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BARE NOUNS IN BRAZILIAN PORTUGUESE: AN EXPERIMENTAL STUDY ON GRINDING

ABSTRACT: Much literature has explored the interpretation of the bare singular (BS) in Brazilian Portuguese. Pires de Oliveira & Rothstein (2011) claim that BS nouns are mass because they denote kinds and argue that this explains why only the BS in Brazilian Portuguese can have a non-cardinal interpretation. In this paper, based on an experimental task with Brazilian Portuguese adult speakers, we explore one of their predictions, namely that the ‘volume interpretation’ of the BS cannot be explained as a case of Grinding. Our results show that Grinding and Volume readings of a BS noun are not equivalent (in favor of their hypothesis). We also show that a volume interpretation of a noun is never preferred when a cardinal interpretation is available, but that this can be explained by other lexical and pragmatic factors. We conclude by suggesting that Rothstein’s (in press) distinction between counting and measuring accounts for the fact that non-cardinal readings are not grinding.

1. INTRODUCTION

Brazilian Portuguese (BrP) grammatically distinguishes between count and mass nouns: only count nouns can be pluralized (except in contexts of coercion¹), as exemplified in the contrast below:

- (1) a. cachorro cachorro-s
 dog dog-PL
 ‘dog’ ‘dogs’
 b. água * água-s
 water water-PL
 ‘water’

Moreover, only count nouns can be directly combined with numerals (again, except in cases of coercion):

- (2) a. três cachorro-s
 three dog-PL
 ‘three dogs’
 b. * três carne-s
 three meat-PL
 c. três quilo-s de carne
 three kilo-PL of meat
 ‘three kilos of meat’

Measure phrases or classifiers (*kilos de* ‘kilos of’) are necessary in order to combine mass nouns with numerals, as exemplified in (2c).

Although Brazilian Portuguese is a Romance language, it behaves in a unique way with respect to bare nouns. In Romance languages, bare nouns are quite restricted and the so-called bare singular (BS), count nouns that occur in argument position without determiners or number morphology², is even more restricted. In Brazilian Portuguese the BS is very productive. It can occur both in generic contexts (3a) and in episodic contexts (3b); also in subject (3a), and object (3b) positions:

- (3) a. Cachorro late
 Dog bark
 ‘Dogs bark.’

- b. João leu livro
 João read book
 'João read a/the book(s).'

Sentence (3a) is generic. It states that barking is a property of dogs. The sentence in (3b) is true in many situations. It is true if one is talking about one book or about several books. The possibility of multiple interpretations may be explained if the only information the BS carries is about the kind of object, i.e. the concept.³

Pires de Oliveira & Rothstein (2011) claim that the BS allows for non-cardinal comparison, which, in principle, is only available for mass nouns. According to the authors, sentences like (4) are expected to be ambiguous:

- (4) João comprou mais livro do que a Maria
 João bought more book of+the that the Maria
 John bought more (units or quantity of) books than Maria.'

Interpretation 1: the number of books that João bought is greater than the number of books that Maria bought (cardinal interpretation).

Interpretation 2: the weight of the quantity of book(s) that João bought is heavier / greater than the weight of the quantity of book(s) that Maria bought (non-cardinal interpretation).

Sentence (4), can be true in a situation where the number of books that John bought is greater than the number of books that Maria bought, i.e. in the cardinal reading. It may also be true in a situation where books are being sold by weight, and João bought 4 kilos (but 2 books) whereas Maria bought 2 kilos (but 10 books). Although the authors do not explicitly discuss whether the two readings are equally available, one may infer from their claim that the BS denotes natural atoms and that there is a preference for the cardinal reading in a neutral context. The non-cardinal readings are restricted to contexts that favor a weight or volume interpretation. For instance, if oranges are usually bought by the kilo, the weight interpretation is then preferred in comparison contexts.⁴

An important aspect of Pires de Oliveira and Rothstein's (2011) proposal is that the non-cardinal interpretation does not correspond with a ground interpretation. The grinding operation shifts a count predicate into a mass predicate.⁵ It explains one of the exceptional uses of the BS in English in sentences such as 'There is cat all over the road', where one is talking about the cat-substance and not the cat-object. The BS in English is very restricted. It can be the mass counterpart of a count noun, namely of the so-called flexible nouns, for example, *ropes* and its mass counterpart *rope*. The BS can also appear in coerced uses, which happen when a count noun is placed in a mass syntax. Pelletier (1979) labeled this coercion "the universal grinder" since it transforms any object into the stuff the object is made of.⁶ Grinding is then an operation that is guided by a syntactic mismatch: a count noun appears in a mass syntactic context. Example (5) is famous in the literature and was discussed by Link (1983):

- (5) There is apple in the salad. (Link 1983; 132 – example 24)

Pelletier and Schubert (1989) also discuss the following example as a case of grinding:

- (6) He has more book than bookshelf. (Pelletier & Schubert 1989; 270 – footnote 24)

