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Variation in trilling: Phonetic realizations of /r/ and /r/

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Introduction

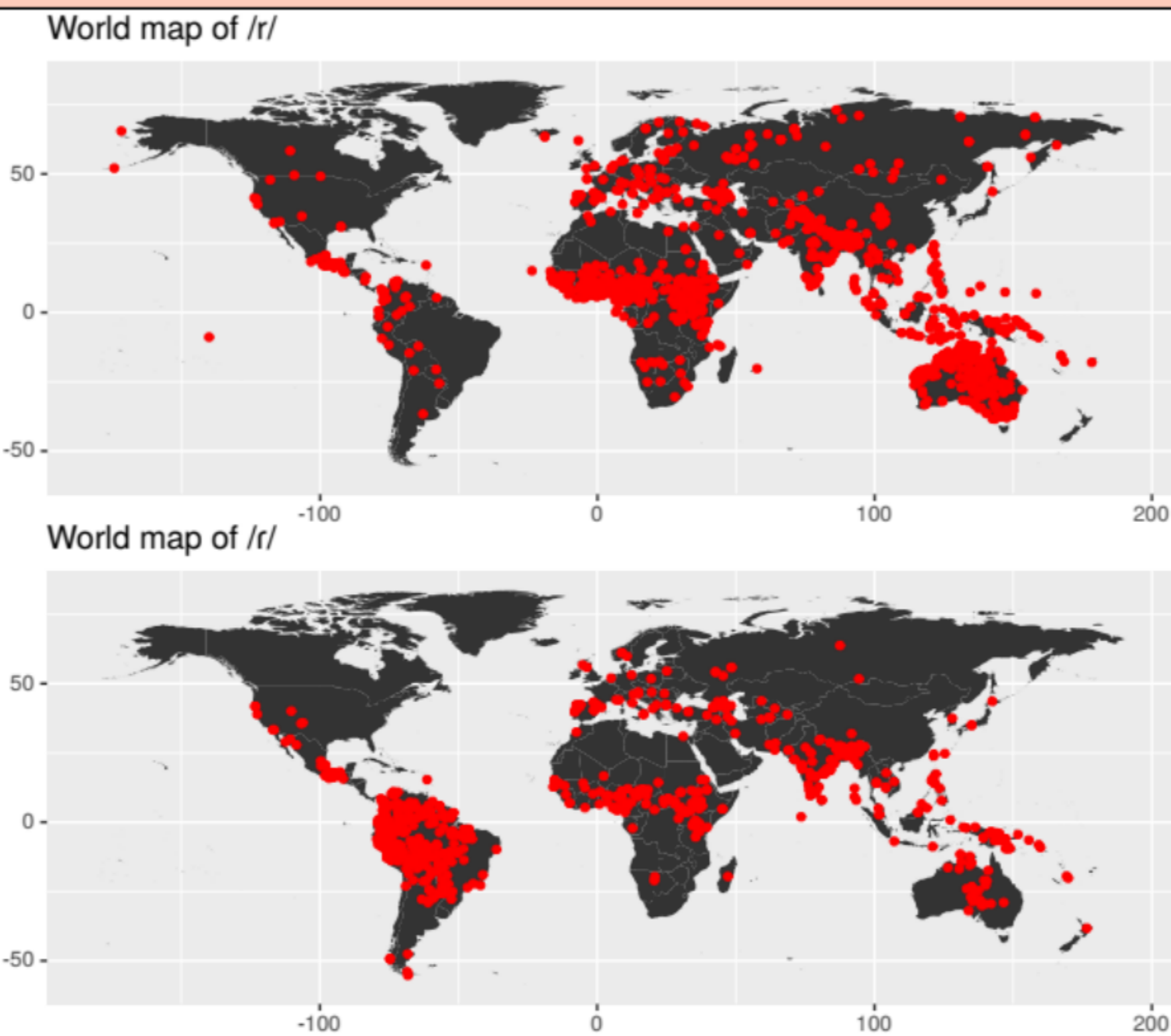


Fig. 1. Distribution of languages with an alveolar trill and an alveolar tap based on PHOIBLE database (Moran & McCloy, 2019)

