

PROSODIC MARKING OF INFORMATION STATUS: EVIDENCE FROM BRAZILIAN PORTUGUESE

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Abstract

The present study has as objective to describe which acoustic parameters are related to the prosodic marking of referential status in Brazilian Portuguese (hence BP). Recent proposals in the area of Information Structure suggest that new and given information are in fact ends of a continuum of possible (mental) states for discourse referents. Word duration and fundamental frequency were the phonetic dimensions analyzed. The results show that the relative position of the referent in the utterance has a great influence in how the prosody is manifested and that duration and average f_0 are parameters related to the distinction between new referents and given and accessible ones. The overall analysis of the data from this production study indicates that BP speakers use prosodic cues to signal the informational status of entities in discourse. Despite the variation among subjects, one can notice that the acoustic differences between the statuses are rather similar within subjects. Unlike the results found in other languages (i.e. German), BP seems to not have a distinctive marking for accessible status, a conclusion which is supported by the data from both studies. Apparently, despite the fact that information status is an inherently cognitive phenomenon, its manifestation is variable across languages.

Keywords: phonetics; speech production; information structure; information status; Brazilian Portuguese

1. Introduction

In the area of Information Structure, discourse referents are known for having not only form and meaning but also a temporary mental state based on their degree of availability (givenness) for the speech interlocutors. Such mental state, also known as information status¹, has been traditionally seen as a dichotomy between new and given referents in discourse. (1) Recent proposals (2, 3) suggest that, in fact, the information status lies on a broad continuum whose ends are new and given statuses. One of the challenges of these studies is first to propose the number of statuses and then map them to their respective linguistic forms across languages. Furthermore, (4, 5) propose a cognitive-based division on

¹ The term **information status** is often found in some texts as **referential status**, though no justification for both names is clear. The former was opted for being more frequently employed.

the activation degree of a referent in the hearer's working memory: new referents are "inactive" in the working memory, whereas given referents are already "active". A third state, namely accessible, is associated to "semi-active" referents.

The information status is several times grammatically encoded, that is, there is a reasonably predictable relationship between the status of a referent and its linguistic form. In languages such as Portuguese, definite articles such as *o, a, os, as* are often associated to previously mentioned referents and indefinite articles such as *um, uma, uns, umas* are associated to newsworthy referents. In Japanese, given information is marked morphosyntactically by the particle *wa* and new information is marked by the particle *ga*. Turkish, on the other hand, is said to have information status encoded by case marking. (6)

Only recently the relationship between the status of a referent in discourse and its prosodic encoding has raised some interest. Some studies have proposed that there is a close correspondence between information status and (de-) accentuation. (1, 7-10)

In West Germanic languages, the pitch accent is used to mark referential status: inactive referential expressions (new referents) are often marked by an accent (H*), and active items (given referents) are typically deaccented (10, 11) in final position. Such "deaccenting" is described as a shift of the expected accent prominence of the referent to a previous sentence item. (10) The result is a given referent with a flatter pitch contour (Figure 1).

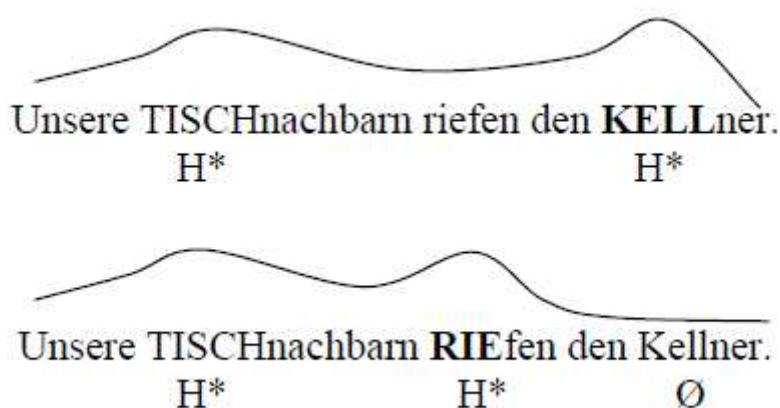


Figure 1: Schematized intonation contour shift in "The people at the next table called the waiter". "den Kellner" (the waiter) is marked by a flat contour. (12, adapted)

(13) used the Assumed Familiarity Taxonomy (2) to describe variations in intonational prominence in

English task-oriented speech. She found that speakers tend to place pitch accents on new information, while marking given information by deaccenting. Other studies in English (14), in German (15-17), Danish (18, 19) and Dutch (20) have found comparable results.

