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ON SYLLABLE STRUCTURE AND PHONOLOGICAL VARIATION: THE CASE OF I-EPENTHESIS BY BRAZILIAN PORTUGUESE LEARNERS OF ENGLISH

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Abstract

Our study employs nonword-learning tasks to examine i-epenthesis in the speech output of 53 Brazilian Portuguese learners of English. One aim is to investigate conflicting views on the syllabification of consonants in various word-medial and final contexts, where they can be parsed as either codas or onsets of empty nuclei. Another aim is to test a proposal (John & Cardoso, 2017) concerning the source of L2 phonological variation: we suggest that L2 variation is lexical rather than derivational, stemming from individual items having dual underlying representations which compete for selection at the moment of speaking. The results of a multivariate statistical analysis indicate: i) a hierarchy of difficulty in the acquisition of the stops /p k/ in different lexical locations; and ii) simultaneous development of dual representations for single lexical items.

Keywords: Second language acquisition; Syllable structure; Phonological variation; Vowel epenthesis; Nonword learning

Introduction

The study reported on here uses nonword-learning tasks to investigate variable i-epenthesis by Brazilian Portuguese (BP) learners of English. The purpose is to gather empirical evidence from second language (L2) acquisition to elucidate questions of syllable structure on the one hand and of phonological variation on the other. First, depending on the theoretical framework, competing syllabic parses apply to consonants in word-final and in certain word-medial positions: these can be analyzed either as codas or as onsets of empty nuclei. To what extent do L2 learners' realization of consonants in the various contexts support one or the other analysis? With regard to BP learners of English, the relevant information comes from the different rates of epenthetic [i], according to the word-final or word-medial context the target consonant appears in. Next, in previous work (John & Cardoso, 2017), we suggested that phonological variation in L2 speech is typically lexical rather than derivational. Using variable i-epenthesis as a test case, can we uncover further evidence for such a view?

Specifically, we focus on i-epenthesis after the stops /p k/ in three contexts: 1) in word-final position (*bishop* → *bisho*[pi], *magic* → *magi*[ki]); 2) in word-medial position before /t/ (*chapter* → *cha*[pi]*ter*, *doctor* → *do*[ki]*tor*); and 3) in word-medial position before /n/ (*Stepney* → *Ste*[pi]*ney*, *techno* → *te*[ki]*no*) (see below for the rationale behind selecting these segments and contexts for our study and behind using nonwords rather than the real words shown here).

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Interestingly, the problem for learners of English is not with the stops per se, since /p k/ are part of the BP phoneme inventory. Rather, the problem concerns the contexts of occurrence: BP allows only a limited set of segments in these locations (i.e., /s l r N/, where /N/ indicates an underspecified nasal consonant), and even then, they are subject to variable processes of lenition (e.g., *paga*/r/ → *paga*[h]) and deletion (e.g., *paga*/r/ → *paga*[Ø]). Where stops potentially occur in these contexts in native Portuguese words or in loanwords to BP, the same strategy of vowel insertion is found: *laptop* → *la*[pi]*to*[pi], *link* → *lin*[ki], *captar* → *ca*[pi]*tar* 'to win', *pacto* → *pa*[ki]*to* 'pact', *apnéa* → *a*[pi]*néa* 'apnea', *aracnídeo* → *ara*[ki]*nídeo* 'arachnid' (Cantoni & Cristófaro-Silva, 2008; Cristófaro-Silva & Almeida, 2008; Nevins, 2008). The phenomenon in L2 English is thus a first language (L1) transfer process. Interestingly, while the interlanguage process is variable, the L1 process is categorical.1

Clearly, i-epenthesis permits /p/ or /k/ to be syllabified as an onset, which is precisely the syllabic position the stops can occupy in BP (see [p]*agar* 'to pay', *lu*[p]*a* 'magnifying glass', [k]*ara* 'face', *di*[k]*a* 'hint'). The syllabic affiliation of /p k/ before epenthesis, on the other hand, is open to debate, with phonological theory instantiating three competing views. The orthodox view (Blevins, 1995; Selkirk, 1982) treats the stops as codas in all three contexts. From the perspective of Government Phonology (Harris & Gussmann, 1998; Kaye, 1990), however, /p k/ are codas only word-medially before /t/, being analyzed as onsets of empty nuclei in the other two contexts. Finally, according to the CVCV approach (Lowenstamm, 1996; Scheer, 2004), phonological representations are composed exclusively of CV strings, amounting to a series of non-branching onsets and nuclei. In this case, /p k/ are Cs (or onsets) followed by empty Vs (or nuclei) in all three cases.[2]

One aim of our study is to contribute to the debate on syllabification by gathering empirical evidence concerning BP English learners' realization of /p k/ in the various contexts. In essence, equivalent epenthesis rates across the three contexts would point to a common syllabic parse (i.e., consistent with either the orthodox coda or the CVCV analysis), whereas differential rates of epenthesis would favour distinct syllabic parses (i.e., consistent with the Government Phonology view).

A further aim is to investigate a proposal we articulated previously regarding L2 phonological variation (John & Cardoso, 2017). Our impression is that variation in L2 speech is particularly common, more so than in L1 speech. Why is this the case? Is L2 variation the same as L1 variation? Our previous findings led us to propose that L2 phonological variation is typically lexical, due to competition between dual underlying representations (URs) associated with individual lexical items. The idea is that, at the moment of lexical access, either UR can be selected as a base for speech output. Thus, BP learner variation in the realization of an item such as *magic* as *magi*[ki] ~ *magi*[k] would be due to variable selection of the URs *magi*/ki/ and *magi*/k/, not to a variable synchronic process of vowel insertion. The derivational approach is typically adopted to explain L1 variation, whether in the form of variable rules (e.g., Cedergren & Sankoff, 1974; Labov, 1969) or crucially unranked or overlapping constraints (e.g., Anttila, 1997; Boersma, 1997; Boersma & Hayes, 2001; Kiparsky, 1993; Reynolds, 1994). The notion of lexical variation has a decidedly marginal status in the variationist literature (e.g., Anttila, 2002; Guy, 2007), but we suggest it should be foregrounded in the case of L2 variation.

The next section provides more extensive information on the background to our current investigation. We review the findings of previous studies of BP i-epenthesis and discuss at greater depth the issues of both the syllabification of consonants in the various contexts and the source of phonological variation in L2 speech. The subsequent sections present our methodology for investigating these issues via nonword learning tasks and the results of a Goldvarb X (Sankoff, Tagliamonte & Smith, 2005) analysis of the data. Finally, we discuss our findings, including the implications of some unexpected patterns in the BP speakers' treatment of the nonwords.

