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Perception of vowel length contrast in Drenjongke (Bhutia)

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Phonetics of vowel length contrast

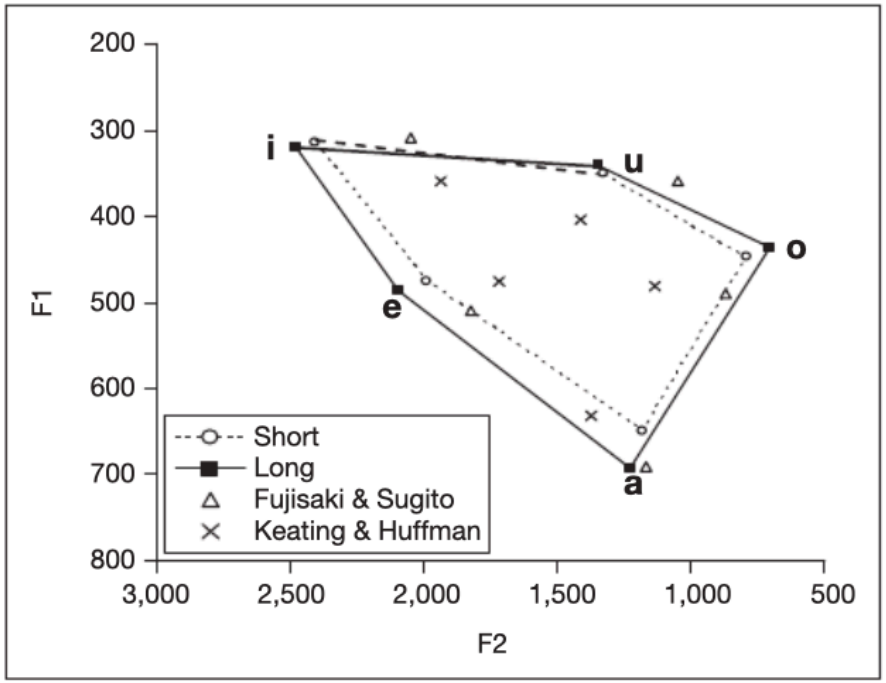
- A short long contrast
  - Primary cue: Duration
  - Secondary cue: Vowel quality

- Cross-linguistically, vowel quality may occur as an additional cue to indicate a vowel length contrast (DiCanio & Whalen 2015)
  - Survey of 56 language → 30% have a difference in quality (Maddieson 1984)
  - The typical pattern is for short vowels to occupy a more central position within the vowel space while long vowels occupy a more peripheral one.

Phonetics of vowel length contrast

- Japanese: Vowel duration is the primary acoustic correlate for the vowel length contrast (Han 1962, Port et al. 1987, Hirata 2004, Hirata and Tsukada 2009 etc.)

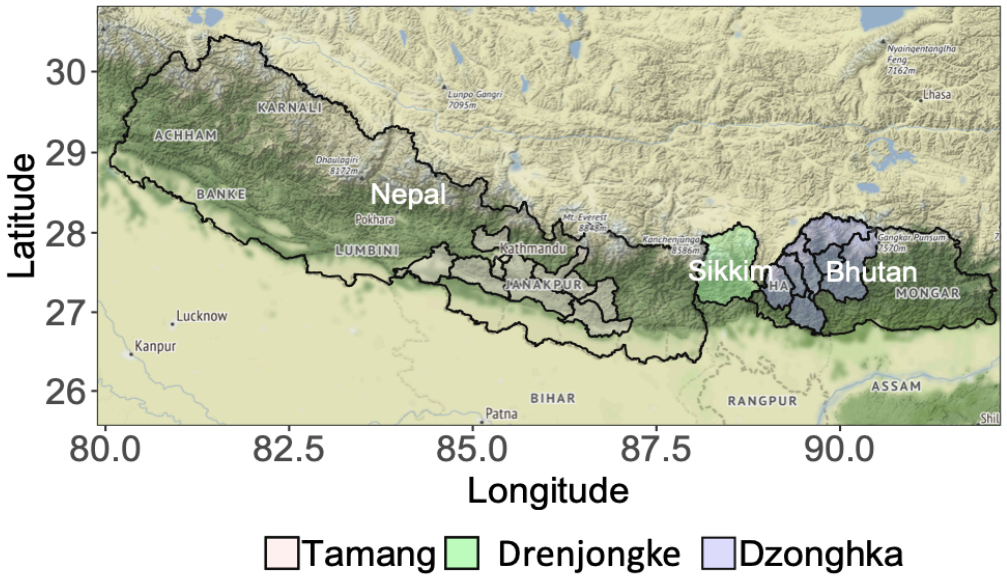
- Japanese long vowels show more formant dispersion (F1 and F2) than short vowels (Hirata & Tsukada 2009).



Vowel plot from Hirata and Tsukada 2009

Drenjongke

- Tibeto-Burman language spoken in Sikkim, India
  - “Bhutia”, “Lhoke” or “Sikkimese”
- Spoken by about 80 000 speakers in Sikkim
- Phonetics of Drenjongke have been studied in (Lee et al. 2018, Lee et al. 2019a, Lee et al. 2019b, Guillemot et al. 2019), but many characteristics need further studies.



Vowel length in Drenjongke

- Previous descriptions of the language report that some vowels in Drenjongke contrast in length: short vs. long (vanDriem 2001, 2016; Yliniemi 2019)

(1)	Minimal pairs for the vowel contrast				
a.	si	'trouble, envy	si:	'feel cool'	Yliniemi (2019; 49)
b.	ka	'order'	ka:	'split'	Yliniemi (2019; 49)
c.	ko	'dig'	ko:	'throw'	Yliniemi (2019; 49)
d.	she	'explain'	she:	'know'	
e.	dru	'boat'	dru:	'six'	

The spelling 'sh' represents [ɕ], and 'dr' represents [ɖ].