The prosodic marking of accessible information remained, however, with no consensus. (16) observed that, in German, accessible referents can be marked by an intermediate prominence according to the semantic relationship between the referent and its antecedent, though the author was not able to conclude to a typical accentual configuration (pitch accent). Apparently, the accentual marking of the accessible status is only consistent when there is a “whole-to-part” relationship.

The phenomenon of deaccenting is often regarded as a possible universal in some studies. (4), for instance, states that “the principal linguistic effects of the given-new distinction in English, and perhaps all languages, reduce to the fact that given information is conveyed in a weaker and more attenuated manner than new”. Nevertheless, as other studies have pointed out, deaccenting might not occur in the same way for all languages. (8, 10) Romance languages have been a challenge for a supposed universality account of deaccenting of given information. (21) conducted a crosslinguistic study with Dutch and Italian in order to assess deaccenting in both languages. The analysis of map-task dialogues reveals that Dutch has a strong tendency to deaccent repeated nouns, whereas the Italian counterparts were all reaccented. The authors point out that an alternative strategy whereby Italian could mark information status via prosody is the use of a different nuclear accent shape or contour, notwithstanding in the same position. In a study for Roman Italian using task-oriented dialogues, (22) concluded that, contrary to West Germanic languages, the vast majority of the repeated mentions are accented irrespective of their information status. (23) used a similar protocol of dialogue task as in (11) in a crosslinguistic study with Romanian and Dutch. Likewise Italian, Romanian presents a very low rate of accent shift for given and contrastive information. In this case, the accentual configuration of new and given items is similar. (21, 23)

In a comparative study with English and Icelandic, (24) analyzed read examples of four speakers of each language where given information was repeated (given) in a setting that would provoke deaccenting. Contrary to their English counterparts, Icelandic speakers kept the accent where the English speakers deaccented, except for a small minority that would do so in cases of hypernymy substitution. Likewise, (25) found the same reaccenting pattern in an analysis of Icelandic newsreaders. Finally, (26) used the same map task protocol from (21) to evaluate deaccenting of given information in Cairo Arabic. Results demonstrate that given items positioned after an in-situ focus are not deaccented.

Languages with tones have also shown examples where reaccenting is much more regular than deaccenting (10). Hindi and Mandarin Chinese do not have a complete deletion of the accent target, but a register compression that allows tones to be realized. (27, 28) In Akan, a level tone language

spoken in Ghana, the observed f_0 contour lowering is triggered by a post-focal effect. (29) As tonal languages have lexical and grammatical distinctions encoded by tones, the f_0 compression still permits the expression of them where it would be expected to have deletion in other languages.

Finally, as some studies in English suggest, the information status can also affect word length. (30) observed that the second mention of nouns in English tends to be “attenuated”, that is, they are less intelligible and shortened. As the authors suggest, listeners make use of priming of already presented words in discourse, that is, as they have already figured out the referent, they just need to use the acoustic signal to retrieve the referent from memory. Other studies also observed duration effects on information status. (31-33)

In Brazilian Portuguese (BP), recent studies such as (34-36) show that prosody is sensitive to information status encoding. (35) analyzed the prosodic marking in three statuses (given, new, and accessible). The results show that new referents are acoustically distinct from given and accessible referents, though no difference was found between given and accessible ones. The authors conclude that some lack of semantic control concerning the experimental items and their respective antecedents could have led to the cancelling of any possible difference. (36) analyzed the influence of sentence position on the acoustic marking of information status. The results show that speakers tend to mark more explicitly the information status when referents are in an initial position in the sentence. However, this study did not consider the accessible status as a condition.

Thus, the aim of the present study is then to deepen in some of the questions related to the prosodic manifestation of the information status in BP. The focus of the study lies on two main points: (a) whether the relative position of the referent is related to its information status and how it is encoded prosodically and more specifically (b) the role of the semantic relationship between the referent and its antecedent for the accessible status.

2. Methods

2.1. Materials

This study was conducted considering two conditions: sentence position and information status. Two corpora were created containing 72 short narratives each, in which the target items were distributed into three conditions: given, new, and accessible. The sentence context determined the information status of the target word (see examples in Tables 1 and 2). In the corpus of the first part of the experiment, the target words are in non-absolute sentence-initial position (i.e., there is an item before the target word e.g. an adverbial expression), and in the corpus of the second part of the experiment, they are in sentence-final position. According to (35), absolute initial position of referents in a

sentence is often marked by an increase of acoustic prominence, as it is the typical place for the beginning of discourse units. Because of that, the effect of discourse unit edges became a concern. The sentences in Table 1 and 2 illustrate the definition of the information status by context (the target words are in **bold** and their respective antecedents in *italics*).

