# A QUANTITATIVE ANALYSIS OF WORD-FINAL /r/-DELETION IN BRAZILIAN PORTUGUESE

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**ABSTRACT**

*This study provides a quantitative analysis for the process of word-final /r/-deletion in the dialect of Portuguese spoken in the city of Belém, in northern Brazil. Two linguistic and four extralinguistic factors are considered in the investigation, all of which have a significant effect on the outcome of the process. Within the framework of Optimality Theory (Prince & Smolensky 1993), I propose an analysis for the general variation patterns found in /r/-deletion, along the lines of Reynolds (1994) and Anttila (1997).*

## 1. INTRODUCTION

This article offers a Labovian quantitative approach to the analysis of the phonological process of word-final /r/-deletion in the Brazilian Portuguese dialect (henceforth BP) spoken in the city of Belém, in northern Brazil. In the study, I focus on one particular topic in the examination of /r/-deletion: the quantitative aspect of the phenomenon, along the lines of Labov (1966 et seq.). In an attempt to explain the general results obtained in the quantitative analysis, this study is couched within the framework of Optimality Theory (Prince & Smolensky 1993, McCarthy & Prince 1993a,b). The data come from my own fieldwork sample of 1,333 tokens of variants of /r/, collected from a five-level stylistic interview with four native speakers of BP temporarily living in Montreal, Canada.

The study offers an account of variation using the tools of Optimality Theory (henceforth OT). Following the works of Reynolds (1994), and Anttila (1997), the quantitative analysis that I present for /r/-deletion in BP provides support for the view that variation can be encoded in the grammar through constraint unranking. The analysis uses tools from theoretical linguistics in the form of OT and includes quantitative findings to provide an account of the non-categorical regularities found in the /r/-deletion process in language use.

This article is composed of four main sections. In section 1, I introduce the topic of /r/-deletion in Brazilian Portuguese and present the dependent

variable and its variants. In section 2, I discuss the six independent variables (four extralinguistic and two linguistic factor groups) selected for the final GoldVarb analysis, while section 3 illustrates and discusses the results obtained in the quantitative study. Finally, in section 4, I introduce the subject of variation in Optimality Theory and propose an OT analysis for the general variation pattern involved in /r/-deletion in this dialect of Brazilian Portuguese.

### 1.1. The dependent variable

In the dialect of Portuguese spoken in the city of Belém, the word-final coda /r/ may surface in three distinct forms, as illustrated in (1). Observe that in the first two cases, the variant selection is determined by the segmental nature of the following segment: [ɾ] in the case of a following vowel, and [x] in instances in which the following word begins with a consonant. Notice in 1c), however, that /r/-deletion may occur in the exact contexts in which one would expect one of these two variants, i.e., in pre-vocalic or pre-consonantal contexts:

(1) Outputs of word-final /r/:[1]

| | | | |
|---|---|---|---|
| (a) | voiced alveolar flap [ɾ]: | dança[ɾ] uma música | 'to dance a song' |
| (b) | voiceless velar fricative [x]: | dança[x] samba | 'to dance samba' |
| (c) | or it may be deleted: | dança_ uma música | 'to dance a song' |
| | | dança_ samba | 'to dance samba' |

The output illustrated in (1c), i.e., /r/-deletion, constitutes a stigmatized, non-standard variant of /r/ that carries social awareness (a *marker* in Labovian terms). This can be verified in the works of many Brazilian writers when they attempt to reproduce the speech of speakers from rural areas or lower socioeconomic classes, as I illustrate in (2) below. What is interesting about /r/-deletion in Portuguese is the fact that, even though the deleted form is usually used to describe the speech of less educated people from rural or undeveloped areas, /r/-deletion is nevertheless present in the speech of speakers from all social classes and regions in Brazil,

[1] As pointed out in the works of Cunha (1987) and Callou & Leite (1990), the variable /r/ has different regional variants in word-final contexts in Brazil. For instance, the pre-consonantal or pre-pausal variant is usually the velar [x] in the state of Rio de Janeiro (southeast), the apico-alveolar [ɾ] in Rio Grande do Sul (south) and the velarized lingual-palatal (or retroflex) [ɽ] in northern São Paulo and southern Minas Gerais (i.e. the 'dialeto caipira' or 'provincial dialect' in southern Brazil).

regardless of educational background. This is in agreement with Callou & Leite's (1990) discussion of the variable /r/, in which they claim that 'the speaker is not aware of which type of variant he or his interlocutor uses':

> 'Traditionally, one believes that the non-preservation of the phonic segment in this context [word-final position] is related to the language of ordinary people. Nevertheless, one verifies its absence, in a very generalized way, in the speech of scholarly speakers in Rio de Janeiro.'

(2) Examples of /r/-deletion as stigmatized forms:

(a) Coelho Neto (1926):[2]

| | |
|---|---|
| Balbina, an ex-slave: | 'Ocê já vai *dêtá_*?'<br>'Are you going to lie down now?'<br>**Note:** standard *deitar* → *dêtá* 'to lie down' |
| Lúcia, a well-educated woman: | 'Não vou me *deitar*, não, tia Balbina.'<br>'No, I'm not going to lie down, aunt Balbina.' |

(b) De Souza (1999):

| | |
|---|---|
| A well-educated boy: | 'Tá com medo de *tirar* retrato? Ou será que tá com medo de *ouvir* sua média?'<br>'Are you afraid to take a picture? Or are you afraid to hear your grade?' |
| Chico Bento,[3] a country boy: | 'Fique sabendo qui vô *passá_* di ano forgado [...].'<br>'I'll have you know that I'll easily pass this year.'<br>**Note:** standard *passar* → *passá* 'to pass' |

Observe in these examples that a typographical accent is used to indicate the absence of /r/ in the utterance of the characters whose speech is characterized by /r/-deletion (an ex-slave in the first example, and a country boy in the second). As I will show later, the accent shown in the /r/-deleted forms indicates the original word's stress, since the vast majority

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2 The date in which the second edition of Coelho Neto's (1926) novel *Rei Negro* (Black King) was published clearly indicates that the /r/-deletion process is not a contemporary phenomenon in Brazilian Portuguese. Observe how the author clearly associates /r/-deletion with the speech of the less educated character, aunt Balbina, as opposed to Lúcia, 'a learned and gifted mestiza'.

3 Chico Bento is a cartoon character created by Maurício de Souza. In his stories, the character symbolizes the uneducated country boy and his speech always contains orthographic mistakes in order to simulate the 'incorrect' speech found in rural areas in (southeastern) Brazil.

of /r/-final words bear stress on the last syllable.[4] In fact, the few words that do not follow this pattern bear an orthographic accent somewhere in the word to indicate the anomaly, e.g., *caráter* 'character', *âmbar* 'amber', etc.

In standard Brazilian Portuguese, the production of the three variants of /r/ is determined by the nature of the following phonological environment, as I illustrate in (3) (cf. Callou & Leite 1990). Observe that the alveolar variant occurs before a vowel, while the velar variant appears if it is followed by a consonant or a pause.

(3) Standard allomorphic variants of /r/: [ɾ] and [x][5]

| | | | |
|---|---|---|---|
| a. | [fala[ɾ]alemaw] | 'to speak German' | (followed by a vowel) |
| b. | [fala[x]portugeʃ] | 'to speak Portuguese' | (followed by a consonant) |
| c. | [fala[x]] | 'to speak' | (followed by a pause) |

The production of /r/-deletion, however, cannot be determined on a purely phonological basis because its occurrence is governed by both social and linguistic factors. In (4), observe that /r/ deletion occurs in the exact environments in which the standard variants shown in (3) surface.

(4) Non-standard variant of /r/: /r/-deletion

| | | | |
|---|---|---|---|
| a. | [fala_alemaw] | 'to speak German' | (followed by a vowel) |
| b. | [fala_portugeʃ] | 'to speak Portuguese' | (followed by a consonant) |
| c. | [fala_ ] | 'to speak' | (followed by a pause) |

For the purpose of this study, the variation analysis focuses exclusively on occurrences of /r/ word-finally, since the /r/-deletion phenomenon op-

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[4] The stress accent is necessary in Portuguese after 'orthographic' r-deletion because otherwise the stress would shift to the penultimate syllable (the preferred stress pattern in the language). In most cases, stress shift yields a different word: *malhar* [ma.ˈʎax], [ma.ˈʎa] 'to work out' → *malha* [ˈma.ʎa] 'jersey' and '(he/she/it) works out'.