Vowel length in Drenjongke

- There is more to this contrast than a difference in vocalic duration (vanDriem 2001, 2016; Yliniemi 2019):

- Only some of the vowels in the Drenjongke phonological inventory have this length contrast
  - A contrast for [i] [e] [a] [u] [o] vs. No contrast for [æ] [y] [ø]

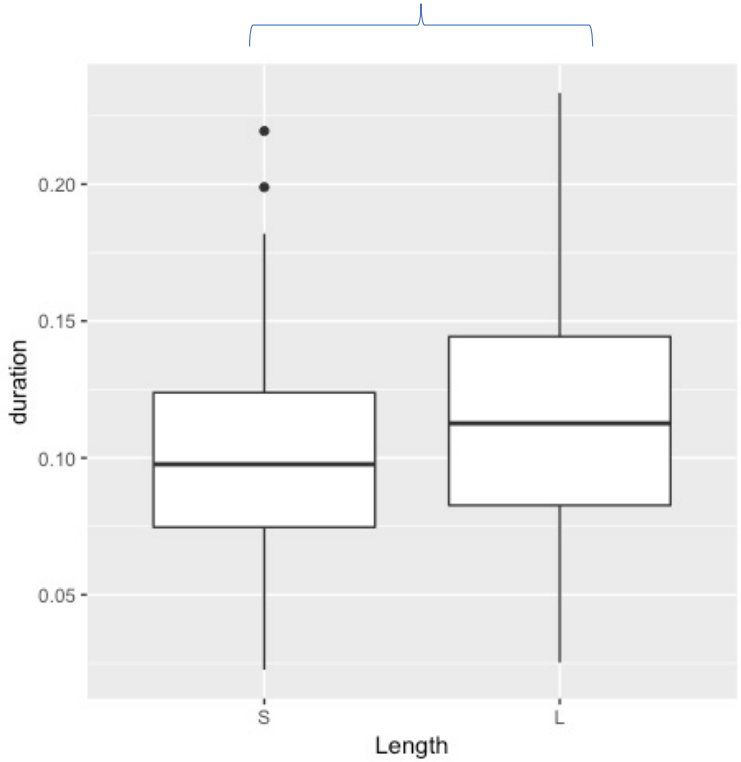
- Complexity in the realization with regard to other acoustic cues
  - Presence/absence of a glottal stop (Yliniemi 2019)
  - Vowel quality difference (vanDriem 2001, 2016)

Production study report: Lee et al. (2019)

- Data collected in March 2019 in Sikkim India
- Production of minimal pairs by 8 speakers or Drenjongke

Results: Vowel segment

$p < 0.001$, t(506.43)=3.98



Distribution of the duration for short and long vowel categories

Short V	Long V	Ratio
m=100ms	m=110ms	1.1

- Low durational ratio
- Sizeable overlap in the distribution of the two categories
- Variations:
  - Interspeaker
  - stimuli pair
- Vowel duration might not be the only acoustic correlate active for the vowel length contrast production

Several phonetic implementation patterns

- There is no unique acoustic parameter that is responsible for the realization of the long vowel
- Co-existence of several phonetic implementation patterns across the repetitions:

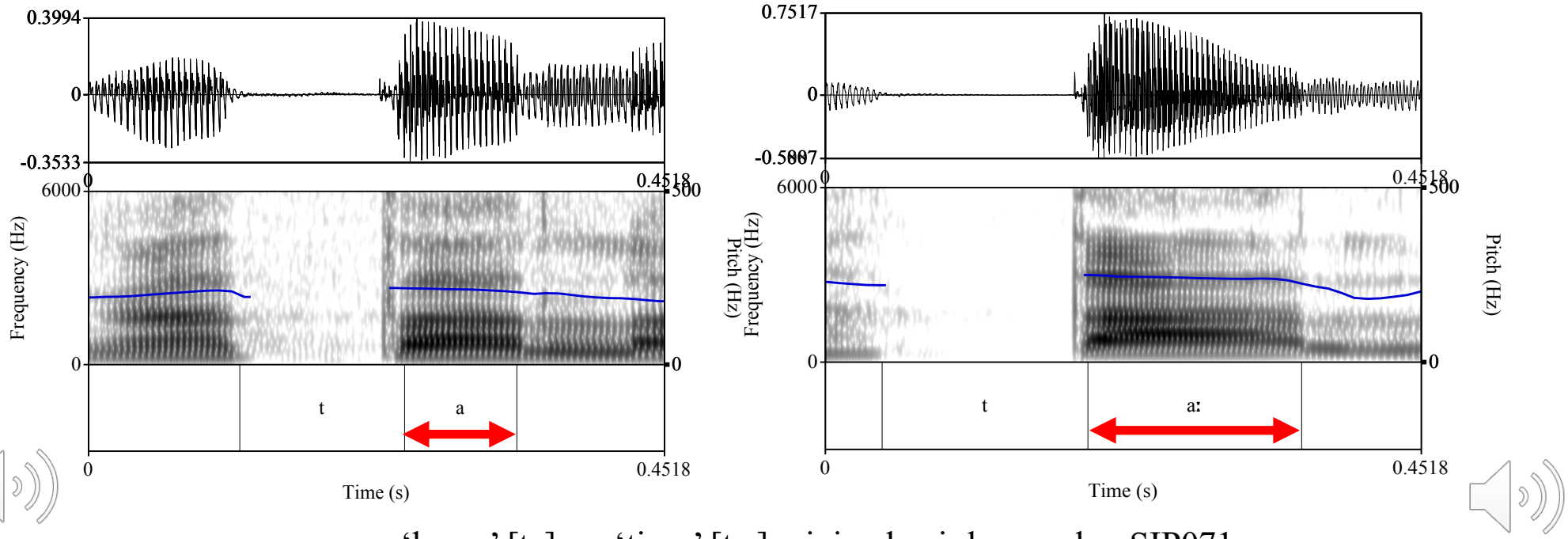
(i) a longer duration of the vowel component when compared to its 'short' counterpart in the minimal pair (*canonical*)

