizona.edu/~kforster/MAZE/>>.

with the preceding context, which can contribute to inhibiting future spillover effects. It is important to remember that, for the participant, the focus of the task to be performed is the construction of a complete sentence with meaning. In this sense, we consider that punctual aspects, such as the morphophonological marking of items in the sentence under construction, can become less salient than in conventional reading tasks. For this reason, although the phenomenon investigated here is more frequent in oral production, but proscribed in the written standard norm, we consider that a reading task, in the molds of a maze task, could be a methodological option that would meet our objective.

Another relevant point to be considered is the fact that the maze task is designed in such a way that only one of the options presented in each step of the reading makes it possible to form a complete sentence. Thus, in our specific case, in which the critical segment was the verb of the sentence (which could agree or not, in a redundant manner, with the subject), this always constituted the best choice for the overall construction of the sentence.

It can therefore be assumed that, in this task, we have a situation of a “forced choice” and what is truly assessed is how much such a choice proves to be demanding (in terms of reaction time) for the participant. According to this rationale, quicker choices would indicate more automatic and unconscious integration of the information, while more drawn out choices would unveil the perception of some type of incongruence between the relevant item considered to complete the sentence and the previously processed material

4.1 Method

The independent variables were: *linear distance* between the subject and verb (long, short, and zero), the *number of the verb* (singular/plural), and the *number of the subject* (singular/plural). The two first variables were *within-subjects* factors and the third, *between-subjects* group factor. The dependent variables were: reaction time in the target reading/choice (the critical segment considered was the verb of the sentence) and the number of target-answers (choice of the verb in the sentence).

In the present paper, we report only the detailed results relevant to the first dependent variable, i.e. reaction time. The number of target-answers did not prove to be an informative measure, given that, as predicted by the rationale of the technique presented above, the

percentage of target-verb choices was quite high in all of the groups and conditions (Target choices – plural subject: 90% long distance, 83% short distance, 80% zero distance; singular subject: 92% long distance, 89% short distance, 87% zero distance). Although a reduction in the number of target-answers can be observed due to the distance (more answers for the conditions of long distance than for the rest), these difference were not statistically significant.

The presentation of experimental stimuli was performed according to a Latin square distribution (all of the members of the group were exposed to all of the conditions, but the same sentence was not present in more than one condition for the same participant). Throughout the test, 18 experimental sentences (three per condition) and 18 distractors were presented. We used a lower number of distractors than usual (proportion 1 experimental to 2 distractors) due to the fact that the experimental sentences themselves presented a considerable variance among themselves as regards size. In this sense, we estimate that the experimental sentences themselves in each condition also work as distractors. Table 1 presents examples of the experimental conditions. Moreover, the very nature of the task, which requires the participant to deal with the “extra irrelevant material” in each choice, also brings an element of distraction that is not present in the traditional reading tasks.

TABLE 1 – Examples of experimental conditions.

Group 1 – Plural Subject	Condition
Os alunos no início da aula atentamente escutaram a professora. The students at the beginning of the class listened closely to the teacher.	pl. Suj long pl. V
Os alunos atentamente escutaram a professora. The students listened closely to the teacher.	pl. Suj short pl. V
Os alunos escutaram a professora. The students listened to the teacher.	pl. Suj zero pl. V
Os alunos no início da aula atentamente escutou a professora. The students at the beginning of the class listened closely to the teacher.	pl. Suj long sing. V
Os alunos atentamente escutou a professora. The students listened closely to the teacher.	pl. Suj short sing. V
Os alunos escutou a professora. The students listened to the teacher.	pl. Suj zero sing. V

Group 2 – Singular Subject	Condition
O aluno no início da aula atentamente escutaram a professora. The student at the beginning of class listened closely to the teacher.	sing. Suj long pl. V
O aluno atentamente escutaram a professora. The student listened closely to the teacher.	sing. Suj short pl. V
O aluno escutaram a professora. The student listened to the teacher.	sing. Suj zero pl. V
O aluno no início da aula atentamente escutou a professora. The student at the beginning of class listened closely to the teacher.	sing. Suj long sing. V
O aluno atentamente escutou a professora. The student listened closely to the teacher.	sing. Suj short sing. V
O aluno escutou a professora. The student listened to the teacher.	sing. Suj zero sing. V