Table 1: Examples of narratives used in the first experiment

Sentence-initial position		
New	De acordo com o manual, uma bateria é o suficiente para ligar o brinquedo novo.	According to the manual, a battery is enough to turn the new toy on.
Given	O rapaz comprou <i>uma bateria</i> para o aparelho. Depois de alguns minutos, a bateria apresentou um cheiro de queimado.	The lad bought <i>a battery</i> for the appliance. After a few minutes, the battery presented a burn smell.
Accessible	Ao sair de casa, o rapaz não conseguiu ligar <i>o carro</i> . Durante a madrugada, a bateria havia congelado.	After leaving home, the lad couldn't start <i>the car</i> . During the night, the battery had been frozen.

Table 2: Examples of narratives used in the second experiment

Sentence-final position		
New	O homem foi à loja para comprar uma bateria .	The man went to the store to buy a battery .
Given	O rapaz comprou <i>uma bateria</i> nova para o seu notebook. Quando ele sentiu um cheiro de queimado, ele foi à loja devolver a bateria .	The lad bought <i>a (new) battery</i> to his notebook. When he smelled burn, he went to the store to return the battery .
Accessible	Ao sair de casa, o rapaz não conseguiu ligar <i>o carro</i> . O frio havia congelado a bateria .	After leaving home, the lad couldn't start <i>the car</i> . The cold had frozen the battery .

All target words had four syllables and second to last stress. (34) shows that the acoustic correlates to the marking of information status tends to become more evident as the number of syllables increase. The choice for only second-to-last stress items is justified for it represents the standard accent pattern for most words in Portuguese. The semantic relationship between the antecedent and the target word

for the accessible condition was also controlled: all accessible referents had a “whole-to-part” (e.g. car-battery) relationship akin to the results found in German. (16) The semantic feature “animacy” was also controlled for all items as a way to control the thematic relationship between the verb and the target word. As animate items tend to occur in subject position, we decided to use only inanimate items so they could sound more natural in both subject and object positions.

2.2. Participants

Nine participants (four for the first part of the experiment and five for the second part) were instructed to read the list of narratives, displayed one by one in a slideshow presentation. The participants were able to control the speed of the slides transition. They were also instructed to first read the sentences silently and then aloud. Such procedure was an attempt to make sure they were focused on the task as they were supposed to be informatively expressive and not simply reading the sentences in a mechanical way.

2.3. Acoustic and statistical analysis

The acoustic analysis considered the following parameters: (a) duration of the target-word, (b) average f_0 contour, (c) standard deviation, (d) range, and (e) time-normalized f_0 contour. Average f_0 refers to the f_0 level of a referent i.e. how high or low the f_0 values of a word are in average. The standard deviation refers to the variation of f_0 values compared to a central value and allows an analysis of how much the f_0 of a word varies. Finally, range refers to the difference between the lowest and the highest values of f_0 of a word. It allows for an analysis of the f_0 excursion of a word.

After the recording sessions, the target words were extracted and annotated on a two-level textgrid in Praat (37). In the first textgrid tier, the items were separated by syllables (including the article) and in the second tier they were only separated by article and referent². Praat scripts were also used to automatize the extraction and calculation of the descriptor values for each acoustic parameter. Duration values were calculated in milliseconds, average f_0 and standard deviation values were calculated in Hertz and range values in semitones. The latter were obtained by applying the formula in (1), in which f_{0max} and f_{0min} are respectively the maximum and minimum values of the fundamental frequency of the target word.³

² For the analysis of duration, only the referents were used for the computation as given and accessible referents have different articles from new referents and can evidently be a bias on the mean values.