(ii) a short vowel followed by a consonant

(iii) a difference in phonation: creaky voice

(iv) a different vowel quality

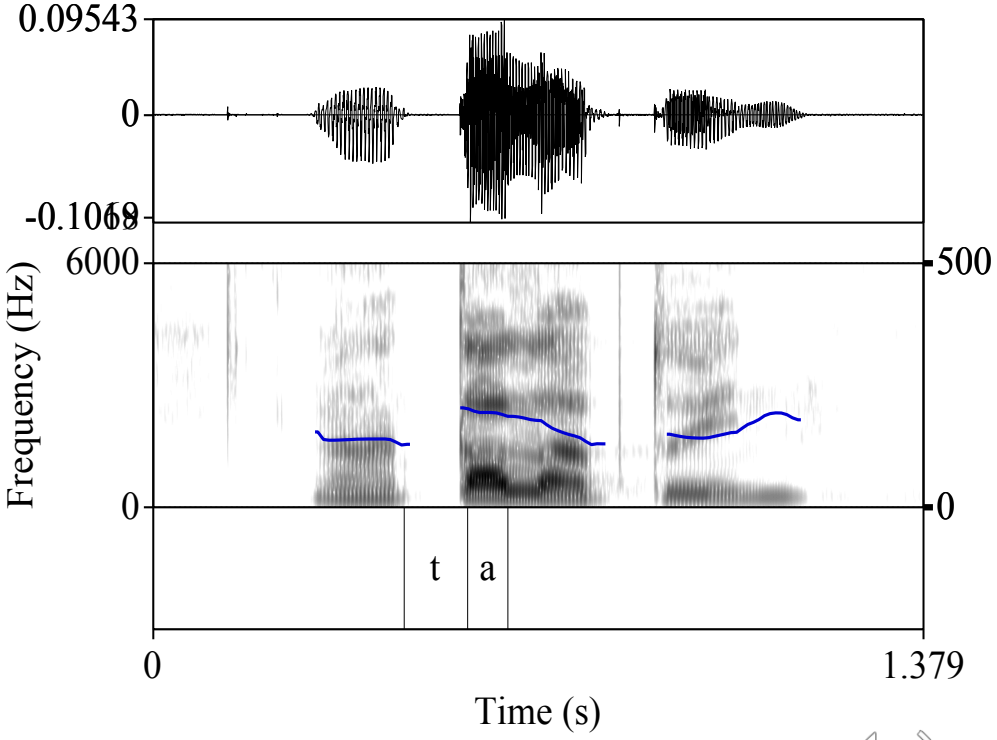
Long category: Duration



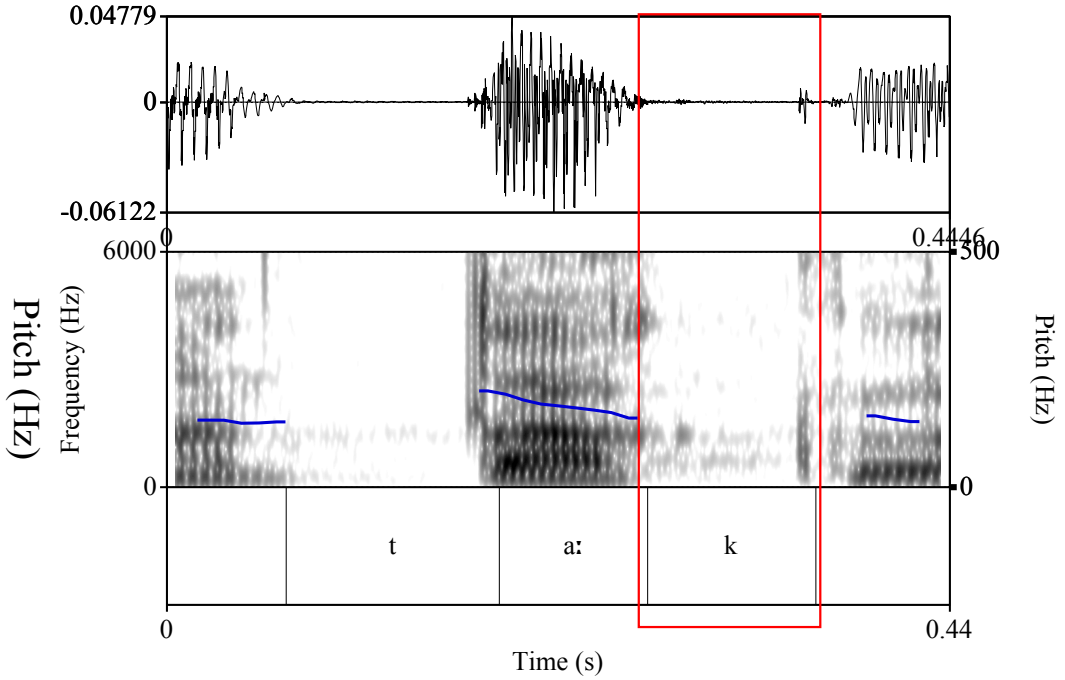
‘horse’ [ta] vs. ‘tiger’ [taː] minimal pair by speaker SIP071

(i) a longer duration of the vowel component of the long vowel (150ms) when compared to its ‘short’ counterpart (80ms) in the minimal pair