Participants

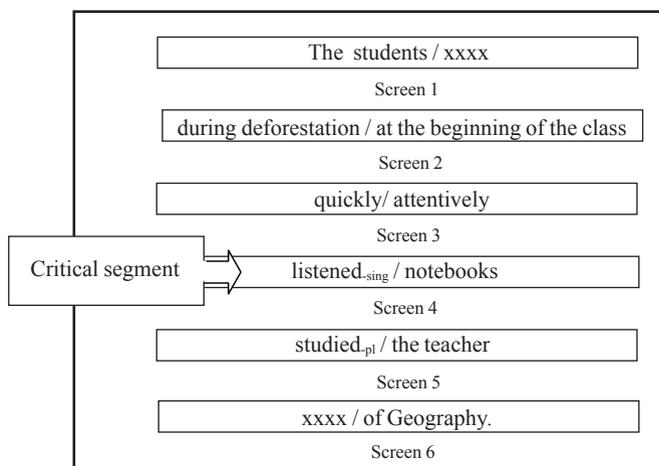
Forty adult volunteers participated in this experiment. All of the participants were undergraduate or graduate students, from a wide range of courses. The average age of the participants was 26 years. The participants were divided into two groups according to the group variable of *number of the subject*. Hence, for one group, only experimental sentences with plural subjects were shown, while for the second group, sentences containing singular subjects were shown.

Procedure

For this experimental activity, sentences divided into segments are presented on a computer screen. For each reading task, two words/segments separated by slashes are exhibited. Only one of the presented options develops the sentence in a correct manner. In each step, the participant selects one of the two presented words/segments using one of the two available keys on the keyboard and marked, respectively by ← (left) and → (right). The first and the last segment did not involve real choices (the alternative in these cases is indicated by xxx), since it has the function of beginning and ending each sentence. After the beginning of the experimental activity, the participant controls the speed in which the new stimuli appear on the screen, according to how he/she

makes his/her choices between the two exhibited options until forming a complete sentence (whose ending was graphically indicated by the presence of a period). The experiment was programmed in the *Linger software*,¹⁰ version 2.94, which also randomized the items and captures the reaction times and the choices of the participants for later analysis. It is important to emphasize that in the pair of choices corresponding to the critical segment (i.e., that which contains the verb of the phrase), the alternative to the verb was never another verb (see also the example presented in Figure 1). The time spent for each experimental session was approximately 12 minutes.

FIGURE 1 – Schematic example of the experimental procedure



4.2 Results and discussion

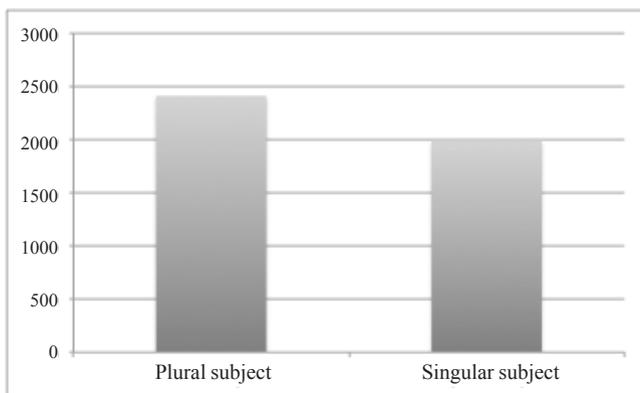
The results for reaction time were submitted to an analysis of the variance in factorial design 2x3x2 (*number of the verb x distance x number of the subject*), given that the variable, *number of subject* was taken as a group factor. For this, the ezANOVA free statistics software

¹⁰ *Linger* is a flexible platform for experiments that investigate language processing. The software was developed in the Ted Gibson Laboratory and is made available, free of charge, and is compatible with any operational system (<<http://tedlab.mit.edu/~dr/Linger/>>).

was used.¹¹ It is important to note that the reaction time was measured in the segment marked as critical, that is, the verb of the sentence (see also Figure 1); all of the results reported below refer to this dependent variable.

The analysis of the reaction times in the critical segment (i.e. pair of options that contain the verb) revealed a key impact of the *number of the subject*, with reaction time means that were significantly higher for sentences with plural subjects ($F(1.38) = 6.28, p=0.02$) (Means: 2412.8ms plural subject and 1988.5ms singular subject).