Background

Previous research on i-epenthesis by BP learners of English has focused almost exclusively on stops in

word-final position. One aspect of the findings concerns the influence of the segment itself on the phenomenon: on the one hand, voiced stops trigger higher rates of epenthesis (b d g >> p t k, with '>>' indicating greater epenthesis – Baptista & Silva Filho, 1997, 2007); on the other, non-coronal stops trigger higher rates of epenthesis (p b k g >> t d – Cardoso, 2007). The former finding is consistent with the universal markedness of voiced obstruents in final position, as evidenced by the common tendency for these to devoice (for an overview of the phenomenon in interlanguage, see Yavaş, 1994; see also Broselow, Chen & Wang, 1998). Likewise, the influence of place of articulation follows the unmarked status of coronals crosslinguistically (Paradis & Prunet, 1991). The two sets of findings are revealing because voiced /b g/ and coronal /t d/ are precisely the stops that, according to Government Phonology, do not occur in medial codas in English; only the voiceless non-coronals /p k/ do (for a comprehensive explanation, see Harris, 1994; Harris & Gussmann, 1998). This view, incidentally, motivated our decision to limit the focus in the current study to the acquisition of /p k/.[3]

A further finding concerns the effect of word length on epenthesis: higher rates were found in monosyllabic as opposed to di- or polysyllabic words (thus *pack* → *pa*[ki] >> *attack* → *atta*[ki] – Cardoso, 2007). This pattern points to the influence in the phonological system of a Word Minimality constraint (McCarthy & Prince, 1993). Interestingly, this constraint is not observed in the BP L1 system, as the language contains a large amount of monosyllabic words such as *pó* 'powder' and *fé* 'faith'. The phenomenon thus constitutes a case of the Emergence of the Unmarked in interlanguage (Broselow, Chen & Wang, 1998; McCarthy & Prince, 1994). Importantly for our study design, we decided to avoid the influence of Word Minimality by comparing final and word-medial epenthesis rates in disyllabic forms only. Because of the limited number of high-frequency disyllabic words with /p k/ in the three contexts, however, we could not use real-word elicitation tasks with our learners. Instead, to test epenthesis rates across the three contexts, we developed a set of nonword-learning tasks (see the methodology section for more detail).

Finally, in a rare exception to the exclusive focus on final consonants, Huf and Alves (2010) found higher rates of epenthesis after absolute-final (e.g., *attack* → *atta*[ki]) as opposed to penultimate stops (*tact* → *ta*[ki]*t*). The authors interpret the finding as indicating higher rates of epenthesis in absolute-final rather than penultimate codas. From a Government Phonology perspective, however, only penultimate consonants such as the /k/ in *tact* are codas; final consonants such as the /k/ in *attack* are onsets of empty nuclei. The difference in behaviour could be seen as supporting this distinct syllabic parse.

The fact that previous studies have focused on consonants in final (or, exceptionally, penultimate) position to the exclusion of word-medial position suggests that researchers tacitly assume an orthodox coda analysis for the stops in all these contexts. If stops are codas in final and in word-medial position before /t/ and /n/, we would expect learners to treat them similarly in all three contexts. In each case, BP learners of English would need to acquire a uniform coda representation for stops such as /p k/. While this is the prevalent view in phonology (Blevins, 1995; Selkirk, 1982), it is not the only one. In Government Phonology (Harris & Gussmann, 1998; Kaye, 1990), it is argued that final consonants are onsets of empty nuclei; only an initial consonant in a medial cluster of falling or level sonority constitutes a coda. Hence, while level-sonority /pt/-/kt/ clusters are coda-onset sequences, rising-sonority clusters that do not form branching onsets, such as /pn/-/kn/, are onset-onset sequences with an intervening empty nucleus. Finally, proponents of CVCV (Lowenstamm, 1996; Scheer, 2004) argue that phonological representations are strictly comprised of sequences of C and V slots, which amount to a series of non-branching onsets and nuclei. All and any consonant is thus in an onset position, and adjacent consonants are necessarily separated by an empty nucleus.

The various syllabic parses for the stops and contexts that are the focus of our study are summarized in Table 1.[4]

Table 1 – Competing views of syllabification

	Orthodox phonology	Government Phonology	CVCV
Medial /pt/-/kt	p.t - k.t	p.t - k.t	pØt - kØt
Medial /pn/-/kn	p.n - k.n	pØn - kØn	pØn - kØn
Final /p#/-/k#/	p. - k.	pØ - kØ	pØ - kØ

In a recent study, we established different epenthesis rates after /p k/ in word-final versus word-medial position before /t/ (John & Cardoso, 2017, to appear). This finding is consistent with, and tentatively supports, the Government Phonology view that the stops are parsed differently in the two locations. Their differential acquisition implies the presence of a dual learning challenge: arguably, learners need to enlarge the set of both onsets of final empty nuclei and of medial codas to include /p k/. Nonetheless, differential acquisition does not necessarily rule out a common syllabic parse (i.e., as codas or as onsets in both locations): it could be argued that differential acquisition derives simply from the stops being determined by separate parameters or constraints in the two contexts. That is, despite identical syllabic affiliation in the two contexts, different aspects of the phonological system might need adjusting to allow the stops to surface in both locations.

For the current and a previous pilot study (John & Cardoso, 2016), we thus expanded the scope of investigation to include /p k/ in word-medial position before /n/. In this context, Government Phonology considers the stops to constitute onsets of empty nuclei, that is, just like final consonants. If, in terms of i-epenthesis, word-medial /p k/ before /n/ patterns with word-final /p k/ rather than with word-medial /p k/ before /t/, this would be consistent with the Government Phonology view. That is, onsets of empty nuclei should pattern together, not with true codas. This is precisely what we found in a pilot study involving BP learners of English in the L2 context of Montreal. There were, however, certain problems in the pilot study with how the word-learning tasks were designed and presented to the participants. As a result, participants had great difficulty retaining the nonwords. For the current study, we thus refined the methodology to favour higher levels of vocabulary retention, seeking to confirm the previous finding among a population of English learners in the foreign language context of Belém, Brazil.

We also adapted the data analysis in order to verify predictions generated by our proposal that L2 phonological variation is typically lexical rather than derivational. L1 variation is usually attributed to a variable synchronic process, which can be modeled via variable rules (Cedergren & Sankoff, 1974; Labov, 1969) or via crucially unranked or overlapping constraints (Anttila, 1997; Boersma, 1997; Boersma & Hayes, 2001; Kiparsky, 1993; Reynolds, 1994).[5] For example, the non-categorical deletion of final /t d/ in North American English is attributed to a variable process that is sensitive to internal (linguistic) and external (extralinguistic) factors such as the nature of the surrounding segmental environment and level of formality (e.g., Guy, 1980; Neu, 1980). The notion that surface variation could in some cases be due to the presence in the lexicon of more than one UR for individual items is rarely entertained in the variationist literature (cf. Anttila, 2000; Guy, 2007). We suspect, however, that much variation in L2 speech is due to precisely this scenario: the idea is that, when individual lexical items are associated with two URs, these compete for selection, with either one being potentially accessed at the moment of speaking (John & Cardoso, 2017).

