1. Introduction

A challenge imposed on theories of sound variation and change is to identify the range of properties that determine the transition from one phonetic state to another one (Labov 1994: 543). A great number of current research in sound change has been concerned with identifying patterns of sound change and their source (Brownman and Goldstein 1992, Docherty et al. 1997, Zsiga 1995). This paper aims to contribute towards this line of research which has recently been evaluating conventional categories of description employed in phonetics and phonology. We will consider cases of lenition in Brazilian Portuguese (henceforth BP). We demonstrate that fine phonetic detail is crucial to determine the development of sound variation and change which may yield the emergence of a new phonetic category.

We also discuss the role of token frequency effects in the implementation of sound changes. We will examine the claim that regular sound changes progress more quickly in items of high token frequency (Bybee 2001: 11). We will argue that patterns of lexical diffusion are important to understand fully how lenition of affricates is implemented in BP.

In the first section we present general information about palatalization and related phenomena in BP. Section 2 presents an acoustic analysis which examines continuous phonetic properties that may be captured in spectrograms. It is argued that the observed patterns reveal important information about the transition from one phonetic state to another one. It is then suggested that phonetic detail is inherent to variation and must be taken into account if one is to fully understand sound changes. In section 3 lenition is examined in relation to token frequency and stress distribution. We argue that patterns of lexical diffusion are implemented through a combination of structural information and token frequency rates.
An important contribution of this paper is to recognize the emergent character of phonetic categories yielding the transition from one phonetic state to another one. The results presented also support the view that sound change is implemented in a phonetically gradual fashion through patterns of lexical diffusion (Bybee 2000, 2001).

2. Palatalization and related phenomena in BP

A diachronic analysis of Brazilian Portuguese shows that affricates were not reported until recently in any variety of Portuguese, except in some loan words (Teyssier 1987). Consider Table 1.

Table 1: Palatalizing and non-palatalizing dialects in BP.

<table>
<thead>
<tr>
<th>Palatalizing varieties</th>
<th>non-palatalizing varieties</th>
<th>orthography</th>
<th>glossa</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. tipo</td>
<td>tipo</td>
<td>tido</td>
<td>'type'</td>
</tr>
<tr>
<td>b. tito</td>
<td>tita</td>
<td>tinta</td>
<td>'paint'</td>
</tr>
<tr>
<td>c. ahti</td>
<td>ahtu</td>
<td>arte</td>
<td>'art'</td>
</tr>
<tr>
<td>d. patiu</td>
<td>patiu</td>
<td>paito</td>
<td>'yard'</td>
</tr>
<tr>
<td>e. t'atro</td>
<td>t'atro</td>
<td>teatro</td>
<td>'theatre'</td>
</tr>
<tr>
<td>f. d'ito</td>
<td>dito</td>
<td>dido</td>
<td>'said'</td>
</tr>
<tr>
<td>g. d'dida</td>
<td>dida</td>
<td>dinda</td>
<td>'woman's name'</td>
</tr>
<tr>
<td>h. a'didg</td>
<td>a'did</td>
<td>arde</td>
<td>'sting'</td>
</tr>
<tr>
<td>i. i'diug</td>
<td>i'diu</td>
<td>i'diu</td>
<td>'Indian'</td>
</tr>
<tr>
<td>j. d'shafjo</td>
<td>d'shafjo</td>
<td>debaixo</td>
<td>'under'</td>
</tr>
</tbody>
</table>

Palatalization is currently the major distinctive feature of Portuguese spoken in Brazil by which alveolar stops occur systematically as affricates when followed by a high front vowel as illustrated in Table 1. The high front vowel may be stressed (1a, b, f, g), unstressed pretonic (1e, j) or unstressed postonic (1c, d, h, i), oral (1a, c, d, e, f, h, i, j), nasal (1b, g) or a glide (1d, i), as it is shown in Table 1.