- ▶ Alveolar trills and alveolar taps and two possible sounds found among languages around the world.
- ▶ The alveolar trill [r] has been well characterized in the literature both from an articulatory point of view. It is often described as a sound where "the tongue tip is made to **vibrate** against [...] the alveolar ridge" (Ladefoged and Maddieson, 1996). The phoneme /r/ is often described as complex (Solé, 1998) and it is one of the latest sounds to be acquired (McLeod & Crowe, 2018).
- ▶ The alveolar tap [ɾ], often associated with the [r], is a sound made when "[...] moving the active articulator directly towards the roof of the mouth" (Ladefoged and Maddieson, 1996).
- ▶ From a typological point of view, it is easy to obtain distributions as well as frequencies of the two phonemes thanks to many databases like PHOIBLE (Moran & McCloy, 2019) or UPSID (Maddieson, 1984). Nevertheless it has been stated that "an actual trill realization of an /r/ is not as common as might be expected from descriptions of languages, where an /r/ is often labeled as a "trill."" (Lindau, 1985, p.161) and "the data collected for UPSID suggest either that trills are not in fact particularly rare or that very many erroneous reports of trills occur in the literature" (Maddieson, 1984, p.89).
- ▶ It is therefore legitimate to ask the following questions with quantitative data:
 - ▶ How /r/ and /r/ are produced crosslinguistically? Which allophones are found for the two phonemes?
 - ▶ How rare is the [r] (i.e. trilling articulation)?

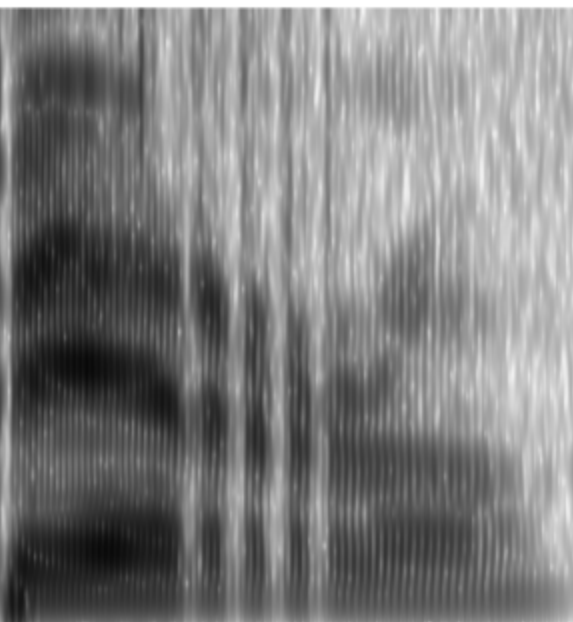
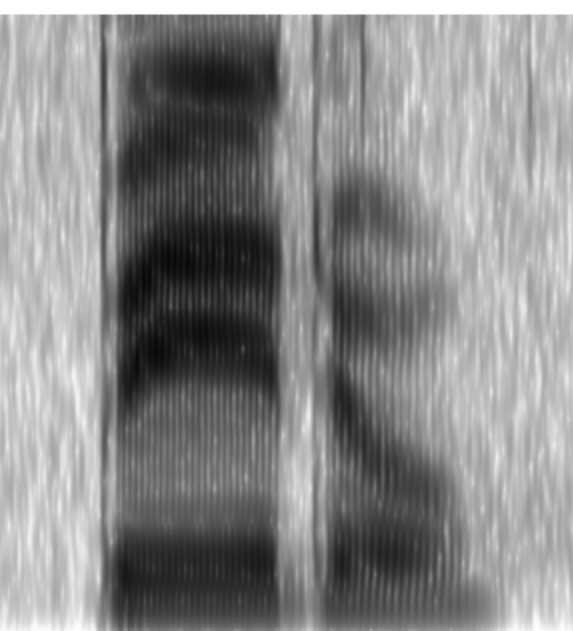


Fig. 2. Spectrograms of an alveolar trill [r] (upper panel) and of an alveolar tap [ɾ] (lower panel) - Recordings from two Spanish speakers pronouncing /pero/ and /pero/



▶ Illustrations of the IPA whose purpose is to highlight the segmental phonetics and phonology of various languages, dialects through the symbols of the International Phonetic Alphabet.