In our view, these competing URs arise in the lexicon in the course of L2 acquisition. As learners progress, they revise their lexical entries, replacing initial (often inaccurate) URs with revised (accurate) URs. Inaccurate URs arise as a result of perceptual illusions. For example, L2 segments may be perceptually assimilated to an L1 category (Best, 1994; Flege, 1995; Kuhl & Iverson, 1995). Substitution phenomena observed in speech output are thus not due to derivational processes; instead, substitution takes place in the lexicon. With regard to consonant clusters and final consonants, L2 speakers sometimes hear ghost vowels that permit the consonants to conform to L1 patterns of syllabification (e.g., Dupoux, Kakehi, Hirose, Pallier & Mehler, 1999). Indeed, BP learners of English tend to hear an illusory vowel after final stops (Cardoso, 2011). Consequently, the so-called epenthetic vowels

found in their speech output presumably correspond to vowels recorded in lexical entries. Relatedly, it has been argued that the epenthetic vowels observed in the L1, in native BP words and loanwords alike, are also part of the UR (Cantoni & Cristófaro-Silva 2008; Cristófaro-Silva & Almeida, 2008). The upshot is that, in both the L1 and the L2 contexts, the term i-epenthesis is really a misnomer.

Apparently, then, the first step for BP learners of English involves constructing URs that contain the illusory vowel (e.g., *magic* = *magi*/ki/). Over time, however, with increased exposure to English and improved proficiency, learners develop the ability to perceive and represent problematic consonants without the vowel (i.e., as codas or as onsets of empty nuclei). At this point, they revise the URs for individual words (e.g., *magi*/ki/ → *magi*/k/). However, the revised UR does not overwrite or otherwise eradicate the original one; instead, the two continue to be present in the lexicon, with both being available for selection at the moment of speaking. Over time, learners get better at accessing the revised (accurate) UR over the original (inaccurate) UR, with rates of *magi*/ki/ steadily declining and rates of *magi*/k/ increasing. Potentially, in speech production, learners reach a stage where only the revised UR is accessed, at which point the original UR functionally ceases to play a role. The three stages are illustrated in Figure 1.

Stage 1		**Stage 2**		**Stage 3**
magi/ki/		*magi*/ki/		
	→	~	→	
		magi/k/		*magi*/k/

Figure 1 – Hypothetical stages in L2 phonological development

Variation is thus limited to stage 2 in development. At this point, where contextual factors are found to influence the phenomenon probabilistically, these would not be affecting rates of application of a variable process; rather they would be influencing the process of UR selection during lexical access, with some factors favouring selection of the original, and others the revised UR.

Crucially, our model of L2 phonological development makes certain predictions. First, learners at stages 1 and 3 of acquisition should exhibit (near) categorically inaccurate and (near) categorically accurate behaviour respectively. Next, variation at stage 2 should be restricted to words that are acquired at the previous initial stage of illusory vowel perception. Variation should not be found among new words acquired later on once the learner has entered stage 2. If stage 2 is characterized by accurate perception, representations for new words should generally not contain illusory vowels, although some residual ghost-vowel perception may still lead learners astray. That is, newly acquired items (such as the nonwords *galip, toktel* and *sepna*) should generally be subject to accurate perception and UR development (e.g., *gali*/p/, *to*/k/*tel*), with only occasional misperceptions (e.g., *se*/pi/*na*). Consequently, learners at stage 2 should show categorical behaviour for recently acquired words: categorical accuracy for most items, with the possibility of categorical inaccuracy for others. Newly acquired items should thus only be subject to between-word variation; within-word variation should be limited to words acquired at stage 1 (or to those items acquired inaccurately at stage 2, once these undergo UR revision). Our predictions for newly acquired words according to the three stages of development are illustrated in Table 2.

Table 2 – Newly acquired (non)words (e.g., *galip, toktel, sepna*)

Stage 1 (categorically inaccurate)	**Stage 2** (categorically accurate OR inaccurate)	**Stage 3** (categorically accurate)
gali/pi/	*gali*/p/	*gali*/p/
to/ki/*tel*	*to*/k/*tel*	*to*/k/*tel*
se/pi/*na*	*se*/pi/*na*	*se*/p/*na*

One of the purposes of our study was to test these predictions using nonword-learning tasks carried out by BP learners of English. Participants who have advanced beyond the initial stage of categorical epenthesis should show only between-word and no within-word variation for these newly acquired items. Our research questions

and hypotheses based on this issue and on the issue of the syllabification of stops in the three contexts are as follows:

1. Do word-medial /p k/ preceding /n/ pattern with final /p k/ rather than word-medial /p k/ preceding /t/?
   Hypothesis: If Government Phonology is correct in analyzing /p k/ as occupying an onset of an empty nucleus in both these positions, the hypothesis is that they should pattern together.

2. Do BP learners of English show only between-word variation in the realization of newly acquired items?
   Hypothesis: Our model of L2 phonological development makes the prediction that learners at stage 2 should show precisely this behaviour; within-word variation is not consistent with our model.

The following section provides information on the methodology employed to investigate these questions.

Methodology

Participants

53 BP adult and teenage learners of English (30 F, 23 M; 15-56 years old, mean 28) in Belém, Brazil, participated in the study. They were students at the *Centro de Educação de Jovens e Adultos* (CEEJA) *Prof. Luiz Octávio Pereira*, a remedial program for people who were dropouts or who, for various reasons, had slipped through gaps in the educational system, ending up with little or no previous schooling. Interestingly, while most ESL studies employ university students (and hence, much of what we know about L2 acquisition comes from this elite population – see Collins & Muñoz, 2016, for an extensive review), our participants were at the opposite end of the academic spectrum. Indeed, only 7 reported previous instruction in English, and even this was only at the beginner level. In terms of English proficiency, then, they were all early beginners, and given the emphasis on pen-and-paper exercises seen in the public school system in Brazil (which focus mostly on grammar and vocabulary), their previous exposure to and production of spoken English was limited or non-existent. Consequently, their awareness of English phonology would be quite basic. This was of some concern to us at first, since we wondered whether they would not simply all be at the initial stage of total L1 transfer and hence categorical i-epenthesis in the three contexts. Fortunately, the concern proved not to be well founded.

Data collection

Participants performed a series of tasks presented via PowerPoint on a laptop computer and intended either to get them to learn a set of 12 nonwords or to collect data on their oral production of these same nonwords. For each of the tasks, including reading-aloud, repetition, identification, and elicitation components, we created three versions in which the nonwords were presented in randomized orders. For the first task, participants were instructed to use "English pronunciation" to read aloud the nonwords, being told these were invented rather than actual words of English. The set of nonwords is reproduced in Table 3, including the 12 target items and 4 distractors (for ease of identification, the target segments are in bold here, though they were not in the version presented to participants).