Palatalization of alveolar stops is seen as an innovative feature of BP in relation to European Portuguese and other African and Asian varieties, although there has been no report in the literature as to when and where it was first noticed (Teyssier 1987: 73). Careful bibliographical research we carried out did not allow us to identify either the starting point or palatalization was observed or its geographical spreading. The first reference to palatalization we found was by Mattoso Câmara (1970: 35) who described the Rio de Janeiro variety. His work was first published in the early seventies and his research was developed in the years preceding publication. He suggests that the palatalization of alveolar stops was then starting to appear in the Rio de Janeiro dialect being that it could be identified as an affiliation of the alveolar stop which was more prominent in the primarily stressed position. Abaurre and Pagotto (2002) analyzed data from the seventies to evaluate interdialectal palatalization of alveolar stops in Brazil focusing mainly on geographical distribution. Their findings are illustrated in Table 2.

Table 2: Geographical distribution of palatalization in BP.

<table>
<thead>
<tr>
<th>Cities</th>
<th>N</th>
<th>%</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recife</td>
<td>66/949</td>
<td>7</td>
<td>.02</td>
</tr>
<tr>
<td>Salvador</td>
<td>642/745</td>
<td>85</td>
<td>.73</td>
</tr>
<tr>
<td>Rio de Janeiro</td>
<td>841/844</td>
<td>100</td>
<td>.99</td>
</tr>
<tr>
<td>São Paulo</td>
<td>543/747</td>
<td>40</td>
<td>.48</td>
</tr>
<tr>
<td>Porto Alegre</td>
<td>304/759</td>
<td>59</td>
<td>.18</td>
</tr>
<tr>
<td>Porto Alegre</td>
<td>2396/4054</td>
<td>59</td>
<td>.18</td>
</tr>
</tbody>
</table>

Table 2 shows that there are varieties of BP where palatalization is fully implemented (as in Rio de Janeiro) and varieties where palatalization is still incipient (as in Recife). Abaurre and Pagotto (2002: 9) also mention that palatalization is spreading into non-palatalizing varieties and becoming a general feature in BP.


In this paper we will consider data from the city of Belo Horizonte. It is a city with a population of 2.23 million, located in the Southeast and it is the 4th major city in Brazil (IBGE <http://www.ibge.gov.br>). Belo Horizonte is a full palatalizing variety of BP (Cristófaro-Silva 2003). We can summa-
rize the facts presented so far by saying that palatalization of alveolar stops triggers an affricate to occur systematically followed by a high front vowel. Belo Horizonte is a fully palatalizing variety where affricates are found in all possible accentual positions and the high front vowel may be oral, nasal or a glide.

In the remainder of this section we will consider two issues related to palatalization of alveolar stops: post-vocalic sibilant palatalization (\textit{tr}[ʃɪ] > \textit{tr}[ʃɪ \textit{tese} 'test']) and lenition of affricates (\textit{tr}[ʃɪ] > \textit{tr}ɪ \textit{tese} 'test'). These issues are relevant to the understanding of lenition of affricates which will be discussed later.

Let us initially consider palatalization of a post-vocalic sibilant. Post-vocalic sibilants in the Belo Horizonte dialect are systematically alveolar except when the sibilant is followed by an affricate. Thus, post-vocalic sibilants are alveolar word-finally, as in \textit{pas} \textit{paz} 'peace', and word-internally when followed by any consonant other than an affricate, as in 'kaska casca' 'peel', 'azna asno 'donkey', \textit{pasta pasto} 'briefcase'. When a post-vocalic sibilant is followed by an affricate it may be realized as alveolar, as in \textit{tr}[ʃɪ] and \textit{dɛzdʒɪ} or as alveopalatal, as in \textit{tr}[ʃɪ \textit{tese} 'test'] or \textit{dɛdzʒɪ dese} 'since' (Barry and Andreeva, 2001).

Let us now consider the other issue related to palatalization of alveolar stops: lenition of affricates. Lenition involves the weakening and eventual loss of a consonantal segment. The cases we will consider in detail later in this article involve post-vocalic sibilants followed by an affricate where the affricate may be lenited: \textit{tr}[ʃɪ] > \textit{tr}ɪ \textit{tese} 'test' or \textit{dɛdzʒɪ} > \textit{dɛdzʒɪ dese} 'since' (Barry and Andreeva, 2001).