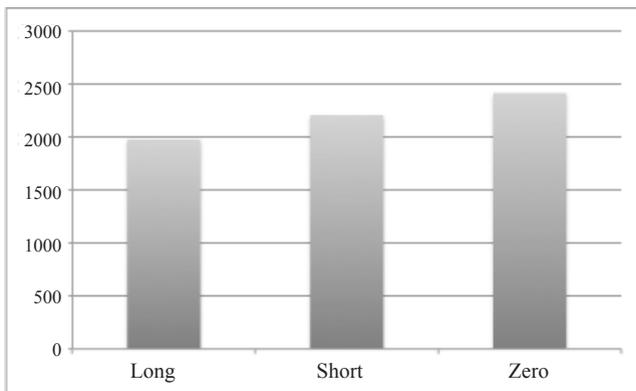
GRAPH 1 – Mean of reaction time (in ms) due to the number of the subject



A key impact of distance was also obtained, due to the gradual increase in reaction time due to the distance, with longer times in the conditions with zero distance and lower times in conditions with long distance ($F(2.76) = 8.84, p=0.0003$) (Means: 1979.1ms, 2207.4ms, and 2415.6ms for long, short, and zero distance, respectively). Graph 2 illustrates this gradation in the average reaction time.

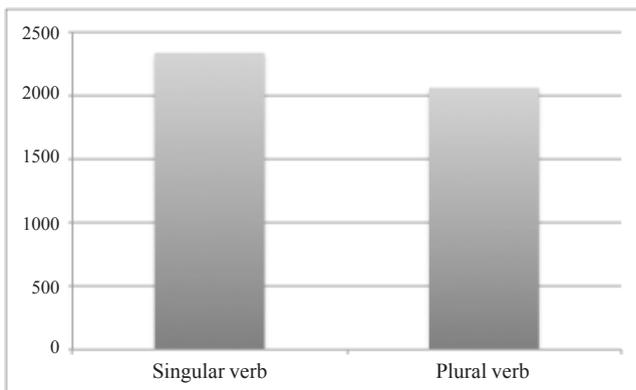
¹¹ Resource available at: <<http://www.cabiatl.com/micro/ezanova/>>. This same software also provides the comparisons between conditional pairs through the Tukey test.

GRAPH 2 – Mean of reaction time (in ms) due to the distance between the subject and the verb



The third variable, which was the *number of the verb*, also presented a main effect, with reaction time averages that were significantly higher in singular verbs ($F(1.38) = 8.99, p=0.004$) (Averages: 2338.1ms and 2063.3ms, for verbs in the singular and in the plural, respectively). As we will see later, this main effect resulted from an expressive increase in the reaction times in the condition of plural subject + singular verb.

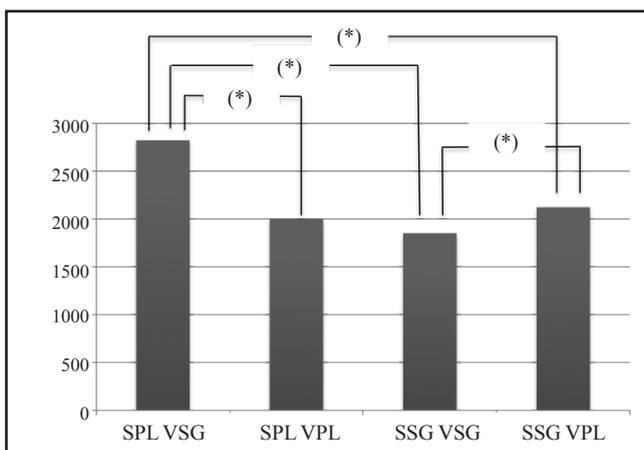
GRAPH 3 – Average time to answer (in ms) due to the number of the verb.



Finally, an interaction effect was obtained between the *number of the subject* and the *number of the verb* ($F(1.38) = 35.4, p=0.000001$)

(Averages: 2822.9ms, 2002.7ms, 1853.2ms and 2123.8ms, for the conditions of SPL VSG, SPL VPL, SSG VSG, and SSG VPL, respectively). The condition that registered the greatest reaction time averages was that of the plural subject + singular verb (Ex. *As músicas... fez... / The music... did...*), the very condition that illustrates the variable verbal condition in BP. Only the comparisons between pairs that presented statistically significant results are marked by an asterisk in Graph 4.

GRAPH 4 – Average time to answer (in ms) due to the interaction between the number of the subject and the number of the verb



As regards the main effect of the *number of the subject* observed here, plural subjects seem to facilitate the maintaining in one's memory of the information relative to the number. In these conditions, longer reaction times were recorded in relation to the reading/choice of the verb, when compared to the times verified in the conditions with singular verbs. As mentioned above, plural subjects do not directly cause attraction errors (BOCK; EBERHARD, 1993; EBERHARD, 1999; RODRIGUES, 2005a). It is important to remember that, in the study conducted by Pearlmutter (2000), differences were only identified between the hierarchical and the linear distances when the head of the subject was plural. In addition, in a study about attraction errors in BP, Rodrigues (2006) did not obtain a significant production of lapses within the conditions with plural subjects. Taken together, these results seem to reinforce the idea that a plural subject DP would be more salient

and, therefore, its features would be maintained in one's memory and recovered with greater ease.

