

# Portuguese Has Two Underlying Rhotics: Evidence from Lisbon and Carioca Varieties

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## 1 Introduction

This paper tackles the controversial issue of how the Portuguese rhotic consonants are represented at the underlying level. At the surface level, Portuguese has two rhotics, a weak-r and a strong-R. In standard European Portuguese (Lisbon variety, henceforth: EP), the weak-r is realised canonically as a tap (Mateus & Andrade, 2000; Silva, 2014), while the strong-R, whose place of articulation may range from velar to uvular (Rennicke & Martins, 2013), is most often a posterior fricative [ʀ] (Pereira, 2020). Similar surface realisations for the two rhotics are attested in the Brazilian Portuguese spoken in Rio de Janeiro (Carioca variety, henceforth: BP): the weak-r is realised as a tap (Câmara Jr., 1953; Callou, 1987) and the strong-R is predominantly articulated as a velar fricative [x] (Callou, 1987; Callou & Leite, 1995).

Like in many other Romance languages (e.g. Spanish, Catalan), the rhotics in Portuguese are only contrastive intervocally (1a), being neutralized in any other position (1b) (Bisol, 1999; Mateus & Andrade, 2000).

### (1) Distribution of rhotic consonants in Portuguese

#### a. contrastive

*caro* [r]

‘expensive’

*carro* [ʀ] (EP) [x] (BP)

‘car’

#### b. non-contrastive

*prato* [r]

‘dish’

*honra* [ʀ] (EP) [x] (BP)

‘honour’

*carta* [r] (EP) [x] (BP)

‘letter’

*melro* [ʀ] (EP) [x] (BP)

‘blackbird’

*rato* [ʀ] (EP) [x] (BP)

‘mouse’

Several attempts have been made in the literature to account for this positional effect on the distribution of Portuguese rhotics. Some phonologists defend that Portuguese has only one underlying rhotic, which is the weak-r. According to this analysis, the posterior fricative [ʀ/x] is always derived by the phonological grammar (Lopez, 1979; Monaretto 1997, Mateus & Andrade 2000, Vigário, 2003; 2021): in word-initial position, the underlying weak-r undergoes a strengthening process (/r/ → [ʀ/x]) and, intervocally, [ʀ/x] stems from the degemination of two consecutive underlying taps: /r.r/. The adherents of this approach believe that the one-rhotic analysis not only achieves better representational (phonemic) economy, but also provides a fairly straightforward explanation for several phenomena – for instance, the fact that Portuguese words with an intervocalic [ʀ/x] are never stressed on the antepenultimate syllable. Mateus and Andrade (2000) reasoned that this is because the intervocalic [ʀ/x] is assumed to be derived from a heterosyllabic underlying geminate, e.g. *cacho*[ʀ]o from *cacho*/r.r/o ‘dog’. The existence of an underlying coda /r/ in the

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penultimate syllable makes it heavy, blocking the stress from being assigned to the antepenultimate position. Additionally, Vigário (2003, 2021) argues that analysing [r] and [ʀ] as allophones for the same underlying segment accounts for the Portuguese adaptation of English words. Namely, the English approximant [ɹ] is nativized either as [r] or [ʀ], conforming to the distribution of Portuguese rhotics, e.g., *roaming* as [ʀ]oaming, *overdose* as ove[r]dose (Freitas et al., 2003). In our view, the strongest argument for postulating /r/ as the only underlying segment comes from morphological alternation in BP. For some speakers of BP, [r] and [x] are in free variation syllable-finally (Callou et al. 1998); however, it is the weak-r that surfaces after morphological alternation, (e.g. *ma[x]* ('sea': single) ~ *ma[r]es* ('sea': plural) ~ *ma[r]ítimo* 'marine'), suggesting that [x] is an allophone of /r/.

Proposals in which the strong-R is deemed as the only underlying rhotic can also be found in the literature. Câmara Jr. (1953) states that [r] is actually a weakened positional variant of an underlying strong-R and the intervocalic [x] corresponds to an underlying geminate (/r.r/). Such analysis was later abandoned by the author himself because of the lack of evidence that the strong-R is a gemination of the weak-r (Câmara Jr., 1977). Abaurre & Sandalo (2003) proposed an analogous analysis according to which [r] stems from an underlying strong-R by a weakening process. However, in this analysis, the underlying strong-R is a coronal trill /r/, implying that even the most prevalent form of strong-R, namely [x], has to be derived by phonological grammar, namely, through a process of debuccalisation.