We would like to point out that by expressing lenition with IPA symbols it appears that a categorical and discrete change takes place, where an affricate is either present or not. We will question this view by showing that a closer examination of very basic properties of data may offer us important information to understand the transition from one phonetic state to another one in the lenited forms under study.

In the following section we present an experimental analysis to support our claim. The analysis to be discussed in the remainder of this paper will be restricted to unvoiced post-vocalic sibilants followed by affricates: \textit{ʃj} and \textit{ʃʃ} and their corresponding lenited forms. This is due to the fact that voiced post-vocalic sibilants followed by affricates, as in \textit{zɛdz} and \textit{zɛdz} occur in just a few words. A two hundred thousand word dictionary count showed only nineteen words which present the voiced sequences in question. However, the phenomena that will be discussed below regarding the voiceless sequences of post-vocalic sibilants and affricates are also observed for the voiced sequences.

3. Experimental analysis

3.1. Experimental motivation

Assimilation and lenition are generally described as categorical processes by which a given segmental sequence turns into another one (Lass 1984; Carr 1999). This is witnessed in traditional views of phonology from Generative models to Optimality theory which overtly exclude predictable information of representation. However, a number of recent works has questioned this traditional view by offering insightful analysis of phonological phenomena. These works may focus on perception (Johnson, 1997; Pisoni 1997) or production (Pierrehumbert 2001). It is likely that a full model to analyze phonological phenomena will combine perception and production in an integrated manner (Bybee 2001).

In this section we will focus on the acoustic examination of production. We assume that the reader is familiar with the general principles of acoustic analysis (Kent and Read 1992; Pickett 1999). However, for the sake of clarity we will identify major acoustic correlates of articulatory properties. We first describe the experiment and then we will examine the relevant data.

3.2. The experiment

An experiment was designed to investigate lenition of affricates. Recording took place at the Phonetics Laboratory at the Federal University of Minas Gerais recording studio using a DAT (Digital Audio Tape, Sony TCD D8) and a unidirectional Sony microphone. Participants were told we were testing memory skills through a number of experiments and they agreed to participate in the research project. A number of 8 female and 8 male university students took part. They were all aged 18 to 30 years old. A number of 28 words were analyzed for each one of the participants giving us a total of 443 tokens. Participants were asked to read aloud a set of sentences (cf. appendix). Words to be analyzed were selected according to their stress pattern (stressed or unstressed) and also according to their frequency of token rate: high or low token frequency. Token frequency count was obtained at http://lael.pucsp.br/corpora/index.htm which represents a corpus of
The effects of token frequency on the implementation of lenition of affricates will be discussed in section 4. All word tokens were individually edited and analyzed using Praat (<www.praat.org>) (Boersma and Weenink, 2006).

In the following section we will present the major acoustic characteristics of voiceless stops, affricates and sibilants in order to offer the reader instruments to be able to evaluate the analysis to be presented.

3.3. Acoustic correlates of stops, affricates and sibilants

Let us initially consider the acoustic representation of alveolar stops and affricates. Consider Figure 1 which shows the spectrograms for the words a'ta atar 'to tie up' and a'f'fa 'made up word for illustrative purposes' focusing on the characteristics of the alveolar stop (on the left) and an alveopalatal affricate (on the right).

![Figure 1: Spectrograms for an intervocalic alveolar stop in the word a'ta atar 'to tie up' and an intervocalic affricate in the word a'f'fa 'made up word for illustrative purposes'.](image)

The essential articulatory feature of a stop consonant is a momentary blockage of airflow through the vocal tract. Thus, amongst other things, a stop is characterized by very little or no acoustic energy whose spectrographic correlate is the lack of energy. This lack of energy is characterized by a gap or blank area in Figure 1. The gap in the spectrogram reflects the acoustic interval corresponding to the articulatory occlusion during the production of the stop. Another important characteristic of a stop is the drastic drop in intensity (Ladefoged, 1982: 170). We have highlighted the drop in intensity in Figure 1 by an arrow. We would like to call special attention to the drop in intensity as one of the acoustic correlates of a stop since this will be important to the facts to be discussed later.