[5] Mattoso Câmara Jr. (1970), Callou (1987) and Callou & Leite (1990) point out that, in the environment of a following consonant or pause (in the context in which the variant [x] surfaces), four variants can be observed in the speech of well-educated speakers in the state of Rio de Janeiro (i.e. the voiced alveolar flap [ɾ], the voiceless velar fricative [x], the voiceless uvular fricative [χ] and the voiceless pharyngeal fricative [ħ]). From these, only two are found in the variety of Portuguese under investigation: the voiceless velar fricative [x] and the voiceless pharyngeal fricative [ħ]. Inasmuch as their distribution involves no social connotation (i.e., they are not *markers*, in Labovian terms) (cf. Callou 1987), the variants [x] and [ħ] were simply grouped into the category of 'voiceless velar fricative [x]' for the purpose of this study.

erates exclusively at the right edge of the word domain in this dialect of Portuguese. The variable /r/ in word-internal coda position was excluded from the quantitative study because of the absence of variation in this context.[6] From a functional perspective, one plausible justification for why the variable does not present variation word-internally may be due to the fact that, in this context, the segment serves to differentiate words in Brazilian Portuguese, as the minimal pairs below illustrate (a pre-syllabic ' indicates the word's main stress and '.' indicates a syllable boundary):

(5) Variable /r/ in word-internal coda position - no variation:

| /r/ word-internally | | | Absence of /r/ word-internally | | |
|---|---|---|---|---|---|
| Example | Orthography | Gloss | Example | Orthography | Gloss |
| ['fax.da] | farda | 'uniform' | ['fa.da] | fada | 'fairy' |
| ['bax.ba] | barba | 'beard' | ['ba.ba] | baba | 'drool' |
| ['max.tʃi] | Marte | 'Mars' | ['ma.tʃi] | mate | '(you) kill' |

From a phonological perspective, a second possibility exists for explaining why the word-internal velar [x] is not subject to deletion: it could be the case that certain types of onset-rhyme dependency relations operate exclusively in word-internal domains (e.g., syllable, foot) but not word-finally in Portuguese. Translating this conception into constraints (cf. Optimality Theory—Prince & Smolensky 1993), Portuguese seems to restrict /r/-deletion application to the word-final domain due to a set of domain-specific constraints banning word-internal deletion. The claim that some constraints have a stronger effect in a larger domain than in a smaller one or vice versa is not an original claim and has been well documented in the linguistic literature (cf. Chomsky & Halle 1968, Selkirk 1972 et seq., Nespor & Vogel 1986, Hyman, Katamba & Walusimbi 1987, Booij 1988, Hayes 1989, 1990, Condoravdi 1990, McCarthy & Prince 1995, Pater 1996, Buckley 1996, Pulleyblank 1997, Cardoso 1997, 1999a, 1999b, Peperkamp 1997, among many others). Since an investigation of the discrepancies in domain-driven variation in /r/-deletion is beyond the scope of the present study, I leave the subject aside for future research (for an OT

6 In northern Rio de Janeiro, Brandão (1995) detected 10% of /r/-deletion in word-internal contexts. She observed, however, that the majority of the tokens of word-internal /r/-deletion involved the word *porque* 'because, why', systematically pronounced as [pu.'ke]. The equivalent of this form in the dialect spoken in Belém is [pox.'ke].

approach to the subject, see McCarthy & Prince 1993a, Itô & Mester 1995, Pater 1996, Buckley 1996, and Cardoso 1999a, b).

### 1.2. Previous studies:

The investigation of the variable /r/ has received considerable attention in studies focusing on the Portuguese varieties spoken in the Northeast and Southeast regions of Brazil. It was first discussed in Amaral's (1920) 'O Dialeto Caipira' (The Provincial Dialect), a descriptive study of the Portuguese variety spoken in the countryside of São Paulo. A discussion of the behavior of the variable /r/ can also be found in the linguistic atlases of the following states: (a) in the northeast: Bahia (1964), Paraíba (1984), Sergipe (1987); (b) in the southeast: Minas Gerais (1977); (c) in the south: Paraná (unpublished). On a smaller scale, studies of the variable /r/ can be found in the works of Istre (1971), Head (1973, 1981), Rodrigues (1974), Brandão (1988) and Silva (1989) describing the dialect of rural areas in the states of São Paulo, Minas Gerais and Rio de Janeiro (southeast region). The most recent study of the variable is presented by Brandão (1995) involving the variety of Portuguese spoken in northern rural Rio de Janeiro. As implied above, the variety spoken in the city of Belém (or in the northern region of Brazil in general) has not been the focus of any previous study. In this context, I propose a quantitative analysis of the word-final dependent variable /r/ in this dialect of Brazilian Portuguese.

A brief discussion of the diachronic dimension of the coda /r/ in Brazilian Portuguese is presented in Mattoso Câmara Jr. (1953, 1970). Nevertheless, the author does not consider /r/-deletion as a variant of /r/. In his 1970 book, he suggests that the pre-consonantal or pre-pausal allomorphic variants of the coda /r/[7] in Brazilian Portuguese illustrate a clear case of language change in progress, in which the articulation of /r/ is moving toward a posterior position in the vocal tract (from alveolar to beyond the velar region). He argues that Portuguese is in an intermediate stage of a process that will probably resemble what is found in the prestigious uvular /r/, or 'grasseyé', in Parisian French. If this is an instance of language change in progress, I believe that the direction of the process will lead us to a more advanced stage, that of /r/-deletion in word-final contexts. In fact, Brandão's (1995) study in northern Rio de Janeiro indicates that word-final /r/-deletion is in a 'very advanced stage [...] and one can

[7] Mattoso Câmara Jr. (1970:35) refers to the different realizations of /r/ as *free variants*, because 'speakers change the articulation of the same phoneme [...] according to the style of the conversation.'

state that [/r/-deletion] is an almost categorical rule.' Results in the same direction are presented in Callou (1987) and Callou & Leite (1990), who claim that a process of language change in progress is taking place in the speech of urban scholarly speakers in the city of Rio de Janeiro. Her apparent time studies presented the following results involving pre-consonantal occurrences of the variable /r/:

(6) /r/-deletion in the speech of scholarly urban speakers in Rio de Janeiro

| Age | Weight of /r/-deletion |
|---|---|
| 25 – 35 | .73 |
| 36 – 50 | .55 |
| 51 – 70 | .23 |

According to the author's rationale, the distribution pattern of /r/-deletion through the various age groups suggests ongoing language change in the speech community on which she focused the investigation: the results achieved in the younger age group (i.e., 25 – 35 years old), which undoubtedly favor the deletion process (.73), illustrate that the likelihood of /r/-deletion decreases as the age level increases (e.g., .23 for the oldest age group 51 – 70). The pattern suggests that newer generations of speakers will probably use the less conservative variant, which could be interpreted as change toward the deletion of /r/.[8] Whether these results can be straightforwardly translated to the outcome of the present study requires further investigation.

## 2. THE INDEPENDENT VARIABLES

In this section, I introduce the independent variables selected for the study. The data set of 1,333 tokens of the variants of /r/, gathered from four native Brazilian Portuguese speakers, was stratified by six independent variables: four extralinguistic factors (*speakers, level of formality, professional status* and *attitude toward /r/ deletion*), discussed in 2.1., and two linguistic factors (*grammatical status of the r-word* and *following phonological environment*), discussed in 2.2.

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8 One question that the authors do not mention in their studies is whether the shift in variation in (6) is related to the fact that, as speakers rise in the social hierarchy or linguistic market through age, they adapt their speech to more standard norms.

## 2.1. Extralinguistic factors

### 2.1.1. Speakers

The fieldwork sample for the analysis consists of data collected from four male Brazilian Portuguese speakers, average age of 32 years old, originally from the city of Belém, temporarily living in Montreal, Canada and enrolled in a graduate program. Speakers 1 and 2 were students and had little formal oral experience in debates, conferences, etc., while speakers 3 and 4 worked as professors in Brazilian universities and had a great deal of oral experience in formal public contexts. They all belong to the middle class and plan to continue their academic lives as professors and researchers at Brazilian universities.

### 2.1.2. Level of formality

The factor *level of formality* investigates whether the /r/-deletion phenomenon in BP conforms to the majority of sociolinguistic studies in which a variant of lower social prestige is favored in less formal situations (cf. Fischer's (1958) studies of the (ng) variable in a New England community, Labov's (1966, 1972) studies of the (r) variable in New York City, Trudgill's (1983) studies of the variable (ng) in Norwich, England, among others). In order to collect tokens from a wide range of stylistic levels, the interview conducted in this study followed the typical sociolinguistic protocol outlined in Labov (1972), with a five-level distinction in a formality hierarchy:

a. *Informal interview* (ifm). At this level of formality, speakers interacted with each other and with others not involved in the study, e.g., talking to guests, answering telephone calls, etc. The subjects met with each other on three separate occasions. Several topics for conversation were stimulated by the investigator, ranging from 'light subject matters' such as sports, food, TV and family to 'more serious topics' such as the political and economical situation in Brazil, the referendum in Québec, etc. When the conversation achieved a more formal tone, the interviewees were brought back to a more relaxed atmosphere through the selection of less serious topics, whenever that was possible. In this type of interview, the observer's paradox (cf. Labov 1972) was minimized because all the speakers were friends with the interviewer and most of the time they did not realize that they were being systematically observed, as later pointed out by two of the interviewees. I am aware, however, that the paradox effect 'can never be solved completely in principle' (Labov 1984: 30). In order to diminish the observer's paradox, the informants

were also asked to tape their conversation whenever they felt ready, for a period of at least two hours, without the researcher's presence. This constituted an average of 30% of the data collected from the informal interview.

b. *Formal interview* (fml). The formal interview was entirely conducted by the researcher with each of the speakers, on an individual basis. In the interview, speakers were asked specific questions about topics related to professional, educational goals, projects for the future, Ph.D. dissertation topic, etc. At this level of formality, the interviewer had almost total influence over the selection of the topic of conversation and he attempted to preserve a formal atmosphere throughout the interview process.

c. *Reading of passages* (pas). This consisted of a series of passages containing the relevant /r/-final words which speakers were asked to read aloud. These texts were collected from newspaper articles, magazines, and passages designed exclusively for the experiment, selected so that they contained relatively colloquial expressions.

d. *Reading of sentences* (stc). The reading of sentences interview, designed exclusively for this study, consisted of sixty sentences which were read aloud by each subject.

e. *Reading of word lists* (wrd). This final hierarchical stylistic level consisted of isolated words (naturally, followed by a deliberate pause) containing the relevant tokens for the study.