The reaction time in the critical segment was inversely proportional to the distance identified in all of the conditions. The long distance between the subject and the verb is associated with the shorter reaction times, regardless of other variables.

The conditions of long distance favor a fading of literal information, and what is maintained in one's memory is an abstract semantic representation. However, when the subject is morphophonologically marked, the morphological feature of the subject DP becomes more accessible in one's memory and, upon locating the possible verb of the sentence, in the case of incongruence, the participant takes a longer time to choose the verb than in the incongruent condition in which the subject is singular (not marked). Nevertheless, due to the characteristics of the experimental task used in this study, the participant, lacking a better alternative, ends up choosing the verb as a more appropriate option. This result is compatible with that observed in the case of errors, both in production and comprehension. As mentioned above, in the production process, errors do not occur when the subject is plural (RODRIGUES, 2006). By contrast, in comprehension, Pearlmutter (2000) only shows impacts of incongruence when there is a plural subject and a singular verb. In the conditions of a singular subject, as well as in our experiment, no difference was shown.

In the short conditions, the subject DP representation with its complete set of morphosyntactic features would still be available when choosing a verb. This would occur in both singular and plural subjects. Thus, choosing the verbs in incongruent conditions reveals significantly higher times than in congruent conditions. In the zero distance condition, the incongruent agreement also presents higher reaction times. In this case, only the comparison between SPL VPL and SPL VSG proved to be statistically significant. The comparison between SSG VSG and SSG VPL, by contrast, proved not to be significant, though the averages have been in the predicted direction (i.e. higher reactions times in the incongruent condition).

Considering this study's results, it can be affirmed that both the distance and the morphophonological marking of the subject seem to have an effect on verbal agreement processing. The averages in each condition and the result of the statistical analysis of the comparison between the

pairs of relevant conditions within each case (congruent vs. incongruent) are presented in Table 2 below.

TABLE 2 – Comparisons between pairs due to the distance between the subject and the verb (mean of reaction time in ms per condition and result of the statistical analysis)

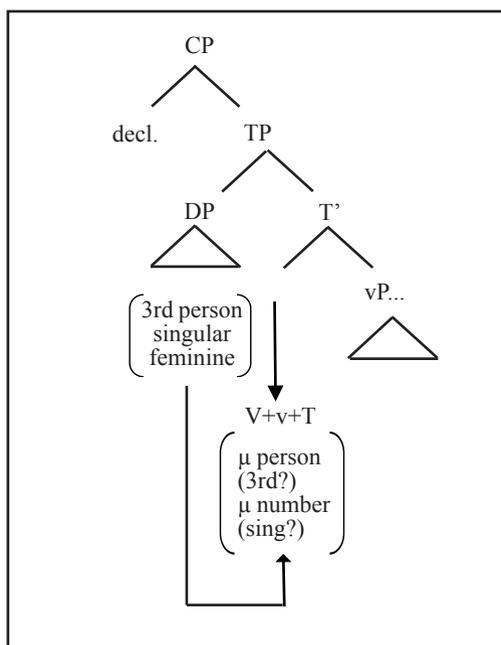
Distance between subject and verb	Pairwise Comparisons			
	SPL VPL x SPL VSG		SSG VSG x SSG VPL	
Long	1746.1831ms	2600.35ms	1715.8ms	1854.1ms
	(t(19)=4.14, $p=0.0006$)		(t(19)=1.03, $p=0.3150$)	
Short	2109.2ms	2809.4ms	1789.6ms	2121.5ms
	(t(19)=3.62, $p=0.001$)		(t(19)=2.43, $p=0.02$)	
Zero	2152.9ms	3059.2ms	2054.3ms	2395.9ms
	(t(19)=3.77, $p=0.0013$)		(t(19)=1.32, $p=0.2$)	

Plural verbs were more quickly processed than were singular verbs. However, the results relative to the interaction effect between the *number of the subject* and the *number of the verb* revealed that the presence of a singular verb in the condition of plural subject + singular verb (*As músicas... fez... / The music_{pl}... did_{sing}...*) substantially raised the reaction time in the critical segment. Thus, the main effect of the *number of the verb* should be considered cautiously, taking into account the interaction effect. This will be presented and discussed below.