For the aforementioned one-rhotic analyses to work, a set of phonological rules have to be formulated specifically for different contexts, which has been pointed out to be an *ad hoc* solution (Rennicke, 2015). Moreover, one-rhotic analyses require an underlying geminate that never surfaces in a language that does not have geminates (Bonet & Mascaró, 1997; Rennicke, 2015). Being sceptical about the one-rhotic approach, Bonet and Mascaró (1997) resort to syllable structure and sonority scale for the explanation of the distribution of Portuguese rhotics<sup>1</sup>. In their proposal, the weak-r is licensed in onset cluster, because the obstruent + tap sequence leads to an increase in sonority, whereas the strong-R, which is assumed to share the same sonority with obstruents, is disfavoured in this position. Furthermore, they unify the occurrence of [r/x] in word-initial position (initial onset), in syllable onset preceded by a consonant and in intervocalic position by postulating that the strong-R is the default one in syllable onset on the basis of sonority (the strong-R leads to a sharp increase in sonority, in comparison with the weak-r). The contrast in intervocalic position is thus captured by assuming the existence of both strong-R (default one) and weak-r (lexically marked one) at the underlying level. The analysis of two underlying rhotics is supported by empirical evidence from L1 phonological acquisition. It has been shown that both Portuguese (Costa, 2010; Amorim, 2014; Pereira et al., 2020) and Brazilian children (Miranda, 1996) process the weak-r and the strong-R as two different phonological categories before adult-like production: laterals ([+sonorant]) are very often produced for the weak-r, whereas obstruents ([-sonorant]) are employed for the target strong-R.

## 2 Current study

This study aims to contribute experimental evidence to the ongoing debate on how the Portuguese rhotics are represented at the underlying level. The empirical data was elicited through a transformational language game, a tool that has been used in many previous studies to explore issues pertaining to underlying phonological representations (e.g. Chomsky & Halle, 1968; Davis, 1993; Nevins & Vaux, 2003; Guimarães & Nevins, 2013). For instance, Harris (2001, *apud* Nevins & Vaux, 2007) discussed the underlying nature of the Spanish rhotics by referring to a language game that inverts the order of syllables, arguing that the underlying form of the Spanish strong-R [r] is actually a tap. Just like in Portuguese, the Spanish strong-R [r] and weak-r [r] are only contrastive intervocalically, whereas they are neutralized in other positions. Although it has been proposed that the surface trill is derived from an underlying tap by phonological grammar, i.e., in word-initial position (Harris, 1969), there is no empirical support for this derivation. This is because the Spanish phonology does not display any morphological nor phrasal process that would move a non-initial rhotic to word-initial position, thus triggering the initial strengthening rule /r/ → [r]. However, there is one marginal process that helps reveal the underlying nature of Spanish [r]. In a language game, Spanish participants were instructed to invert the order of syllables of Spanish words. For

<sup>1</sup> The analysis in Bonet & Mascaró (1997) was proposed to account for rhotics distribution in Iberian Romance Languages (e.g. Catalan, Portuguese and Spanish).

instance, the word *rosa* ‘rose’, with an initial rhotic, would become *saro*. The result of this game (e.g. [saro]) supports the analysis that the word-initial rhotic is an underlying tap (otherwise, [saro] would have been yielded; Harris, 2001, *apud* Nevins & Vaux, 2007).

Although this language game, which inverts syllable order, seems to be an efficient tool to test the underlying nature of Portuguese rhotics, some criticism may be raised: It is unclear whether the participants would rely on orthography when constructing the output. In the case they do (e.g. reconstructing <rosa> as <saro>), only the output with a tap should be expected, because in intervocalic position a single <r> in Portuguese corresponds to a tap, whereas [R/x] is represented by <rr>. Moreover, if the output contains a strong-R, it will not provide strong support for its underlying form, due to the possibility that the participant could have first applied the initial-strengthening rule by transforming the underlying form /rɔza/ into the surface form [ˈrɔzɐ] and then segment the surface form into two syllables, [Rɔ] and [zɐ], before compressing them into the output required by the game ([ˈzɐRɔ]).

In the current study, we designed a novel language game that creates a morphological alternation and, at the same time, controls for possible intervening variables as the ones we have mentioned. The game prompts derivation by requiring the naming of objects represented in either coloured or black-and-white pictures. When being presented with coloured pictures, participants were asked to pronounce faithfully the corresponding Portuguese words (e.g. *gato* ‘cat’); whereas, for pictures in black-and-white, they were instructed to add a stressed prefix [ˈpa] to the original words (e.g. *págato*, for the Portuguese word *gato* ‘cat’) (see Figure 1).



Figure 1. Participants were instructed to produce *gato* when they were presented with the coloured picture of a cat and *págato* for the black-and-white version.