All the data collected for this experiment result from recording sessions of about two hours and thirty minutes of interview for each speaker. A General Electric table tape recorder, model N3-3157A, was used for the interview and transcriptions of the material. The use of a more sophisticated tape recorder was not necessary because the production of the expected variants was clear most of the time.

### 2.1.3. Professional status

In a variety of sociolinguistic studies, the *professional status of the speaker* factor has played an important role in determining the output of a variable process (cf. Labov's (1972) studies involving three department stores in New York City, Macaulay's (1977) studies of the glottal stop [ʔ] in Glasgow, Auger (1990), Chambers (1995), among others). In his investigation of the glottal stop variable in Glasgow, Macaulay (1977) took an unorthodox view of professional status by establishing the factor of occupation as the only class indicator in his community, based on his intuition that

'the occupational use of language by clerks and sales assistants might make a sociolinguistic difference between them and the plumbers and cabinet-makers who share their social status but not their need to talk in their jobs.' (Chambers, 1995: 46). It is this intuition that underlies the conception of the 'talk market' or 'marché linguistique' (cf. Sankoff & Sankoff 1973, Chambers 1995). The same intuition can be applied to the context of the present work: since students are not required to have as good a command of the standard variety of the language as are, for instance, professors, it is easy to predict that students are more likely to favor the application of /r/-deletion, a non-standard variant. Due to the satisfactory results obtained in several studies in which occupation had an important role in the output of a variable rule, the four speakers were stratified into two separate professional groups: (1) the group of *students*, and (2) the group of *professors*.

### 2.1.4. Attitude toward /r/ deletion

Rissel's (1990: 279) article on /r/ assibilation in the Spanish of San Luis Potosí indicates the role of attitude as an important social factor for a variable rule analysis. In her studies, she investigates the interaction of gender and attitude in the process of /r/ assibilation in San Luis Potosí, which yields interesting results: 'for holders of non-traditional attitudes [e.g., favoring women's emancipation], there was virtually no difference in the rates of assibilation for males and females. As attitudes became more traditional [e.g., 'women should stay at home'], the differences between male and female speech became more marked.' Influenced by Rissel's technique, a similar one was designed for the present study. For this investigation, however, the focus of 'attitude' is transferred exclusively toward the judgment of the different realizations of the variants of /r/ and their social connotations.

Another technique for examining the social evaluation (or attitude) of different realizations of a variable (or speech-styles, accents, dialects, languages, etc.) was developed by Lambert (1967) and Giles & Powesland (1975) (among others) and has successfully been used in several studies in which social psychological factors involving attitude seem to play a role (cf. Giles & Powesland 1975, Honey 1977, Honey 1989, Hawkins 1993). In the 'matched-guise' experiment, as described in Giles & Powesland (1975: 7), speakers 'are told that they are to hear the voices of different speakers, usually reading the same passage of 'neutral' verbal material, and are asked to evaluate the speakers on a rating scale [...].' They add further that

the advantage of such a method is that it 'reveals more about listeners' feelings towards outgroups than can be found by direct attitude questionnaires.'

From a conceptual perspective, such an approach is preferable in the analysis of /r/-deletion in Portuguese. The perceptual nature of the variable, however, renders the approach inappropriate. As indicated in the discussion in section 1, BP speakers are not able to discern the distinct variants of /r/[9] (i.e., [x] and [ø] in this dialect) (cf. Callou & Leite 1990), and therefore they would be unable to evaluate the social connotations (i.e., social and economical status, region, educational background of the speaker, etc.) present in different recorded material containing exclusively the two different variants. In order to achieve such judgments, the passages under investigation in a matched-guise experiment would have to include other phonological, lexical, morphological or syntactic cues. This would consequently diminish the credibility of the results.

To determine whether speakers are aware of the /r/-deletion process and if this is reflected in their speech, the *attitude toward /r/-deletion* factor was employed in the analysis of the BP data. The attitudinal factor was based on answers to two questions: (a) 'What is your opinion about the pronunciation of 'r' in the following words?'; and (b) 'Do you think that the pronunciation or suppression of 'r' in word final position is linked to social prestige, social class? Who do you think pronounces and does not pronounce the 'r'?' Responses to these questions were rated on a scale of three values: (1) [+] was assigned for those speakers who did not see any difference between the deletion or presence of /r/ and considered both forms adequate, without any link to more prestigious classes or other specific social groups; (2) [0] was assigned for those speakers who agreed that both forms were acceptable, even though they admitted a relation to social factors such as social class, educational level, and stylistic level; and (3) [-] was assigned for speakers who explicitly demonstrated an objection to /r/ deletion.

The survey described above was administered after each speaker had gone through the entire five-level interviewing process so that the ques-

9 According to Callou and Leite (1990), 'the speaker is not aware of which type of variant [of /r/] he or his interlocutor uses'. In order words, speakers do not realize that they or their interlocutors 'delete' their 'r's and therefore they will not be able evaluate their interlocutor's speech based entirely on the cues provided by the different realizations of the variable /r/.

tions would not interfere with the speakers' performance during the recording sessions

### 2.2. Linguistic factors

#### 2.2.1. Grammatical status of the r-word

The grammatical categories in which the word-final variable /r/ occurs in Portuguese are (1) *verbs*, e.g., infinitive forms found in periphrastic constructions such as *eu vou escrever* 'I will write' and in subjunctive forms such as *se eu escrever* 'if I write'; (2) *monomorphemic nouns*, e.g., *amor* 'love', *lugar* 'place' and proper names such as *Osmar, Walcir*; and (3) *derived nouns*, e.g. *cantor* 'singer', formed by a root verb plus the agentive /or/ (i.e., [ox ). One category of which only one /r/-final word is a constituent is that of pronouns: *qualquer* 'any'. Nevertheless, the lack of a considerable number of examples of 'qualquer' in the informal and formal interviews persuaded me to eliminate the factor from the statistical analysis. There were six tokens of 'qualquer' in the spontaneous interviews, in which there was 100% of /r/-deletion. In the reading sessions, however, 100% of /r/-preservation was observed.

The purpose of differentiating (inflected) verbs and derived nouns from monomorphemic nouns is to verify whether the existence of a bimorphemic cluster in these cases (e.g., *canta* + *r* 'sing + infinitive marker') would favor or disfavor /r/-deletion.[10] In Labov's (1968) studies of t/d deletion in non-standard English in New York City, for instance, he was able to demonstrate that t/d deletion was more likely to occur in cases in which t/d was not part of a cluster (e.g., mist [mɪst]) than in cases in which the past marker t/d was a constituent of a bimorphemic cluster (e.g., missed [mɪst]). The difference between the two homophonous examples is that /t/-deletion in 'missed', for instance, would constitute loss of grammatical information (i.e., the past tense [t]), while /t/-deletion in 'mist' would not. Significant results were also found in Winford's (1992) investigation of Afro-American Vernacular English and English-based creoles in which the contrast between monomorphemic versus bimorphemic proved to be significant. On the other hand, Brandão's (1995) studies in northern Rio de Janeiro counter-intuitively indicate that *verbs* are more likely to

[10] The intuition raised here is a corollary of the Functional Hypothesis (Kiparsky 1972): *There is a tendency for semantically relevant information to be retained in surface structure.* I am aware, however, that the hypothesis is easily falsified, as pointed out an anonymous reviewer: many languages have phonological rules which obscure semantic information.

trigger /r/-deletion than *nouns*. Her research, however, does not take the distinction between monomorphemic and bimorphemic nouns into consideration, which could have had an effect in her results. We will return to this issue when we discuss the numerical results obtained for the factor group.