Notice that the picture on the right handsie in Figure 1 represents an affricate. An affricate consists of a stop followed by a sibilant, which in the case of Figure 1 is alveopalatal. Sibilants are acoustically characterized by noise energy which in the picture on right handsie in Figure 1 is expressed by the darker area which follows the stop (in the affricate). Notice that there is a rise in intensity when the sibilant occurs after the stop. Thus, we may say that an affricate may be acoustically characterized by two contiguous acoustic properties. For its initial part which corresponds to the stop there is a closure which is represented by the blank space in the spectrogram and also by the drop in intensity. The alveopalatal sibilant in the affricate, which follows the stop, is characterized by the noise energy expressed by the darker area in the spectrogram and the rise in intensity. Let us now consider alveolar and alveopalatal sibilants. Figure 2 presents spectrograms for the words a sa assar 'to roast' and a fa achar 'to find'.

![Figure 2: Spectrograms illustrating an intervocalic alveolar sibilant in the word a sa assar 'to roast' and an intervocalic alveopalatal sibilant in the word a fa achar 'to find'.](image)
In both spectrograms in Figure 2 the more prominent darker area characterizes the sibilant which is identified by an arrow. The word *'asa assar* 'to roast', which presents an intervocalic alveolar sibilant, is illustrated on the left handside in Figure 2. The noise energy from the fricative concentrates over the superior part of the spectrogram. On the right handside it is illustrated the spectrogram for word *'afa achar* 'to find' where an alveopalatal sibilant occurs intervocally. The noise energy from the alveopalatal fricative is also observed and in this case it is observed across the height of the spectrogram. Above the spectrograms are shown oscilograms where we also indicated the sibilants by an arrow. In the following section we will provide an acoustic evaluation of our data in order to consider lenition of affricates.

### 3.4. Lenition of affricates

One of the crucial issues for theories of sound change is what to consider as a crucial point for a sound change to enter the linguistic system and to progress and settle or not. The debate resolves around two issues. One of them concerns the neogrammariand and lexical diffusion theories (Wang 1969). The other issue concerns the nature of information which is present in lexical representations. We will leave the discussion of neogrammariand and lexical diffusion theories to section 4.

In this section we will address some aspects which are relevant to examine the nature of elements present in lexical representations. We will show that lenition of affricates operates in a gradual fashion being that the acoustic properties inherent to the affricate remain in the signal offering important information to lexical representations (Browman and Goldstein 1992; Albano 2001. See also Kochetov's contribution to this volume, for a critical analysis of Articulatory Phonology). We suggest that lenition reflects the fact that previous sequential gestures are then manifested simultaneously for at least part of their articulation. Changes in the organization of gestures or their timing produce acoustic-perceptual changes that may be captured in spectrograms. Thus, it is rather the overlapping of articulatory properties that produces the acoustic effect of a gesture being hidden indicating the gradual nature of lenition in BP.

Consider Figure 3 which illustrates post-vocalic sibilants followed by an affricate in the word *constipado* 'constipated'. An arrow in the spectrogram on the left handside in Figure 3 indicates an alveolar sibilant which is followed by an affricate, i.e., *conf[sf]tʃipado*. On the right handsie in Figure 3 the arrow indicates an alveopalatal sibilant which is followed by the affricate, i.e., *conf[ʃʃ]tʃipado*.

![Figure 3: Affricates preceded by a sibilant in the word constipado 'constipated'.](image)

In both spectrograms in Figure 3 one observes the closure of the stop in the affricate which is characterized by a blank area and the drop in intensity. Thus, in both spectrograms in Figure 3 there is a sibilant followed by an affricate. Let us now consider cases which involve lenition. Consider Figure 4.