³ Samples of acoustic data and corresponding Praat metafiles (f_0 and textgrid files) of the experiments are available at goo.gl/hmj5TF.

$$12 \log_2 \left(\frac{\text{maxHz}}{\text{minHz}} \right) \tag{1}$$

The data from each participant were analyzed separately. Information status with three levels (given, new, and accessible) was the independent variable in each experiment. Analyses of variance (ANOVAs) were carried out to determine if the difference in the mean values of parameters (a)-(d) were statistically significant using statistical packages from R. (38) Bonferroni post-hoc tests were also carried out to adjust the alpha level for multiple comparisons. For the parameter (e), the intonation contours were normalized by time, following a Praat script proposed in (34). The contours were smoothed and the voiceless intervals interpolated. Finally, five samples of f_0 were extracted from each syllable (including the determiner). The analysis of (e) allowed a visual inspection of the behavior of the f_0 contour as a whole, considering the referent and its article.

3. Results

3.1. Statistical results

The results of the first part of the experiment (i.e. referents in sentence-initial position) are shown in Table 3. The data indicate that the information status affects the duration means in most participants (f1, m1, and m2, where f stands for *female* and m for *male*). Further post-hoc tests (Table 4) show that new referents are significantly longer than given and accessible referents. However, no significant difference could be observed between given and accessible referents. The information status also significantly affects average f_0 of referents in most participants. Post-hoc tests show that new referents are also distinct from given and accessible referents, but not given from accessible referents. The standard deviation was affected in only one participant (f1). For range, no significant difference was found in any participant.

Table 3: Summary of ANOVA statistics (F-values) for mean duration, mean average f_0 , mean standard deviation, and mean range values of the referents in sentence-initial position.

	duration		average f_0		standard deviation		range	
	F (2, 69)	p-value	F (2, 69)	p-value	F (2, 69)	p-value	F (2, 69)	p-value
f1	3.6303	0.03	23.608	< 0.001	6.7643	< 0.001	1.7019	n.s.
f2	0.4963	n.s.	1.057	n.s.	0.051	n.s.	0.0213	n.s.
m1	5.691	< 0.001	9.8039	< 0.001	1.1349	n.s.	1.6818	n.s.
m2	3.2178	0.04	5.327	< 0.001	0.564	n.s.	0.07	n.s.

Table 4: Post-hoc (Bonferroni) tests for ANOVAS for mean duration, mean average f_0 , and mean standard deviation values of the referents in sentence-initial position.

	duration			average f_0			standard deviation		
	new-giv	new-acc	acc-giv	new-giv	new-acc	acc-giv	new-giv	new-acc	acc-giv
f1	0.05	n.s.	n.s.	< 0.001	< 0.001	n.s.	< 0.001	< 0.001	n.s.
f2	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
f3	< 0.01	0.05	n.s.	< 0.001	< 0.001	n.s.	< 0.001	< 0.001	n.s.
m1	n.s.	n.s.	n.s.	< 0.05	< 0.01	n.s.	< 0.05	< 0.01	n.s.

The statistical results of the second part of the experiment (i.e. referents in sentence-final position) are in Table 5. The results indicate that duration is not affected by information status in the end of the sentence. The analysis of average f_0 also showed little difference among conditions. Only in one subject (f1), the ANOVA showed a marginal difference. Apparently, the f_0 level of all referents are produced around the same average level, regardless its referential status. Likewise the results of average f_0 , the overall results of standard deviation showed no significant difference among the conditions. In only one subject (f3), the difference between conditions showed to be significant. The post-hoc test shows that the standard deviation contrast is between new and given conditions. The results for f_0 range show that it is not strongly influenced by referential status. In only two subjects (f2 and m1), the analyses show marginal results. Such results are not sufficient to make any conclusion of a positive effect on range though.

Table 5: Summary of ANOVA statistics (F-values) for mean duration, mean average f_0 , mean standard deviation, and mean range values of the referents in sentence-final position.

	duration		average f_0		standard deviation		range	
	F (2, 69)	p-value	F (2, 69)	p-value	F (2, 69)	p-value	F (2, 69)	p-value
f1	0.5018	n.s.	2.7515	0.07	0.4571	n.s.	0.3318	n.s.
f2	0.5005	n.s.	1.8926	n.s.	1.3449	n.s.	2.7133	0.07
f3	0.606	n.s.	0.1368	n.s.	2.9997	0.05	1.4215	n.s.
m1	0.3627	n.s.	0.0743	n.s.	1.1738	n.s.	2.6855	0.07
m2	0.3035	n.s.	2.0514	n.s.	0.6846	n.s.	0.0625	n.s.