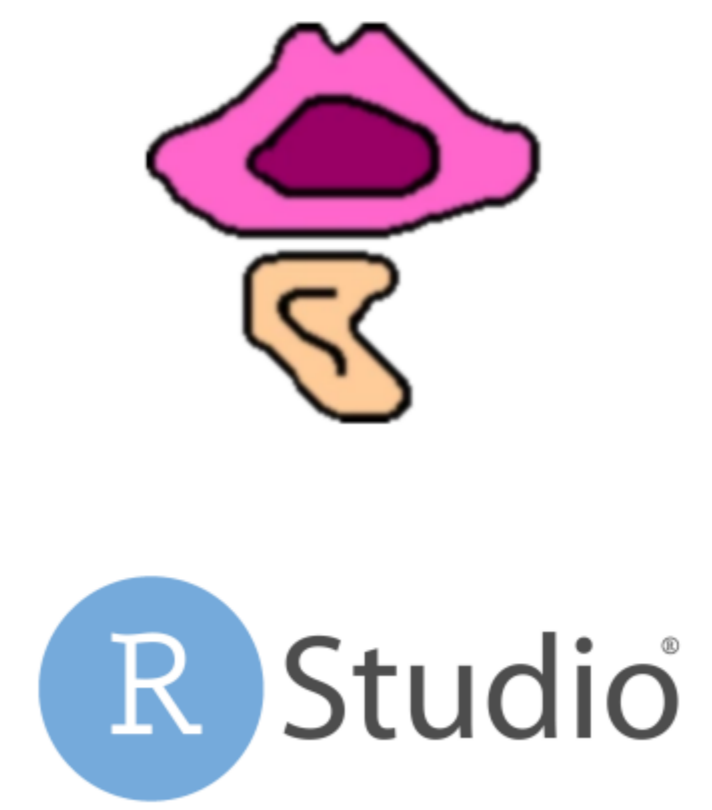
▶ Our corpus is composed of 78 recordings of a narrative attached to the articles (about ~1min each) (one recording = one speaker ≠ one language)

▶ In most of the cases it was the fable "The North Wind and the Sun" who is also phonetically and/or phonemically transcribed in the article

▶ We had a step of data curation of descriptive label used by the linguists (for better comparability of the articles)



- ▶ Segmentation was done in Praat (Boersma & Weenink, 2001)
- ▶ We annotated for four kind of coronal allophones:
 1. Tapped phones
 2. Trilled phones
 3. Approximant phones
 4. Fricative phones
- ▶ Data analysis (of 1625 occurrences (tokens) from which 993 were tapped or trilled) was done in R using RStudio interface (R Core Team, 2020)