Table 3 – List of nonwords for the reading-aloud task

1. basa	5. gu**p**ta	9. mine**k**	13. se**p**na
2. be**k**nu	6. kuvi	10. nidu	14. tola
3. filo**p**	7. lo**p**ni	11. pu**k**tu	15. va**k**ni
4. gali**p**	8. mi**k**ta	12. redo**k**	16. ze**p**tu

Next, in order to start learning the nonwords, participants performed a repetition task, which we audio-recorded using a Microsoft LX-3000 headphone/microphone set attached to a laptop computer. The software adopted for audio recording (mono, with a bit depth of 16 bits and a sample rate

of 44.1 kHz) was Audacity 2.1. On each of a series of four PowerPoint slides, they saw three images taken from the Bank of Standardized Stimuli (Brodeur, Dionne-Dostie, Montreuil & Lepage, 2010). Upon clicking on each image, they heard a recording of the word in isolation and at the end of a carrier phrase: for example, the participant would hear '*Minek, this is a minek*', after clicking on the image of an elephant. The recordings were made by three adult speakers of standard Canadian English (2 M, 1 F), with recordings from different speakers being used both in different versions of the tasks and across different tasks within a given version. The aim was to expose the participants to various voices for the nonwords so as to ensure development of richer phonological representations. This decision was based on research findings suggesting that increasing the variability in the oral input results in greater learning (Bradlow, 2008; Lively, Logan, & Pisoni, 1993; Thomson, 2011). The screen shot in Figure 2 reproduces one of the slides from the repetition task.

Figure 2 – Repetition task: sample slide

The participants would repeat what they heard and try to memorize the word associated with the image. In our previous pilot study (John & Cardoso, 2016), the participants were often unsuccessful at recalling the words later on, during post-tests. Consequently, for this study, we removed the four distractors from the word-learning tasks, effectively reducing the retention load from 16 to 12 words. We also encouraged the participants to listen and repeat as many times as they wished, and they could also return to earlier slides to review before moving on to the next task. The intention was to maximize their learning by providing as much practice time as they deemed necessary. For the purposes of data collection, however, only the initial two repetitions of each nonword (i.e., in isolation and at the end of the carrier phrase) were retained.

Tasks 3 and 4 were identification tasks intended to ensure, check and reinforce the learning that took place in the preceding repetition task. For Task 3, the participants saw an image and listened to two recordings (e.g., *Mikta, this is a mikta* and *Zeptu, this is a zeptu*), having to decide which recording correctly identified the image. Afterwards, they were provided with feedback on their responses in order to give them a chance to learn any nonwords they were unsure of. Figure 3 provides an example of a slide from Task 3.

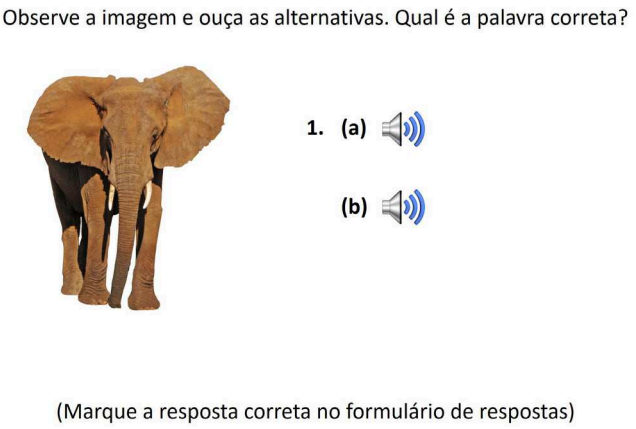

Figure 3 – Identification Task 3: sample slide

For Task 4, the participants saw two images and listened to a single recording, having to decide which image the recording referred to. Again, they were provided with feedback on their responses in order to give them another chance to learn nonword-image associations. Figure 4 provides an example of a slide from Task 4.

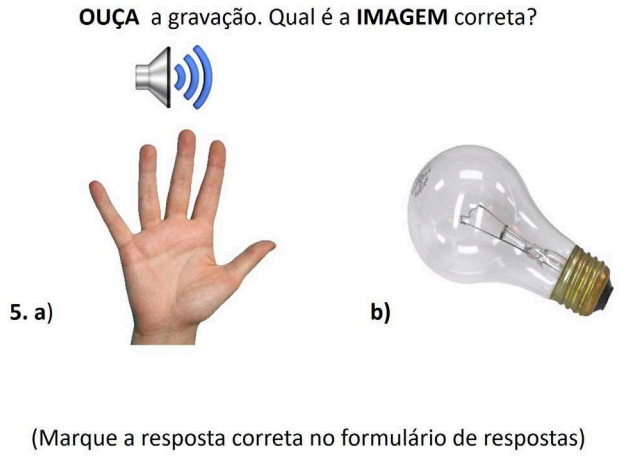

Figure 4 – Slide from identification Task 4

Tasks 5 and 6 were elicitation tasks, the first being a practice test with feedback on error and the second being an actual test of their retention and production of the nonwords. Only the recordings from Task 6 were retained for the data analysis. In Task 5, the participants were asked to identify the nonword associated with the image, saying it aloud in isolation and at the end of the carrier phrase. They would then click on the sound file to verify their responses (see Figure 5). This constituted a last opportunity to learn the nonwords before being tested on them. In order to guide lexical access, the first two sounds in the target word were provided.

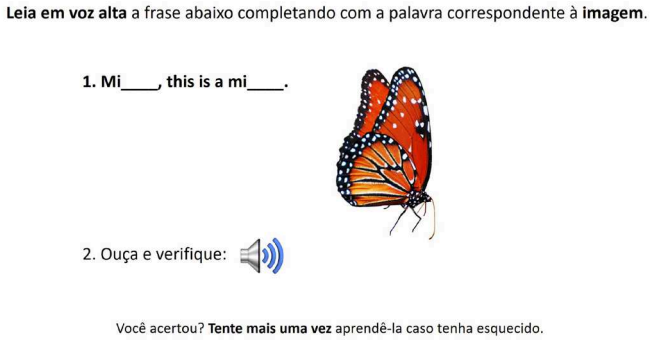

Figure 5 – Elicitation Task 5: sample slide

Task 6 had the identical set-up, except that the participants could not verify their responses afterwards. This constituted the final, immediate post-test phase of the data collection, checking production of the nonwords retained from the preceding learning tasks. As with the repetition task, two tokens of each nonword were collected: the item in isolation and then at the end of the carrier phrase. The purpose was not to test vocabulary retention per se, but rather to verify pronunciation of the just-acquired forms. Figure 6 illustrates Task 6.

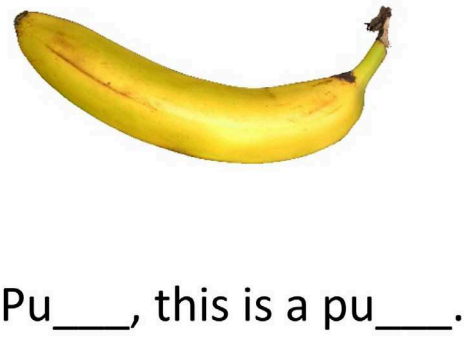

Figure 6 – Elicitation Task 6: sample slide

Finally, in Task 7, participants performed the same reading-aloud task as initially, producing each of the nonwords in isolation. The different stages in the data collection and nonword-learning tasks are reproduced in Table 4. To reiterate, for the purposes of the analysis, only the data collected in Tasks 1, 2, 6, and 7 were retained (indicated by an asterisk).