3.2. Analysis of time-normalized contours

The analysis of the time-normalized contours show that in sentence-initial position, new referents can be characterized by two contour peaks, one aligned to pre-stressed syllables and the other aligned to the stressed syllable. The visual analysis allows us to see the overall tendency for new referents to have a higher f_0 level as it presents higher f_0 values compared to given and accessible referents. Given and accessible referents tend to present similar contours and to have only one peak aligned to the

stressed syllable (the subject f_2 , on the other hand, shows a peak aligned to the pre-stressed syllables, even with a smaller amplitude). A small prominence aligned to pre-stressed syllables in these two conditions can be explained by the presence of a secondary accent associated to the general rhythmic structure. Compared to new referents, given and accessible tend also to present relatively flat contours (Figure 2). Unlike Germanic languages, whose main differences lie on accentual configuration aligned to stressed syllables (16), in BP the main differences can be observed in the initial part of the noun phrases, as the stressed and post-stressed syllables tend to present similar behavior.

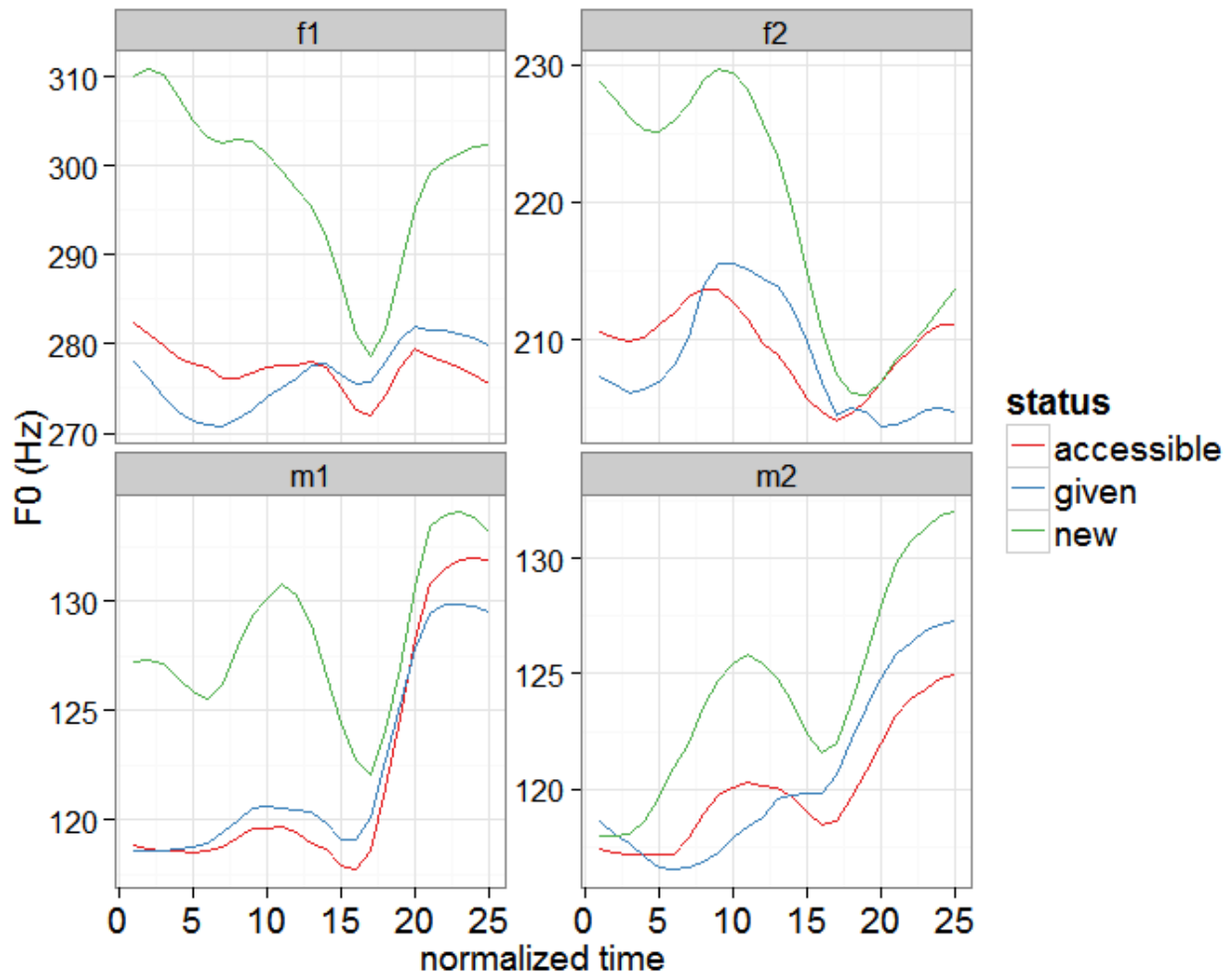


Figure 2: Mean time-normalized f_0 contours for referents in sentence-initial position⁴

The analysis of time-normalized contours in sentence-final position shows that behavior of the f_0 contour for all conditions is very similar, with only one peak aligned to the stressed syllable (Figure 3). In only one participant (m1), accessible referents present a rather flat contour with no prominence associated to post-stressed syllables.