In this way, a morphological alternation triggered by the black-and-white version of a picture is created. The prefixation is expected to reveal the underlying nature of the word-initial rhotic, on which different approaches diverge. If the word-initial [R/x] is derived from an underlying /r/ (Mateus & Andrade, 2000; Vigário, 2003; 2021), a tap should surface after prefixation (for the Portuguese word *rosa* ‘rose’, pá[r]osa would be produced), because the initial strengthening rule which is responsible for transforming /r/ to [R/x] would be blocked due to the loss of the application domain, namely the left-edge of the prosodic word (see Vigário, 2003 for discussion). On the contrary, if the word-initial [R/x] corresponds to an underlying strong-R (Bonet & Mascaró, 1997; Abaurre & Sandalo, 2003), a posterior fricative should be realised (e.g. for the Portuguese word *rosa*, pá[R/x]osa would be produced).

Two important methodological concerns were at the root of the experimental design. Firstly, the selected items are such that, when the original Portuguese words are submitted to derivation, they become pseudowords. Secondly, the adjunction of the stressed prefix leads to an intentional change in the stress pattern of the word – the paroxytone word (e.g. [ˈrɔzɐ], *rosa* ‘rose’) becomes a proparoxytone pseudoword (e.g. [ˈparuzɐ]). Hence, the original stressed syllable becomes unstressed, which in turn typically induces vowel reduction in Portuguese (e.g., for EP, [ˈrɔzɐ]/ [ˈparuzɐ]). This stress shift (with consequences on vowel quality) was meant to ensure that the elicited form after prefixation corresponds to a single lexical unit (one prosodic word), instead of a compound or a multiword sequence.

The stimuli consist of 24 disyllabic trochaic words of the CVCV form: 8 test items, with an initial rhotic; 12 fillers, with an initial consonant other than a rhotic; and 4 control items with an initial /s/. Inspired by Guimarães & Nevins (2013), we included these control items with the purpose of detecting potential orthographic influence. Notice that, for a word such as <saco> ([ˈsaku]), the derived word <pasaco> could lead to two possible realizations, [ˈpasəku] or [ˈpazəku]. The latter is possible only when there is interference from orthography, because combining the written form of prefix <pá> and <saco>

would give rise to an intervocalic <s> (<pásaco>), which is always produced as [z] in Portuguese. Therefore, the use of intervocalic [z] after prefixation would indicate an orthographic influence.

Given the differences in terms of phonology (vowel reduction process; see Bisol, 1999 for BP and Mateus & Andrade, 2000 for EP) and lexicon between the EP and BP varieties, two versions of the game were created. All the items included in the game are presented in Table 1.

Table 1. List of items for the EP and BP versions of the game.

	EP	BP
<b>Test items</b>	<i>robe</i> ‘robe’, <i>rosa</i> ‘rose’, <i>roda</i> ‘wheel’, <i>rolo</i> ‘roll’, <i>rocha</i> ‘rock’, <i>ramo</i> ‘branch’, <i>remo</i> ‘oar’, <i>rato</i> ‘mouse’	<i>robe</i> ‘robe’, <i>rosa</i> ‘rose’, <i>roda</i> ‘wheel’, <i>rolo</i> ‘roll’, <i>rocha</i> ‘rock’, <i>roça</i> ‘country’, <i>rodo</i> ‘squeegee’, <i>rolha</i> ‘cork’
<b>Fillers</b>	<i>dado</i> ‘dice’, <i>vaca</i> ‘cow’, <i>pato</i> ‘duck’, <i>mola</i> ‘spring’, <i>casa</i> ‘house’, <i>pêra</i> ‘pear’, <i>mesa</i> ‘table’, <i>gato</i> ‘cat’, <i>jarro</i> ‘jar’, <i>bola</i> ‘ball’, <i>mala</i> ‘suitcase’, <i>mota</i> ‘motorbike’	<i>copo</i> ‘glass’, <i>nota</i> ‘bill’, <i>pote</i> ‘pot’, <i>mola</i> ‘spring’, <i>côco</i> ‘coconut’, <i>pêra</i> ‘pear’, <i>mesa</i> ‘table’, <i>gota</i> ‘drop’, <i>boca</i> ‘mouth’, <i>bola</i> ‘ball’, <i>lobo</i> ‘wolf’, <i>moto</i> ‘motorbike’
<b>Control items</b>	<i>sopa</i> ‘soup’, <i>sapo</i> ‘frog’, <i>saco</i> ‘bag’, <i>sino</i> ‘bell’	<i>sopa</i> ‘soup’, <i>seta</i> ‘arrow’, <i>sola</i> ‘sole’, <i>solo</i> ‘soil’

Sixteen native speakers of Portuguese, 8 from Lisbon (EP group, age: 22-36, 4 females) and 8 from Rio de Janeiro (BP group, age: 21-27, 4 females), were recruited through personal contact. After giving consent, each of them had a synchronous recorded Zoom meeting with the second author, a native speaker of EP. The game started with a demonstration phase, in which the experimenter explained the intended morphological alternation with 3 filler items, giving explicit instruction on how to name different versions (coloured or black-and-white) of a picture. Afterwards, we used 4 different filler items to familiarise the participants with the game, until they understood it. Finally, they were trained with another 4 fillers to name only the picture highlighted with a red frame, which can either be a coloured (e.g., Figure 2) or a black-and-white one (e.g., Figure 3).