(ii) Long category: an obstruent coda

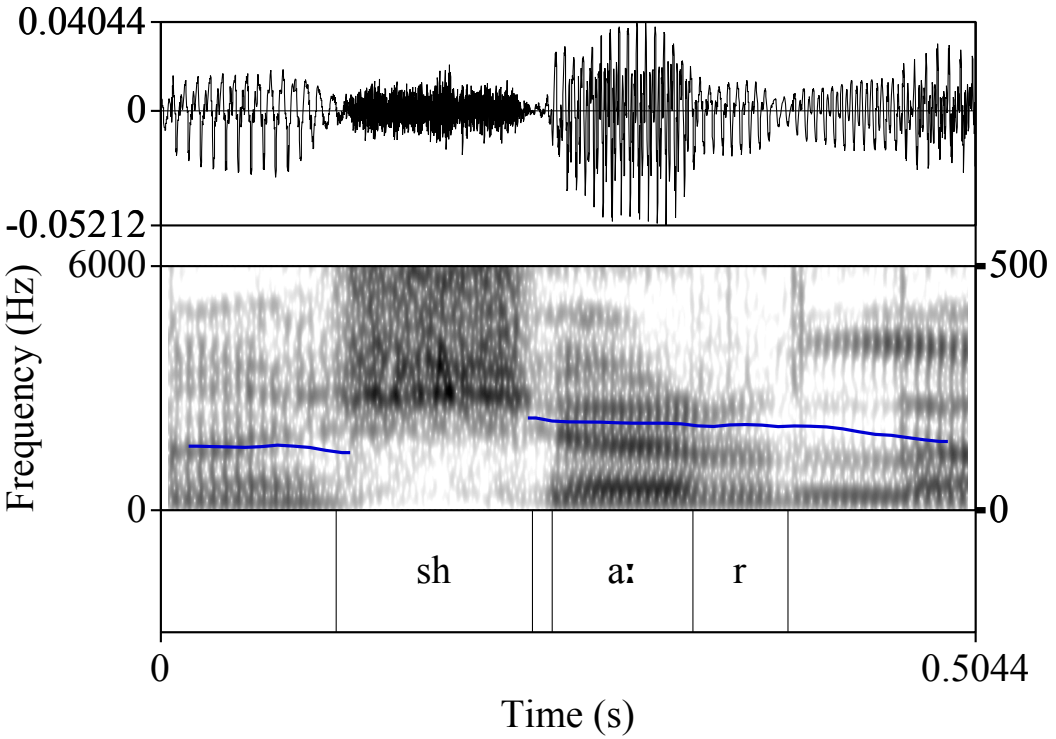


‘horse’ /ta/ pronounced as [ta] by SIP054



‘tiger’ /ta:/ pronounced as [tak] with a velar stop by SIP054

(ii) Long category: a sonorant coda

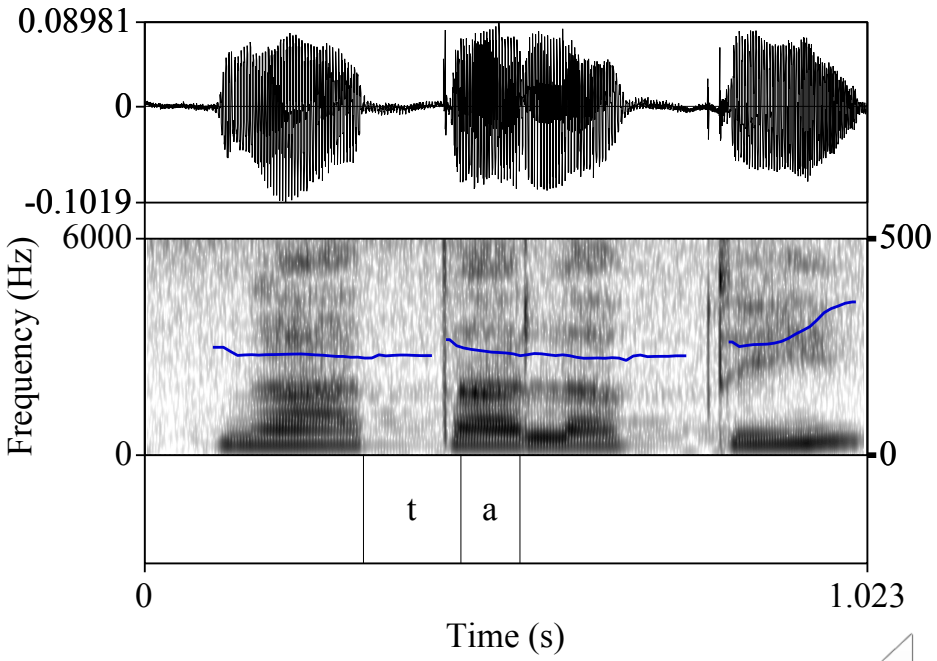


'east' /ɕa:/ pronounced as [ɕar] with a sonorant coda by SIP054

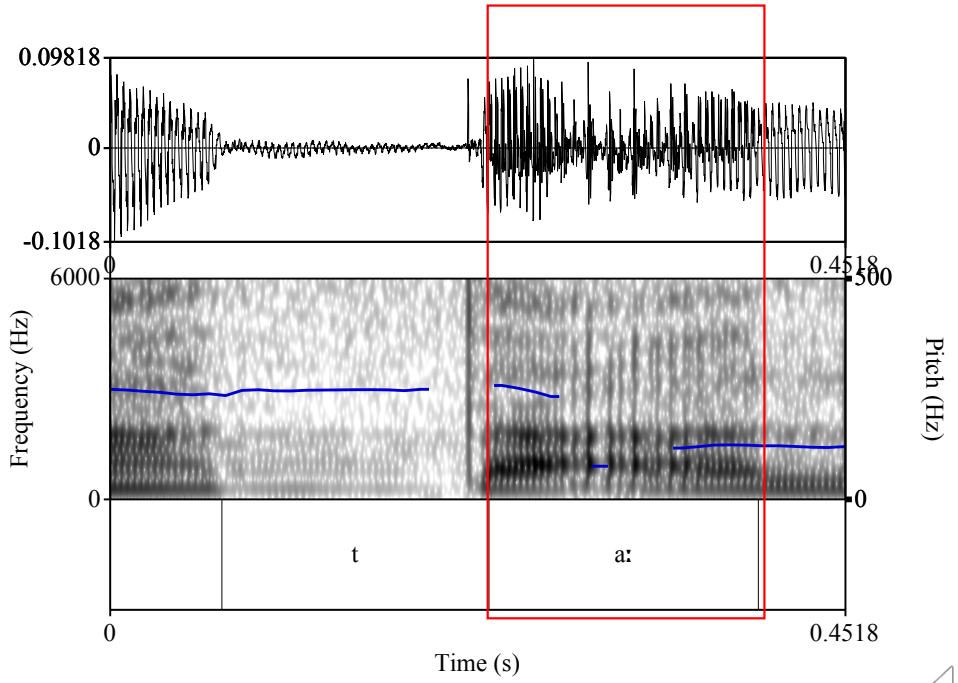
(ii) a short vowel followed by a consonant

- [ʔ], as well as [r] or [l] in some other tokens

(iii) Long category: creaky voice (+ long duration)