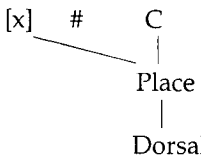
### 2.2.2. Following phonological environment

The factor group *following phonological environment* initially consisted of three sub-groups, from which only the third displayed significant results on the outcome of the /r/-deletion process: (1) Place of Articulation of the Following Consonant (i.e., (a) Labial, (b) Coronal and (c) Dorsal), (2) Manner of Articulation of the Following Consonant (i.e., (a) Glide, (b) Liquid, (c) Nasal, (d) Fricative or Affricate and (e) Plosives); and (3) Following Phonological Environment (i.e., (a) Consonant, (b) Vowel and (c) Pause).

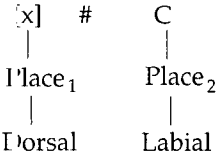
1. The Place of Articulation of the Following Consonant factor was included in this investigation based on the hypothesis that the place of articulation of the following word's initial consonant could have an effect on the outcome of the /r/-deletion process. As has been well documented in the literature on syllable structure, heterosyllabic coda-onset restrictions are sensitive to place (e.g., where the coda /r/ licenses its own place vs. where place is shared with the following onset consonant). Since the word-final consonant [x] is dorsal (i.e., velar) in pre-consonantal or pre-pausal contexts, it could be the case that /r/-preservation would be more likely to occur if the following consonant is also dorsal (e.g., /k, g/), in which case both the coda and the onset would share the same place of articulation; (see 7a). This is in contrast to cases where the coda is followed by a non-dorsal (i.e., labial (e.g., /f, v, m/, etc.) or coronal (e.g., /t, d, s/, etc.)) segment. In the latter case, /r/-deletion would be more likely to occur because otherwise the coda would be required to license its own place; (see 7b).[11]

[11] In Optimality Theoretic terms (Prince & Smolensky 1993), this would lead to a violation of the constraint NoCoda: 'Codas cannot license a Root node'. Observe, however, that the sharing of place node in (7a) does not violate NoCoda. For a more detailed discussion of the subject, see Kawasaki (1998) and Cardoso (1999a).

(7) (a) /r/-preservation expected:
e.g.: / falar kãtoneʃ / → [ falax kãtoneʃ ]




(b) /r/-deletion expected:
e.g.: / falar poxtugeʃ / → [ fala_ poxtugeʃ ]




2. The Manner of Articulation of the Following Consonant factor was selected based on the cross-linguistic observation that heterosyllabic coda-onset restrictions are sonority driven (e.g., onsets must be less sonorous than codas). The prediction for the present study is that /r/-deletion would be used to repair a relatively bad sonority profile (for example, while an /x-p/ coda-onset sequence may be preserved because the onset /p/ is less sonorous than the coda /x/, an /x-m/ sequence may surface as [_-m] (i.e., /r/-deletion) because of the bad sonority profile – the onset /m/ is more sonorous than the coda /x/). In the sonority hierarchy below, observe that the nasal consonant /m/ is more sonorous to the word-final fricative /x/ than the plosive /p/ is.

(8) Sonority Scale (Selkirk 1984):

| Glides > | Liquids > | Nasals > | Fricatives, Affricates > | Plosives |
|---|---|---|---|---|
| /a, ɔ/ | /r, l/ | /m, n/ | /x, z, ʒ/ | /tʃ, dʒ/ | /p, d, k/ |

In a preliminary study, however, none of these two factor groups demonstrated any significance for the /r/-deletion process, since the numerical values obtained in the statistical analysis were around the .50 likelihood for each factor. In other words, it seems that place and manner of articulation do not seem to play a significant role on the outcome of the /r/-deletion process in this dialect of Brazilian Portuguese, at least at

this stage of the investigation.[12] For this reason, the two factor groups were excluded from further statistical analyses.

3. Following Phonological Environment. Taking into consideration the preliminary results involving the two factor groups above, three following phonological environments were considered in this investigation: *consonant, vowel* and *pause*. Based on the universal preference for onsets and avoidance of codas, I predicted more likelihood of /r/-deletion in the phonological context of a following consonant and pause, and /r/-preservation in the context of a following vowel so that word-final /r/ can be syllabified as the onset of the following word's initial syllable, as is the case argued for many Romance languages (cf. Chierchia (1983) for Italian, Harris (1983) for Spanish; and more general studies on resyllabification in Romance languages in Nespor & Vogel (1986), Hannahs (1995) and Peperkamp (1997)).

## 3. CONSTRAINTS ON /r/-DELETION: RESULTS

In this section, I provide the results of the quantitative analysis conducted using the GoldVarb statistical program (Rand & Sankoff 1990) for /r/-deletion in Brazilian Portuguese. Along with VARBRUL for PC computers (Pintzuk 1988), GoldVarb is the only program deliberately designed to handle the types of data derived from studies of language variation. In Young & Bayley's (1996) terms, GoldVarb is able to manage 'the distributional imbalances of linguistic features in sociolinguistic data.'

The output of a typical GoldVarb analysis contains the following information (see the Appendix for a summary): (i) The *raw number* (N) and the *percentage* of rule application involving each factor. These results, however, do not provide enough information since they do not express the influence of each factor independently of the others. (ii) The *factor weight* measures the influence that each factor has in the process under investigation, based on the corpus analyzed. It provides the most accurate view of the likelihood of variant occurrence. It consists of a list of values associated with each factor independently of other factors in the same factor group. The value indicates the degree to which a factor promotes the occurrence of each variant for the process being investigated. The higher the value, the higher the influence of that factor in the selection of the variable

[12] These results seem to conform with those of Brandão (1995), for whom word-final /r/-deletion has reached a near categorical status in the dialect of northern Rio de Janeiro.

output. A weight value of either 1.00 or 0.00 indicates that a given factor has a categorical influence on variation for the dependent variable investigated (e.g., /r/-deletion in Brazilian Portuguese): in the context of a group factor for which the program assigned a categorical value, a weight of 1.00 indicates that a certain variant will always occur, while a weight of 0.00 indicates that that variant will never appear. Because the /r/-deletion phenomenon consists of two variants, the weight of .50 will be established as the watershed between the weights that enhance the likelihood of a certain variant's occurrence (above .50) and those that inhibit its appearance (below .50). (iii) The *input probability* is the likelihood that each variant has of occurring in general. In the present investigation, this value reflects the overall probability of /r/-deletion independently of the specific contribution of particular factors such as stylistic level or the phonological nature of the following segment. In the case of /r/-deletion, for instance, the likelihood of the process to apply, regardless of any given factor considered in the study, is .47, which can be roughly translated as 47% of the times.

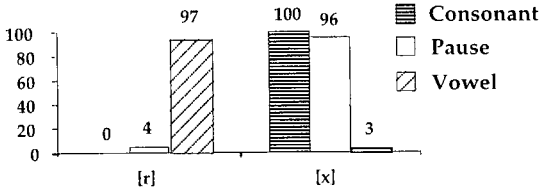
The first GoldVarb run includes all the original group factors as they were initially conceived based on the investigator's hypothesis. It is not uncommon, however, to find that a certain group or factor does not contribute substantially to the observed variation: e.g., near categorical results (called 'knockouts') or factor groups consisting of a single factor (called 'singletons'). Because the GoldVarb program cannot calculate the weights of factors or factor groups consisting of knockouts or singletons, it is necessary to modify the analysis, either by removing these problematic factors or factor groups, or by regrouping them with other related groups or factor groups. Also, interactive factor groups (i.e., *Attitude toward /r/-deletion*, *Professional status* and *Speakers*) should be analyzed independently from one another so that there is no interference of one factor over the other. These factors interact with each other because each group inherently includes the other, e.g., every speaker is included in the factor group *professional status* and was assigned one of three attitudinal values included in the study - see discussion in 3.2.2 and 3.2.3. The process discussed above is called recoding. In order to refine the model of variation, subsequent GoldVarb runs should be conducted until the final results contain no knockouts or singletons, and until all factors that are theoretically similar (and equally influential) are regrouped into a single factor or removed from the quantitative analysis. The researcher is then able to perform a binomial, up and down (or step-up/step-down) analysis of the data, which will inform him/her whether all the factor groups contribute

to the pattern of variation under investigation. In this type of analysis, the program initially analyzes one factor group and then adds one group at a time, until all the factor groups are included in the analysis. The groups that are selected in both step-up and step-down runs (which should ideally be the same!) are the factor groups which are significant for the analysis. Nevertheless, a careful analysis of the results is necessary because, due to interference of one group over another, some groups may not be selected in the binomial analysis (e.g., *professional status* and *attitude toward /r/-deletion* in this study) because they redundantly include each other.

The results of a GoldVarb study should be interpreted as holding over the whole of the data corpus which is being investigated and, to the extent that this is a representative sample, to all similar speakers and linguistic and extralinguistic contexts.

### 3.1. Variants [x] and [r]:

**Figure 1: Variants [x] and [r] and phonological environment (%)**




The results obtained for the velar and alveolar variants of /r/ were either categorical or showed no significant variation, as can be seen in Figure 1.

The results are given in percentage because the GoldVarb program cannot provide a probabilistic analysis with the knockouts, that is, absence of variation, found for the two variants in the environment of a following consonant. As a consequence, only two variants were considered for the variable /r/ analysis: /r/-deletion and /r/-preservation.