It is important to note that the nouns *apple* and *book*, count nouns in a mass syntactic context, have distinct interpretations. While in (5) we clearly expect that we are no longer talking about whole apples, in (6) we do not expect that the books have undergone any physical transformation. That is, in (5), an undefined number of apples has been reduced to ground portions of apples (slices, small bits, etc.) while in (6) an undefined number of books maintain their distinct object status. This means that in (6) the sentence is clearly about the volume of book objects. If (6) is seen as an example of grinding, then it would be possible to explain the volume interpretation of the BS in Brazilian Portuguese as a case of coercion. This discussion then depends on how exactly grinding is characterized. Does grinding necessarily involve transforming an object into its substance counterpart as argued by Link (1983)? Should we extend the definition of grinding to include cases like (6) that refer to non-transformed objects, as Pelletier & Schu-

bert (1989) do?

Previous studies in Brazilian Portuguese have explored only volume interpretations of the BS, including objects and food items in a non-transformed state. These studies have given support to the hypothesis that BS nouns can be interpreted as referring to volume (cf. Beviláqua 2015). However, as problematized above, depending on the characterization of grinding, one could argue that this non-cardinal reading is due to grinding. Following this argument, the BS would be a count noun after all and the mass hypothesis in Pires de Oliveira & Rothstein (2011) would no longer be tenable.

The main goal of this study is to distinguish conditions that involve volume and grinding interpretations. We intend to verify empirically Rothstein's (2009) and Landman's (2011) claim that grinding is not equivalent to a mass interpretation (volume interpretation). Another goal is to check whether volume and cardinal interpretations of the BS are both equally possible. We will present our research questions in the next section.

2. BRAZILIAN PORTUGUESE BARE SINGULARS: THEORETICAL DISCUSSION

Several papers have discussed the distribution and interpretation of bare arguments in Brazilian Portuguese (Schmitt & Munn 1999; Muller 2002; Dobrovie-Sorin & Pires De Oliveira 2010, among others). For the purposes of this paper we will contrast two proposals: Muller (2002) and Pires de Oliveira & Rothstein (2011).

Muller (2002) explicitly claims that the difference between the BS and the Bare Plural (BP) in Brazilian Portuguese is that the BS denotes inclusively, denoting atoms and pluralities, whereas the BP denotes exclusively, only denoting pluralities, but not the atoms. Thus, (7) is true only if more than one book was bought:

- (7) João comprou livro-s
 João bought book-PL
 João bought books.'

Müller's proposal relies on an argument raised by Schmitt & Munn (1999), according to which BS nouns are count nouns because they

contrast in acceptability with mass nouns in several grammatical environments. Let us compare the examples in (8) and (9):

- (8) Criança (nessa idade) pesa 20 quilos
 Child (at this age) weighs 20 kilos
 'Children at this age weigh 20 kilos.' (Schmitt & Munn 1999, p. 11)
- (9) * Ouro pesa 20 g
 Gold weighs 20 g (Schmitt & Munn 1999, p. 11)

These examples suggest that the BS *criança* 'child' (8) allows a distributive reading, whereas the bare mass *ouro* 'gold' does not. The data are explained if only count nouns have atoms in their denotation.

The same contrast between BS nouns and bare mass nouns observed in distributive predicates can be observed in constructions with reciprocals, as illustrated in (10) and (11):

- (10) Criança briga uma com a outra
 Child fight one with the other
 'Children fight one another.' (Schmitt & Munn 1999, p. 11)
- (11) * Ouro toca um no outro
 Gold touches one in+the other

In this pair of examples, BS nouns and bare mass nouns once again pattern differently. Only the BS can occur with reciprocals as in (10). According to Schmitt & Munn (1999) and Muller (2002), count nouns allow reciprocals because they have atoms in their denotation.

Pires de Oliveira & Rothstein (2011) challenge this explanation, claiming that mass nouns such as *mobília* (furniture) allow distributive readings and can occur in constructions with reciprocals:

- (12) Móvel (nessa loja) pesa 20 quilos
 Furniture (in+this store) weighs 20 kilos
 'Furniture (in this store) weighs 20 kilos.'
- (13) Móvel (dessa marca) encaixa uma na outra
 Furniture (of+this type) fits one in+the other
 'Furniture (of this type) fits one another.'

(Pires de Oliveira & Rothstein 2011; 2157 – examples 10 and 11)

The authors argue that the BS being a count noun with atoms in the denotation is not the explanation for contrasts in (8)-(9) and (10)-(11). They claim that the relevant notion is that of natural atomicity, which should be distinguished from the grammatical notion of semantic atomicity. *Mobília* (furniture) is a mass noun, and therefore has no semantic atoms. Its natural atomicity is what allows its combination with distributive predicates, reciprocals and reflexives. They conclude that the contrasts above are not due to a count versus mass distinction, but rather to the fact that the BS is built from natural atoms, such as furniture-type nouns.