![Figure 4: Lenition of an affricate in the word constipado 'constipated' conf[ʃʃ]tʃipado expressed by a sequence of alveopalatal sibilants with the concomitant drop in intensity.](image)
Figure 4 illustrates the word *constipado* 'constipated' where two sibilants occur contiguously and there is no closure between them. The arrows in the spectrogram and in the oscillogram indicate the noise energy corresponding to the sibilants. The drop in intensity between the sibilants may also be observed in Figure 4. However, the drop in intensity which is typical in stops (Figure 1) is not typical in sibilants (cf. Figure 2). We suggest that the drop in intensity which is observed between the sibilants in Figure 4 reflects the former sequential gestures of the affricate closure and the sibilant being manifested simultaneously. In other words it is the overlapping of articulatory properties that produce the acoustic effect of a gesture being hidden. Lenition, thus, in the case under investigation consists of the concomitant articulation which follows from gestural compression. The drop in intensity in Figure 4 expresses a property from the affricate which occurs in the lenited form. Consider now some further cases of lenition which are illustrated in Figure 5.

![Figure 5: Lenition of affricates in the word *con[j]ipar* 'constipated' (on the left) and in the word *in[j]igar* 'instigate' (on the right).](image)

Figure 5 illustrates lenited forms with no closure of the affricate between the sibilants. On the left, the word *con[j]ipar* 'constipated' shows an alveolar sibilant followed by an alveopalatal sibilant. On the right, the word *in[j]igar* 'instigate' is illustrated showing two alveopalatal sibilants. The arrows in the spectrogram and in the oscillogram highlight the lenited affricates. Notice that in both words illustrated in Figure 5 the drop in intensity between the sibilants which corresponds to the closure in the stop is not as abrupt as was shown on Figure 4. In Figure 5 the drop in intensity is rather smaller. The decrease in intensity follows from greater gestural compression. One may then posit that further gestural compression may yield a regular sibilant to occur. Consider then the spectrogram for the word *con[j]ipar* 'constipated' in Figure 6.

![Figure 6: Lenition of affricate in the word *con[j]ipar* 'constipated'.](image)

The spectrogram in Figure 6 illustrates the word 'constipated' where lenition yields the manifestation of an alveopalatal sibilant, i.e. j. Notice that the intensity feature from the stop (in the affricate) is not present during the production of the sibilant shown above. Figure 6 illustrates a case of much greater gestural compression than the ones presented in Figures 4 and 5.

At this point we may say that lenition applies in a phonetically gradual fashion creating a number of patterns that reflect gestural compression which follows from a gestural overlap that takes place gradually. Thus, lenition ranges from the drop in intensity between sibilants which were formerly related to the stop in the affricate to the manifestation of an alveopalatal fricative.

At this stage we can say that there are two sources for alveopalatal sibilants in BP: a regular one (Figure 2) and one related to lenition of affricates (Figure 6). Following a preliminary evaluation of data we posit that the duration of the sibilant is different for each case in question. More specifically we posit the hypothesis that the duration of lenited sibilants is longer than the duration of regular sibilants. Unfortunately, as the experiment we carried out was not specifically designed to examine durational patterns we are not
able to pursue this issue here. Sangster (2001) offers and insightful analysis along this line of research which may be taken into consideration in future research. In the following section we consider token frequency effects on the implementation of lenition (Guimarães 2004).

4. Frequency effects on lenition of affricates

In this section we return to one of the core issues related to sound changes, which is the debate between neogrammarian and diffusionist perspectives. In a very concise manner we may say that neogrammarian changes are said to be phonetically gradual and lexically abrupt (Osthoff and Brugmann 1978). Lexical diffusion changes are said to be phonetically abrupt and lexically gradual (Wang 1969). The categorical distinction between neogrammarian and lexical diffusion changes has opened a lively debate (Labov 1994; Oliveira 1991). An additional perspective to neogrammarian and diffusionist theories is suggested by Bybee (2001) who assumes that sound change is both phonetically and lexically gradual. In cases of phonetically motivated sound changes Bybee suggests that more frequently used words are affected first.