Methodology

Results

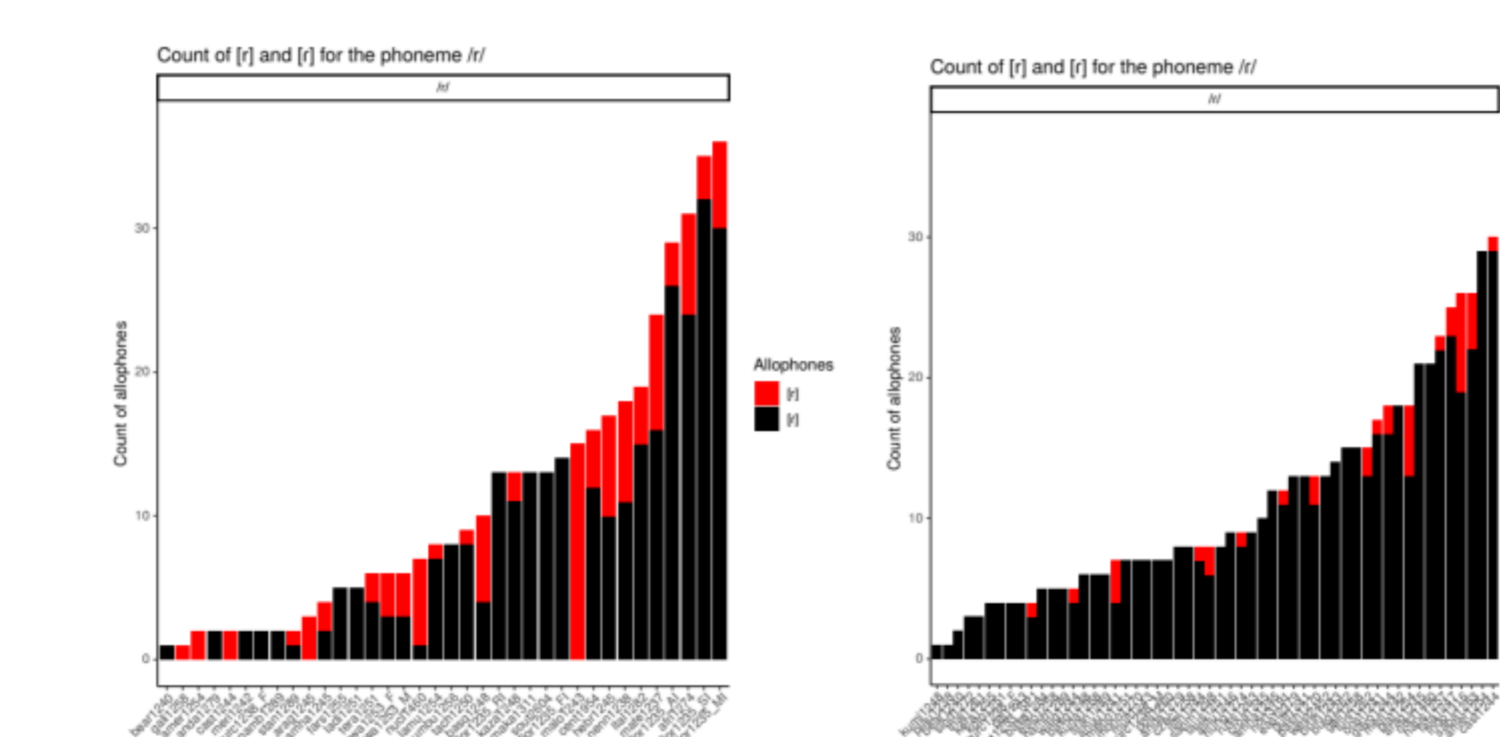


Fig. 3. Count of the trilled and tapped allophones for phonemic trill /r/ (on the right) and the tap /r/ for each speaker (with the glottocode associated) included.

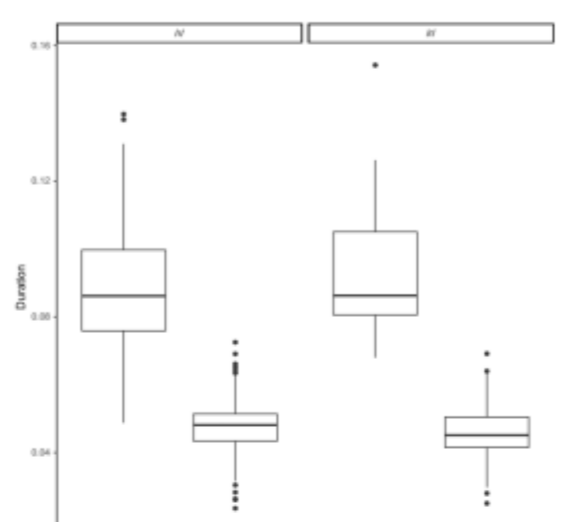


Fig. 4. Duration of [r] and [ɾ] based on if they are allophones of /r/ or /r/. In both condition trills are longer than taps (t(92.733) = 20.511, p<0.01)

- ▶ There is inter- and intra-individual variation
- ▶ Inter-recording variation is characterized by a tendency for a trade-off between taps and approximants
- ▶ Intra-recording variation is characterized by a tendency to have several allophones (and not just one). Some authors of the illustrations mention an effect of the phonological context (we have only preliminary results for the moment)
- ▶ Overlap in phonetic realizations (including languages where there is a trill/tap contrast [16 languages in our sample])
- ▶ Trilling is relatively more frequent in /r/ than in /r/ (and more frequent when there is a contrast with a /r/)
- ▶ We found that phonetic trills are longer than taps (Fig. 4.), and that phonemic trills are longer than phonemic tap (after data duration and including all the variants) (t(1006.3)=8.7662, p<0.01)

	Trill allophone	Tap allophone	Fric. allophone	App. allophone
/r/	99 (16%)	300 (47%)	22 (3%)	212 (34%)
/r/	37 (4%)	557 (56%)	29 (3%)	339 (37%)

Tab. 1. Counts of the different allophones of the phonemic trill and the phonemic tap in the recordings (no distinction between languages with and without a trill/tap contrast).