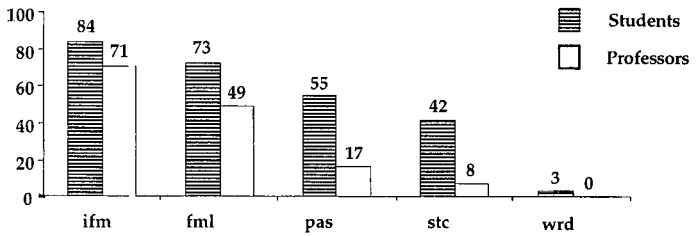
### 3.2. Social Factors

#### 3.2.1. Level of Formality

This section presents the quantitative results obtained for the social factors included in this study. From all the independent variables, *level of formality* was the factor group that presented the most interesting range

of variation, substantiating the claim that /r/-deletion in Brazilian Portuguese is highly influenced by the *level of formality* in which the conversation is conducted. Based on the assumption that the four speakers belong to two distinct social groups, that is, a group of *professors* and a group of *students*, Figure 2 illustrates the percentage of /r/-deletion according to the professional status of the speakers. Notice how the percentage of /r/-deletion decreases as the stylistic level becomes more formal. Also, observe that the professional status *students* displays higher percentage of /r/-deletion at all levels in the stylistic hierarchy that I adopt. In other words, the patterns of /r/-deletion in Figure 2 imply that the more formal the situation is, and the higher the speaker's position is in the linguistic market hierarchy, the less likely /r/-deletion will occur.

**Figure 2: Professional Status and Level of Formality (%)**




**ifm**: informal interview; **fml**: formal interview; **pas**: reading of passages; **stc**: reading of sentences; **wrd**: reading of word lists

In Table 1, I illustrate the probability of /r/-deletion according to the stylistic level of the interview: /r/-deletion is highly favored in informal situations, with occurrence probability of .84, and it is less favored as the context becomes more formal, with a relatively null probability of .03 of /r/-deletion at a more formal stylistic level.

**Table 1: Level of formality and /r/-deletion**

| Level of formality | GoldVarb weight | % of /r/-deletion |
|---|---|---|
| Informal | .84 | 77% |
| Formal | .70 | 61% |
| Passage | .42 | 36% |
| Sentence | .28 | 25% |
| Word list | .03 | 2% |

### 3.2.2. Professional status

The foremost step-wise run of the GoldVarb program identified this factor group as non-significant, even though the probabilistic analysis appears to provide statistically significant results. A closer look at the characteristics of this factor group, however, indicates that the factor *professional status* is inherently included in the groups *attitude toward /r/-deletion* and *speakers* (e.g., every speaker, who was assigned one of the three values of attitude toward /r/-deletion, belongs to one of the two professional categories considered in the study). In order to achieve a more accurate model of variation, the two interfering factor groups were temporarily excluded from the probabilistic analysis. The numerical results, however, remained relatively the same: the group *professional status* was ultimately considered significant in both stepping up and stepping down runs, and yet the final values did not bring any significant changes to the general statistical results calculated in the first GoldVarb run (i.e., the group of Students favor /r/-deletion by .67 (59%), while the group of Professors disfavors deletion by .34 (35%): compare these results to those in Table 2).

As predicted in 2.1.3, the quantitative analysis identified the *professional status* factor as significant. The numerical results in Table 2, compiled from the first GoldVarb analysis, indicate that the application of the /r/-deletion rule is highly motivated by the professional status of the speakers: the group of students favors the process by .68 while the group of professors disfavors it by .35.

**Table 2: Professional status and /r/-deletion**

| Professional status | GoldVarb weight | % of /r/-deletion |
|---|---|---|
| Student | .68 | 59% |
| Professor | .35 | 35% |

A note of caution is necessary in the interpretation of these results. Due to the very small number of speakers included in the investigation, one should not deduce any definitive conclusions about the effects of this factor group, especially in the context of a corpus in which there are only two speakers in each of the two professional categories established (i.e., *professors* and *students*). On that account, one should more reliably affirm that there is interspeaker variation involved in the /r/-deletion process, which may consequently serve as a clue for future research. Even though the results presented here imply the relevance of the factor *professional*

*status*, only large corpora studies will be able to reveal whether it plays a definitive role in the process under investigation. The same interpretative restrictions apply to the discussion of the effects of *attitude toward /r/-deletion*, discussed below.

### 3.2.3. Attitudinal factor

The factor *attitude toward /r/-deletion* presented similar problems to those discussed in 3.2.2 above: the first step-wise run of the GoldVarb program identified this factor group as non-significant, while the results of the probabilistic analysis proved the opposite. For confirmation, the same procedures described above were applied here and the factor group was finally considered significant in both stepping up and stepping down runs. As one would expect, the numerical results without the interfering factors *professional status* and *speakers* did not show any considerable difference if compared to the results obtained in the first statistical analysis containing all the factor groups (shown in Table 3): speakers who have a positive attitude toward /r/-deletion favor the application of the rule (.68), while those who have a negative attitude disfavor /r/-deletion (.33); finally, the non-standard variant is neither favored nor disfavored (.50) in the speech of those who have a neutral attitude toward /r/-deletion.

The conclusive results, illustrated in Table 3, conform to the results discussed above: speakers who have a positive attitude toward /r/-deletion favor the application of the process by .66, while speakers with a negative attitude disfavor it by .34. As expected, speakers with a neutral attitude neither favor nor disfavor the process, as shown by the .50 probability of /r/-deletion. These results demonstrate that speakers who have a more favorable attitude toward /r/-deletion present a higher likelihood of deletion than those who have a negative attitude. In other words, speakers are relatively aware of the /r/-deletion process, which is clearly reflected in their speech.

**Table 3: Attitudinal factor and /r/-deletion**

| Attitudinal value | GoldVarb weight | % of /r/-deletion |
|---|---|---|
| + | .66 | 61% |
| 0 | .50 | 47% |
| – | .34 | 33% |

### 3.2.4. Speakers

Unlike the two previous factor group, *speakers* was considered significant in all analyses in which it was included, in both stepping up and stepping down runs of GoldVarb. As previously discussed, speakers 1 and 2 favor /r/-deletion by .69 and .64 respectively and form the group of students, while speakers 3 and 4 disfavor the application of the rule by .33 and .35 and constitute the group of professors, as illustrated in Table 4. Observe that the numerical difference between speakers 1 and 2 and speakers 3 and 4 is most likely not significant.

**Table 4: Factor speaker and /r/-deletion**

| Speakers | GoldVarb weight | % of /r/-deletion |
|---|---|---|
| Speaker 1 | .69 | 61% |
| Speaker 2 | .64 | 57% |
| Speaker 3 | .33 | 33% |
| Speaker 4 | .35 | 37% |

Due to the limited number of speakers included in the study, these results should be understood as the most probable to reflect the /r/-deletion phenomenon at this stage of the investigation. As discussed in 3.2.2. above, from the statistical results illustrated here, one may merely conclude that there is interspeaker variation in /r/-deletion in Brazilian Portuguese. Notwithstanding these limitations, the analysis presented here undoubtedly serves as a point of departure for future research.

## 3.3. Linguistic Factors

### 3.3.1. Grammatical status of the r-word

Contrary to my initial hypothesis, the probability of /r/-deletion in verbs and derived nouns is equally favored by .54, while it is disfavored if the r-word is a monomorphemic noun by .37, as shown in Table 5.

**Table 5: Factor grammatical status of the /r/ word and /r/-deletion**

| /r/-word status | GoldVarb weight | % of /r/-deletion |
|---|---|---|
| Verbs | .54 | 54% |
| Derived nouns | .54 | 39% |
| Monomorphemic Nouns | .37 | 32% |

The results obtained for the factor *verbs* are in agreement with Brandão's (1995) study of the variable /r/ in northern Rio de Janeiro. In her

analysis, there is higher probability of /r/-deletion in (bimorphemic) verbal forms (92%; weight: .64) than in bimorphemic and monomorphemic nouns (63%; weight: .24) [13] These results also seem to refute my initial hypothesis that /r/-deletion in bimorphemic words would be less favored because deletion would lead to loss of grammatical information (i.e., the infinitive marker /r/ in infinitive verbal forms). A more detailed examination of some BP data, however, confirms that this is not the case for infinitive forms and derived nouns in Portuguese, which are redundantly marked via both the morpheme /r/ and primary stress on the last, /r/-bearing syllable. As a result, when the non-standard variant is selected, /r/-deletion is compensated by stress-preservation in spoken BP:[14]

(9) /r/-deletion compensation by way of stress preservation

| Standard form | | /r/-deletion | Orthographic form | Gloss |
|---|---|---|---|---|
| [pax.ˈtʃix] | → | [pax.ˈtʃi] | *partir* | 'to leave' |
| [lej.ˈtox] | → | [lej.ˈto] | *leitor* | 'reader' |
| [ʒɔ.ˈgax] | → | [jɔ.ˈga] | *jogar* | 'to play' |

The reason for the discrepancy between the results found in bimorphemic instances of /r/ (in which case /r/-deletion is favored) such as *partir* 'to leave' and *leitor* 'reader', and monomorphemic instances of /r/ (in which cases /r/-deletion is disfavored) such as *dor* 'pain', *lugar* 'place' and *Waldemar* (a proper name) requires further investigation.

