

Acoustic & Articulatory Analysis of Tone in Four Languages of Nepal

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The Setting

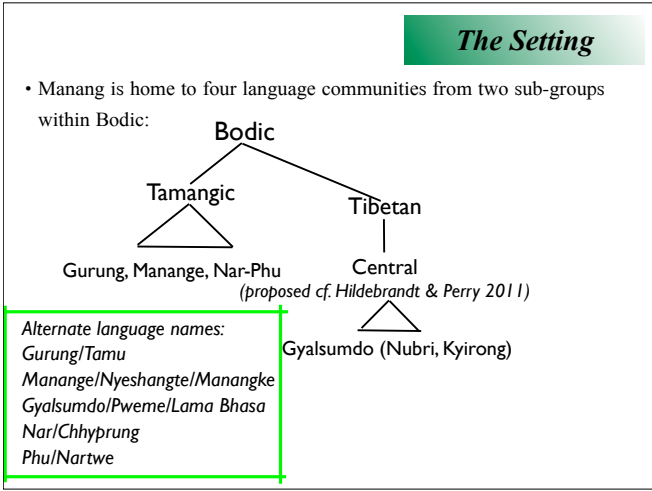
- Manang is home to four language communities from two sub-groups within Bodic:

```
graph TD; Bodic --> Tamangic; Bodic --> Tibetan; Tamangic --> Gurung_Manange_NarPhu[Gurung, Manange, Nar-Phu]; Tibetan --> Central; Central --> Gyalsumdo[Nubri, Kyirong];
```

Alternate language names:

- Gurung/Tamu
- Manange/Nyeshangte/Manangke
- Gyalsumdo/Pweme/Lama Bhasa
- Nar/Chhyprung
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- Sociolinguistic, lg. usage and lg. attitude surveys now ongoing parallel to this acoustic/articulatory study of the segmental & suprasegmental systems so far indicate that many Gyalsumdo crossed the Larke Pass from Gorkha District, but there are some familial linkages to Mustang District too
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- Mazaudon (2005, 2012), Mazaudon & Michaud (2006, 2008): fieldwork, including instrumental-based methods, can shed light on often difficult-to-describe tonal characteristics and possibly reveal evolutionary paths in languages of different genealogical distances
- (And, an overlaying of instrumental investigations alongside the sociolinguistic dimensions can also uncover possible extra-linguistic factors as relevant to unexpected observations)
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- The migration histories of Tamangic peoples & languages vis-a-vis Gyalsumdo are still somewhat unclear, but Gyalsumdos have lived amongst (primarily) Gurung speakers for may, many generations in lower Manang
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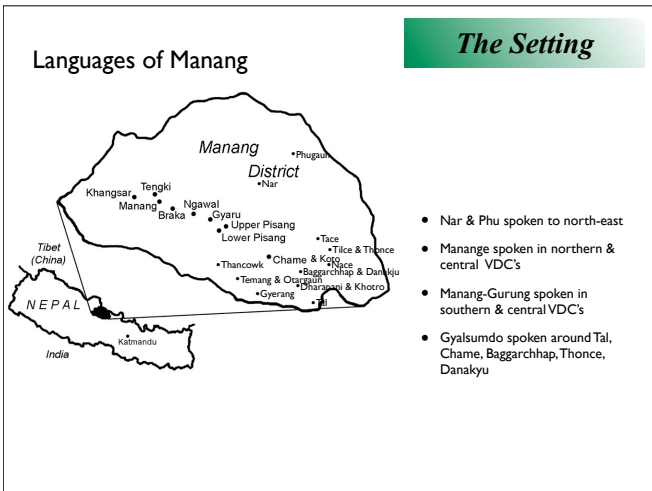
A map of the Manang District in Nepal. The district is outlined in black and labeled "Manang District". It is situated north of Kathmandu, which is marked with a dot and labeled. To the west is the border with Tibet (China), and to the south is the border with India. Several towns are marked with dots and labeled: Phugui, Nar, Thence, Thonche, Tace, Upper Pisang, Lower Pisang, Gyaru, Ngawal, Braka, Manang, Tengki, Khangsar, Thancowk, Chame & Koro, Baggarchhap & Danakju, Thencang & Odakhu, Dharphap & Khoro, Gyelang, and Phu.

