Utsat tonogenesis and its implications for the representation of tone

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Thirteenth International Conference on Austronesian Linguistics (13-ICAL) – July 21, 2015

Roadmap

1. Introduction: Theories of contour tones
2. Revisiting Utsat tonogenesis
3. Sound change from an Evolutionary Phonology perspective
4. Phonologization in Utsat and its implications for the representation of tone
5. Conclusion

1 – Introduction: Theories of contour tones

Introduction to tone

Tonal languages have contrastive phonological categories whose primary phonetic correlate is fundamental frequency (F_0)

- The presence of these categories in the inventory is *lexical tone*

For example, Mandarin contrasts lexical items by the presence of one of four tones (note that IPA tone notation differs from *pinyin*):

Word	IPA	Tone	Gloss
發	[fá]	H (high)	‘emit’
罰	[fǎ]	LH (rising)	‘penalize’
法	[fà]	L (low)	‘law’
髮	[fâ]	HL (falling)	‘hair’

Types of tonal categories

Tonal categories are often grouped into *level* vs. *contour* tones

Level tones have a relatively flat pitch contour on the surface

- E.g. H (high), M (mid) and L (low) tones

Contour tones do not have flat pitch contours

- E.g. rising, falling, convex (rising->falling), concave (falling->rising)

Level tones are generally treated as single phonological entities, but the treatment of contour tones is more controversial

- Is a falling tone a single phonological entity (F) or a series of two targets (HL)?

Models of contour tone representation

Two main analyses of contour tones have been explored in the literature:

Unitary Contour Tones

- (At least some) contour tones are unitary; single phonological entity
- Distinctive features govern properties specific to contour tones, such as [±RISING], [±FALLING] and [±CONVEX] from Wang 1967

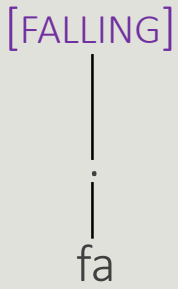
Autosegmental Contour Tones (Goldsmith 1976)

- All contour tones are sequences of level tone categories
- These sequences are assigned to single syllables
- Distinctive features only govern tone height, if at all (Clements et al. 2011)

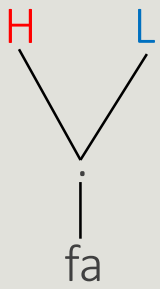
Models of contour tone representation

An example of each of these representations, using Mandarin 髮 [fâ] *hair* which has a falling tone:

Unitary contour tone



Autosegmental contour tone



Models of contour tone representation

Each analysis has its pros and cons:

Pros of unitary contour tones:

- Describe properties of the **tone differential** (rate/direction of change in tone without reference to specific tone heights)
- Allow for tone contour vs. **tone register** features, active for example in Vietnamese reduplication (Nhàn 1992)
- Still allows for multiple tones assigned to one syllable. Allows for autosegmental analysis for languages that require it.
- May better match speaker intuitions.

Cons of unitary contour tones:

- Inefficient, requires richer feature theory

Models of contour tone representation

Each analysis has its pros and cons:

Pros of autosegmental analysis:

- Some languages have alternations between contour tones and multiple level tones
- Efficient, requires fewer phonological primitives

Cons of autosegmental analysis:

- Assumed for all languages! Many languages show **no synchronic evidence** for decomposability of contour tones.
- Some languages only have a contrast between a contour tone and zero, e.g. Franconian German (Gussenhoven 2004). Why posit multiple elements?
- Falling tones are perceived and produced early in development (Clumeck 1980, Kent & Murray 1982).

Models of contour tone representation

Deciding between these two analyses is difficult:

- Many of the languages with the richest inventories of contour tones are isolating languages. These languages often lack the kind of phonological interactions that evidence the autosegmental analysis.
- Many tonal phonological rules can be written using either analysis, for example Mandarin Third-Tone Sandhi (assuming 3rd tone = low level tone):
  - [LOW] -> [FALLING] / [LOW] _ (Contour tone features)
    - A low tone becomes a falling tone before another low tone.
  - Ø -> H / [L _]$_{\sigma}$ [L]$_{\sigma}$ (Autosegmental contour tones)
    - A high tone is inserted after a low tone in a syllable preceding another low tone.

Due to its efficiency, the autosegmental analysis has been widely adopted in the literature (Yip 1989)

Goal of this presentation

Previous work comparing these two analyses of contour tones has focused on evidence from synchronic grammars.