Other evidence supports this conclusion. Barner & Snedeker (2005) show that furniture-type nouns are mass nouns that allow for cardinal interpretation precisely because they denote atomic individuals (the chair, the sofa, etc.). Schwarzschild (2011) and Rothstein (2010) further show that mass nouns that denote atoms, such as *furniture*, can be combined with adjectives that qualify the atom, such as *big*:

(14) The furniture in that nightclub is round.

(Schwarzschild 2011; 665 – example 40)

The property of being round is attributed to each of the pieces of furniture. Thus, the distributive effect and the possibility of reciprocals and reflexives with the BS might be due to natural atomicity (Rothstein 2010).

According to Bale & Barner (2009), comparatives are the best test for distinguishing between mass and count. In comparative sentences, the BP is always interpreted as referring to cardinalities, i.e. the individuals are counted and the number of individuals is what is compared, see (15):

(15) João tem mais carro-s que Pedro
 João has more car-PL than Pedro
 'João has more cars than Pedro.'

Also, in English the BP only allows comparison by cardinality. Bale and Barner argue that non-cardinal scales are available for substance mass nouns and cardinal scales are available for furniture type nouns.⁷

If the BS is a plural noun, as some authors have argued (cf. Muller 2002), it should behave exactly as the BP in comparatives. It should

then only allow comparison by cardinality. On the other hand, if it is a mass noun, allowing the non-cardinal comparison only available for mass nouns, then Pires de Oliveira & Rothstein (2011) are in the right direction.

The authors claim that the example below is ambiguous. Suppose that João is going to school and is carrying a very heavy backpack, although in fact it is loaded with just one very thick book. His mother can felicitously utter:

(16) É muito livro pra você levar⁸
 Is much book for you to carry
 'This is too much book for you to carry.'

(Pires de Oliveira & Rothstein 2011; 2172 – example 53)

The availability of a non-cardinal reading for the BS in Brazilian Portuguese is predicted by Pires de Oliveira & Rothstein (2011). They propose that the BS is a kind-denoting term. Although the authors are not clear about how the non-cardinal interpretation is semantically derived, their intuition seems to be that kinds may be compared with respect to any dimension that is pragmatically relevant. This is compatible with Rothstein's (in press) recent proposal concerning measuring. The BP, on the other hand, denotes an atomic lattice structure, i.e. the structure resulting from the closure of a set of atoms under the sum operation. If atomic structures are grammatically encoded (following Rothstein 2010), they must be compared by the number of individuals. We will come back to this semantic analysis in the conclusion. Our main proposal is to verify whether the non-cardinal readings of the BS are due to grinding. The possibility of a non-cardinal reading for the BS shows that it is in contrast with the BP, which only allows cardinal interpretation. However, if the non-cardinal interpretation is due to grinding, then the BS can still be analyzed as a count noun. If the non-cardinal interpretations are not necessarily due to grinding, then there is another piece of evidence to support Pires de Oliveira and Rothstein (2011)'s hypothesis.

The question is then: is the volume reading due to grinding⁹? Much literature on the universal grinder shift has shown that food items are more likely to be reinterpreted via coercion (cf. Gleason 1965 apud Pelletier 1975; Frisson & Frazier 2005; Wiese & Maling 2005). If this is the

case, then we do not expect any contrast between object-denoting BS (e.g. *garrafa* ‘bottle’) and the food-denoting BS (e.g. *tomate* ‘tomato’). On the other hand, if these nouns behave differently when a grinding interpretation is available, then this is an indication that there is a difference between volume and grinding readings.

Based on the aspects discussed so far, let us summarize the three theoretical questions we intend to address in this paper:

- (1) What is the nature of the volume interpretation of the BS? Is volume derived from (or equivalent to) a grinding operation?
- (2) Will the BS and the BP behave differently in volume and grinding interpretations? More specifically, will the BP be incompatible with those interpretations while the BS is compatible?
- (3) Are volume and cardinal interpretations of the BS equally likely in a neutral context?

To address these questions, three hypotheses were tested:

- (i) The BS can be measured by volume while the BP cannot, – Pires de Oliveira and Rothstein (2011)’s prediction;
- (ii) Only the BS-food noun will be compatible with a grinding interpretation;
- (iii) BP-objects and BP-food nouns will not be accepted in either grinding or volume contexts.

3. EXPERIMENT

3.1. Participants

The sample was comprised of 40 Brazilian Portuguese adult native speakers, all undergraduate students from Universidade Federal de Santa Catarina (UFSC), pursuing different major degrees. Few of them were from the first year undergraduates in Letters. The data were collected in person, at Núcleo de Estudos Gramaticais (NEG), Centro de Comunicação e Expressão (CCE), UFSC. We have not controlled for age. Students majoring in linguistics studies were not recruited.

