Loanword adaptation and phonetic approximation: beyond phonological categories

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Overview

Today's puzzle:

- Some loanwords are not produced like native words
  and are not faithful to the foreign input either—and no (native) repair applies

☞ The resulting string is an **expansion of what is possible in the native phonology**

Structures under focus: English /tu/ in Brazilian Portuguese (BP)

a. *two, too, to* → [t͡ʃu]
b. *student* → [ist͡ʃudent]
c. *today* → [t͡ʃudej]

☞ In native BP, [t͡ʃi] is allowed, but not *[t͡ʃu]

Loanword adaptation

Category proximity or phonetic approximation?

- **What motivates this pattern in BP English: phonology or phonetics?**

  Our puzzle in context: **Category proximity...** (LaCharité and Paradis 2005)

  or phonetic approximation? (Boersma and Hamann 2009)

Category proximity (LaCharité and Paradis, 2005, p. 227)

a. If a given phonological category in L2 does not exist in L1, this category will be replaced by the closest phonological category in L1, *even if the L1 inventory contains sounds acoustically more similar to the target*

b. Category proximity: determined by the number of changes (e.g., features) necessary for a phoneme in L2 to become a phoneme in L1

Loanword adaptation

Category proximity or phonetic approximation?

- An example of the debate:

  English → Spanish

  English /ɪ ʊ/ are phonetically closer to **Spanish** /e o/ than to /i u/ (Delattre 1981)

A. By phonetic approximation, we should get *building* as [*beldeŋ] and *cook* as [*kok]
B. But, in reality, we get [bildiŋ] and [kuk]

Option A changes the feature [high], selecting ≠ existing phonological categories

Option B keeps features (categories) intact by sacrificing phonetic approximation

Loanword adaptation

Category proximity or phonetic approximation?

The Spanish example suggests that **category proximity** $\succ$ **phonetic approximation**

☞ What happens when adapted forms involve **allophony**?

Loanword adaptation: the BP case

Category proximity or phonetic approximation?

In **BP**, [t͡ʃ d͡ʒ] are allophones of /t d/ before /i/

- Examples: *tipo* [t͡ʃi.pu], *dia* [d͡ʒi.a]; **but** *tudo* [tu.du], *dúzia* [du.zi.a]

BP speakers: English loanword adaptation

- *tea* as [t͡ʃi] and *deep* as [d͡ʒip]: affrication of /t d/ before /i/
- **But** /tu/ in English is also affricated by BP speakers: *two, too, to* = [t͡ʃu]
- This does not occur with /du/: *do* = [du] (cf. *[d͡ʒu]), *doom* = [dum] (cf. *[d͡ʒum])

☞ Although affrication of /t/ before /i/ is expected (allophony), it is surprising before /u/

Loanword adaptation: the BP case

Previous studies

- Previous studies have argued that this case of **spurious affrication (SA)** is **not caused by speakers perceiving aspiration as affrication:** (Nevins and Braun 2009)
  - Forms like *student*, which do not have aspiration, are also problematic
  - **Proposal:** BP speakers represent /tu/ as /tiu/ (/u/ is more fronted after coronals)
  - ☞ Representations contain phonetic approximation perceived by speakers
  - Affrication is a surface effect

- Issues with this proposal:
  - Does not explain why /du/ is not affricated
  - Does not explain cases like [t͡ʃudej] 'today' (frequently produced with vowel reduction)

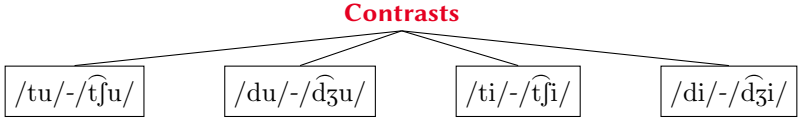
Additional issue: the perception of aspiration vs. affrication by speakers was not tested

☞ **Today:** perception data suggest that **aspiration is a key factor**

Methods

AXB task with CV stimuli (recorded by two native speakers of Canadian English)

- **Target items** ($n = 32$): [±voice] plosives and affricates /t d t͡ʃ d͡ʒ/[1] + /i u/
- *Fillers* ($n = 76$): /ɑ/ and/or other consonants (e.g., /s z/)



Participants: BP speakers ($n = 26$) → English learners living in Canada

Controls: native English speakers ($n = 13$) who resided in the same region

[1] Voiceless plosives were recorded with aspiration.