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[13] Recall from the discussion in 2.2.1 that Brandão's (1995) study does not include the distinction between monomorphemic and bimorphemic nouns into consideration, which could have had an effect in the results shown for nouns here.

[14] Observe that this discussion does not constitute a counterexample to Kiparsky's functional hypothesis (see footnote 10), since the semantic information expressed by the suffix in these forms is not lost when /r/-deletion occurs. If, however, there is a shift of stress to the penultimate syllable (like the vast majority of non-/r/-final Portuguese words (see discussion in 1.1)), this will lead to a complete change in meaning:

| /r/ word-internally | | | Absence of /r/ word-internally | | |
|---|---|---|---|---|---|
| Example | Orthography | Gloss | Example | Orthography | Gloss |
| [lej.ˈto_] | leitor | 'reader' | [ˈlej.to] | leito | 'bed' |
| [ʒɔ.ˈga_] | jogar | 'to play' | [ʒɔˈ.ga] | joga | '(he) plays' |

### 3.3.2. Following phonological environment

The factor *following phonological environment* was found to be significant in both runs of the GoldVarb program. The results are illustrated in Table 6. Notice that the following consonant and vowel environments favor /r/-deletion by .55 and .62 respectively, while pause disfavors it by .38. These findings contradict a number of sociolinguistic studies in which 'the effect of a consonant is identical to that of a pause, and both are quite distinct from the effect of a vowel' as discussed in Winford (1992). In this study, pause and consonant do not behave identically, and pause presents an even more conservative pattern toward /r/-deletion. A similar result was obtained by Guy (1980) in his studies on t/d deletion in Philadelphia English. In his investigation, a following pause does not pattern with consonants and presents an even more conservative environment than a following vowel.[15]

**Table 6: Following phonological environment and /r/-deletion**

| Phonological environment | GoldVarb weight | % of /r/-deletion |
|---|---|---|
| Consonant | .55 | 57% |
| Vowel | .62 | 61% |
| Pause | .38 | 29% |

## 4. /r/-DELETION IN OPTIMALITY THEORY

In this section, I provide an Optimality Theoretic account of word-final /r/-deletion in Brazilian Portuguese. Optimality Theory (Prince & Smolensky 1993) is a theory of constraint interaction which advocates that a grammar consists of a set of universal constraints CON which form part of Universal Grammar. Two important premises of OT are (1) *Violability*: constraints are violable; violation of low ranked constraints occurs in order to satisfy higher ranked ones; and (2) *Ranking*: constraints are ranked on a language-particular basis; the notion of minimal violation is thus defined in terms of a language-specific ranking. Accordingly, while all constraints are present in the grammars of all languages, cross-linguistic variation can be accounted for by variation in language-specific constraint

[15] A probable solution for this disparity of results was a reanalysis of the factor *level of formality* without consideration of the word list item, a possible source of the problem, in which 60 words were grouped having only pause as a following environment. The results, however, did not yield any significant change in the overall pattern.

rankings. Constraints are primarily of two types: those that demand a match between the input (underlying representation, i.e., UR) and the output (surface representation) - faithfulness constraints (e.g., MAX-IO: every segment in the input has a correspondent in the output), and those that demand structurally well-formed outputs—markedness constraints (e.g., NoCoda: Codas are not allowed). In my analysis, I adopt the Correspondence Theory version of OT (McCarthy & Prince 1995), where faithfulness constraints are expressed in terms of the identity relation between input and output (in contrast to standard OT (Prince & Smolensky 1993, McCarthy & Prince 1993a, b) where all constraints are stated on outputs). This way, each candidate comes from GEN (the function *generator*) with a correspondence relation that holds between the elements of the input and those of the output, and evaluation is performed in parallel on the whole candidate set. The candidate that best satisfies the constraint hierarchy of the language emerges as the optimal form.

### 4.1. The constraints and the syllabic structure of Brazilian Portuguese

In this section, I present a brief introduction to the syllabification of onsets and codas in Brazilian Portuguese and discuss the relevant OT constraints involved in the process of syllabification in the language.

As is the case for the majority of languages in the world, BP favors onsets in its syllable structure (cf. Mattoso Câmara Jr. 1971, Giangola 1995, 1997):

| (10) | | | |
|---|---|---|---|
| | [pa.ra.lɛ.le.'pi.pi.du] | *paralelepipedo* | 'cobblestone' |
| | [xɔ.tʃi.'(l)ɔ.gi] | *hot dog* | 'hot dog' |
| | [ma.ka 'ʃej.ra] | *macaxeira* | 'cassava' |

This observation can be captured by the constraint ONSET:

(11) ONSET (Prince & Smolensky 1993)
Every syllable has an onset.

Nevertheless, the language also allows onsetless syllables when no consonant is available in its underlying representation. Unlike many languages that resolve a vocalic hiatus environment (i.e., an underlying /VV/ context) by a series of repair strategies (e.g., Consonant Epenthesis, Semivocalization, Vowel Elision, etc.—cf. Casali 1996; Cardoso, to appear; Borowsky, to appear), BP opts for the preservation of the hiatus:

| (12) | | | |
|---|---|---|---|
| | [pro.i.'bix] | *proibir* | 'to prohibit' |
| | [a.ta.'uw.fu] | *Ataulfo* | (a proper name) |
| | [i.'a.ra] | *Iara* | (a proper name) |

The data above suggest that, even though ONSET plays an explicit role in the grammar of Portuguese, its ranking should be positioned in the lower end of the constraint hierarchy of the language. In the context of the variation analysis, its lower ranking in BP is able to account for why /r/-deletion is unexpectedly more likely to apply in contexts in which /r/ is followed by (a) a vowel (.62) (in which case the output violates ONSET), than in contexts in which it precedes (b) a consonant (.55) or (c) a pause (.38) (see Table 6). We may conclude, thus, that the disfavor for the resyllabification of the coda /r/ as the onset of the following vowel-initial syllable is the result of the lower ranking of ONSET in this dialect of Portuguese.

Brazilian Portuguese is also characterized by a relative lack of consonants that can occupy the Coda position in its syllabic structure. As Mattoso Câmara Jr. (1971: 26) notes: 'The Portuguese language is characterized by a large predominance of *free* or *open* syllables [i.e., CV syllables]' and what may appear as a coda belongs to a very restricted set of consonants (Mattoso Câmara Jr. 1971, Lopez, 1979, Shaw 1986, Giangola 1995, 1997, 1999). In this dialect of Portuguese, the consonants allowed in Coda position are:[16]

i) The allophones of /s/ (a) [ʃ] (e.g., *casas* ['ka.zaʃ] 'houses' before a voiceless consonant or a pause]); and (b) [ʒ] (e.g., *casas vermelhas* ['ka.zaʒ.vex.'me.ʎaʃ] 'the red houses', before a voiced consonant. Interestingly, the variable /s/ also displays variation in both word-in-

---

16 Some authors consider the glides /j/ and /w/ to be consonantal in Brazilian Portuguese. These segments are found in falling diphthongs (a) /j/ (e.g., [paj] *pai* 'father'); and (b) /w/ (e.g., [paw] *pau* 'wood'). The issue involving the nature of these 'positional consonants' (i.e., vowel in nature, nevertheless consonants in position) is controversial. While Barbosa (1965—via Mattoso 1970), Head (1964—via Mattoso 1970) and Giangola (1995) consider them to be consonants, Mattoso Câmara Jr. (1970: 46) adopts a less traditional approach and proposes that these glides are in fact 'nonsyllabic' vowels. In this proposal, glides syllabify within the nucleus of the syllable and therefore do not constitute codas in Brazilian Portuguese. This view is also in agreement with Giangola (1996).

There is also conspicuous evidence that BP allows one more type of coda segment, the nasal coda (Mattoso Câmara Jr. 1971, Giangola 1995). These word-final nasal consonants (restricted to /n/ and /m/ in Portuguese), however, never surface in BP – their feature [nasal] spreads to the previous vowel and the root node is completely disassociated from the syllable node, resulting in a (C)V (codaless) syllabic structure; e.g. /bɔN/ [bɔ̃] *bom* 'good'.

ternal and word-final contexts: (a) /s/-preservation (i.e., /s/-palatalization: /s/ → [ʃ]): [ɔ.ni.buʃ.'pre.tu] *ônibus preto* 'black bus'; (b) /s/-aspiration (/s/ → [h]): ['plah.tʃi.ku] *plástico* 'plastic'; and (c) /s/-deletion (/s/ → ∅: ['me_.mu] *mesmo* 'same'. See Gryner & Macedo (1981).

ii) The allophone of syllable-final /r/ → [x] (e.g., *falar* [fa.'lax] 'to speak', before a consonant or a pause).

iii) The allophone of syllable-final /l/ → [w] (e.g., /bra.zil/ →[bra.'ziw] *Brasil* 'Brazil'; compare it with [bra.zi.'lej.ru] *brasileiro* 'Brazilian'). Observe that in these cases, the underlying Coda /l/ *disappears* in consequence of its vocalization (cf. Mattoso Câmara Jr. 1971:30).