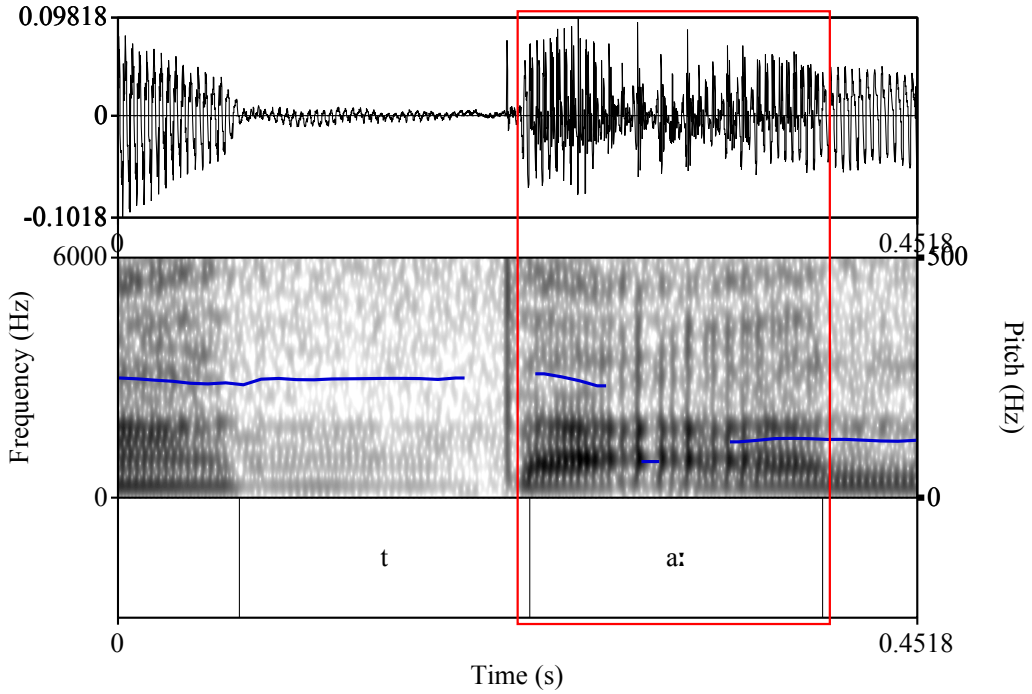


‘horse’ /ta/ pronounced as [ta] by SIP021



‘tiger’ /ta:/ pronounced as [ta̰:] with creaky voice by SIP021

(iii) Long vowel: creaky voice

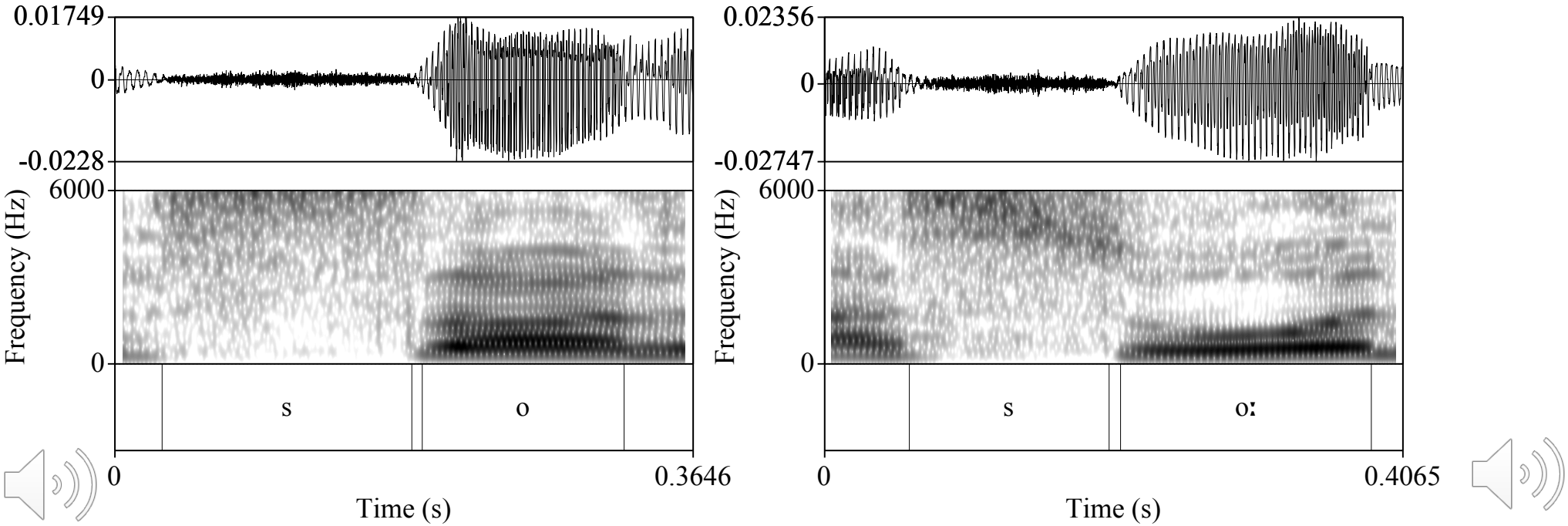


‘tiger’ /ta:/ pronounced as [tą̰:] with creaky voice by SIP021

(iii) phonation difference : creaky voice

- Post-vocalic glottal pulses

(iv) Long vowel: different vowel quality



so ’tooth’ vs. sô ‘save’ pronounced by SIP050

The use of a secondary cue - cross-linguistic findings

- When a short-long contrast has a low durational ratio, other cues can be deployed to keep the distinction salient.
  - e.g. Norwegian singleton vs. geminates
    duration of the preceding vowel (Fintoft 1961)

- This may also be the case in Drenjongke:
  - When the vowel contrast is not saliently realized with a duration difference, the long vowel category utilizes other types of phonetic cues to maintain the contrast: a consonant can be inserted, the vowel is laryngealized, or the vowel quality can be differentiated
- Perception?

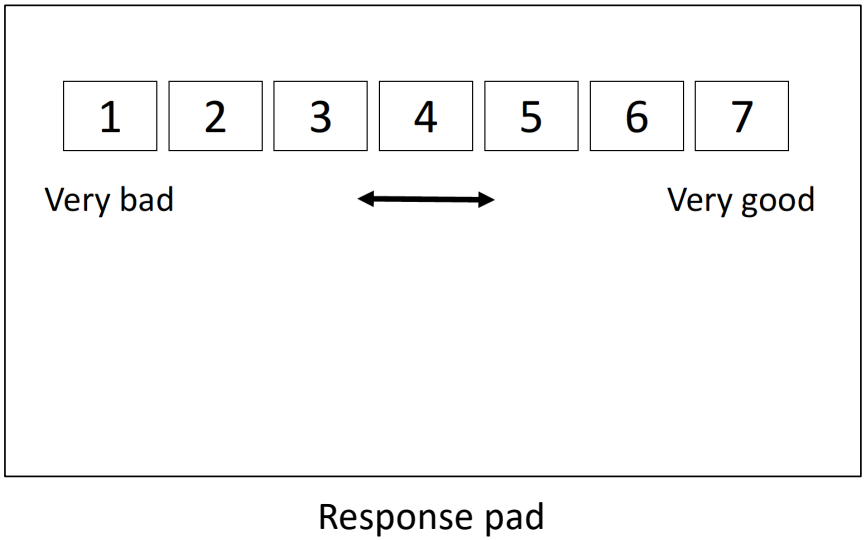
Research questions

- Do speakers assimilate all realizations to the same phonemic category?

- Would speakers of the language accept all of these forms as possible realizations of long vowels?

Method (1)

- Perceptual experiment march 2019

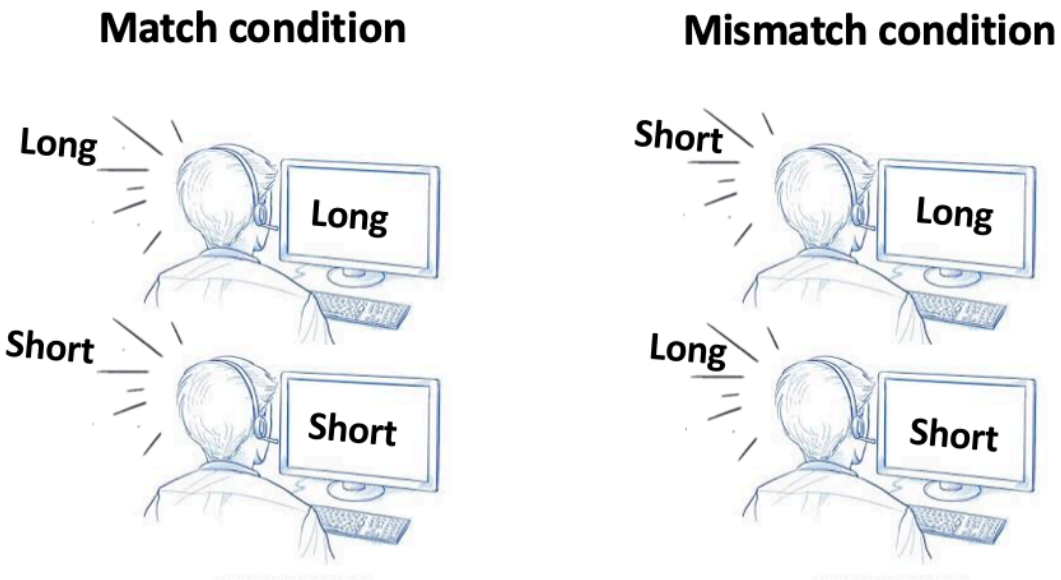


Response pad

- 39 native speakers of Drenjongke
- In Gangtok, Sikkim

- Perceptual experiment using Superlab
- Goodness-of-fit rating on a response pad using 1-to-7 point scale, 7 being the perfect fit.