Methods

Statistical analysis

- Hierarchical logistic and linear regressions (Bayes)
  - random effects by item and speaker
  - (*by-item random intercept + by-speaker random slope and intercept for vowel:consonant interaction*)
  - minimally informative priors (Bürkner 2018)

Model specification

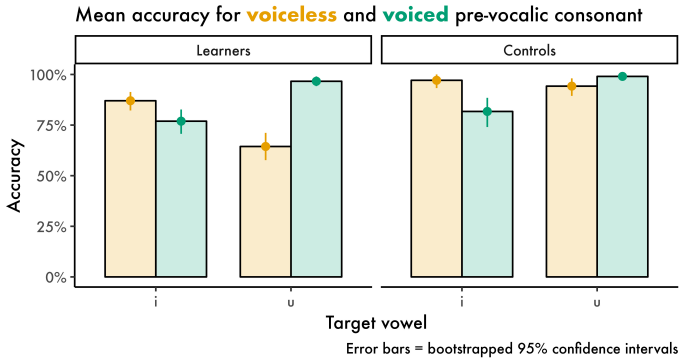
```
Y ~ C * V + (1 + C * V | ID) + (1 | item)
```

☞ Where `Y` is **accuracy** (Bernoulli) or **reaction time** (lognormal)

Results and analysis

Accuracy

☞ /tu/-/t͡ʃu/: **most difficult** condition for learners (< 75%)



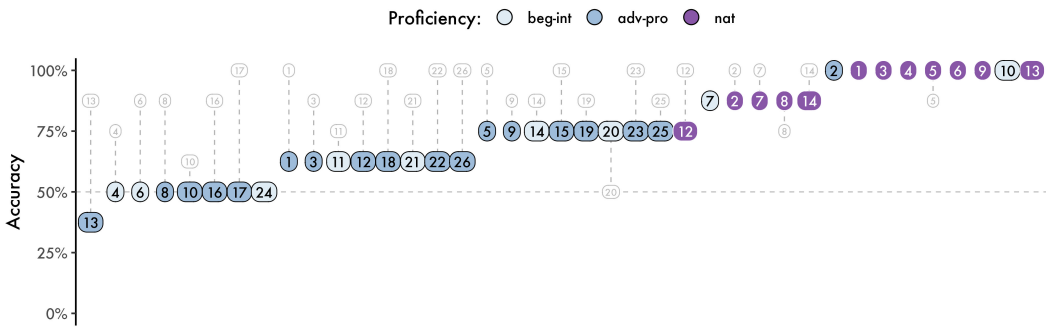
$\hat{\beta} = -4.34$, 95% CrI = $[-7.01, -1.82]$: effect of `consonant[t]-vowel[u]` interaction

Results and analysis

Individual variation

- Performance with /tu/-/t͡ʃu/ (colors) vs. /ti/-/t͡ʃi/ (gray) as a function of proficiency

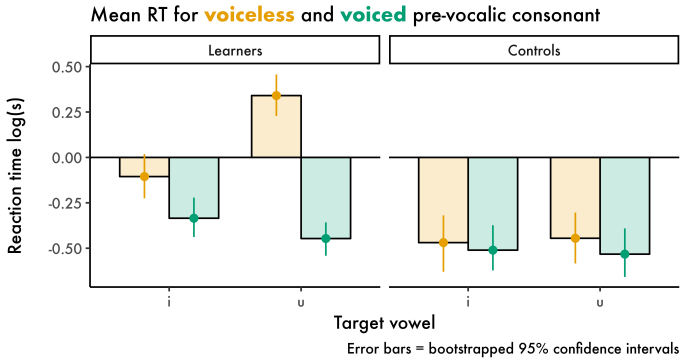
☞ /tu/-/t͡ʃu/ is more difficult for practically all participants



Results and analysis

Reaction time

☞ /tu/-/t͡ʃu/: **slowest** condition for learners ($\bar{x} = 1.31s$)



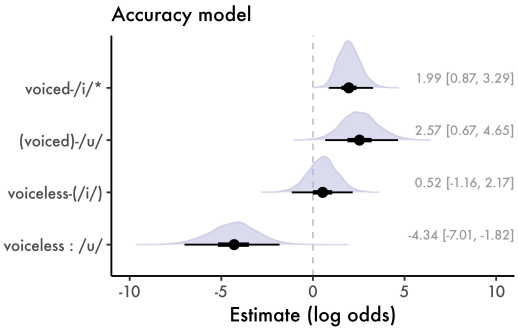
$\hat{\beta} = 0.55$, 95% CrI = $[0.05, 1.06]$: effect of `consonant[t]-vowel[u]` interaction

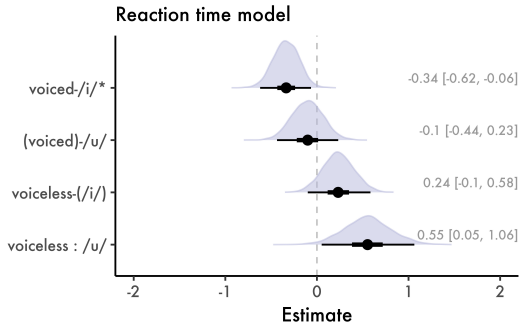
Results and analysis

Models (* = intercept)