Table 4 – Data collection and nonword-learning tasks

Task	Content
1. Pre-reading aloud task*	List of 16 nonwords, including 4 distractors
2. Repetition task*	12 target nonwords, in isolation and in carrier phrase
3. Identification task	1 image and 2 recordings
4. Identification task	2 images and 1 recording
5. Elicitation (practice) task	Nonword in isolation and in carrier phrase
6. Elicitation (test) task*	Nonword in isolation and in carrier phrase
7. Post-reading aloud*	List of 16 nonwords, including 4 distractors

Data coding

The data were then coded both for the dependent variable of i-epenthesis and for the following independent variables:

Position in word: (1) final; (2) medial before /t/; (3) medial before /t/
Consonant: (1) /p/; (2) /k/
Task: (1) pre-reading aloud; (2) repetition (tokens 1 vs. 2); (3) elicitation (tokens 1 vs. 2); (4) post-reading aloud

The presence of i-epenthesis was determined by the first researcher listening to the recordings over a headset; the second researcher was consulted whenever presence or absence was difficult to determine.[6]

Results

We adopted a variationist methodology for collecting and analyzing linguistic data due to the nature of the study – it is essentially variationist in the sense that the variation that we report is (inherently) subject to the influence of not one but multiple contextual influences or multiple causes (Young & Bayley, 1996). As such, the data were analyzed via Goldvarb X (Sankoff et al., 2005), a multiple regression statistical program specifically designed to handle linguistic variation. The program assigns to individual factors a weight ranging from 0 to 1 to indicate the relative contribution of the factor to the application of a variable phenomenon such as i-epenthesis. Anything in excess of 0.5 indicates that a factor favours the phenomenon. Since Goldvarb only handles variation, the data from one participant with categorical epenthesis were eliminated after the first run; in order to refine the analysis, limiting it to factors that contribute significantly to the phenomenon under study, the factor group 'participant' was then eliminated after the second run, since our main interest, within the realm of typical variationist research, is on the speech community, not individuals (Bayley, 2005).

The results presented in Table 5 are from the third and final Goldvarb run, showing both the factors weights and the percentage of i-epenthesis when the given factor is present. According to these results, i-epenthesis is more likely to occur when the target /p/ and /k/ appear before /n/ (.729; Position), when the target consonant is a /p/ (.553; Consonant), and when the participants are engaged in reading aloud tasks (.752 and .558 on pretest and posttest respectively; Task).[7] Focusing on the most relevant variables, the position in which the target /p/ and /k/ occur, we observe a developmental sequence that ranks medial /p k/ before /n/ at the hardest end of a hierarchy based on difficulty (0.729), followed by final /p k/ (0.400) and medial /p k/ before /t/ (0.361). Finally, tokens 1 and 2 in both the repetition and elicitation tasks were assigned different factor weights (0.378 vs. 0.404 and 0.448 vs. 0.428), indicating that epenthesis rates were not identical for the two tokens.

Table 5 – Factor weights/ % assigned by the Goldvarb X analysis: i-epenthesis

Factor groups	**Factor weights / %**			
Position	*Final* 0.400/ 65	*Before /t/* 0.361/ 61	*Before /n/* 0.729/ 88	
Consonant	*/p/* 0.553/ 75	*/k/* 0.449/ 68		
Task	*Pre-reading aloud* 0.752/ 88	*Repetition (tokens 1 & 2)* 0.378/ 62 0.404/ 64	*Elicitation (tokens 1 & 2)* 0. 448/ 68 0.428/ 67	*Post-reading aloud* 0.558/ 77

Aside from the results of the Goldvarb analysis, a few other observations can be made about the data. First, the participants occasionally realized the vowels /u/ or /a/ rather than /i/ after /p k/. No other vowels were inserted instead of /i/. We coded such instances as applications of epenthesis, but because they were so infrequent, we maintained the designation of the dependent variable as i-epenthesis rather than the more generic vowel epenthesis.

Various transformations of the target items other than vowel epenthesis were also observed. For example, at times, the participants deleted /p k/ (e.g., *gupta → guta, redok → redo*). At others, they substituted the consonant following /p k/, with both n → t and t → n substitutions being observed (e.g., *sepna → sepita, mikta → mikina*). Interestingly, while p → k substitutions (e.g., *lopni → lokini*) were fairly common (25 in all), there were no instances of the reverse k → p substitution. The following section considers the implications of the findings for our hypotheses.

Discussion

One motivation for our exploring i-epenthesis in medial and final contexts was to investigate the different syllabic parses that have been proposed for consonants in these locations. Depending on the theoretical framework, /p k/ in word-final position and in word-medial position before /t/ or /n/ are analyzed either as all codas (orthodox phonology) or all Cs/onsets followed by empty Vs/nuclei (CVCV) or else as codas before /t/ and as onsets of empty nuclei in the two other contexts (Government Phonology). If BP learners of English treat /p k/ in the three contexts similarly, hence acquiring them simultaneously, this would suggest a unified learning challenge and would be consistent with a common syllabic affiliation. If learners treat and acquire /p k/ differentially in the three contexts, this would suggest that learners face a dual challenge of permitting /p k/ in both a coda and an onset of an empty nucleus. Specifically, we anticipated that medial /p k/ before /n/ should behave similarly to final /p k/ if these consonants are parsed as onsets in the two locations; being parsed as a coda, medial /p k/ before /t/, on the other hand, should behave differently. That is, the two onset locations should show similar rates of i-epenthesis, whereas the coda location should have a different rate.

Our results show that /p k/ are treated differently in the three contexts, a finding which is not consistent with a common syllabic parse as a coda or onset. On the other hand, the results are inconclusive in terms of supporting the Government Phonology view. What we find is a hierarchy of difficulty across the three locations, going from hardest to easiest: medial /p k/ before /n/ >> final /p k/ >> medial /p k/ before /t/ (compare the factor weights: 0.729 >> 0.400 >> 0.361 respectively). Apparently, acquisition proceeds independently according to context, suggesting a developmental process that follows linguistic universals, not L1 transfer, as the observed patterns are not triggered by BP phonology (Major, 1986). In addition, as the factor weights indicate, the rates of epenthesis after final /p k/ (0.400) and medial /p k/ before /t/ (0.361), which supposedly require different syllabic parses, are much closer than the rates after final /p k/ (0.400) and medial /p k/ before /n/ (0.729), which supposedly both involve onsets of empty nuclei. The findings contrast somewhat with what we observed in our previous pilot study (John & Cardoso, 2016). Although the same hierarchy of difficulty emerged, the factor weights showed final /p k/ (0.556) to pattern closely with medial /p k/ before /n/ (0.648), not with medial /p k/ before /t/ (0.299). In brief, the findings from the pilot study appear to confirm the Government Phonology view, whereas the findings from the current study fail to support it.