Method (2)

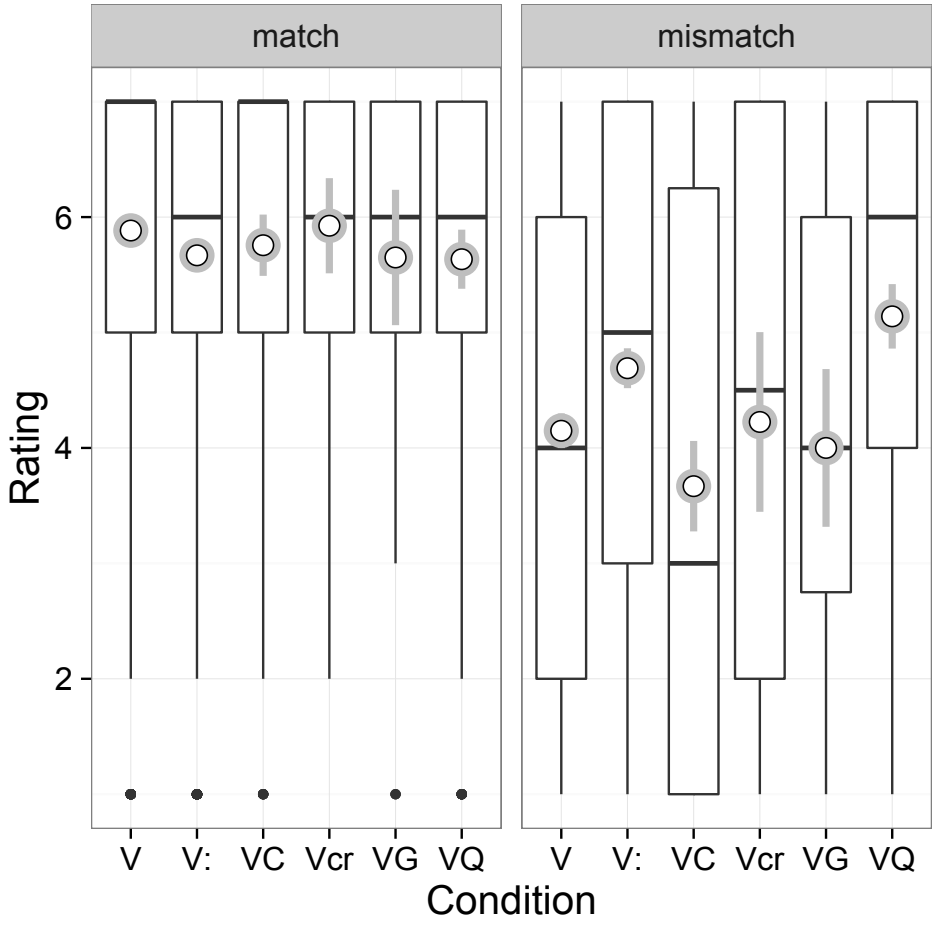


- Listeners were visually presented a word which contains either a short vowel or a long vowel.

- They were also ***presented with auditory stimuli***; half of the auditory stimuli "matched" ***the visual prompt*** in terms of their phonological length status; the other half contained a "mismatched" vowel.

- The "match" condition shows various realizations of long vowels which were not necessarily phonetically long (cf. production results).

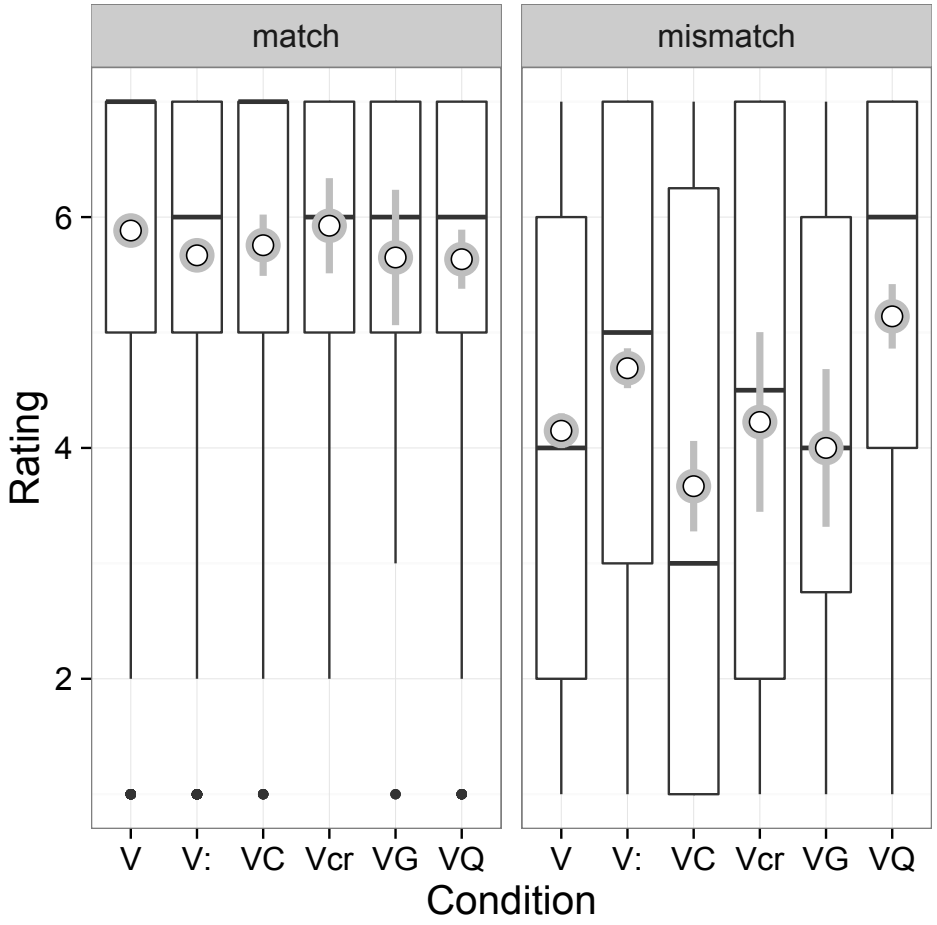
Results:



- The mismatch conditions show generally low rating.
- All the match conditions showed higher rating, even when they do not contain phonetically long vowel (the right 4 bars).