- Posterior distribution of effects for both models + 50% and 95% CrI

☞ **voiceless : /u/** → lower accuracy and slower reaction time



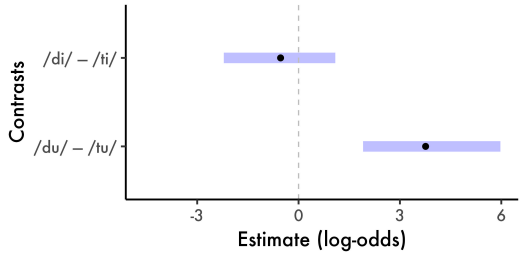


Results and analysis

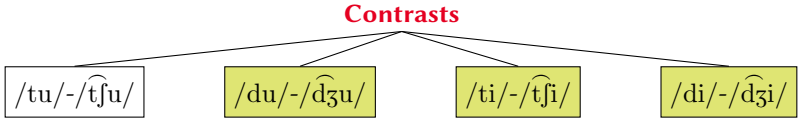
Multiple comparisons

- No statistical difference for /di/-/ti/
- But accuracy with /tu/ lower than /du/

☞ Hence the positive effect in the figure



Discussion



Results for $\frac{3}{4}$ of the contrasts are consistent with:

- allophonic patterns of BP (higher accuracy; faster RT)
- observations about perception/production of allophonic variation (Peperkamp et al. 2003)

☞ **But what about /tu/-/t͡ʃu/?**

Discussion

Idea: BP speakers approximate cues in the phonetic form [tʰu] as [t͡ʃu]

- This may come from the **aspiration noise** + **fronted quality** of [u] in English

☞ **How do we know this is not just about aspiration?** /tɑ/ vs. /t͡ʃɑ/ (fillers)

- Ceiling performance for both learners and control group

Discussion

☞ **And what about words like *student*?**

- Why do BP speakers produce affrication in these contexts? (Nevins and Braun 2009)
- Not all unaspirated plosives are equal (Lisker and Abramson 1964; Pierrehumbert et al. 2000; Ladefoged and Johnson 2011)

- **Plausible assumption:** BP speakers perceive [st] as [st] + noise
  - unaspirated [t] in English has **longer VOT** than [t] in BP (Cho et al. 2019)
- This explains why /tu/ and /stu/ are perceived/produced as [t͡ʃ] and [st͡ʃ]

Discussion

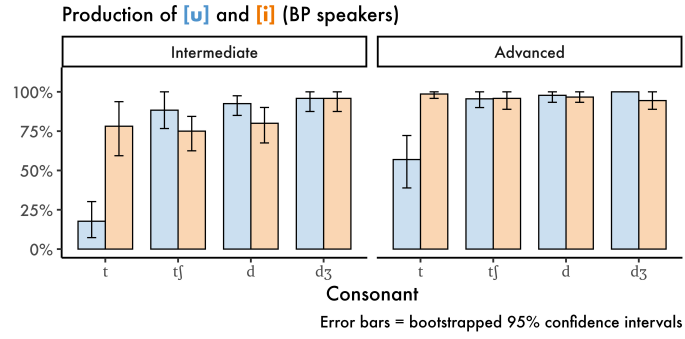
☞ Learners' underlying form is **not** the target form /tu/

- Instead, surface aspiration is incorporated into the UR and is adapted to the closest category: $\boxed{/\widehat{\text{tʃ}}\text{u}/}$
- Consistent with models where perception → representations (Boersma and Hamann 2009)

Discussion

And learners' production?

- The sequence /tu/ is also the most complex condition in production
- We observe this difficulty even in advanced learners



Discussion

Marginal representations

☞ /t͡ʃu/ is a **marginal representation** in Brazilian English

Marginal representation

- Deviation from native patterns
- Expansion of what is possible in the learners' language
- Motivation from perception; form not necessarily identical to what is found in the source language: [t͡ʃu] ≠ [tʰu]
- Low cost in loanword adaptation: it is not necessary to create new categories

Discussion

The borrowing system is capable of accommodating these **marginal representations**

- Another example: loanwords containing /ʌ/ (e.g., *pub*), adapted to [ɐ] (Guzzo 2019)

☞ [ɐ] is only found in nasal contexts in BP (allophone of /a/):

a. *cama* [kɐ̃ma]

b. *canto* [kɐ̃ntu]

- The borrowing system allows the allophone to emerge in additional contexts (i.e., non-nasal):

a. *pub* [pɐbi]

b. *Starbucks* [istarbɐkis]

- This results in an **expansion of the distribution of allophonic patterns**

Final considerations

In summary: **category proximity ≻ phonetic approximation**? (LaCharité and Paradis 2005)

- Our results do not contradict this notion

☞ We see that phonetic approximation **can** be the main factor in loanword adaptation...

... when phonological categories are not involved, and/or

... when the allophonic system can be expanded to accommodate perception

Final considerations

Back to Nevins and Braun (2009):

- [t͡ʃu] productions are mainly motivated by phonetic approximation (in perception)
- Yes, but...

1. aspiration **does** have a central role, and
2. data suggest that learners' representations include affrication

☞ **Marginal representations**

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