The observation above can be captured by the constraint NoCoda, which expresses the cross-linguistic observation on syllabic well-formedness that coda segments are marked and therefore are disfavored cross-linguistically.[17] This constraint is violated in cases of /r/-preservation: / falar / [ fa.'lax] 'to speak'.

(13) NoCoda:
Syllables do not have codas (Prince & Smolensky 1993)

In the case of BP, only the consonants /s/, /r/, /l/ and their allophonic variants can syllabify as codas, which in turn may be subject to one of the following repair strategies to eliminate the marked segment and satisfy NoCoda: (a) deletion of /s/ and /r/; and (b) vocalization of /l/.

Another relevant constraint for the analysis of /r/-deletion is MAX-IO, which militates against deletion. It ensures that every segment of the input ($S_1$) has a corresponding segment in the output ($S_2$). Note that MAX-IO is violated in cases of /r/-deletion.

(14) MAX-IO (McCarthy & Prince 1995)
Every segment of the input has a correspondent in the output. (No deletion)

---

[17] The adaptation of loan words in Portuguese also serve as clear evidence that the language disfavors coda consonants. Observe in the following examples that the insertion of the epenthetic vowel [i] is used as a repair strategy for the syllabification of an otherwise illicit coda:

| | | | |
|---|---|---|---|
| (i) | *hot dog* | [xɔ.ti.'dɔ.gi] | 'hot dog' |
| | *pop* | ['pɔ.pi] | 'pop' |
| | *chique* | ['ʃi.ki] | 'chic' |

Finally, the present analysis requires a constraint that imposes a ban on phonological epenthesis, since the (re)syllabification of the word-final /r/ as the onset of an epenthetic vowel is not a valid option in BP.[18]

**Table 7: Violations of DEP-IO (No epenthesis)**

| | | | | | |
|---|---|---|---|---|---|
| a. /kaN.tar | → | [kã.ˈtax] | *[kã.ˈta.rə] | *[kã.ˈta.ri] | 'to sing' |
| b. /seN.tir/ | → | [sẽ.ˈtʃix] | *[sẽ.ˈtʃi.rə] | *[sẽ.ˈtʃi.ri] | 'to feel' |
| c, /por/ | → | [pox] | *[ˈpo.rə] | *[ˈpo.ri] | 'to put' |

In order to eliminate the possibility of vocalic epenthesis in the process of /r/-deletion, the adoption of the constraint DEP-IO is necessary. Its position should be at the higher end of the constraint hierarchy, since no form that violates the constraint is an option in Brazilian Portuguese, as shown above.

(15) DEP-IO (McCarthy & Prince 1995)
Every segment of the output has a correspondent in the input. (No epenthesis)

It should be clear by now that the two constraints that are most relevant in the process involving variation in /r/-deletion are: NoCoda, responsible for /r/-deletion, and MAX-IO, responsible for the preservation of the coda segment in the output. The two other constraints, each located at an extreme end of the constraint hierarchy, are relevant because they rule out less-optimal forms (i.e., ONSET rules out the resyllabification of /r/ as the onset of a vowel-initial following word,[19] and DEP-IO rules out the possibility of vowel epenthesis). In the following section, I will demonstrate how the interaction of the constraints NoCoda and MAX-IO accounts for the general variation pattern observed in the /r/-deletion process in Brazilian Portuguese.

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18 In some dialects of European Portuguese, however, the epenthetic vowel [ə] may be used to syllabify the word-final consonant /r/, e.g., *cantar* /kaN.tar/ [kã.ˈta.rə]; *sair* /sair/ [sa.ˈi.rə] 'to leave'.

19 I am not inferring that the resyllabification of /r/ as the onset of the following vowel-initial word is not a possibility in BP. As this study demonstrates, the probability of resyllabification of /r/ as the onset of the following syllable is relative low but not unlikely (.38). It is the interaction of the higher ranked MAX-IO (that enforces /r/-preservation) and NoCoda (that militates against /r/-preservation) that accounts for the results observed. The discussion involving variation and the predictability of probabilistic values will be addressed in section 4.2.

### 4.2. Variation in Optimality Theory—an OT analysis of /r/-deletion in Portuguese

In this section, I introduce the topic of how variation can be encoded in an Optimality Theoretic grammar and subsequently provide an analysis for the phenomenon of /r/-deletion in Brazilian Portuguese.

According to several authors (cf. Reynolds 1994, Naomi & Reynolds 1994, Anttila 1997, Taler 1997, Cardoso 1999), the framework of Optimality Theory provides the best tools for analyzing variation: (a) it allows for multiple outputs within a single grammar through crucial unranking of constraints, without the need to resort to separate rules for each distinct output; (b) it expresses how a certain environment favors or does not favor the application of a phonological process; and (c) it allows for quantitative values to be directly encoded in (and therefore predicted by) the grammar.

In order to achieve these goals, Anttila (1997) has proposed the possibility of crucial unranking of constraints. In his approach, from the number of rankings allowed by a set of crucially unranked constraints, distinct outputs can be predicted. The author demonstrates that the probability of each variant's occurrence is the result of the total number of rankings (or tableaux) generated by the variably ranked constraints, divided by the number of rankings for which each variant wins.

(16) Variant Probabilistic Prediction (Anttila 1997):

(a) A candidate is predicted by the grammar iff it wins in some tableaux.

(b) If a candidate wins in $n$ tableaux and $t$ is the total number of tableaux, then the candidate's probability of occurrence is $n/t$.

To illustrate, suppose that in a given grammar, GRAM, two constraints B and C are unranked with respect to each other. This is indicated by the semi-colon (to distinguish crucial non-ranking from cases of indeterminate ranking) between the two constraints involved, with the curly brackets delimiting the set of floating constraints. As a result, the two different constraint rankings in (17b) are possible.

(17) A variably ranked grammar:

(a) Constraint ranking: A >> { B ; C } >> D

(b) Possibilities of rankings:

(a) A >> **B** >> **C** >> D

(b) A >> **C** >> **B** >> D

Imagine that two optimal forms are possible in GRAM, i.e., $Cand_1$ and $Cand_2$. $Cand_1$ is selected when B is ranked higher than C, while $Cand_2$ is selected in the reverse situation. This is illustrated in the two tableaux in (18).

(18) Tableau (a) A >> B >> C >> D Tableau (b) A >> C >> B >> D

| | A | B | C | D |
|---|---|---|---|---|
| ☞ $Cand_1$ | | | * | |
| $Cand_2$ | | *! | | |

| | A | C | B | D |
|---|---|---|---|---|
| $Cand_1$ | | *! | | |
| ☞ $Cand_2$ | | | * | |

Following Anttila's (1997) Variant Probabilistic Prediction, the unranking of constraints B and C results in a pattern in which two outputs are possible, and the probability of each output occurrence can be predicted by (16). For example, candidates 1 and 2 in (18) win in exactly one tableau each ($n$=1), and two is the total number of tableaux ($t$=2). $n/t = 1/2 = 0.5$ or 50%. Each candidate's probability of occurrence is thus 0.5 and each variant is likely to occur 50% of the time in the same grammar.

The same rationale can be applied to the Brazilian Portuguese phenomenon under investigation. The general behavior of variation involving the /r/-deletion process can be accounted for if we assume that the constraints MAX-IO and NoCoda are crucially unranked with respect to each other in the grammar of BP, as illustrated in (19).[20] From the crucial unranking of these constraints, the variants /r/-preservation and /r/-deletion are predicted. Applying Anttila's variant probability prediction, the results illustrated in (20) are obtained. Observe that under each variant, the left column indicates the number of rankings (or tableaux)[21] for each variant of /r/ in which that candidate is the winner, and the right column indicates the probability of each variant's occurrence, calculated by the formula $n/t$ in (16). Under each variant, compare the actual probability observed in the BP data and its likelihood of application according to the GoldVarb program.

(19) Constraint ranking:

DEP-IO >> { MAX-IO; NoCoda } >> ONSET

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20 The Assumption that the constraints NoCoda and MAX-IO are crucially unranked with respect to each other (however *crucially ranked* with respect to DEP-IO and ONSET!) embraces the view that these constraints are in fact equally ranked in the grammar of Portuguese.

21 The tableaux are merely illustrative devices. What is crucial in the analysis is the number of possible rankings established by the crucially unranked constraint set.