V = short vowel
V: = long vowel
VC = vowel followed by a consonant
Vcr = vowel with creaky voice quality
VG = vowel followed by a glotal stop
VQ = different vowel quality

Results:



- This means that listeners are rating various phonetic realizations of phonological long vowels equally high.

V = short vowel
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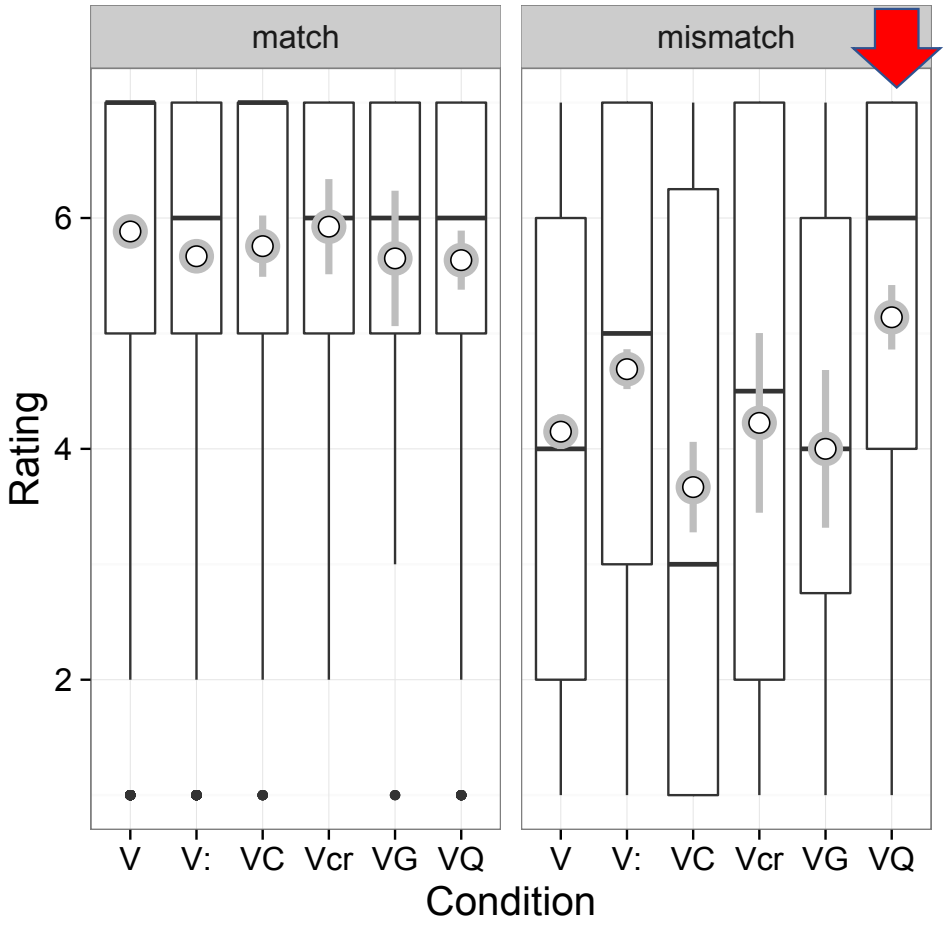
VG = vowel followed by a glotal stop
VQ = different vowel quality

Results



- The ‘different vowel quality (VQ)’ in the mismatch condition was judged to be better than the other mismatch conditions.

- This may be because they matched in terms of (short) rhyme duration.

V = short vowel
V: = long vowel
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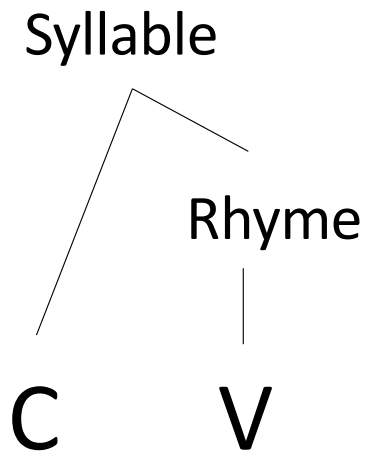
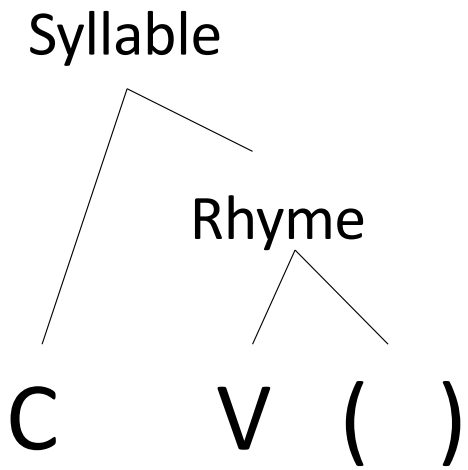
VG = vowel followed by a glotal stop
VQ = different vowel quality

Discussion: what's happening?

Phonological "Short"



Phonological "Long"



Conclusion

- Whether visual and auditory stimuli matched in terms of phonological length was important.

  → Listeners identify all different phonetic realizations of long vowels as the same phonological vowel length.

- It may be the case that Drenjongke listeners are tuned to the entire rhyme duration when perceiving the contrast between the short versus “long” categories.

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