3.2. Materials and Methods

A Truth-Value Judgment Test (TVJT) was performed. Participants were presented with a video, with a target sentence that included either a BS noun (17a) or a BP noun (17b). Then they had to answer whether or not the sentence was a good or bad description for the video:



Figure 1: Stimuli from the BS and the BP (object) in Condition 1 (Volume vs. Cardinality) - noun: *caixa* ‘box’

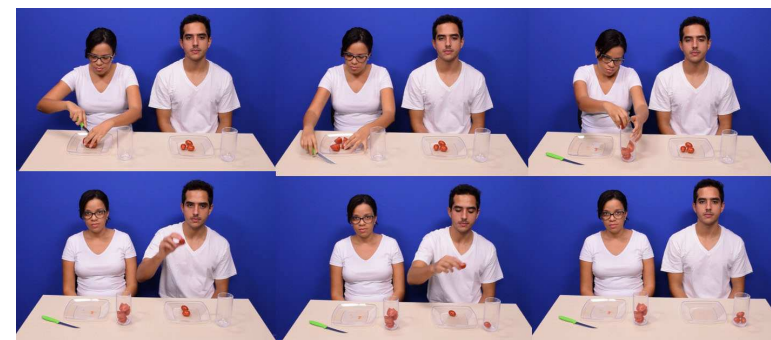


Figure 2: Stimuli from the BS and the BP (food) in Condition 2 (Grinding vs. Cardinality) - noun: *tomate* ‘tomatos’

- (17) a. O Nico colocou mais caixa na sacola que a
The Nico put more box in+the bag than the
Dora
Dora
- b. O Nico colocou mais tomate-s no copo que a
The Nico put more tomato-PL in+the glass than the
Dora
Dora

All the sentences had the same structure and there were three containers: a bag, a jar and a glass. Half of the time Nico had the big object, half of the time Dora had the big object. The truth values were also randomized to avoid some biased answers. Consider, for instance, figure 1 and the target sentence in (17a). A true answer for that sentence in that context is interpreted as volume. However, the same context was used to evaluate the sentence 'A Dora colocou mais caixa na sacola que o Nico' (Dora put more box in the bag than Nico). The expectation was that the answer would be false if the participant was interpreting as volume.

We manipulated two types of conditions. In Condition 1 (Volume vs Cardinality), participants were presented with two characters (Nico and Dora). One character had an item that corresponded to the Volume answer (e.g., a large banana) while the other character had three items that corresponded to a cardinal answer (e.g., three bananas that together did not have a greater volume than the big banana). In Condition 2 (Grinding vs Cardinality), instead of contrasting cardinality with volume, we contrasted cardinality with a grinding situation. One character had a large item (object or food item) ground in several pieces (e.g., a large banana cut in several pieces).¹⁰

The experiment was constructed with 32 target sentences, 16 lexical items – 4 BS nouns denoting food (BS-food), 4 BS nouns denoting objects (BS-object), 4 BP nouns denoting food (BP-food), and 4 BP nouns denoting objects (BP-object) – in 2 different conditions – as described above. Nouns that denote food and nouns that denote objects were contrasted because we wanted to find out whether having food-related nouns would increase the acceptance of the grinding interpretation, as much literature on the topic would predict. If so, this would point to a distinction between the grinding and the volume readings. Fillers

were also included in a proportion of 2:1.¹¹ Due to the high number of sentences for participants, i.e. 96, four experimental lists were set up, each containing an equal number of items of each condition, and only one version of each quartet. Each participant judged 24 sentence-context pairs. The sentences were presented in a fixed random order. The nouns tested are shown in the table below:

BSfood	banana (banana)	tomate (tomato)	cenoura (carrot)	batata (potato)
BSobject	caixa (box)	meia (sock)	envelope (envelope)	garrafa (bottle)
BPfood	bananas (bananas)	tomates (tomatos)	cenouras (carrots)	batatas (potatos)
BPobject	caixas (boxes)	meias (socks)	envelopes (envelopes)	garrafas (bottles)

Table 1: Lexical items tested

3.3. Procedures

Participants were randomly assigned to one of the four lists and were tested individually. Stimuli were displayed in the Web browser Google Chrome. Subjects viewed the content in full screen mode on a 14-inch monitor with aspect ratio 16:10, screen mode WXGA, and resolution 1280 x 800.

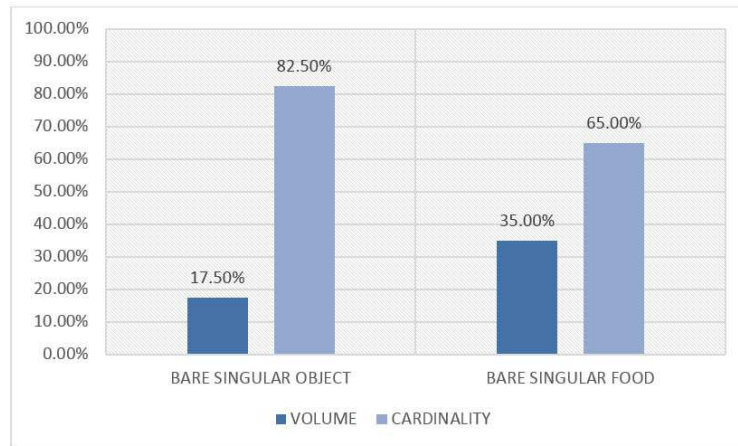
They watched the video (as exemplified in Figures 1 and 2) and heard a sentence (as exemplified in (17)), both played automatically. They were told that they could neither re-watch the videos nor re-listen to the sentences. They had to judge whether the sentence was a good description for the video displayed or not. If they believed it was, they were instructed to choose “true”; otherwise they should choose “false”. Half of the questions required a “true” response, half a “false” response, counterbalanced across conditions. The entire experiment lasted no more than 20 minutes.

