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# Cue weighting after a tone-split in Tamang (Tibeto-Burman, Nepal)

## A perception study of stop initial words

LabPhon 16  
20-22 June 2018

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### Introduction

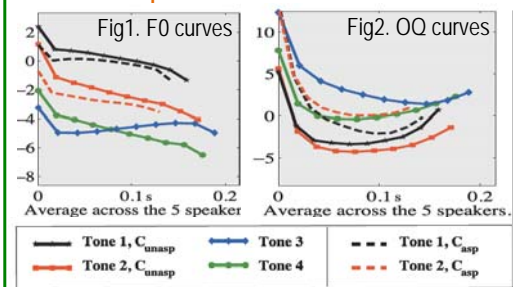
- Tamang: close to Tibetan. ≈ 2000K speakers.
- A transphonologization: Tone split (general pattern) [±voice] > H (+ modal) vs. L (+ breathy)



| Initial C<br>old > modern   | tone split |                 |
|---|------------|-----------------|
|   | height     | tone *A tone *B |
| p, p <sup>h</sup><br>s<br>*h <sub>m</sub> > m, *h <sub>l</sub> > l<br>... | high       |                 |
| *b > p [p~b~b]<br>*z > s<br>m, l<br>...                                   | low        |                 |

NB. Voicing contrast totally disappeared on continuants in Tamang:  
/m,n,r,j,l/ always voiced  
/s/ always voiceless

- (figured slopes at time of split are symbolic : phonetic value unknown)
- Synchronic consequence in Risiangku Tamang (a conservative Tamang dialect): **multiple cues** used in production of tones
  - Production data using electroglottograph (Mazaudon & Michaud 2008): (higher open quotient (OQ) => breathier voice)
  - 20% token plosive **Ci prevoicing** on **low tones** (0% on high tones)
  - lower F0** and **breathier voice** on **low tones**
  - some **inter-speaker tradeoff** relation between low **F0** and **breathiness**



smaller F0 difference compared to other tone or tonogenetic lg, e.g.: Seoul Korean (between today's H & L):  
-Male: ≈ 4st;  
-Female: ≈ 5st (Bang et al. 2018)

### This study

#### Research question

- Besides the **new cue** of **F0** (height and slope), what is the contribution of the **older cues** in tone perception?
- **Ci pre-voicing**: marginal in production of plosive Ci
  - **breathiness**: secondary/enhancing cue of low F0 (see Kuang & Liberman 2015)

#### Method

- Who: 28 participants (14M + 14F, mean age: 49, from 33 to 79)
- Where: Kathmandu and Risiangku village of Nepal
- What: synthesized stimuli
- carrier sentence /ʔtsu X-pa/ 'This is X' (A.) or 'Someone X's this' (V.)
- Forced choice among 4 pictures
- 1pa-pa 'thin'; 2pa-pa 'harsh'; 3pa-pa 'bring'; 4pa-pa 'pile up'
- NB: ʔ perfect quadruplet with a plain stop => target words have a vowel length difference (ambiguous vowel duration was used in all stimuli)
- Variables: 4x2x3x2x2 = 96 stimuli (already too long for some older villagers)
- Synthesized parameters

| F0 onset | prevoiced | voice quality of V1 | V1 slope          | V2 slope          |
|----------|-----------|---------------------|-------------------|-------------------|
| •115 Hz  | •yes      | •modal              | •rising (+10 Hz)  | •rising (+5 Hz)   |
| •130 Hz  | •no       | (H1-H2 = 2.5dB)     | •falling (-20 Hz) | •falling (-15 Hz) |
| •145 Hz  |           | •breathy            |                   |                   |
| •160 Hz  |           | (H1-H2 = 7dB)       |                   |                   |
|          |           | •super breathy      |                   |                   |
|          |           | (H1-H2 = 12dB)      |                   |                   |

Based on glottal opening degree settings in VocalTractLab (Birkholz)

### Results

Fig 3. Identification as High Tone

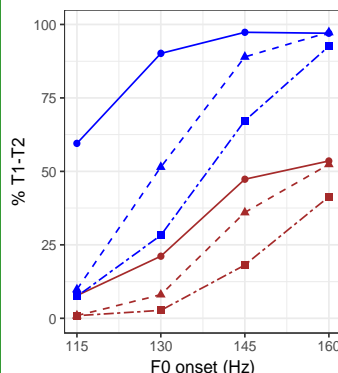
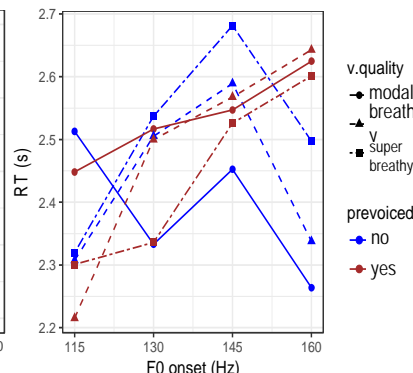
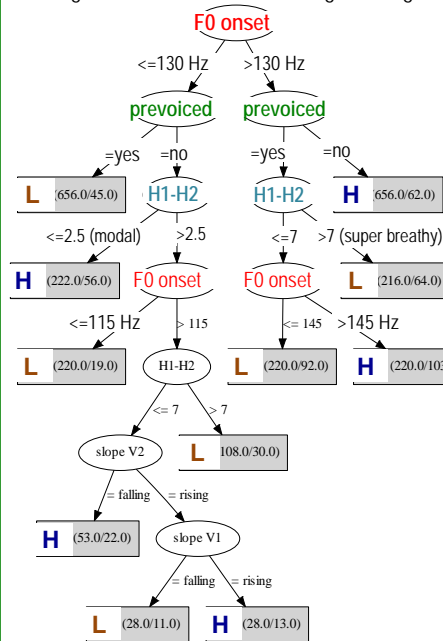


Fig 4. Response Time



- Ci prevoicing, although rare in production, carries the **decision for Low tone** in perception (>50%) whatever the associated features (H/L pitch or Voice quality)
- RT ↑ if **High F0** contradicts **Ci prevoicing**
- fastest RT for lowest F0+breathy**, whatever Ci prevoicing
- modal voice** has become **associated with high tone** (congruent H + Modal => fastest RT ; clashing L + Modal => 60% H responses)
- breathy voice** does not prevent **high tone** identification in %, but **slows down the RT**, esp. if the pitch is not Highest

Fig 5. Decision tree model using C4.5 algorithm



**F0: most important** in perception, main component of the tone

**Ci prevoicing: very important** in perception, although de-phonologized, and currently **marginal** in production

**voice quality: important**, esp. **when the other two cues are conflicting**

### Discussion

- old features/cues continue to be used in perception
- H/L emphasized in this study, because of historical perspective, but each of the 4 tones has its profile: e.g., T3 is breathier and has higher pitch than T4. (Hence, perception results are also influenced by properties other than H or L)
- In perception of high vs. low tones in Risiangku Tamang:
  - **F0 (the new cue): most important**, main component of the tone
- If we consider **markedness** for **redundant** cues:
  - **modal** phonation signals H tone, while **breathy** is **unmarked**
  - **Ci prevoicing** signals L tone, while **Ci voicelessness** is **unmarked**
- loss of oldest cue after phonologization** is **production-driven**: similar pattern observed in Afrikaans (Coetzee et al. 2018) and in Dutch (Pinget 2015): (some) speakers who deviate in production still use Ci voicing in word identification