In the previous section it was shown that lenition is phonetically implemented in a gradual fashion in BP. In this section we intend to offer evidence that lenition is lexically implemented in a gradual manner through patterns of lexical diffusion.

We examined 28 words which were grouped according to token frequency count: high and low token frequency. We also grouped words in relation to stress, i.e., whether lenition applied to a stressed syllable or to an unstressed one. Results are presented in Table 3.

Table 3: Lenition in relation to stress and token frequency.

<table>
<thead>
<tr>
<th>More Frequent</th>
<th>Less Frequent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affricate</td>
<td>Lenition</td>
</tr>
<tr>
<td>N.</td>
<td>%</td>
</tr>
<tr>
<td>Unstressed</td>
<td>8/176 5%</td>
</tr>
<tr>
<td>Stressed</td>
<td>16/48 34%</td>
</tr>
</tbody>
</table>

Chi-square = 66.2823178802747, p < 0.001

We examined whether lenition took place or an affricate occurred. The criterion to identify an affricate was the presence of a blank area in the spectrogram that would characterize the closure for the stop in the affricate. If no gap was observed in the spectrogram the token was then categorized as lenited. We are aware that the discrete categorization of tokens into two distinct groups is not perfectly consistent with the theoretical background we are using. However, we believe that this preliminary analysis may offer insight to future investigations.

We suggest that frequency effects combined with stress patterns may offer us a better understanding of data presented on Table 3. Lenition first appeared in unstressed positions in more frequently used words (95%) then progressed towards unstressed positions in less frequently used words (76%). Thus, lenition is favoured in unstressed positions. In its current stage lenition is progressing towards stressed positions in frequently used words (67%) and lenition is less frequent in stressed positions in rarely used words (31%). These facts show that token frequency and stress are closely related in the implementation of lenition thus supporting Bybee's claim that token frequency is important in the implementation of sound changes. Besides examining token frequency effects we also considered the lexical hypothesis that individual words behave differently towards a given phenomena. A closer examination of lenition rates for each word shows that the general tendency is for more frequently used words to present a higher rate of lenition. Consider Figure 7.

Figure 7 illustrates the rates for lenition in individual words. Notice that more frequently used words have a tendency to present a high rate of lenition, indicated by the grey bars grouped towards the left on Figure 7. On the other hand, less frequently used words have a tendency to present a lower rate of lenition which is indicated by the white bars towards the right in Figure 7. Notice that there are words which do not follow this general expected tendency for token frequency. An example is the word number 10 (cabalística) which has a high rate of lenition but is not used that frequently. If we consider the word number 26 (justiça) we observe that it has a high token count but a lower rate of lenition. The behaviour of individual words with respect to frequency effects simply indicate that general token frequency tendencies are followed although some lexical items do not behave as expected with respect to token frequency tendencies.
gestures are now manifested simultaneously. Changes in the organization of gestures or their timing produce acoustic-perceptual changes that may be captured in spectrograms (Brownman and Goldstein 1992; Albano 2001). Thus, an important contribution of this paper is to recognize the emergent character of phonetic categories yielding the transition from one phonetic state to another one. Our results support the view that sound variation and change is implemented in a phonetically gradual fashion.

Additionally, this paper supports the claim that token frequency is relevant in the implementation of sound variation and change. We have shown that more frequently used words undergo lenition at a higher rate than lower frequency ones. We also showed that stress plays an important role in the implementation of lenition of affricates, since words may, if appropriate, behave in a non-predictable manner with respect to frequency effects. Thus, the results presented in this paper support the view that sound variation and change is phonetically and lexically implemented in a gradual manner (Bybee 2000, 2001).

A number of issues raised in this paper still deserves further investigation. The evaluation of durational values of regular and lenited sibilants may contribute to a better understanding of similar segments. Another pertinent issue to be pursued in future works regards the analysis of frequency effects grouped logarithmical manner (Mendoza-Denton et al. 2003). The perceptual evaluation of regular and lenited sibilants also may be investigated. Some preliminary results show that regular sibilants are generally perceived as a sibilant whereas lenited sibilants are mainly perceived as affricates (Guimarães 2004).