Before they started the task, the participants were instructed and exposed to two contexts similar to the ones in the task, and they had to judge “true” or “false”. The training aimed to make sure that participants understood the task. During the training section, the participants could ask questions.

3.4. Results

3.4.1. Bare Singular Results

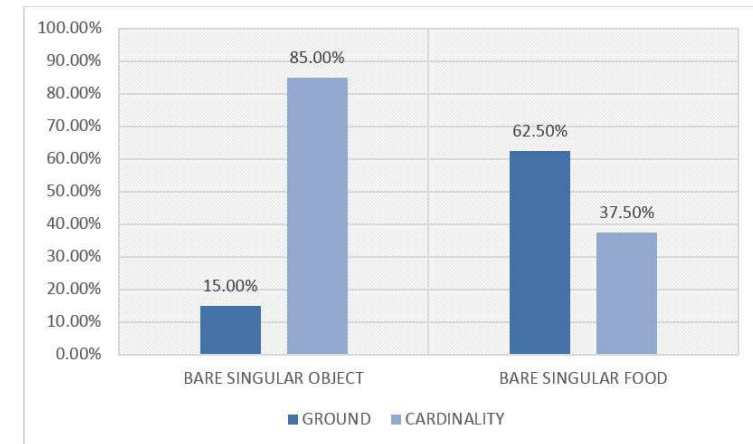
The results for the BS in Condition 1 (Volume vs Cardinality) are presented in Graph 1:¹²



Graph 1: Percentage of acceptance of the BS (food and object) regarding the Condition 1

The volume answer was marginally chosen when the cardinality answer was available for both BS food nouns (35%) and BS object nouns (17,5%). The results showed a slight numerical difference of judgments between BS-food nouns and BS-object nouns, but this difference was not statistically significant ($\chi^2(1)=3.164$, $p=.075$).

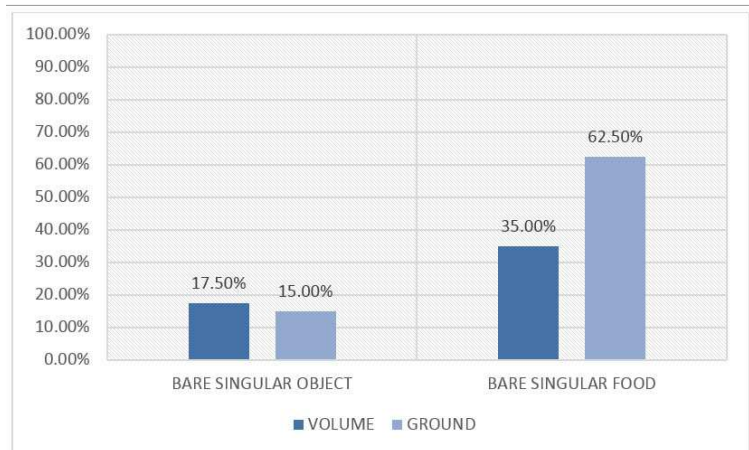
Second, we present the results for the BS in Condition 2 (Ground versus Cardinality):



Graph 2: Percentage of acceptance of the BS (food and object) regarding Condition 2

It is clear that the rate of acceptance for BS-food nouns (62,5%) was higher in ground scenarios in comparison with BS object nouns (15%). This difference was statistically significant ($\chi^2(1)=17.013$, $p=.000$), suggesting a lexical effect (food vs. object).

In Graph 3 we summarize the results for the items that included the BS:

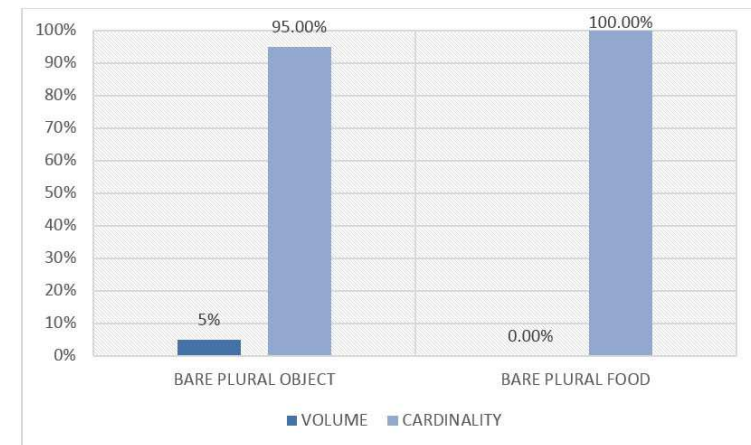


Graph 3: Percentage of acceptance of the BS regarding volume and ground answers

In sum, there was no significant difference between BS food nouns and object nouns in the volume condition. However, as mentioned in the discussion of Graph 2, we did find a lexical effect (food/object) when the grinding answer was available.