- Nar & Phu spoken to north-east
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## Tamangic Tonogenesis

|      |     | Tamang                           | Gurung                         | Thakali                        | Manange             |
|------|-----|----------------------------------|--------------------------------|--------------------------------|---------------------|
| *HI  | /1/ | 54 ± asp                         | 33 ± asp                       | 54                             | 22 ± asp            |
|      | /2/ | 55 ± asp                         | 54 ± asp                       | 44                             | 44 ± asp            |
| *LOW | /3/ | 33/22 f <sub>i</sub> , + asp     | 11 f <sub>i</sub> , -asp       | 11 f <sub>i</sub> , -asp       | 52 -asp (only obs)  |
|      | /4/ | 211 f <sub>i</sub> , + asp, [b]? | 12 f <sub>i</sub> , -asp, [b]? | 121 f <sub>i</sub> , -asp, [b] | 42 + asp (only obs) |

(f<sub>i</sub> = breathy/murmur phonation; [b] = possible phonetic voicing effect of onset;  
Chao numbering system where 5 = high, 1 = low)

- However: Mazaudon & Michaud (2008, 2006), Hildebrandt (2007), Mazaudon (2005) – high degrees of idiolectal & dialectal variation, phonetic correlates differently weighted across languages, varied role of F0 in defining the systems

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## Evolution of Tibetan Tones

| WT Initials     | Modern Reflexes           | e.g. in Kyirong Tib.     | e.g. in Nubri                                        |
|-----------------|---------------------------|--------------------------|------------------------------------------------------|
| voiced          | LOW, voiceless (± asp)    | "Mid", unvoiced          | low voiced or voiced breathy                         |
| pfx + voiced    | LOW, voiced/unasp         | "Low", ± voiced, breathy | voiced modal or voiced breathy, or voiceless breathy |
| voiceless (asp) | (MID-)HIGH, voiceless asp | "High", aspirated        | high voiceless asp                                   |
| pfx + voiceless | HIGH, voiceless unasp     | "High"                   | high voiceless unasp                                 |

(adapted from Mazaudon 1977, Huber 2002 for Kyirong, Webster 1992 for Nubri)

- Additionally, WT finals -g, -d, -s, -/ns > modern-system contour tones (with corresponding long vowels in e.g. Kyirong)

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## Data & Methods

### The Bigger Project

- 80-90 words elicited from speakers in each village throughout Manang
- Organized by a range of phonetic, phonological & lexical factors: onset type, word-size, stem vowel quality, comparability across tone models, lex. category
- If village is represented by more than one language, we attempt representation from each lg.

### Sub-set for This Talk

- Approximately 40 monosyllabic words (nouns, numerals) of mixed vowel quality and syllable structures

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## Data & Methods

### The Bigger Project

- Even representation of male/female, preferred age range 18-40 years
- In Year 1 of project: 10 Manang-Gurung speakers represented, only 6 Gyalsumdo speakers located so far (we hope to work with others living in Kathmandu)

### Sub-set for This Talk

- Four Manang-Gurung (2 m, 2 f)
- Four Gyalsumdo (2 m, 2 f)
- Two Nar (1 m, 1 f) – data gathered in 2010
- 9 Manange (8 f, 1 m) – data gathered in 2001, selected data shown today

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## Data & Methods

### The Bigger Project

- Pitch (5 measurement points, F0), relative vowel intensity (dB), relative vowel/vcd onset jitter (%), obstruent onset V.O.T., vowel duration, vowel spectral tilt (comparison of the amplitude of F0 to H2)
- Electroglographic Analysis: closed-quotient value (EGG CQ) of all voiced onsets (including sonorants) and initial vowels

### Sub-set for This Talk

- M-G: all measurements done (so far also the only lg. w/serious perception tests conducted)
- Gyal: all measurements done
- Nar: no EGG
- Manange: no EGG, spectral tilt, jitter, or intensity

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## Data & Methods

- Words were recorded in isolation (three repetitions) & frame-medial or final context (three repetitions)
- Gurung *kwe* 'bee' & *la-pa* 'drive.away-NOM'
- For nouns: toso ṇA-e *kwe* mro-e-po [now 1SG-ERG bee see-ASP-NOM] 'Now I see a *bee*.'
- For verbs: toso ṇA-e *la-pa* tsa-ti-po [now 1SG-ERG drive.away-DEONT want-ASP-NOM] 'Now I want to *drive away*.'
- Gyalsumdo *to* 'stone' & *to* 'walk/go'
  - For nouns: ṇA *to* t<sup>h</sup>on-sō [1SG stone see-TAM/EVID] 'I saw the *stone*.'
  - For verbs: ṇA tanta *to-ke* (re) [1SG now walk/go-TAM/EVID (EVID)] 'I am *walking* now/I *walk* now.'