Appendix

Sentences used for data collection. Words investigated are underlined

1. O instituto brasileiro de geografia e estatística (IBGE) aponta que, contrariamente ao que se pensa, o número de nascimentos de homens é maior do que o de mulheres em Belo Horizonte.

2. A desconfiança é a característica principal do mineiro. O mineiro da cidade grande tem um estilo de vida agitado. Mas, há muitas vantagens de se morar em Belo Horizonte. Uma delas é o acesso à cultura. O teatro, por exemplo, é uma manifestação artística que vem ganhando

Figure 7: Frequency effects in lenition in individual words.

The data discussed in this section provides us with evidence for a model which incorporates token frequency effects into the organization of linguistic systems. General tendencies are important but words may have specific behaviour that does not fit into the major token frequency tendencies.

5. Conclusion

This article examined lenition of affricates in BP. It was shown that there is a great range of fine phonetic detail related to the implementation of lenition. The phonetic variability observed is related to the fact that previous sequential
cada vez mais espaço nessa cidade. Além disso, na área musical, um festival de novos talentos tem surgido a cada dia.

3. Belo Horizonte é uma cidade em constante crescimento. Pode-se notar o crescimento desordenado de alguns bairros. O reajuste dos preços do material de construção nos últimos meses parece ter freado um pouco os investimentos no setor da construção civil. O que não é bom nem para quem mexe com construção nem para os possíveis compradores.

4. Uma das atividades que tem crescido é a reciclagem de materiais. Esse trabalho tem mudado o destino de muita gente, que sobrevive de catar papel, plástico e vidro.

5. Com os problemas da Santa Casa, o maior hospital do SUS de Belo Horizonte, muitas pessoas têm ficado sem atendimento. A cistite, uma doença que afeta principalmente as mulheres, tem diagnóstico fácil, mas a falta de medicamentos tem feito avançar esse doença principalmente na população mais carente.

6. Em Venda Nova, uma empregada doméstica acabou ofendendo a secretária do posto de saúde porque teve que esperar horas por um atendimento a seu filho que estava constipado.

7. Um dos grandes problemas que atormenta a população é a dengue, uma doença transmitida por um mosquito pestylenque se reproduz em locais de água limpa e parada. Em época de chuva, o enchimento de pequenas poças de água contribui para a proliferação desse mosquito.


9. Instituições de combate a droga procuram instigar jovens a buscar novas atividades que possam preencher o tempo ocioso. Tem-se chegado a conclusão de que não adianta fazer um discurso pernóstico. Os jovens necessitam de ajuda concreta.

10. No dia da fundação dessa instituição, o presidente fez um discurso inicial e, em um tom ritualístico, convocou as empresas particulares a ajudarem no combate a droga. Um problema que tem mexido com a vida de toda a população.

11. Alguns psicólogos fazem um trabalho voluntário aplicando o chamado teste vocacional para ajudar os jovens que ainda não escolheram a profissão.

12. Os especialistas alertam que mesmo o adolescente quieto e ensurdiço pode estar precisando de ajuda. Os pais precisam assumir um ponto de vista realístico para encarár os problemas de seus filhos. Existe, em Belo Horizonte, uma instituição de ajuda aos dependentes químicos que oferece cursos aos pais e faz encaminhamentos a clínicas especializadas.


15. Na estiva, foram encontradas muitas caixas de bebidas vindas do México, sem a nota fiscal. Todas foram apreendidas pela polícia.

16. Foi constatado nos últimos meses uma baixa dos preços de roupas no comércio de Belo Horizonte. Um vestido que antes custava R$120,00 pode ser encontrado por R$80,00 ou até menos.

17. O cachimbo era muito usado antigamente. Hoje só usam cachimbo pessoas mais velhas e no interior.

18. Geralmente, nas cidades do interior, ocorre uma disputa cabalística entre dois partidos políticos. Na verdade, levam-se em conta não só as questões políticas, mas também os interesses pessoais.