3.4.2. Bare Plural Results

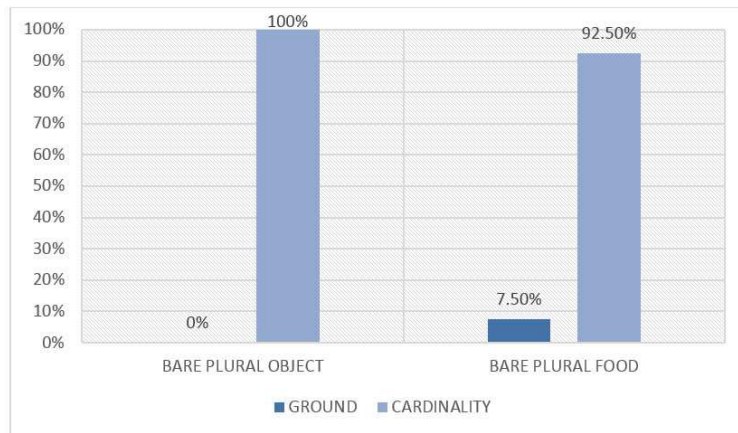
First, we discuss the results for the BP in condition 1 (Volume versus Cardinal). The results are presented in Graphic 4:



Graph 4: Percentage of acceptance of the BP (food and object) regarding the Condition 1

The results show that it is highly unlikely that the BP (food/object) will be associated with the volume interpretation: only in 5% of the trials the participants associated BP-object nouns with a volume interpretation. For BP-food nouns, participants always chose the cardinality answer. The chi-square test did not reach statistical significance ($\chi^2(1)=2.069$, $p=.150$), indicating that BP nouns are not measured by volume.

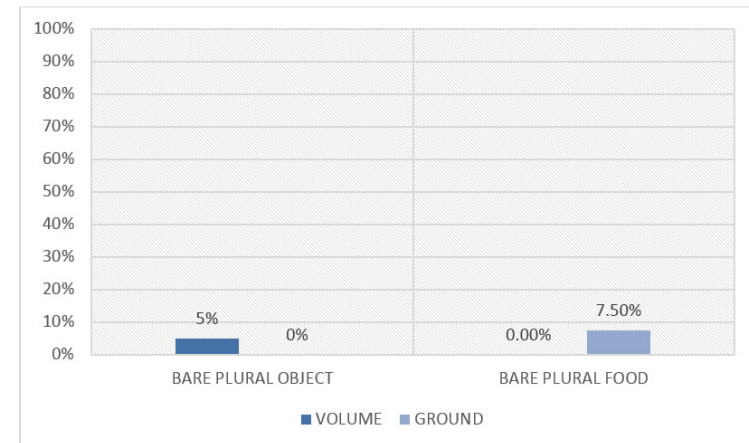
Graph 5 presents the results for the BP in Ground scenarios:



Graph 5: Percentage of acceptance of the BP (food and object) regarding Condition 2

The results show that it is also unlikely that the BP (food/object) will be associated with a ground interpretation. BP food nouns were associated with the grinding answer in 7,5% of the trials; that was never the case for object nouns. A chi-square test provided a non-statistical significance ($\chi^2(1)=3.117$, $p=.077$), showing that BP nouns are unlikely to be compatible with grinding.

In Graph 6 we summarize the results for the items that included the BP:



Graph 6: Percentage of the BP (food and object) regarding Ground and Volume answers

We can conclude, then, that it is highly unlikely that the BP will be associated with Ground and Volume interpretations in Brazilian Portuguese; a cardinal interpretation seems to be consistently preferred in those cases.

4. DISCUSSION

The main findings of this study were:

- (i) The BP is highly unlikely to be associated with grinding and volume answers, possibly because the plural blocks¹³ any mass interpretation of the noun (as expected in Muller (2002) and Pires de Oliveira & Rothstein (2011));
- (ii) There is a lexical effect in condition 2 (Grinding vs. Cardinality): food-denoting BS nouns are more likely to be accepted with the grinding answer in contrast to object-denoting BS nouns. Note,

however, that a lexical effect was not found in condition 1 (Volume vs. Cardinality answers);

- (iii) The Volume answer is unlikely to be chosen when the Cardinality answer is available for the BS (as predicted by Muller 2002);

In addition, these three findings lead us to another one:

- (iv) The BS does not behave as the BP (as predicted by Pires de Oliveira & Rothstein 2011).