Another aim of the study was to investigate our proposal that L2 variation, for example in i-epenthesis, is lexical rather than derivational. That is, it is due to competition between dual URs for individual lexical items. In our view, the two URs emerge sequentially in the course of acquisition: first, due to misperceptions, learners construct inaccurate URs, and then, as they become able to perceive and represent the target forms correctly, they revise their lexical entries such that either the original (inaccurate) or the revised (accurate) UR can be selected as a base for speech output. If this model is correct, learners should show

categorical behaviour for new items: BP learners at stage 1 in acquisition, who are subject to illusory vowel perception, should show categorical i-epenthesis after newly acquired nonwords; learners at stage 2, however, having largely overcome illusory vowel perception, should show categorically accurate production, although occasional misperceptions could lead to categorically inaccurate production for certain items. Importantly, according to our model, we would not expect to find variation in the realization of one and the same lexical item. In brief, while between-word variation for just-acquired forms is consistent with the model, within-word variation is not.

Variation in i-epenthesis was found across the tasks. This finding, however, is not necessarily evidence of true within-word variation. The highest rates of epenthesis were found in the pre-reading aloud task, followed by the post-reading aloud task. It could be argued that this is a task effect: in reading aloud, particularly before having any experience with how the nonwords are pronounced by speakers of English, arguably the participants tend to access their L1 phonological system to determine how to articulate the forms. Indeed, we should emphasize that, in reading aloud words in BP, the participants would be used to producing vowels that do not appear in the orthography, but that allow the output to conform to L1 syllabification patterns.

For our purposes, then, the more crucial information comes from the repetition and elicitation tasks. First, there were some differences between the tasks, with the repetition task showing slightly lower rates of epenthesis (token 1: 0.378; token 2: 0.404) than the elicitation task (token 1: 0.448; token 2: 0.428). Note that these differences are not statistically different; they are presented as such for the sake of argumentation. Next, more importantly, there was frequent variation in the realization of the first and second tokens in each target production in the carrier phrase adopted, as evidenced by the different factor weights accorded to the two tokens. What this means is that in the tasks, at times, the participants realized the first token accurately and the second inaccurately (e.g., *Gu*[p]*ta, this is a gu*[pi]*ta*) or vice versa (e.g., *Mi*[ki]*ta, this is a mi*[k]*ta*). What this means is that both as they are constructing a lexical entry (the repetition task) and as they are accessing an entry (the elicitation task), competing accurate and inaccurate URs are in play. The implication is that dual URs do not arise in the L2 lexicon sequentially, as we posited; rather, they emerge simultaneously as new words are acquired. Learners show uncertainty when positing a UR for a new item, developing competing URs at the moment of acquisition. Interestingly, this behaviour seems to start quite early on: our participants were generally low in proficiency, with little previous experience with spoken English. Nonetheless, as indicated in the previous section, only one participant (whose data were discarded from further statistical analysis because of categorical i-epenthesis) actually occupied the initial stage of phonological acquisition, with total transfer of L1 phantom vowel perception and hence categorical epenthesis.

Another possibility that we might entertain is that i-epenthesis is not lexical at all, but derivational, due to a variable process of vowel insertion. That is, perhaps L2 phonological variation is not special, but closely parallels what is found in L1s. We think that this view is misguided. First, the evidence for ghost vowel perception (e.g., Dupoux et al., 1999; Cardoso, 2011) points inevitably to the conclusion that apparent epenthetic vowels are in fact underlying. Likewise, further arguments have been mounted to demonstrate the underlying status of these vowels in L1 BP (Cantoni & Cristófaro-Silva 2008; Cristófaro-Silva & Almeida, 2008). Finally, /i/ was not the only vowel that was inserted after /p k/ in the nonwords. Occasionally, /u/ or /a/ were added instead (e.g., *filop* → *filo*[pu]; *gupta* → *gu*[pa]*ta*; *beknu* → *be*[ka]*nu*), with nothing in the context to predict when one or the other (or instead [i]) would appear. In order for these patterns to be derivational, we would need to posit three phonological processes of variable vowel epenthesis that apply arbitrarily and at random. Instead, we stand by the claim that so-called epenthetic [i] is underlying and is the default illusory vowel, with /u/ or /a/ occasionally being heard in place of /i/.

On a final note, consistent with our previous findings (John & Cardoso, 2016), epenthesis rates were found to be higher after /p/ than /k/. This finding

confirms the observation that, alongside coronal (Paradis & Prunet, 1991), velar place has special unmarked status cross-linguistically (Rice, 1996). In languages such as Selayarese (Mithun & Basri, 1986), nasals that do not receive a place specification via spreading from an adjacent consonant are assigned velar place by default (John, 2014). Interestingly, the unmarked status of velar /k/ over labial /p/ also found an echo in a substitution pattern we observed in the data. To reiterate, other transformations of the target forms than only vowel epenthesis occurred. At times, for example, the consonant following /p/ or /k/ was switched, with both n → t (e.g., *sepna* → *sepita*) and t → n (e.g., *mikta* → *mikina*) being instantiated. In terms of substitutions targeting /p k/, however, while we found 25 instances of the pattern p → k (e.g., *lopni* → *lokini*), there were no instances of the reverse k → p pattern. In brief, this unexpected finding provides further evidence for the default unmarked status of velars.

Conclusion

In sum, we set out first to investigate rates of i-epenthesis after the stops /p k/ by BP learners of English in different lexical contexts: in word-final position and in word-medial position before either /t/ or /n/. Based on the Government Phonology view that both final consonants and medial /p k/ before /n/ constitute onsets of empty nuclei, we predicted that they should trigger similar rates of i-epenthesis; medial /p k/ before /t/, on the other hand, should behave differently, since these are in coda position. However, syllabification appears not to hold the full explanation for contextual variation in epenthesis: we found a hierarchy of difficulty across the three contexts (/pn/-/kn/ >> /p#/-#k#/ >> /pt/-/kt/). This is more consistent with the notion of a developmental sequence than with the notion of consonants associated with the same syllabic constituents patterning together. Especially, our findings contradict both the orthodox phonology and CVCV views, whereby /p k/ are either codas or onsets across the three contexts, in which case they should be acquired (evidenced by similar epenthesis rates) more or less simultaneously.

Next, we wished to test a proposal articulated in previous work (John & Cardoso, 2017) whereby the source of L2 phonological variation is lexical rather than derivational: we proposed that dual URs are associated with single lexical items, either of which may be accessed as a base for speech output. Hypothetically, dual URs arise sequentially in the learner lexicon as inaccurate forms, which develop due to perceptual illusions, are gradually replaced with revised accurate forms. These latter forms develop once learners are able to perceive and represent /p k/ correctly. In this case, at the later stage of accurate perception, newly acquired items should generally be produced accurately. Certainly, learners should not exhibit within-word variation. However, this is precisely what we found: learners showed variation for newly acquired items from the start. That is, dual URs for individual items seem to be acquired simultaneously at this stage in acquisition. Our model of phonological development thus proves to be overly simplistic.