Notes

1. The authors would like to register support from CNPq Conselho Nacional de Desenvolvimento Científico e Tecnológico (grant number: 30.41.21/2002-9) and
2. In Rio de Janeiro all post-vocalic sibilants are alveopalatal: 'paj paz 'peace', pafa pasta 'briefcase', lagga rasga 'rip' (Callou and Leite 1990). In Recife, a northeastern variety, post-vocalic sibilants are alveopalatal when followed by a coronal consonant: agno asna 'donkey', pafa pasta 'briefcase', deghi desde 'since', and post-vocalic sibilants are alveolar when followed by noncoronal consonants or followed by a pause: kaska casca 'peel' or as in 'paz paz 'peace' (Cristofero-Silva 2001; Mota 2002). We mention here dialectal variation concerning post-vocalic sibilants for the sake of curiosity and as a piece of information for future research on this topic.


4. We expected to collect 448 tokens (16 participants x 28 words). However, some words were read as a different one or the participant did not read it. Then, the total number of analyzed tokens was 443 (missing 5).

5. The figures below illustrate recordings from one of the authors for illustrative purposes. For details of these segments in other languages see: Kent and Read 1992; Johnson 1997; Ladefoged 1982, 2003. The infinitive verbal forms were pronounced without the final r-sound reflecting a characteristic pronunciation in Belo Horizonte see Oliveira 1983.

6. An experiment designed to compare regular and lenited sibilants shall investigate identical or very similar contexts. For example a regular sibilant in the word a[JE] ache 'Find!' and a lenited sibilant in the word ha[JE] ha[JE] haste 'pole'. We did not distinguish words with identical environments in our experiment. A preliminary analysis of durational patterns in regular and lenited sibilants is presented in Guimarães (2004) which led us to posit the durational hypothesis presented here. However the number of tokens examined in Guimarães (2004) was very small to offer definite results.

7. Phillips (1984, 2001); Bybee (2001) argue that sound changes which are not phonetically motivated affect less frequently words first.

8. In our experiment low frequency word presented a count below 10 tokens and high frequency words presented a count above 600 tokens (over one million words corpus). An interesting possibility which may be examined in future works is to group token frequency in a logarithmical manner Mendonza-Denton et al. (2003).

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Silent onsets? An optimality-theoretic approach to French *h aspiré* words

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This paper reexamines one of the classical problems of French phonology: the phenomenon of *h aspiré* words (Fouché 1959, Klein 1963, Rothe 1978, Encrevé 1988, Green and Hintze 2004). These vowel initial items display a special behavior with respect to typical phonological processes of French, such as *enchaînement*, *liaison*, and *élision*. Based on the analysis of experimental data we investigate the phonetic realizations of these items and propose an optimality-theoretic (OT) approach in order to account for this phenomenon as well as for the variation encountered in our data.

The paper is organized as follows: We start with an overview of the relevant facts from a rather descriptive point of view (section 1) before presenting the data analyzed for the present study (section 2). While section 3 reviews selected non OT approaches to French *h aspiré* words, section 4 goes into the problem of gradient variation from an optimality-theoretic perspective: We give an overview of the proposals under discussion before putting forward our own account that largely relies on the model of Stochastic OT developed by Boersma and Hayes (2001). Section 5, finally, offers some concluding remarks.

1. The phenomenon

One of the characteristics of French phonology lies within the strong tendency to create regular CV sequences and to avoid hiatus (V.V) through the application of phonological processes such as *enchaînement* (syllabification of a fixed final consonant into the empty onset position of the following word, 1a), *liaison* (surfacing of a latent final consonant into the onset position of the following word, 2a) and *élision* (deletion of certain vowels in pre-vocalic position, 3a). All these processes have in common that they create onsets for vowel-initial words (that would otherwise violate the high-ranked constraint *ONSET*), but at the same time they mask the left edges of these words by a consonantal element. There is, however, a group of words that – despite of