First, we observed that the BP is unlikely to be accepted with grinding and volume interpretations in Brazilian Portuguese. These results are parallel to the distribution and interpretation of the BP in English (cf. Barner & Snedeker (2005)) where the volume as well as the grinding interpretations are blocked if the noun is pluralized:

- (18) There were bananas all over the road.
Context 1: there are several units of bananas on the roads.
Context 2: there is an amount of smashed banana spread over the road.

Second, we observed that there is a lexical effect in Condition 2 (Grinding vs. Cardinality), but not in Condition 1 (Volume vs. Cardinality). This effect was predicted by the literature on coercion (food items [‘restaurant talk’] are more likely to be coerced, cf. Frisson & Frazier 2005). This lexical noun effect could be analyzed as a pragmatic/cognitive effect. Once we grind an object it loses its functionality and is not seen as an object anymore. On the other hand, when we grind a fruit it is still edible. This result suggests that grinding and volume do not involve the same operation, as suggested by Rothstein (2009) and Landman (2011).

Third, the volume answer is unlikely to be chosen when the cardinality answer is available for the BS in neutral contexts,¹⁴ as shown by Lima & Gomes (2016). Pires de Oliveira & Rothstein 2011 claim that the BS could be interpreted as referring to a non-cardinal dimension (as confirmed by Beviláqua & Pires De Oliveira (2014)), as exemplified in example (16), repeated below for convenience. This is only the case if the context is biased:

- (19) É muito livro pra você levar.
Is much book for you to carry
‘This is too much book for you to carry.’ (Pires de Oliveira & Rothstein 2011)

Two tentative hypotheses could explain the low acceptance of a volume interpretation for BS nouns. The first is the lexical statistics hypothesis, and the second is the cognitive bias hypothesis. Samuelson & Smith (1999) have shown that, in English, novel words are more likely to be analyzed as count nouns. Hypothetically, this is the case because in that language count nouns are more frequent in speech than mass nouns. Likewise, lexical frequency could explain why English speakers prefer the object kind construal more than Japanese speakers do. Li et al. (2009) conclude that this is so because Japanese has no count syntax, thus there are no comparable probabilistic expectations.¹⁵

The cognitive bias hypothesis (Gomes & Lima 2015) says that in neutral contexts, when given a choice between cardinal and volume interpretations, speakers choose cardinality for nouns that have natural atoms. Neutral contexts are those that do not bias a mass interpretation of the BS (Gomes & Lima 2015). Under this hypothesis, if context favors a mass interpretation, the BS can be interpreted as referring to volume, like bare mass nouns. This was predicted by Pires de Oliveira & Rothstein (2011) and shown in Beviláqua & Pires De Oliveira (2014) studies. Otherwise, the BS is interpreted as referring to cardinalities, and since the BS has natural atoms, this scale is the preferred one. The BP cannot be interpreted by volume even in these contexts, as shown in Beviláqua & Pires De Oliveira (2014), for the reasons above. As such, while in neutral contexts, the BS and the BP behave similarly (see the results for object denoting nouns in the study presented in this paper), in contexts that bias a volume interpretation only the BS will be accepted. Therefore, these two types of bare arguments do not have the same basic denotation. In this paper, all contexts were neutral: they did not favor a grinding or volume interpretation over cardinality. Thus, these results are compatible with the cognitive bias hypothesis. Neither a preference for volume answers nor an equal likelihood of acceptance for volume and cardinality answers was found.

Fourth, if the BS is a plural noun, it should show the same behavior as the BP in comparatives, since comparison blocks the access to the

atoms. However, the results show that they do not have the same behavior. Specifically, volume and grinding interpretations are unlikely to be associated with BP.

To conclude, an important implication of these results is that there is a difference between the requirements for Grinding and Volume. The results for food-denoting BS nouns show different results in Conditions 1 and 2. As such, these two interpretations are not equivalent. Based on these results, a sentence such as (19) should be analyzed as a case of non-cardinal interpretation, where the object is not affected/transformed. In other words, its interpretation is not due to coercion via grinding. What happens here is that a different dimension is selected. In (19), instead of counting the books one is measuring the books according to their weight. This is precisely the volume reading that is found with the BS in Brazilian Portuguese.

To conclude, the results suggest that one should distinguish volume interpretations from grinding operations since a lexical effect is only found in Condition 2. We propose that the results of this study reflect a distinction between counting and measuring, as proposed in Rothstein (in press), and grinding. Informally, measuring is a function that maps an object onto a point on a scale, the dimension of which may be contextually given. Thus, an object can be measured according to different dimensions: volume, area, weight, etc. As extensively argued by Rothstein (in press), this is not the same operation as counting, because counting is a correspondence between objects and numbers. Nevertheless, neither of these operations affects the structure of the object, while grinding does, since it turns an object into its substance mass denotation.

5. FINAL REMARKS

In this paper, based on an experimental task, we explored the following prediction:

- A volume (non-cardinal) interpretation of a BS is not equivalent to the grinding operation.