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| Three Gurung Tone Models: |                                                           | Data & Methods                                                                   |                                                                                |
|---------------------------|-----------------------------------------------------------|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
|                           | Kaski Gurung<br>(Glover 1974)                             | Manange (Hildebrandt<br>2004)                                                    | Tamu (TSS 2004)                                                                |
| Tone 1                    | “clear, relaxed”                                          | “low, level”                                                                     | modal (low)                                                                    |
| Tone 2                    | “clear, intense”                                          | “high, level”                                                                    | modal (high)                                                                   |
| Tone 3                    | “breathy, low”                                            | “very high, falling”                                                             | breathy                                                                        |
| Tone 4                    | “breathy, rising”                                         | “mid, falling”                                                                   | breathy (high)                                                                 |
| Justification             | authoritative, long-standing<br>reference for Gurung tone | a sister language with which MG<br>people have had long-term,<br>intense contact | a newer account of multiple<br>Gurung dialects w/ large<br>lexicon, but not MG |

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| Tone Models: Lexical Mis-matches |       | Data & Methods |           |
|----------------------------------|-------|----------------|-----------|
| Word/Gloss                       | Kaski | Manange        | Tamu      |
| <i>ti</i> ‘house’                | /2/   | /4/            | /1/       |
| <i>po</i> ‘popped corn’          | /2/   | /4/            | /3/       |
| <i>to</i> ‘pillar’               | /3/   | /2/            | /4/       |
| <i>kā</i> ‘chin’                 | /2/   | /1/            | /2/ ~ /3/ |

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- Tone models for the other languages:
- Gyalsumdo: WT correspondences (keeping an eye to what Kyirong and Nubri display)
- Manange: my prior work based on my own fieldwork, dissertation, grammar and other published information (Mazaudon 1978, Nagano 1984, Hoshi 1986a, b)
- Nar(-Phu): Noonan (2003 and notes) and Mazaudon (1996)

| Tone | Chao  | Auditory Properties | Onset Consonant Properties                 |
|------|-------|---------------------|--------------------------------------------|
| /1/  | 22    | Low & Level         | Not Applicable                             |
| /2/  | 44    | High & Level        | Not Applicable                             |
| /3/  | 52    | High & Falling      | If initial C is [+ obstruent], unaspirated |
| /4/  | 42/32 | Mid & Falling       | If initial C is [+ obstruent], aspirated   |

Manange Tones  
(Hildebrandt 2003, 2004, 2005)

| TONE NUMBER | PITCH CONTOUR, CHAO SCALE | EXAMPLE                     |
|-------------|---------------------------|-----------------------------|
| 1           | 53                        | nāŋ 'reciprocal obligation' |
| 2           | 44                        | naŋ 'full'                  |
| 3           | 12                        | nfiŋ 'planted in rows'      |
| 4           | 21 or 31                  | nhiŋ 'in'                   |

Nar-Phu Tones (Noonan 2003 339)

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## *Observations & Analysis*

- What can we look to as modern reflexes, or as features to the tonogenetic developments in these languages?
- Just what kind of variation is possible amongst any generalizations?
  - Pitch-melody (within/across the two registers)
  - Behavior of initial obstruents (VOT)
  - Voicing of vowels with respect to Electroglottographic measurements

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|                                                                                                                                                                             |  | Observations & Analysis |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------------------------|--|
| <ul style="list-style-type: none"><li>• One place to begin: Pitch-melody within “high” vs. “low” register groupings (Four Manange speakers, 6 measurement points)</li></ul> |  |                         |  |
|                                                                                                                                                                             |  |                         |  |
|                                                                                                                                                                             |  |                         |  |

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## Observations & Analysis

- Pitch-melody: Four Manang-Gurung speakers (5 measurement points)

Averages, Monosyllabics, Manange Model

Legend: 1 (blue), 2 (red), 3 (green), 4 (light blue)

