Effects of allophony and the representation of English loanwords in Brazilian Portuguese

Natália B. Guzzo and Guilherme D. Garcia (*Université Laval*)

Overview. In loanword adaptation, it has been argued that category proximity is preferred over phonetic approximation (LaCharité and Paradis, 2005). For example, *building* and *cook* are adapted to Spanish as [bildiŋ] and [kuk], respectively, even though English /ɪ ʊ/ are phonetically closer to /e o/ than to /i u/ in Spanish (Delattre, 1981). If phonetic approximation were the main factor in these adaptations, we would expect *[beldeŋ] and *[kok], which in turn would modify the value of the feature [high] in the vowels, selecting a different existing phonological category in the target language. Similar adaptations have been shown in other languages. In this paper, we consider a context of loanword adaptation in Brazilian Portuguese (BP) where category proximity does not apply due to the allophonic status of the adapted forms. Such a scenario yields a pattern of adaptation that is mostly driven by phonetic proximity, even though it results in forms that are not part of the borrowing system. This suggests that phonological representations in loanword adaptation may involve an expansion of the borrowing system.

The process. In the adaptation of English words and in L2 English speech, BP speakers often produce English /ti/-/di/ sequences as [t͡ʃi]-[d͡ʒi] (*tea* [t͡ʃi], *deep* [d͡ʒip]). This spurious affrication (SA) is not surprising, as many BP varieties display /t d/ palatalization (to [t͡ʃ d͡ʒ]) before a high front vowel (e.g., [ˈt͡ʃipu] 'type' vs. [ˈtudu] 'all'). However, the English sequence /tu/ is also produced with SA by these speakers (*two*, *to*, *too* = [t͡ʃu]), which is unexpected given that alveolar stops do not affricate before [u] in BP. This manifestation of SA in BP English has been explored by Nevins and Braun (2009), who argue that it cannot be caused by the aspiration in /tu/, since forms such as *student*, where no aspiration occurs, also result in SA. Instead, they propose that BP speakers build a non-target-like underlying representation for /tu/ (/ti̯u/) based on the fronted quality of English /u/ in [tṷ] sequences. In this paper, we present perception data showing that BP speakers with high proficiency levels misperceive aspirated /tu/ to a much higher degree than unaspirated /du/ in an AXB task, which strongly suggests that aspiration is in effect a key factor in SA in BP English.

Methods. An AXB task was developed where each item consisted of a CV syllable. Target items ($n = 32$) contained voiceless or voiced stops and affricates /t d t͡ʃ d͡ʒ/ followed by vowels /i u/. Filler items ($n = 76$) included vowel /ɑ/ and/or other consonants (e.g., /s z/). The target trials compared the perception of /tu/-/t͡ʃu/, /du/-/d͡ʒu/, /ti/-/t͡ʃi/, and /di/-/d͡ʒi/. The stimuli were recorded by two native speakers of Canadian English. The voiceless stops were produced with aspiration ([t^h]). Participants were BP speakers (i.e., L2 learners of English) living in an anglophone Canadian city ($n = 26$) and native English speakers (controls) residing in the same region ($n = 13$).

Results. As shown in Fig. 1 (left plot), /tu/-/t͡ʃu/ was clearly the most difficult target type for the BP speakers ($< 75\%$ accuracy) in the experiment (cf. /du/-/d͡ʒu/ types): $\hat{\beta} = -3.7$, 95% CrI = $[-5.97, -1.47]$ (effect of `consonant[t]-vowel[u]` interaction in a Bayesian logistic regression with by-item random intercept, by-speaker random slope for vowel and random intercept, and minimally informative priors). In addition, examination of the left panel in the plot shows that the BP speakers also had difficulty differentiating /ti/-/t͡ʃi/ and /di/-/d͡ʒi/ relative to /du/-/d͡ʒu/, for which performance was at ceiling. Regarding the fillers, BP speakers had no issues with /tɑ/-/t͡ʃɑ/. These results are consistent with the BP speakers' reaction times (right plot), as they were the slowest for /tu/-/t͡ʃu/ ($\hat{\beta} = 0.56$, 95% CrI = $[0.08, 1.01]$; Bayesian linear regression with the same model specification as above).

Discussion. The results for /ti/-/t͡ʃi/, /di/-/d͡ʒi/, and /du/-/d͡ʒu/ are consistent with BP allophonic patterns as well as observations about the perception and production of allophonic

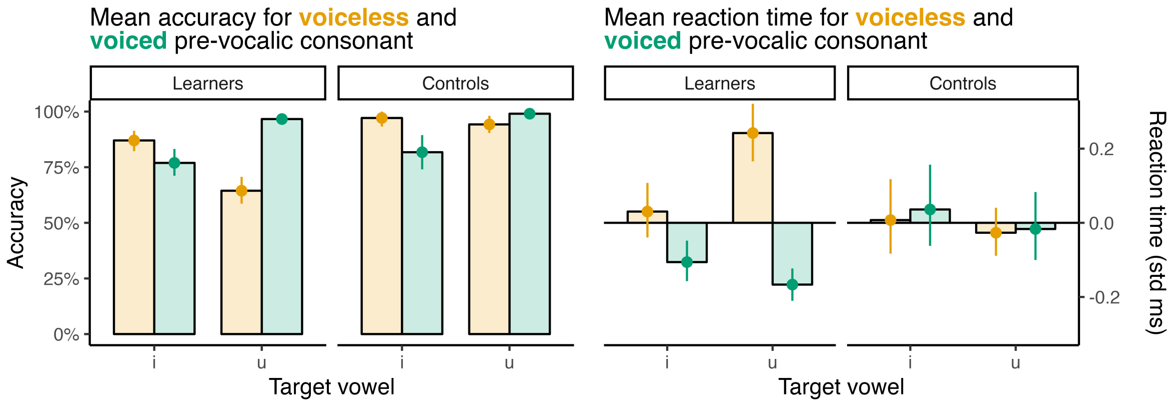

Figure 1: Mean accuracy (left) and reaction times (right; standardized by speaker) as well as associated bootstrapped 95% confidence intervals for learners ($n = 26$) and controls ($n = 13$).