Are there diachronic processes that inform theories of tonal representation? If so, what representation do they suggest?

The goal of this presentation is to approach the representation of contour tones by revisiting accounts of tonogenesis in the Chamic languages with special attention to Utsat.

Using Evolutionary Phonology to link processes of sound change to synchronic grammars, I will argue that the autosegmental analysis of contour tones is **not sufficient for all languages**.

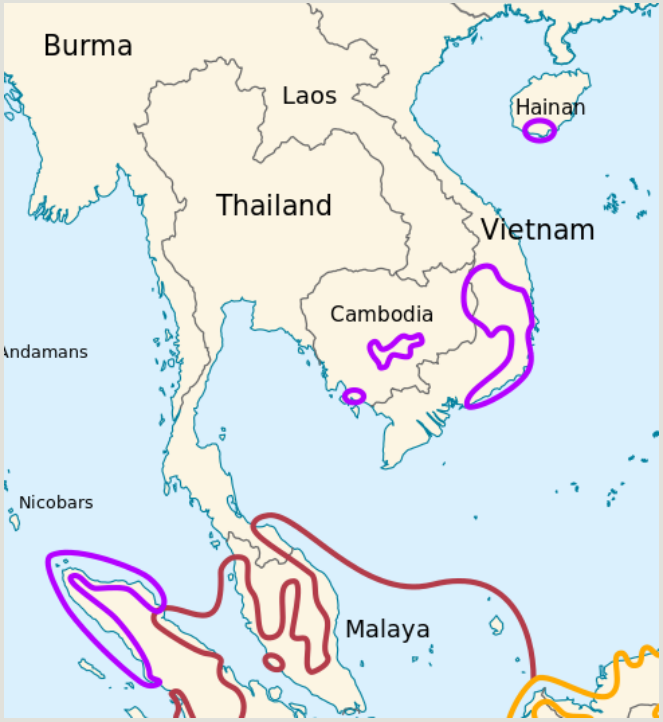
2 – Revisiting Utsat tonogenesis

The Chamic languages

The Chamic languages are a subgroup of Malayo-Polynesian languages in Vietnam, Cambodia, Aceh and Hainan Island, China.

Most Chamic languages underwent syllable restructuring and registro-/tonogenesis.

- Some authors attribute this to heavy contact with Mon-Khmer and other tonal languages (Thurgood 1999), others cite external factors such as general shifts in prosody (Brunelle & Pittayaporn 2012).



Source: Wikipedia
Chamic languages in purple

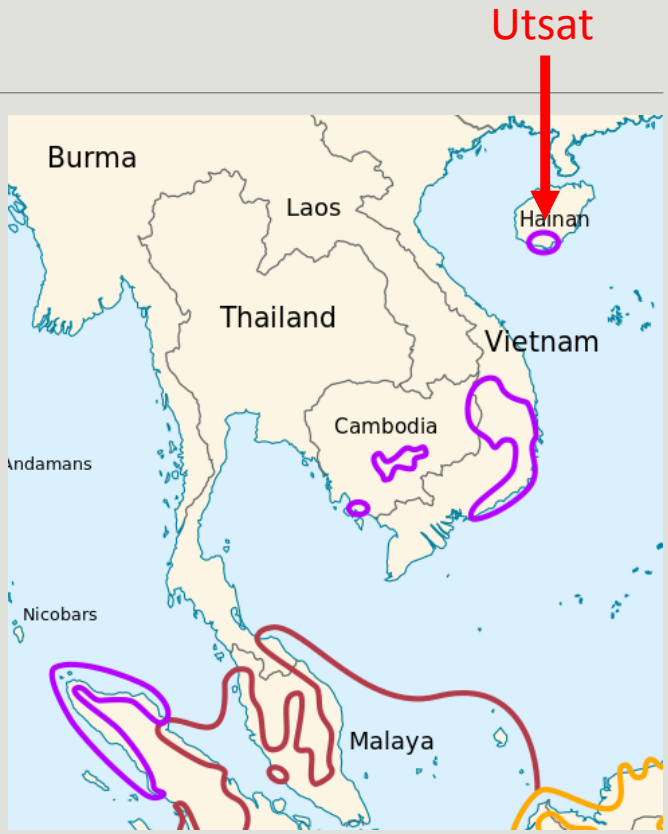
Utsat

Utsat (also known as Tsat) is a Chamic language with 4000 speakers (as of 2007).