⁴ Line color indicates different referential status. f_0 samples are displayed in the horizontal axis - each five samples correspond to a syllable in the test NP. The article extends over the first five samples; the pre-stressed syllables extend from sample 5 to sample 15 and the stressed syllable from sample 15 to 20.

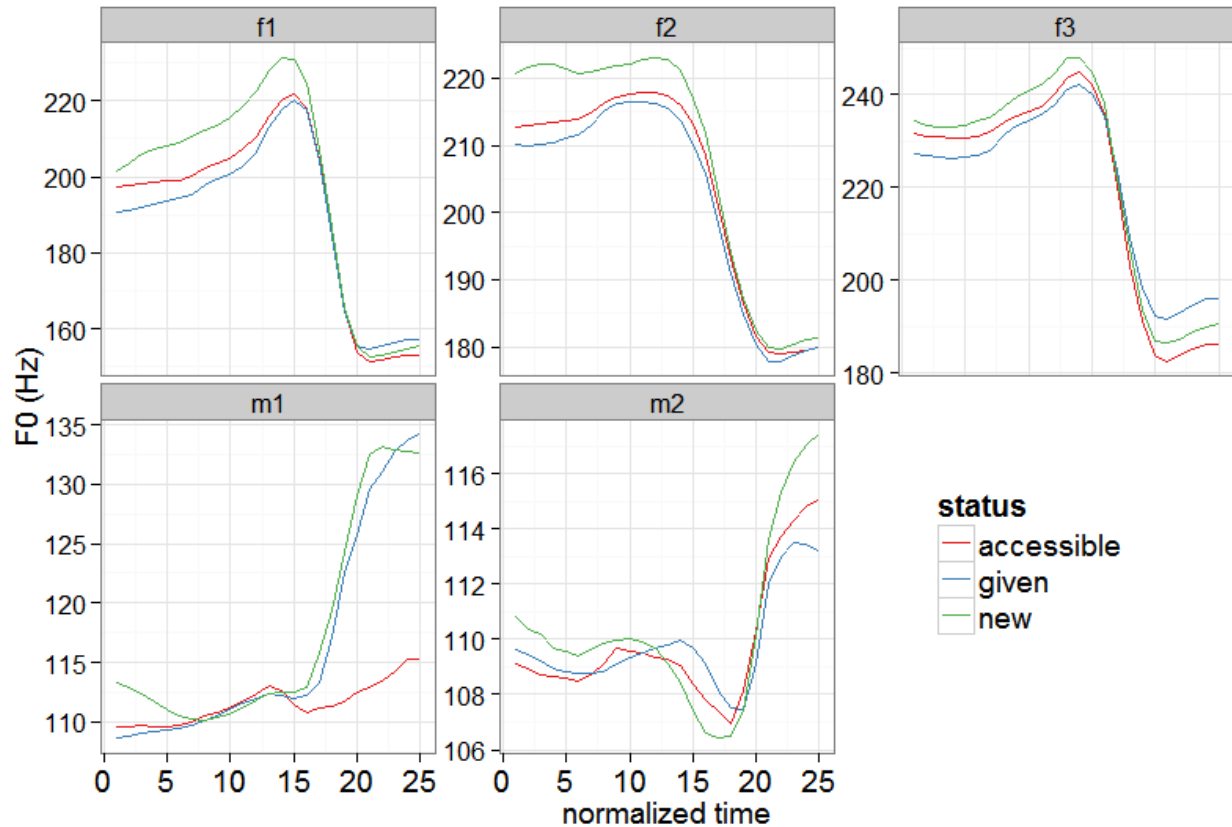


Figure 3: Mean time-normalized f_0 contours for referents in sentence-final position. Likewise the data presented in Figure 2, each five samples correspond to one syllable in the NP.