Our study has certain limitations. First, the participants were only exposed to the novel nonword items in one sitting. Perhaps such just-acquired forms show instability only at first; with repeated exposure over a number of days, we might find the learners settle on and consistently access a single UR. It would thus be worthwhile extending the learning period and employing a delayed post-test. In addition, to better explore our proposal regarding L2 variation, it would be useful to compare rates of i-epenthesis for early and newly acquired items. Do learners get better at constructing accurate URs as they increase their proficiency? In this case, we would expect new items to show lower rates of epenthesis than items acquired early on. Future research can explore these issues in greater depth, whether with the phenomenon of i-epenthesis or with other interlanguage phenomena such as segmental substitution. In a nutshell, the future is doubtless rich and always variable.

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Notes

1. This distinction between the L1 and L2 manifestations of the phenomenon may appear to be a simplification since, as a reviewer pointed out to us, some variation has been observed in the phonetic realization of epenthetic [i] in BP, such that the vowel is phonetically gradient and hence variable (e.g., Cristófaro-Silva & Almeida, 2008). Indeed, it even seems that at times neither epenthetic nor regular [i] is realized, at least in the speech of the undergraduate students from Belo Horizonte used in Cristófaro-Silva and Almeida's study. It is unclear, however, to what extent this variation holds for other L1 regional variants. In addition, apparent L1 variation (even absence of [i]) may simply derive from phonetic implementation, including the BP process of variable devoicing of the vowel after a voiceless obstruent. We would thus argue that the distinction between categorical presence of the vowel in the L1 and non-categorical in the L2 holds at the abstract phonological level.
2. Further complicating matters, some have argued (Piggott, 1999; Rice, 2003) that word-final consonants may be parsed as codas in some languages but as onsets of empty nuclei in others. For more on this issue, see John and Cardoso (2017), where we argue that, while English appears to employ an onset parse for final consonants, BP is consistent with a coda parse.
3. Some may dispute the Government Phonology view that only /p k/ occur in medial codas, pointing to heterosyllabic medial clusters with initial voiced stops such as /b/ in *ob.solete* and /g/ in *ig.nite*, in addition to the coronal stops /t/ in *at.las* and /d/ in *kid.ney.* Nonetheless, such exceptions often contain a morpheme boundary (in which case the stops are morpheme-final) or else they fail to exhibit the level or falling sonority cline displayed by bona fide coda-onset sequences such as /k.t/ in *actor* and /n.d/ in *tinder*. As a consequence, Government Phonology analyzes these as word-internal onsets of empty nuclei.
4. One possibility that we overlook here is that final consonants may be extrasyllabic (e.g., Ito, 1988). We do so because, in most accounts, final consonants are extrasyllabic only in the initial stages, being incorporated into a coda constituent in the course of the derivation.
5. Another possibility is that variation stems from multiple grammars (Kroch, 1989), with the speaker switching back and forth between more than one categorical variant of the language. Furthermore, it has been proposed that between-word variation may derive from lexically indexed constraints (Coetzee, 2009).
6. The decision not to employ an acoustic analysis using a spectrograph (e.g., via Praat) was based on the observation that, even with this kind of fine-grained phonetic analysis, tokens can fall into a grey (gradient) area within which a researcher still has to ultimately determine an arbitrary cut-off point for what constitutes epenthesis or not. We preferred the cut-off point to be determined by how targetlike (i.e., without i-epenthesis) something sounded to a native-speaker's ears.
7. To return to the issue of data coding, it would strictly speaking be more accurate to state that the results indicate which factors favour *perception of the presence of i-epenthesis* by experienced listeners.

References

Anttila, A. (1997). Deriving variation from grammar: A study of Finnish genitives. In F. Hinskens, R. Van Hout and L. Wetzels (Eds.), *Variation, Change and*

Phonological Theory (pp. 35–68). Amsterdam: John Benjamins.

Anttila, A. (2002). Variation and phonological theory. In J. Chambers, P. Trudgill and N. Schilling-Estes (Eds.), *Handbook of Language Variation and Change* (pp. 206–43). Oxford: Blackwell.

Baptista, B., & Silva Filho, J. (1997). The influence of markedness and syllable contact on the production of English consonants by EFL learners. In J. Leather and A. James (Eds.), *New Sounds 1997: Proceedings of the Third International Symposium on the Acquisition of Second Language Speech* (pp. 26–34). Klagenfurt: University of Klagenfurt.

Baptista, B., & Silva Filho, J. da (2007). The influence of voicing and sonority relationships on the production of English final consonants. In B. Baptista and M. Watkins (Eds.), *English with a Latin Beat: Studies in Portuguese/Spanish-English Interphonology* (pp. 73–89). Amsterdam: John Benjamins.

Bayley, R. (2005). Second language acquisition and sociolinguistic variation. *Intercultural Communication Studies, 14*(2), 1-13

Best, C. T. (1994). The emergence of native-language phonological influences in infants: A perceptual assimilation model. In J. C. Goodman & H. C. Nusbaum (Eds.), *The development of speech perception: The transition from speech sounds to spoken words* (pp. 233-277). Cambridge, MA: The MIT Press.

Blevins, J. (1995). The syllable in phonological theory. In J.A. Goldsmith (Ed.), *The Handbook of Phonological Theory* (pp. 206–44). Oxford: Blackwell.

Boersma, P. (1997). How we learn variation, optionality, and probability. In *Proceedings of the Institute of Phonetic Sciences 21* (pp. 43–58). Amsterdam: University of Amsterdam.

Boersma, P., & Hayes, B. (2001). Empirical tests of the gradual learning algorithm. *Linguistic Inquiry, 32*(1), 45–86.

Bradlow, A. R. (2008) Training non-native language sound patterns: Lessons from training Japanese adults on the English /r/-/l/ contrast. In J. G. Hansen Edwards & M. L. Zampini (Eds.), *State-of-the-art issues in second language phonology* (pp. 287-308). Amsterdam: John Benjamins.

Brodeur, M., Dionne-Dostie, E., Montreuil, T., & Lepage, M. (2010). The Bank of Standardized Stimuli (BOSS), a new set of 480 normative photos of objects to be used as visual stimuli in cognitive research. *PLoS ONE*, *5*(5), e10773.

Broselow, E., Chen, S.-I., & Wang, C. (1998). The emergence of the unmarked in second language phonology. *Studies in Second Language Acquisition, 20,* 261–80.

Cantoni, M., & Cristófaro-Silva, T. (2008). Verbal stress assignment in Brazilian Portuguese and the prosodic interpretation of segmental sequences. In *Proceedings of the Speech Prosody Conference, Campinas 2008* (pp. 587–90). São Paulo: Universidade de Campinas.

Cardoso, W. (2007). The variable development of English word-final stops by Brazilian Portuguese speakers: A stochastic optimality theoretic account. *Language Variation and Change, 19*, 219–48.

Cardoso, W. (2011). The development of coda perception in second language phonology: A variationist perspective. *Second Language Research, 27*(4), 433–65.

Cedergren, H. J., & Sankoff, D. (1974). Variable rules: Performance as a statistical reflection of competence. *Language, 50*(2), 333–55.