- Spoken by the Utsul people of Hainan Island, China, near the city of Sanya.

Underwent the most extensive shift in syllable structure of the Chamic languages.

- Proto-Chamic had disyllabic roots, *CVCVC
- Utsat is monosyllabic with an inventory of five tones (Maddieson & Pang 1993)
- Maximal Utsat syllable: CV{N,ʔ}^{T}



Source: Wikipedia
Chamic languages in purple

Sound change in Chamic

The tonogenesis of Utsat and similar processes that occurred in other Chamic languages have been described by Thurgood 1993, 1999.

Utsat is a useful case study of tonogenesis as many of the proposed intermediate stages reflect the states of related Chamic languages.

- Being able to reconstruct these intermediate stages allows us to go into greater detail as to how and *why* specific sound changes occurred in Utsat's development.

Utsat's tonogenetic path from Proto-Chamic can be divided into two phases:

- I – Syllable restructuring and the development of a breathy voice register
- II – Development of the tonal inventory

Utsat tonogenesis I: genesis of breathy register

Proto-Chamic had $C_1VC_2VC_3$ roots

V becomes breathy voiced if onset is voiced stop (D), onset becomes aspirated voiceless in Utsat (Thurgood 1999)

$DVCVC \rightarrow T^h\ddot{V}CVC$

$CVDVC \rightarrow CVT^h\ddot{V}C$

Breathy voice spreads over C_2 if C_2 = sonorant or non-/h/ voiceless (Utsat) or opposite in other Chamic languages (Thurgood 1993, 1999)

$DVC_2VC \rightarrow T^h\ddot{V}C_2\ddot{V}C$, C_2 = {[+SON], [-VOICED] except /h/}

Disyllabic → sesquisyllabic → monosyllabic, V_1 deleted (ibid.)

$C_1VC_2VC \rightarrow C_1C_2VC \rightarrow C_2VC$

$\rightarrow C_1jVC \rightarrow C_1iVC$ (C_2 = [COR +SON])

Utsat tonogenesis I: monosyllabic roots

Intermediate stage (Macaulay 2014)

C_1VC_2 (C_2 = ʔ or N)

V either breathy or modal voiced, both occur with all onsets

- Onset aspiration distinction comes from whether it was C_1 or C_2 voiced originally

Coda stops and /s/ debuccalize to /ʔ h/, /h/ > Ø, coda can only be /ʔ n/

This stage input to tonogenesis (Macaulay 2014)

Stages of phonation spreading can be seen in other Chamic languages like Western Cham (WC on next slide; Thurgood 1999)

Utsat tonogenesis I: example roots

		Proto-Chamic root	Phonation spread	Utsat σR	Utsat IF	WC reflex	Gloss
a.	i.	*ribɔw	*ribɔ̤w	*(r)bɔ̤w	*phə̤		"thousand"
	ii.		*ribɔ̤w	-	-	ripɔ̤w	
b.	i.	*jalaan	*jə̤lə̤a̤n	*(j)lə̤a̤n	*lə̤a̤n		"path"
	ii.		*jə̤lə̤a̤n	-	-	cə̤lə̤n	
c.	i.	*bituk	*bi̤tṳk	*(b)tṳk	*tṳʔ		"cough"
	ii.		*bi̤tuk	-	-	pətuʔ	
d.	i.	*jahit	*jə̤hit	*sit	*siʔ		"sew"
	ii.		*jə̤hi̤t	-	-	chi̤ʔ	
e.	i.	*lima	-	*(l)ma	*ma		"five"
	ii.		-	-	-	lamɨ	
f.	i.	*labuh	*labṳh	*(l)bṳh	*phṳh		"fall down"
	ii.		*labṳh	-	-	lapṳh	

(Data from Thurgood 1993, 1999; table from Macaulay 2014)
σR = syllable restructuring; IF = intermediate form; WC = Western Cham
Breathy voice and voiced stops in Proto-Chamic marked in orange for convenience

Utsat tonogenesis II: tonal development

Five tones in modern Utsat: H, M, L, LH/rising, HL/falling

Overview of pre/post-tonogenesis correspondences:

Intermediate stage	Modern Utsat	Tone
CVh, C̤Vh	CV́	H
(*else*)	CV̄(N)	M
C̤V(N)	CV̀(N)	L
CV?	CV̌?	LH/rising
C̤V?	CV̂?	HL/falling