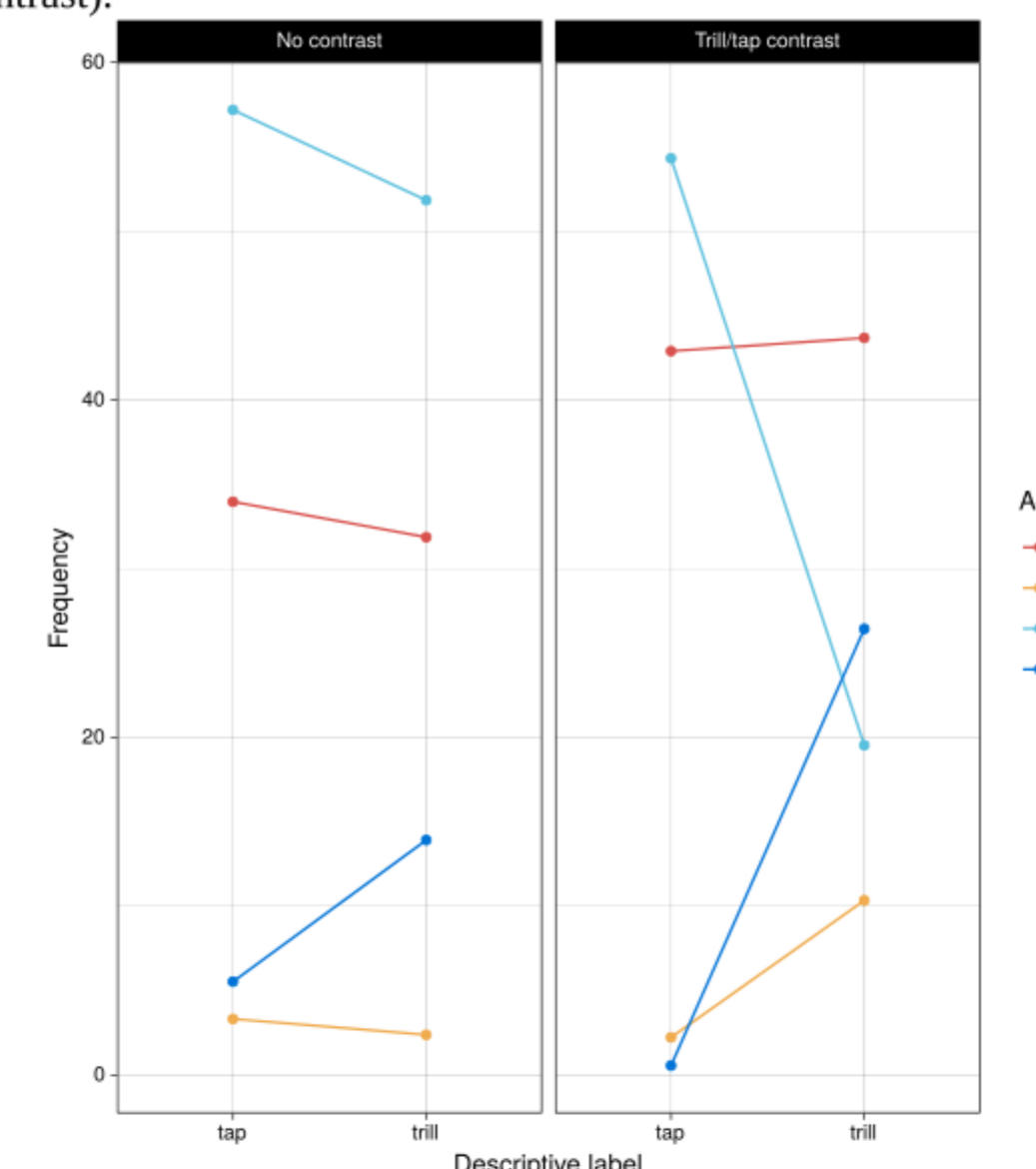


Fig. 5. Average frequencies of the different allophones for the phonemic trill and tap based on the presence of trill/tap contrast in the language/dialect.

▶ "speakers that do [trill], have tap and approximant allophones as well as the trill" (Lindau, 1985, p.161).