4. Discussion

On the whole, the data from the experiment corroborate the results found in other studies concerning the prosodic marking of information status in BP. Apparently, the position of the referent in the sentence seems to affect the way speakers use the different acoustic parameters.

In the first part of the experiment (target words in sentence-initial position), the differences in the mean of duration and average f_0 were significantly affected by information status. However, when the referents were in sentence-final position, none of the acoustic correlates presented any significant difference. A possible explanation for such results comes from proposals which suggest a distribution order of referents in the information structure. (1, 39, 40) Through the Given-before-new Principle, (39) proposes that a sentence follows a rule in which given information tends to occur in the beginning of the sentence and new information tends to occur in final positions. The Syntax-Discourse Model (40), in a similar fashion, proposes that information in the beginning of a sentence tends to be given as it serves as a hook to other discourse units already mentioned.

If the final position is *par excellence* the place for new information, then an acoustic prominence to mark new referents seems to be less necessary in this position. In this case, the hearers could make use of other types of linguistic information or the order principle to mark information status (for instance, morphosyntactic information). Similarly, when new referents occur in initial position, the speakers need to signalize to hearers that that information was not previously mentioned. Such idea is corroborated by the Effort Code. (41, 42) Speakers of a language share a grammaticalized biological code in which relevant information is marked by greater articulatory effort. The speaker must indicate that there is relevant information where one would expect non-relevant information. In this way, the occurrence of unmentioned information in initial position is marked and must receive acoustic prominence to signalize that it is in fact new (and therefore relevant). For BP, this signal is apparently done with an increase of duration and average f_0 values.

The results for given referents would follow the same explanation. As given referents are expected to happen in the beginning of a sentence, they are mapped to its respective information status by the sentence order principle. In sentence-final position, they also tend to be less prominent as they are previously mentioned information thus non-relevant.

The analysis of accessible referents indicates that, despite the findings in German (16), they do not have any distinctive acoustic correlate when compared to given referents. Apparently, accessible referents behave in a similar fashion to given referents, what may give rise to some questions. First, it is possible that during the experiment the participants might have been guided by morphosyntactic cues (e.g. definite and indefinite articles) but not by contextual information. As accessible and given referents are marked by definite articles, it could have led to an identification of the target words with a single status. An evidence for such interpretation is that there was not any significant difference in any of the acoustic parameters for both sentence positions. Second, as (16) pointed out, the acoustic marking of accessible referents is rather variable, and in one single case (when referents and antecedents hold a whole-to-part relationship) there was a typical marking H+L*. There are some other proposals that deny a direct phonological correlate for accessible information. (43) (5) proposes that accessible referents, when in a semi-active state, would have prosodic prominences similar to new referents. The present empirical analysis presented here shows, nonetheless, that accessible referents hold a prosodic encoding similar to given referents. Finally, the idea that the marking of intermediate statuses in the information status continuum is variable across languages must be considered. As seen in the Introduction, different languages can prosodically encode information status in different ways. As West Germanic languages tend to alter the intonational configuration of given referents (deaccenting), Romance languages tend to keep the configuration (reaccenting). Also, it is possible that other languages change the intonation configuration in other ways. Typological differences across languages might explain why accessible referents in BP tend to behave like given referents and in

German they tend to behave like new ones. More exploratory studies about such questions are necessary. So far, our current data are comparable only to German studies (16). Further work must consider the above mentioned hypotheses for a deeper understanding of the acoustic marking of accessible status.

Finally, another important question that draws attention is individual variability. Along the experiment, participants vary the combination of duration and mean f_0 . In some of them, the range values show a significant difference. As a pragmatic phenomenon with several interfaces, other factors possibly related to individual variability, such as register, personal style, emphatic focus and dialect are assumed to play a secondary role.

5. Conclusion

This study had as objective to investigate which acoustic correlates are associated to the marking of information status in BP, considering the relative position of the referents in the sentence. The results corroborate earlier studies (34-36) and show that prosodic information is affected by information status in discourse. The position of referents also affected the way referents are acoustically marked. In sentence-initial position, duration and average f_0 distinctively mark new from given and accessible referents. In sentence-final position, the three statuses do not have any distinctive marking. A strong hypothesis is that such difference is due to the general organization of information structure in the sentence level, where new information is expected in final position therefore does not need distinctive marking. At last, the lack of acoustic difference between given and accessible statuses allow for a series of possible factors from the influence of other types of linguistic information (e.g. morphosyntactic) to typological differences across languages.

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