Utsat tonogenesis II: tonal development

H tone from coda /h/

[h] has varying effects on F_0, but documented cases of raising pitch

Takhian Thong Chong (DiCanio 2009:5-6) modal/breathy registers have (non-contrastive) rise in tone if /h/ in coda

Punjabi (Thurgood 2008:14; Ohala 1973:11) H tone on stems ending in /h/

IF	Modern Utsat
CVh	CV́ (H)
else	CV̄ (M)
CV̤	CV̀ (L)
CVʔ	CV̌ʔ (LH)
CV̤ʔ	CV̂ʔ (HL)

Utsat tonogenesis II: tonal development

M tone from modal CV, CVN (the "elsewhere" case)

L tone from low F_0 of breathy voice (Laver 1994)
- also seen in Punjabi (Ohala 1978)

IF	Modern Utsat
CVh	CV́ (H)
else	CV̄ (M)
C̤V	CV̀ (L)
CVʔ	CV̌ʔ (LH)
C̤Vʔ	CV̂ʔ (HL)

Utsat tonogenesis II: tonal development

LH/rising tone from earlier environment of modal voiced vowel + coda glottal stop

Glottal stops often produced as constricted glottis phonation on (part of) vowel instead of true stop (Garallek 2003)

This phonation can have a high F_0 ("tense voice") or low F_0 ("creaky voice")

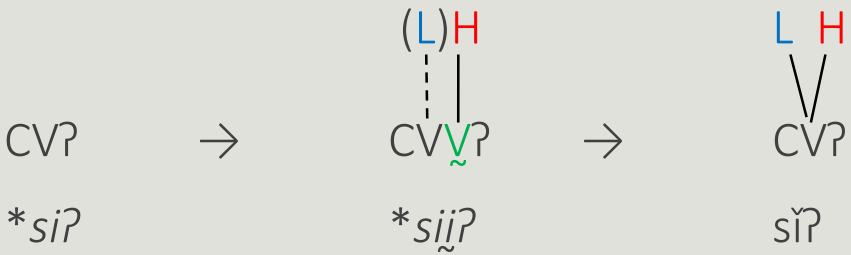
Coda glottal stop > tense voice > rising tone attested in Vietnamese (Thurgood 2008, Gage 1985)

Laryngealized coda > tense voice > high tone in some Athabaskan languages (Kingston 2005)

IF	Modern Utsat
CVh	CV́ (H)
else	CV̄ (M)
CV̰	CV̀ (L)
CVʔ	CV̌ʔ (LH)
CV̰ʔ	CV̂ʔ (HL)

Utsat tonogenesis II: tonal development

Example: PC **jahit* "sew" → IF **siʔ* → sĭʔ



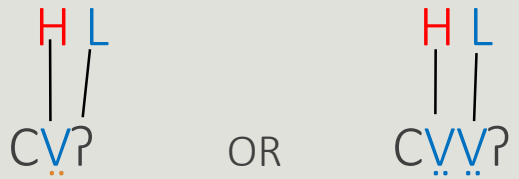
IF	Modern Utsat
CVh	CV́ (H)
else	CV̄ (M)
CV̤	CV̀ (L)
CVʔ	CV̌ʔ (LH)
CV̤ʔ	CV̂ʔ (HL)

(where V̰ refers specifically to tense voice; IPA does not distinguish tense/creaky voice)

Utsat tonogenesis II: tonal development

HL/falling tone from breathy voiced vowel with coda glottal stop

If separated into two targets, H would be assigned to breathy voiced vowel:



IF	Modern Utsat
CVh	CV́ (H)
else	CV̄ (M)
CV̤	CV̀ (L)
CVʔ	CV̌ʔ (LH)
CV̤ʔ	CV̂ʔ (HL)

This is an **unexpected result**! Breathy voice notoriously has low F_0. In fact, breathy voice vowel gave rise to level L tone!

How can a low-F_0 environment be phonologized as H?

Utsat tonogenesis II: tonal development

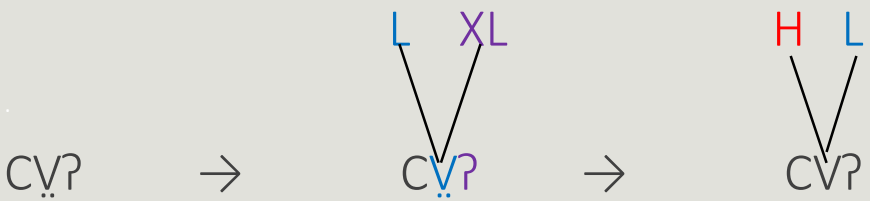
Breathy voice incompatible with tense/creaky phonation (Laver 1980), full glottal stop realized on these words?