Cristófaro-Silva, T., & Almeida, L. (2008). On the nature of epenthetic vowels. In L. Bisol and C. R. Brescancini (Eds.), *Contemporary Phonology in Brazil* (pp. 193–212). Cambridge: Cambridge Scholars Publishing.

Coetzee, A. (2009). Phonological variation and lexical frequency. In A. Schardl, M. Walkow and M. Abdurrahman (Eds.), *NELS 38*: *Proceedings of the North East Linguistic Society*, Volume 1 (pp. 189–202). Amherst: GLSA.

Collins, L., & Muñoz, C. (2016). The foreign language classroom: Current perspectives and future considerations. *The Modern Language Journal, 100*(1), 133-147.

Dupoux, E., K. Kakehi, Y. Hirose, C. Pallier, & J. Mehler. 1999. Epenthetic vowels in Japanese: A perceptual illusion? *Journal of Experimental Psychology: Human Perception and Performance, 25*, 1568-1578.

Flege, J. E. (1995). Second-language speech learning: Theory, findings, and problems. In W. Strange (Ed.), *Speech perception and linguistic experience: Issues in cross-language research* (pp. 229-273). Timonium, MD: York Press.

Guy, G. (1980). Variation in the group and the individual: the case of final stop deletion. In W. Labov (Ed.), *Locating Language in Time and Space* (pp. 1-36). New York: Academic Press.

_____. (2007). Lexical exceptions in variable phonology. *University of Pennsylvania Working Paper in Linguistics, 13*(2), 109-119.

Harris, J. (1994). *English Sound Structure*. Oxford: Blackwell.

Harris, J., & Gussmann, E. (1998). Final codas: Why the west was wrong. In E. Cyran (Ed.), *Structure and Interpretation in Phonology: Studies in Phonology* (pp. 139–62). Lublin: Folia.

Huf, J. C. C., & Alves, U. K. (2010). A produção de /p/ et /k/ em codas simples e complexas do inglès (L2) por aprendizes gaúchos. *Verba Volant, 1*(1), 1–27.

Ito, J. (1988) *Syllable Theory in Prosodic Phonology*. New York: Garland Publishing.

John, P. (2014). *The Phonology of Empty Categories.* Unpublished doctoral dissertation, Université du Québec à Montréal.

John, P. & Cardoso, W. (2016). A question of syllable structure: contextual acquisition of /p/ and /k/ by Brazilian Portuguese learners of English. *Gradus, 1*(1), 126-144.

John, P., & Cardoso, W. (2017). Medial coda and final stops in Brazilian Portuguese-English contact. In M. Yavaş, M. Kehoe and W. Cardoso (Eds.), *Romance-Germanic Bilingual Phonology*. Sheffield: Equinox Publishing.

John, P., & Cardoso, W. (to appear). Are word-final consonants codas? Evidence form Brazilian Portuguese ESL/EFL learners. In J. Volin and R. Skarnitzl (Eds.), *Pronunciation of English by Speakers of Other Languages*. Newcastle upon Tyne: Cambridge Scholars Publishing.

Kaye, J. (1990). 'Coda' licensing. *Phonology, 7*, 301–30.

Kiparsky, P. (1993). Variable rules. Paper presented at the Rutgers Optimality Workshop. New Brunswick, NJ.

Kroch, A. (1989). Reflexes of grammar in patterns of language change. *Language Variation and Change, 1,* 199–244.

Kuhl, P. K., & Iverson, P. (1995). Linguistic experience and the "perceptual magnet effect". In W. Strange (Ed.), *Speech perception and linguistic experience: Issues in cross-language research* (pp. 121-154). Baltimore, MD: York Press.

Labov, W. (1969). The logic of nonstandard English. *Georgetown Monographs on Language and Linguistics, 22*, 1–31.

_____. (2001). *Principles of Linguistic Change: Social Factors.* Malden, MA: Blackwell.

Lively, S. E., Logan, J. S., & Pisoni, D. B. (1993). Training Japanese listeners to identify English /r/ and /l/ II: The role of phonetic environment and talker variability in learning new perceptual categories. *Journal of the Acoustical Society of America, 94*, 1242-1255.

Lowenstamm, J. (1996). CV as the only syllable type. In J. Durand and B. Laks (Eds.), *Current Trends in Phonology: Models and Methods* (pp. 419–41). Salford, Manchester: ESRI.

Major, R. (1986). Paragoge and degree of foreign accent in Brazilian English. *Second Language Research, 2*, 53–71.

McCarthy, J. J, & Prince, A. (1993). *Prosodic Morphology I: Constraint Interaction and Satisfaction*. Unpublished manuscript, University of Massachusetts, Amherst, MA and Rutgers University, New Brunswick NJ.

_____. (1994). The emergence of the unmarked: Optimality in prosodic morphology. In *Papers from the Annual Meeting of the North East Linguistic Society 24*, 333–79.

Mithun, M., & Basri, H. (1986) The phonology of Selayarese. *Oceanic Linguistics*, *25*, 210-254.

Nevins, A. (2008). Review of *A Lateral Theory of Phonology: What is CVCV and Why Should it be?* by Tobias Scheer. *Lingua, 118*(3), 425–34.

Neu, H. (1980). Ranking of constraints on /t,d/ deletion in American English; A statistical analysis. In W. Labov (Ed.), *Locating Language in Time and Spac*e (pp. 37-54). New York: Academic Press.

Paradis, C., & Prunet, J.-F. (Eds.). (1991). *Phonetics and Phonology: The Special Status of Coronals.* San Diego: Academic Press.

Piggott, G. (1999). At the right edge of words. *The Linguistic Review, 16*(2), 143–85.

Reynolds, W. (1994). *Variation and Phonological Theory*. PhD Dissertation, University of Pennsylvania, Philadelphia, PA.

Rice, K. (1996). Default variability: the coronal-velar relationship. *Natural Language & Linguistic Theory*, *14*(3), 493-543.

Sankoff, D., Tagliamonte, S., & Smith, E. (2005). GoldVarb X: a variable rule application for Macintosh and Windows. http://individual.utoronto.ca/tagliamonte/goldvarb.html

Scheer, T. (2004). *A Lateral Theory of Phonology. What Is CVCV and Why Should It Be?* Berlin: Mouton de Gruyter.

Selkirk, E. (1982). The syllable. In H. van der Hulst and N. Smith (Eds.), *The Structure of Phonological Representations*, *Part 2*, (pp. 337–83). Dordrecht: Foris.

Thomson, R. (2011). Computer Assisted Pronunciation Training: Targeting Second Language Vowel Perception Improves Pronunciation. *CALICO Journal, 28*(3), 744-765.

Yavaş, M. (1994). Final stop devoicing in interlanguage. In M. Yavaş (Ed.), *First and Second Language Phonology* (pp. 267–82). San Diego: Singular.

Young, R. & Bayley, R. (1996). VARBRUL analysis for second language acquisition research. In R. Bayley & D. Preston (Eds.), *Second language acquisition and linguistic variation* (pp, 253-306). Amsterdam: John Benjamins.

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