Categories: F1, F2, M1, M2

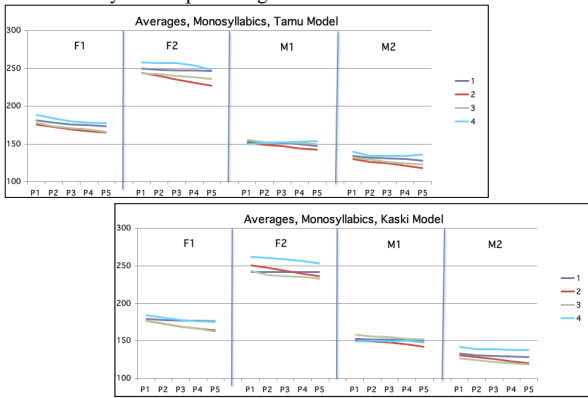
Measurement points: P1, P2, P3, P4, P5

- Manange (prior slide): four-way separation for most speakers (not male)
- M-G: a high-low separation only emerges when plotted against Manange model for 3 of 4 speakers so far, which seems to be an interesting development for communities in this region

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## Observations & Analysis

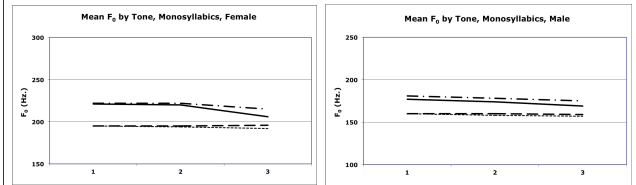
- Pitch-melody: When plotted against the Tamu and Kaski models...



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## Observations & Analysis

- Pitch-melody: Two Nar-Phu speakers (3 measurement points)

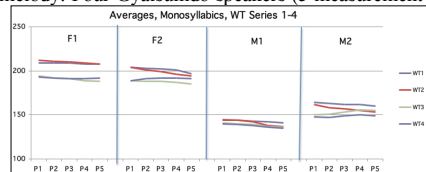


- No clear evidence (yet) for additional melody distinctions within a high-low register

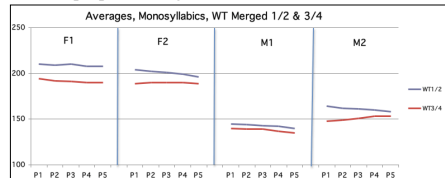
20

## Observations & Analysis

- Pitch-melody: Four Gyalsumdo speakers (5 measurement points)



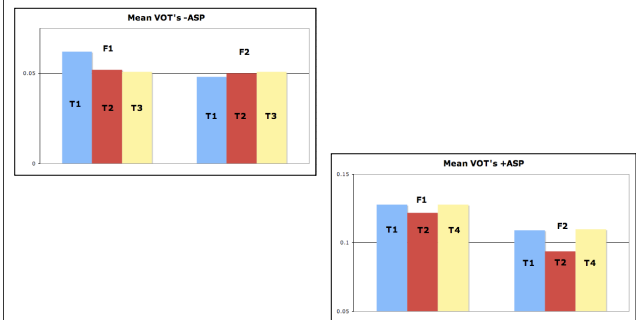
- The four categories are not obvious, but when WT 1/2 and WT 3/4 are merged into a proposed “high” v. “low”, the differences are significant



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## Observations & Analysis

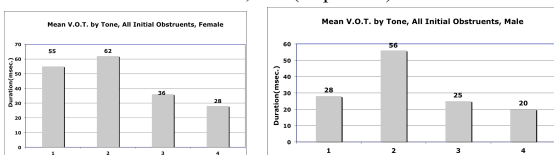
- Another possible cue: Voice Onset Time (VOT) differences on initials in different registers (or tone groupings within the H-L division) may emerge as a reflex of older (obstruent) voicing contrasts (Manange, 2 speakers)



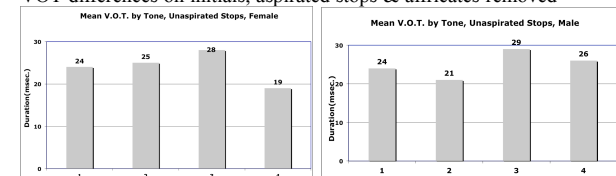
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## Observations & Analysis