variation (Peperkamp et al., 2003). Regarding /tu/-/t͡ʃu/, we argue that BP speakers approximate the cues present in the phonetic form [tʰu] as [t͡ʃu], which could stem from the aspiration noise, combined with the fronted quality of English [u], being perceived as affrication. One question that remains is why BP speakers seemingly also produce affrication in contexts where aspiration is not observed in English (e.g., in *student*, following Nevins and Braun 2009). We argue that these productions do not challenge the proposal that SA in BP English is driven by perception. The assumption that unaspirated /t/ in English is indeed perceived as unaspirated by BP speakers rests on the premise that "all unaspirated stops are the same", an observation that does not hold cross-linguistically (Lisker and Abramson, 1964; Pierrehumbert et al., 2000; Ladefoged and Johnson, 2011). Thus, it is plausible to assume that BP speakers perceive [st] sequences as [st + noise] given that English /t/, even when unaspirated, has considerably longer VOT than BP /t/ (Cho et al., 2019). This would explain why both /tu/ and /stu/ forms are often perceived (and produced) as [t͡ʃ] and [st͡ʃ] in BP English.

Marginal representations. Our results suggest that BP speakers' underlying representation of the English /tu/ string is not target /tu/, but rather one that incorporates the aspiration noise and adapts it to the closest native category (i.e., /t͡ʃu/). This proposal is consistent with models of phonology in which representations are constrained by perception (e.g., the bidirectional model of Boersma and Hamann 2009). In addition, given the relationship between representation(s) and variable surface forms ([tu]∼ [t͡ʃu]), our proposal is also consistent with probabilistic frameworks (e.g., Goldwater and Johnson 2003; Wilson 2006).

SA in BP English supports the idea that borrowing systems are able to accommodate marginal representations, that is, representations that deviate from the native patterns by expanding what is allowed in the borrowing system. Although marginal representations are motivated by perception, they are not necessarily identical to the forms observed in the source.

In BP English, another case of marginal representations is observed in loanwords containing /ʌ/ (e.g., *bug*, *pub*; Guzzo 2019), which does not exist in BP. These loanwords are often adapted with [ɐ], which in native BP is constrained to nasal contexts. Like SA in BP English, this pattern results in an expansion of the borrowing system by allowing an allophone to emerge in additional contexts. The cost of marginal representations in loanword adaptation is low, since there is no phonological category involved: both [ɐ] and [t͡ʃ] already exist as allophones in the phonological grammar of BP.

Finally, these results do not contradict the notion that category approximation trumps phonetic proximity (LaCharité and Paradis, 2005). Rather, they demonstrate that the latter can be the main factor in loanword adaptation once the former does not apply.

References

Boersma, P. and S. Hamann (2009). Loanword adaptation as first-language phonological perception. In A. Calabrese and L. Wetzels (Eds.), *Loan Phonology*, pp. 11–58. John Benjamins Publishing.

Cho, T., D. H. Whalen, and G. Docherty (2019). Voice onset time and beyond: Exploring laryngeal contrast in 19 languages. *Journal of Phonetics 72*, 52–65.

Delattre, P. (1981). An acoustic and articulatory study of vowel reduction in four languages. In P. Delattre (Ed.), *Studies in comparative phonetics*, pp. 63–93. Heidelberg: Julius Groos Verlag.

Goldwater, S. and M. Johnson (2003). Learning OT constraint rankings using a Maximum Entropy model. In *Proceedings of the Stockholm workshop on variation within Optimality Theory*, pp. 111–120.

Guzzo, N. B. (2019). Native and non-native patterns in conflict: Lexicon vs. grammar in loanword adaptation in Brazilian Portuguese. In K. Hout, A. Mai, A. McCollum, S. Rose, and M. Zaslansky (Eds.), *Proceedings of the Annual Meetings on Phonology*, Volume 6.

LaCharité, D. and C. Paradis (2005). Category preservation and proximity versus phonetic approximation in loanword adaptation. *Linguistic Inquiry 36*(2), 223–258.

Ladefoged, P. and K. Johnson (2011). *A course in phonetics* (6th ed.). Boston: Wadsworth.

Lisker, L. and A. Abramson (1964). A cross-language study of voicing in initial stops: Acoustical measurements. *Word 20*, 384–422.

Nevins, A. and D. Braun (2009). The role of underlying representations in L2 Brazilian English. In A. Calabrese and L. Wetzels (Eds.), *Loan Phonology*, pp. 181–192. John Benjamins Publishing.

Peperkamp, S., M. Pettinato, and E. Dupoux (2003). Allophonic variation and the acquisition of phoneme categories. In B. Beachley, A. Brown, and F. Conlin (Eds.), *Proceedings of the 27th Annual Boston University Conference on Language Development*. Sommerville, MA: Cascadilla Press.

Pierrehumbert, J., M. Beckman, and D. R. Ladd (2000). Conceptual foundations of phonology as a laboratory science. In N. Burton-Roberts, P. Carr, and G. Docherty (Eds.), *Phonological knowledge*, pp. 273–303. Oxford: Oxford University Press.

Wilson, C. (2006). Learning phonology with substantive bias: an experimental and computational study of velar palatalization. *Cognitive Science 30*(5), 945–982.