Our study has shown that the grinding and volume interpretations are not equivalent. Instead, they involve different operations and this is

reflected by participants' reaction to the videos when food-denoting nouns are manipulated. If volume and grinding were equivalent, we would not find a significant effect of noun type (object vs. food) nor would we find a significant effect of condition type (Grinding vs. Volume) for food items. In this study we also observed that the BP is unlikely to be associated with grinding and volume. Hypothetically, the plural blocks any mass interpretation of the noun, as predicted in both Muller (2002) and Pires de Oliveira & Rothstein (2011). These results are explained by Rothstein's (in press) proposal to distinguish between counting and measuring. The volume reading is a way of measuring and plurality is the grammatical mark of a correspondence between a number and an object, which means counting.

This study gives support to Pires de Oliveira & Rothstein (2011) proposal that the BS in Brazilian Portuguese is not an atomic predicate and is instead mass in the sense that it denotes the kind. As such it must be measured and not counted. Our results also show that naturally atomic bare nouns are highly unlikely to be associated with Volume (Measure reading) when a cardinal interpretation is available, in neutral contexts. Similar results were found by Lima & Gomes (2016). Following these authors, we claim that these results could be seen as the result of a cognitive bias effect and lexical statistics.

An issue that remains to be explored is the interpretation of the BS in English, as exemplified in (5) and (6). Is it the case then that English has a BS and *book* denotes the kind? Would the same analysis apply to *apple* in (5)? These are issues that go well beyond the aim of this paper since they involve fine-grained analysis of the semantics of noun phrases across languages.

Finally, to conclude, we are aware that context can bias a particular interpretation of nouns for object mass nouns, as has been shown by Grimm & Levin (2012), and for the BS in Volume contexts, as shown by Beviláqua & Pires De Oliveira (2014). In future studies we intend to manipulate the features explored here using verbal contextual cues in order to test whether this could make any difference in the results.

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Notes

¹Coercion is a technical term for shifts from count to mass nouns and mass nouns to count nouns. We come back to this issue in the paper. For a discussion about mass and count nouns in Brazilian Portuguese see Paraguassu (2010) and the references therein.

²See Dobrovie-Sorin et al. (2006) for an account of bare nouns in Romance languages.

³See Pires De Oliveira & De Swart (2015) for a description of the semantic contribution of the BS in object position when compared to other noun phrases.

⁴See Pires De Oliveira & Mendes De Souza (2013).

⁵See Chierchia (2010) for a formal definition.

⁶See Cheng et al. (2008) for a discussion of how universal so-called universal grinding is. The authors argue that languages differ with respect to the availability of the count to mass shift. For our purposes, what matters is the difference between grinding and other types of interpretation (such as cardinal and volume interpretations).

⁷However, Grimm & Levin (2012), and Rothstein (2012) argue that this is not the case, because furniture allows for non-cardinal readings as well.

⁸The literature on comparison in English assumes that the noun is a Bare Plural, which means that it is a DP if the Bare Plural denotes the kind. In this paper we assume the hypothesis that these are bare nouns which denote the kind and are type shifted to predicates. See Pires De Oliveira & Mendes De Souza (2013).

⁹The literature describes three types of coercion in the nominal domain: the universal packer/packager (Gleason 1965; Pelletier 1975), which derives portions from substances; the universal sorter (Bunt 1985) which derives sorts from substances; and the universal grinder (Pelletier 1975) which transforms objects into substances. In this paper we won't explore the universal packager and universal sorter interpretations, but the reader might consult Doetjes (1997); Frisson & Frazier (2005); Wiese & Maling (2005), and Lima (2014) for an extended discussion on those shifts.

¹⁰As correctly pointed out by one of reviewers, in the experiment grinding is not represented as the activity of smashing/grinding something into a substance, but rather as cutting/ripping something into pieces. This is a very important difference (Landman 2011 on the difference between "mess mass" (grinding) and "fission"), but the literature on coercion has not paid attention to it, as shown by the prototypical examples of grinding in the literature, exemplified in (5) and (6).

¹¹The fillers relied on the same scenes and were about different issues, which played with the size of the objects. For instance, 'Dora put the big banana on the bag'.

¹²As we have already pointed out in the methodology, a consequence of randomizing the truth-values is that we cannot count the number of true and false answers directly; rather we have counted the interpretations of volume or cardinality.

¹³When only this reading is available in the context, participants do accept it (see.

Beviláqua & Pires De Oliveira 2014) including for artifacts (non-food). But in contexts without a bias, this reading is highly dispreferred.

¹⁴When only this reading is available in the context, participants do accept it (see. Beviláqua & Pires De Oliveira 2014 including for artifacts (non-food). But in contexts without a bias, this reading is highly dispreferred.

¹⁵See also Lima & Gomes (2016) for a more detailed discussion of the lexical hypothesis and cognitive bias hypothesis for Brazilian Portuguese.

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