- VOT differences on initials, Nar (2 speakers)



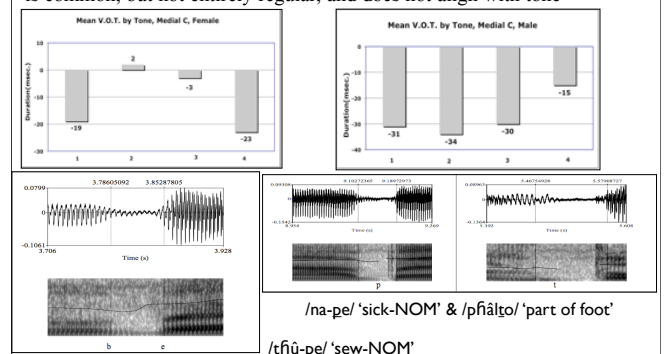
- VOT differences on initials, aspirated stops & affricates removed



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## Observations & Analysis

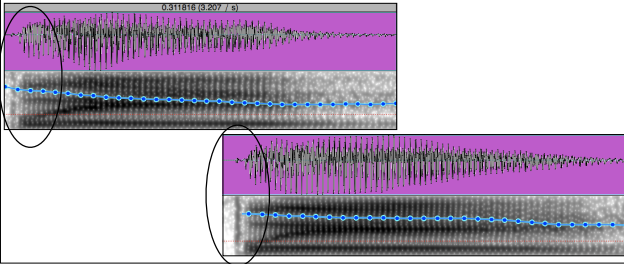
- In word-medial position, passive plosive voicing assimilation (V\_V) is common, but not entirely regular, and does not align with tone



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## Observations & Analysis

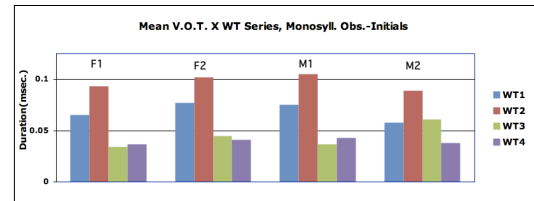
- No measurable VOT differences on initials, Manang-Gurung
- F2 (from Nace village) has 2 words with marginal/weak pre-voicing: /p<sup>w</sup>e/ 'iron' (upper image), /p<sup>w</sup>e/ 'wool' (lower image)
- Caveat: very small word-set, 'true' aspiration is rare overall, only with some velar-initial & affricate-initial words; bilabial initials frequently spirantized, otherwise solidly voiceless



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## Observations & Analysis

- VOT differences on initials, Gyalsumdo (4 speakers)

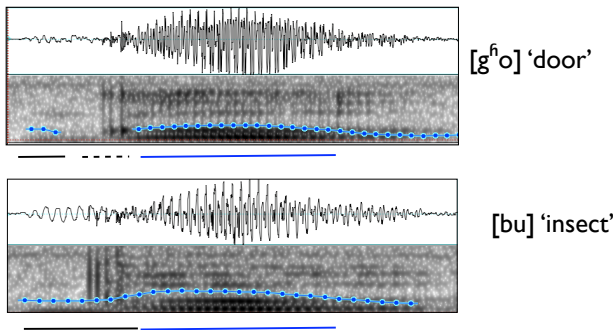


- The male speakers show a strong tendency towards pre-voicing or else breathy onsets with words in WT 3 & WT 4 (those cases are not reflected in these bar-graphs)

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## Observations & Analysis

- Pre-voicing/Breathy initials, Gyalsumdo:



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## Observations & Analysis

- Electroglottographic cues: Mazaudon and Michaud (2008) observed that the open-quotient (Oq) values were significantly higher, with a dipping then rising pattern through time for the LOW tones vs. HI.
- i.e. for the LOW tones, they observed an overall rise in airflow rate in the nucleus

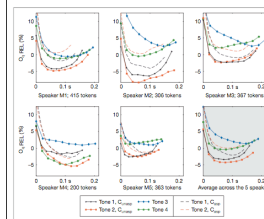


Fig. 4. Normalized curves of Oq (relative to the mean Oq value of each speaker), plotted against average duration.