(20) **Table 8: Prediction and actual probability of /r/-deletion**

| Total number of tableaux | Number of tableaux / Prediction: *n/t* | | | |
|---|---|---|---|---|
| | /r/-deletion | | /r/-preservation | |
| 2 | 1 | .50 | 1 | .50 |
| Actual probability | .47 | | .53 | |

As you recall from the discussion in section 3, the input probability of the /r/ phenomenon to apply, regardless of any factor considered in isolation, is .47 (see the Appendix). This can be interpreted as the following: the /r/-deletion rule may apply 47% of the time in BP, regardless of style, following phonological environment, grammatical status of the /r/-final word, and so on.

For illustrative purposes, I will demonstrate how the ranking responsible for the results found in /r/-deletion determines the selection of each of the two variants involved, and predicts the probability of each variant to occur. According to Table 8, the set of unranking constraints in (19) yields two rankings. From these, one ranking results in the selection of the candidate in which /r/ is preserved ($t/n$ ½ = .50) and the other results in /r/-deletion ($t/n$ ½ = .50).

(21) Possibilities of rankings and respective outputs

(a) DEP-IO >> ***MAX-IO*** >> ***NoCoda*** >> ONSET *output*: /r/-preservation

(b) DEP-IO >> ***NoCoda*** >> ***MAX-IO*** >> ONSET *output*: /r/-deletion

(22) Tableau (a): MAX-IO >> NoCoda (output: /r/-preservation = [x])

| Candidates | DEP-IO | MAX-IO | NoCoda | ONSET |
|---|---|---|---|---|
| ☞ fa . 'lax | | | * | |
| fa . 'la | | *! | | |
| fa . 'la . rV[22] | *! | | | |

(23) Tableau (b): NoCoda >> MAX-IO (output: /r/-deletion = [ø])

| Candidates | DEP-IO | NoCoda | MAX-IO | ONSET |
|---|---|---|---|---|
| fa . 'lax | | *! | | |
| ☞ fa . 'la | | | * | |
| fa . 'la . rV | *! | | | |

This analysis diverges from that of previous variation studies (cf. Reynolds 1994, Nagy & Reynolds 1997, Anttila 1997, Taler 1997, Cardoso

[22] V = an unspecified epenthetic vowel.

1998, 1999) in not including precise predictions of the quantitative patterns for each linguistic and extralinguistic variable investigated. Specifically, the analysis does not, for instance, quantitatively account for why /r/-deletion is more likely to apply in the context of a following vowel than that of a following consonant. A lower ranking of ONSET seems to partially explain the likelihood of /r/-deletion in the context of a vowel-initial following word; however, its mere low ranking in the hierarchy is unable to make precise predictions about the occurrence of the variants /r/-preservation or /r/-deletion in this respective context.

In this context, the present investigation attempts to account for variation *per se*, without the incorporation of every numerical value attached to each of the independent variables into the grammar.[23] Although far from ideal, the approach of crucial unranking utilized here is advantageous in comparison to previous frameworks: (i) at least, it allows for variation to occur in the first place, without the need to resort to a distinct rule for each variable output, as in rule-based approaches; (ii) in addition, it rules out the possibility of the assignment of a distinct categorical grammar to account for every single variant involved in the variation process (i.e., it does

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[23] Van Oostendorp (1997) avoids the quantitative aspect of variation in his analysis of style levels in French, Dutch and Turkish. He claims that an OT type of analysis allows one to 'take any two style levels in a language and predict which of the two is the more formal', entirely based on the observation that 'the more formal the style level, the higher ranked the faithfulness constraints'. His rationale can be easily applied to account for the variation patterns involving level of formality in the /r/-deletion process. Considering that speakers are more concerned with the listener's perception in more formal situations and less so as the degree of formality decreases, it is reasonable to assume that faithfulness constraints such as MAX-IO are listener-oriented, while markedness constraints such as NoCoda are speaker-oriented (Oostendorp 1997, Taler 1997, Cardoso 1999a, among others). In other words, speakers turn their concern to their own convenience in informal situations by eliminating or simplifying marked segments such as codas, while in more formal situations, speakers worry about the listener's perception by not deleting or simplifying these marked segments. In an OT approach, this can be accounted for by the higher ranking of faithfulness constraints in more formal situations (Oostendorp 1997) (e.g., MAX-IO >> NoCoda). In informal situations, however, markedness constraints would be ranked higher than faithfulness constraints and speaker-oriented candidates would be selected, (e.g. NoCoda >> MAX-IO). To conclude, faithfulness constraints such as MAX-IO should be ranked at the 'formal' end of the constraint hierarchy of Brazilian Portuguese.

away with the possibility of complete ordering of constraints in competing grammars (cf. Kiparsky 1993), co-grammars and reranking of constraints). In sum, the analysis presented here takes into consideration the general outcome of the variation patterns observed in the process of /r/-deletion in Brazilian Portuguese.

## 5. CONCLUSIONS

This study has presented a quantitative analysis for the process of /r/-deletion in Brazilian Portuguese. Considering the limitations imposed by the restricted number of speakers and the relatively low number of social and linguistic factors involved, the results presented here can be conceivably representative of the /r/-deletion phenomenon. Moreover, the study also provides important results about the phenomenon by showing the relevance of both linguistic and extralinguistic factors in determining the outcome of the /r/-deletion process. From all the factor groups initially considered in the study, the factors *speakers* (which redundantly includes the interactive factors *professional status* and *attitude toward /r/-deletion), level of formality, grammatical status of the r-word* and *the following phonological environment* proved to be significant in the selection of a variant of /r/.

The investigation has also attempted to demonstrate how Optimality Theory can serve as a framework for analyzing patterns of variation: it not only allows the possibility of multiple outputs, but also allows the possibility of predictability of occurrence for each variant involved in the variation process. For the present analysis, I have provided an OT account for the general pattern observed involving /r/-deletion in Brazilian Portuguese in which two outputs are possible. In order to account for these variable results, I have proposed the crucial unranking of NoCoda and MAX-IO, the constraints responsible for /r/-deletion and /r/-preservation, whose unranking accounts for the .50 probability of each variant's occurrence in the language.

The claim that the probability of each variant's occurrence may be encoded in (and therefore predicted by) the grammar yields important consequences for the study of variation and linguistic theory in general, because it constitutes an attempt to narrow down the distinction between competence and performance. By proposing an analysis in which variables as well as the predictability of each variant's occurrence are encoded in the grammar, and therefore into competence, we obtain a more accurate and comprehensive approach to the study of language. My analysis (among

many others in the sociolinguistic literature) presupposes that variation is an inherent part of what is normally referred to as competence. As a consequence, the competence that I strive to account for in this study includes much more than what Chomsky (1965)[24] proposes to be competence. As Labov (1972: 226) points out,

> [t]he ability of human beings to accept, preserve, and interpret rules with variable constraints is clearly an important aspect of their linguistic competence or *langue*. But no one is aware of this competence, and there are no intuitive judgments accessible to reveal it to us. Instead, naïve perception of our own and others' behavior is usually categorical, and only careful study of language in use will demonstrate the existence of this capacity to operate with variable rules.

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[24] In the traditional (i.e., non-variationist) view, the focus of linguistic theory lies almost entirely on the 'ideal speaker-listener, in a completely homogeneous speech community' (Chomsky 1965).

## APPENDIX

### GoldVarb results for /r/-deletion in Brazilian Portuguese[25]

| Factor Groups and Factors in /r/-deletion | | % | Weight | N |
|---|---|---|---|---|
| (1) | **Grammatical Status** | | | |
| | Verbs | 54 | .54 | 443 |
| | Monomorphemic Nouns | 32 | .37 | 95 |
| | Derived Nouns | 39 | .54 | 88 |
| (2) | **Following Environment** | | | |
| | Consonant | 57 | .55 | 241 |
| | Vowel | 61 | .62 | 231 |
| | Pause | 29 | .38 | 154 |
| (3) | **Level of Formality** | | | |
| | Informal | 77 | .84 | 287 |
| | Formal | 61 | .70 | 177 |
| | Passages | 36 | .42 | 101 |
| | Sentences | 25 | .28 | 59 |
| | Word Lists | 1 | .03 | 2 |
| (4) | **Attitude** | | | |
| | Positive | 61 | .66 | 203 |
| | Neutral | 47 | .50 | 308 |
| | Negative | 33 | .34 | 115 |
| (5) | **Professional Status** | | | |
| | Student | 59 | .68 | 390 |
| | Professor | 35 | .35 | 236 |
| (6) | **Speakers** | | | |
| | 1 | 61 | .69 | 203 |
| | 2 | 57 | .64 | 187 |
| | 3 | 33 | .33 | 115 |
| | 4 | 37 | .35 | 121 |
| **Total of tokens** | | | **1.333** | |
| **Input probability** | | | **.47** | |

[25] The probability weights presented here were rounded off to the nearest two-digit value. These results were extracted from the binomial step up and step down analysis including all the factor groups above, without re-coding of the redundant factors *attitude toward /r/-deletion* and *professional status* (see discussions in 3.2.2 and 3.2.3).

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