The interaction between the *number of the subject* and the *number of the verb* showed that the congruent conditions (plural subject/plural verb and singular subject/singular verb) do not present a significant difference amongst themselves. By contrast, the incongruent conditions (plural subject/singular verb and singular subject/plural verb) present a significant difference when compared to the others, with higher reactions times – as already pointed out – for the combination of plural subject + singular verb. This result could indicate that such a combination is not perceived as grammatical by the participants of the test (university students, potential speakers of the standard language structure of BP) and that adopting values that are distinct from their grammar in order to allow for the proper processing of a sentence could require additional processing time.

However, the high reaction time recorded in this condition can also be analyzed considering the recovery mechanisms of the subject's features, as discussed in §3. In the parsing/comprehension of linguistic utterances, a feature-checking operation is triggered to compute the subject-verb agreement (RODRIGUES *et al.*, 2008). Thus, a verification of the feature values of number and person between the subject and verb does occur.

FIGURE 2 – Formal representation of the feature-checking operation in the subject/verb relationship during syntactic computation



In the conducted experimental task, when the participant reaches the verb of the sentence, feature-checking mechanisms must be activated. According to a view that presumes a slot-based memory system, interference effects would be directly associated with the fading of information within the working memory (see also PEARLMUTTER, 2000). As we saw above, in plural DPs, the features seem to be less susceptible to fading. Hence, in the plural subject condition of our experiment, in which the features of number are more prominent, the

presence of a verb in the singular seems to be the most conflicting situation for the computation of the sentence agreement features. An incongruence between the features of the number of the subject and those of the verb may be more salient in this configuration than in the other tested anomalous condition: singular subject + plural verb. In this second case, the incongruence – although it is detected by the participants, as suggested by the difference found between this condition (ungrammatical in BP) and the relevant condition of singular subject + singular verb (grammatical) – seems to generate a lesser strangeness, possibly due to a sub-specification of the feature of the DP in the working memory.

As seen in §3, previous results obtained with children and adults, as regards both nominal and verbal agreement, have indicated that sentences containing non-redundant agreement record significantly higher reaction times than do sentences with redundant agreement. These results include experiments conducted with children from 6-7 years of age (which allows one to eliminate a future role of formal teaching in the judgment of a linguistic variety that is less socially distinguished) and students from the first year of high school in EJA Centers (i.e. speakers whose grammar would potentially contemplate the non-redundant agreement rules) (MARCILESE *et al.*, 2015; AZALIM, 2016; HENRIQUE, 2016; MARCILESE *et al.*, in preparation). Similar results (higher reaction times for non-redundant agreement, regardless of other sociolinguistic variables) have also been reported for English (SQUIRES, 2014).

In this sense, our results run in line with this series of studies. The fact that the tested populations in the studies mentioned above were diverse regarding the level of exposure to the redundant and non-redundant variants (adults with higher education, adults with junior high school education, and children), coupled with the identification of the same standards in nominal and verbal agreement, seem to reinforce the analysis defended here in terms of the relevance of the marking of plural in the first item (subject of the sentence or determiner, in the case of nominal agreement) in the computation of features.

5. Final Remarks

In this paper, we sought to explore the procedural dimension in relation to a well-known phenomenon of linguistic variation in BP: verbal agreement. We investigated specifically to what extent linear distance – a

factor already studied in experimental psycholinguistics – could play a relevant role in non-redundant agreement processing by speakers who would not necessarily be users of this variant.

Returning to our research questions, formulated in the end of §3, one can affirm that the results obtained are compatible with an effect of linear distance in agreement processing, possibly linked to a greater fading of subject features in conditions of long distance between the subject and the verb, which presented the shortest reaction times of all of the conditions. The results also suggest differences in the processing of redundant and non-redundant rules and point to the relevance of markedness in feature-checking mechanisms. Based on pairwise comparisons, one can affirm that, though the analysis of variance did not reveal an interaction effect between *distance* and *number marking* in the subject and in the verb, these factors appear to both impact agreement processing.

The type of study developed here – establishing an explicit dialog between variation and processing – which is highly exploratory and practically non-existent in Brazil, presents challenges both in theoretical and methodological terms. The maze task proved to be sensitive to morphosyntactic effects and appropriate for the investigation of a well-stigmatized phenomenon in the standard written modality.

We hope that this study will contribute to stimulating the development of new research that seeks to establish and straighten the dialog among studies that treat the heterogeneity of the linguistic system and approaches that seek to unveil the cognitive nature of this variation.

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