Figure 2. Item *bola* ‘ball’. Elicitation of *bola*.



Figure 3. Item *gota* ‘drop’. Elicitation of *págota*.

In the testing phase, the participants were first presented with 24 randomized pairs of pictures (the

same order of presentation for all participants), representing 8 test items, 4 controls and 12 fillers. For the pairs corresponding to test and control items, the black-and-white version was always highlighted, whereas the coloured version was consistently the highlighted one for the fillers. In this way, we elicited the derivational forms of test and control items and the unchanged forms of the fillers. At the end of the game, the participants were asked to name the coloured version of the 8 test items. This was done to obtain the surface form of the word-initial strong-R used by each participant, which may vary between a trill or a posterior fricative.

### 3 Results

Only tokens produced with the expected stress shift and vowel reduction were considered for the analysis. In total, the participants produced 128 tokens, among which 7 in the EP group (10.94%) and 23 in the BP group (35.94%) were excluded. The detailed exclusion criteria are illustrated in Table 2.

Table 2. Number of excluded tokens according to exclusion criteria.

	EP	BP
Stress errors	4	1
Vowel reduction errors	1	21
No response/lexical errors	2	1

Among 98 valid productions, the posterior fricative ([ʀ] in the Lisbon variety and [h] in the Carioca variety) was consistently produced after prefixation by 7 Portuguese and 8 Brazilian participants. In total, the production of a strong-R was found in 53 tokens of the EP group (93% of valid productions) and in 41 tokens in the BP group (100%). Only one speaker from Lisbon alternated between [r] and [ʀ] (50% vs. 50%). However, the use of [z] in the control condition suggests that this speaker, at least occasionally, relied on orthography during the game. Therefore, the use of [r] after prefixation is likely due to a strategy employed by this participant in the game, namely resorting to orthographic representation. Regarding the surface form of the word-initial strong-R, elicited at the end of the game, all 16 participants produced a posterior fricative, the most prevalent realisation for the strong-R in Portuguese.

### 4 Discussion and conclusion

Competing analyses for the underlying nature of Portuguese rhotics diverge on whether the word-initial fricative ([ʀ] in EP and [x] in BP) is derived by phonological grammar or not. In this study, a transformational language game was designed to create a morphological alternation. 16 native speakers of Portuguese (8 from Lisbon and 8 from Rio de Janeiro) were asked to name objects represented in coloured or in black-and-white pictures. They were trained to add a stressed prefix [ˈpa] to the corresponding Portuguese word only when seeing a picture in black-and-white. Results show that the prefixation does not lead to an alternation from strong-R to weak-r, contradicting the analysis that the Portuguese word-initial rhotic undergoes a position-sensitive phonological process (Lopez, 1979; Monaretto, 1997; Mateus & Andrade, 2000; Vigário, 2003; 2021). Instead, the current findings provide empirical support for the Portuguese word-initial rhotic being a strong-R underlyingly (Bonet & Mascaró, 1997; Abaurre & Sandalo, 2003), more specifically a posterior fricative, rather than a trill.

Regarding the question of whether only the strong-R (Abaurre & Sandalo, 2003) or both the strong-R and the weak-r are stored at the underlying level (Bonet & Mascaró, 1997), we believe that the two-rhotic analysis is more adequate. Regardless of the assumed underlying form, one-rhotic analyses fail to offer a fair explanation for the contrast between the strong-R and the weak-r in intervocalic position. Such analyses require assuming the existence of a geminate that never surfaces in Portuguese (Bonet & Mascaró, 1997; Rennie, 2015), i.e. /rr/ in Mateus & Andrade (2000) and /rr/ in Abaurre & Sandalo (2003). Furthermore, the representational economy is not really better achieved by one-rhotic analyses. Many phonologists would agree that representational economy is reflected in the use of phonological features, instead of in the number of phonemes (Clements, 2001; 2003). Considering the proposals of featural

representation for the Portuguese strong-R (e.g. Mateus & Andrade, 2000; Rennie, 2015; Amorim & Veloso, 2018), no additional features that are underspecified elsewhere are employed. Thus, the inventory of specified features in the lexicon does not increase from a one-rhotic to a two-rhotic account.

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