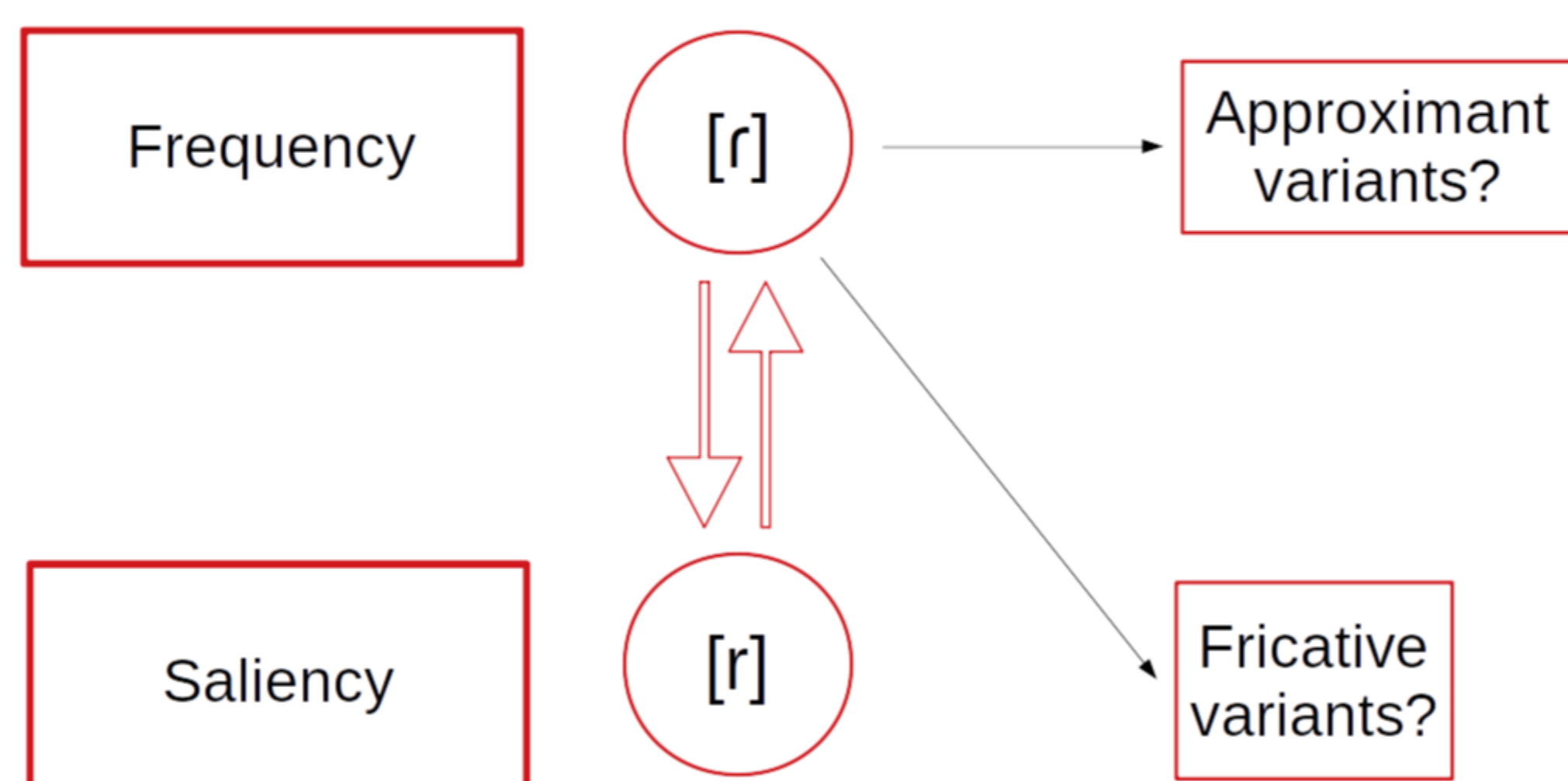


Fig. 6. Graph of relationships between the different allophones studied in our investigation. Tap is associated with frequency and trill with saliency. Many authors of the Illustrations of the IPA have specified that trills are found mostly in emphatic speech or when speakers have a careful pronunciation.

Primacy of the tap over the trill?

"A reverse directionality (of trills originating as stylistic variants of taps in strong positions) is not implausible" (Sebregts, 2014, p.179)

Our results are in line with other studies on rhotic variation where trilling is not as frequent as it could be expected (Bleu, 2002; Henriksen, 2015; Bradley, 2012; Vigil, 2018; Zahler and Daidone, 2014; Sebregts, 2015; Rennie, 2015; Jauriberry, 2016; Stuart-Smith et al. 2014; Romano, 2013; Magnuson, 2008; Rafat, 2010)

Limits:

We only analyzed narrative recordings but some recordings of word lists are also available and could be included for further analysis.

We only annotated for four allophones while some studies on rhotics variation have annotated more than 15 variants (Sebregts, 2014; Rennie, 2015)

Preliminary results on context:

- ▶ Our preliminary results on the context show that the first phonological context where we find trilling the most is intervocalic position.
- ▶ Trilling (in comparison with tapping) is found relatively more in word initial (followed by a vowel) and word final position (preceded by a vowel), and before a sonorant.
- ▶ Our preliminary results also show that trilling is disfavored when following an obstruent.

Discussion

- ▶ All the authors of Illustrations of the IPA for their work used in this study.
- ▶ The ConSOLE 30 organizers and the two anonymous reviewers of the abstract.
- ▶ My thesis supervisors Dan Dediu and François Pellegrino.
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Acknowledgments

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