p. 240

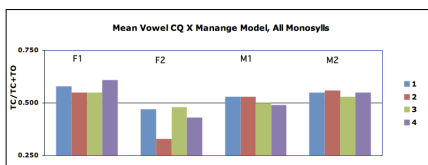
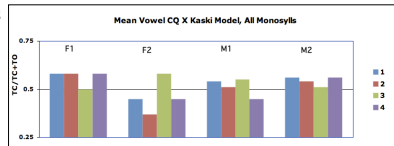
- My study: all words recorded through a EG2-PCX2 two-channel EGG assembly (see slide #1)
- I measured Closed Quotient (CQ): difference between time of v.f. closure in relation to total time of voicing cycle; Non-modal predicted to carry lower CQ values than modal, as v.f. closure is shorter in time & opening portion lags for longer
- I took only one measurement point

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- EGG CQ for Manang-Gurung:

## Observations & Analysis

- When either the Kaski or the Manange tone models are considered, a weak correlation between /4/ vowels and lower CQ, but it is not consistent across speakers

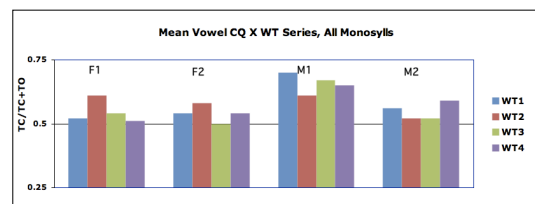


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- EGG CQ for Gyalsumdo:

## Observations & Analysis

- For three of four speakers, initial vowels of WT 3 and/or 4 show lowered CQ values in comparison to other categories, but this is not always significant



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| Tamangic Languages of Manang |                                                       |                                                                     | Summary                   |
|------------------------------|-------------------------------------------------------|---------------------------------------------------------------------|---------------------------|
| Characteristics              | Manange                                               | M-G                                                                 | Nar(-Phu)                 |
| pitch-melody                 | high-low & level-falling/contour                      | High-Low emerges only when compared to Manange model                | High-Low                  |
| onset voicing                | never voiced, but aspiration split in tones /3/ & /4/ | no (real) evidence of voicing, and phonetic aspiration rare overall | lower VOT in low register |
| other cues                   |                                                       |                                                                     | jitter?                   |

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| Gyalsumdo      |                                                                                                                                                         | Summary |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| My Proposal    | Characterized by                                                                                                                                        |         |
| "Hi" (WT 1/2)  | Higher F0 (no evidence for contour diffs. yet), ±asp obs.                                                                                               |         |
| "Low" (WT 3/4) | Lower F0, tendency towards obstruent voicing, particularly by males, weak evidence for shorter vocal fold closure for vowels, obstruent aspiration rare |         |

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| Summary                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• What is not showing any consistent patterning so far?</li> <li>• Vowel duration</li> <li>• Spectral tilt (F0-H2)</li> <li>• Vowel Jitter (but female Nar speaker does show some increased jitter on tones /3, 4/)</li> <li>• What from here?</li> <li>• Voicing properties on medial consonants</li> <li>• F0 properties manifested across larger units</li> <li>• Possibly additional CQ measurements across the nucleus</li> </ul> |

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| Final Remarks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• While still quite tentative (with parallel data collections planned for upper Manang in 2013 and 2014), this talk represents a first view to a systematic comparative examination of the phonetic manifestation of tone in these languages</li> <li>• The situation observed for Manang-Gurung so far is particularly interesting when compared with other varieties spoken elsewhere in Nepal</li> <li>• What are the consequences of language contact in such close proximity on these systems (and their emergent cues), especially in light of their relative diachronic youthfulness?</li> </ul> |

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| Final Remarks                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Gyalsumdo is surrounded by Manang-Gurung, but its system may be appreciated by quite different cues</li> <li>• I'm particularly interested in the picture that will be painted additional measurements from recordings done with other speakers, alongside those of Nar-Phu, as these are the two languages of Manang that that show the greatest sudden interruption in available speakers below the age of 50</li> </ul> |
| <p>Thank You (full references supplied upon request)<br/>         Thanks to Dubi Nanda Dhakal &amp; Oliver Bond for help w/data collection<br/>         Thanks to Jillian Lowery &amp; Cassidy Martin for assistance<br/>         with data organization &amp; coding<br/>         Research supported by NSF I 149639<br/>         Thank you to Manang language communities for their participation</p>                                                             |

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