Full glottal stop perceived by *dip* in F_0 (Hillenbrand & Houde 1996; Garralek 2003).

Negative tone differential phonologized as falling tone?

So far:

IF	Modern Utsat
CVh	CV́ (H)
else	CV̄ (M)
C$\underset{..}{\text{V}}$	CV̀ (L)
CV?	CV̌? (LH)
C$\underset{..}{\text{V}}$?	CV̂? (HL)

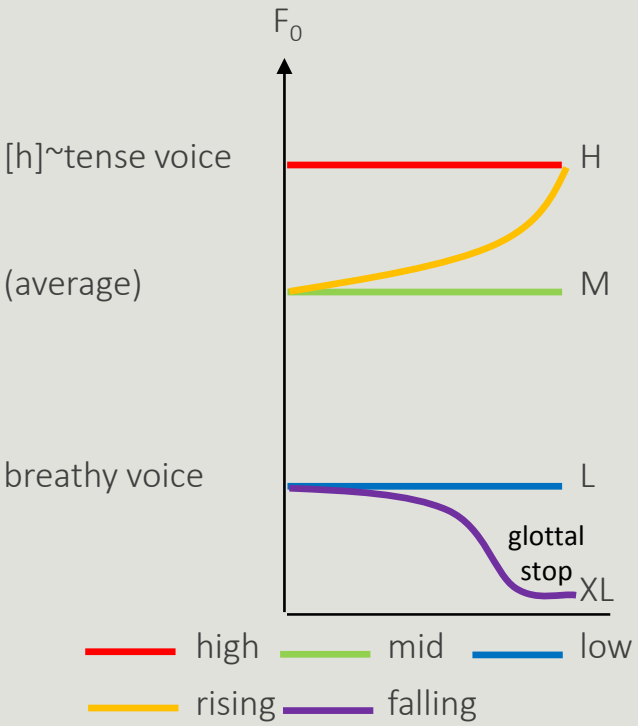


How did latter change happen?

Perception and Utsat tonogenesis

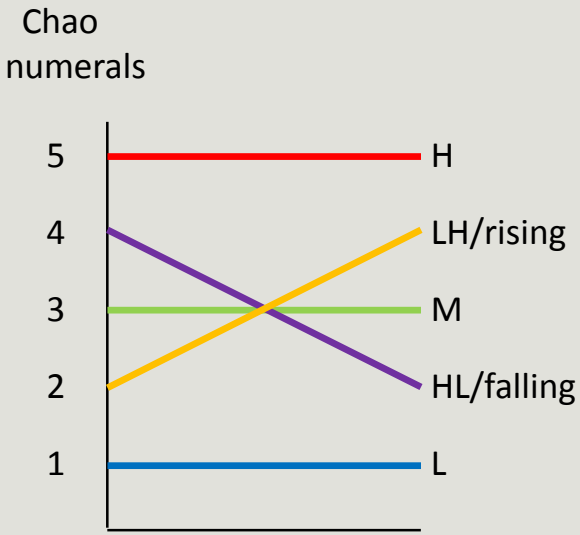
Perceived tone

(relative pitches over course of contour)



Phonologized tone

(Maddieson & Pang 1993)



Problems with autosegmental analysis

A universal analysis of contour tones as decomposable into level tones brings up two main issues when considering the Utsat data:

1. Phonologization of an H tone from a particularly low-F_0 environment.
   - What did the original phonetic environment have in common with the phonologized tone?
   - Is the similarity between perceived/phonologized tone greater if contour tones are considered unitary?
   - Is there a way to analyze the Utsat tonal inventory as the *expected* result of tonogenesis?

Problems with autosegmental analysis

A universal analysis of contour tones as decomposable into level tones brings up two main issues when considering the Utsat data:

2. Shift in the acoustic-perceptual space: in the original environment, the falling tone's highest point was the same tone height as the low level tone. Post-phonologization, the **entire** falling tone is **above** the low level tone. How can this discrepancy be explained?
   - This shift does not affect the contrast between this tone and the others in the inventory. Is there a motivation for this shift, or is an analysis possible where no shift occurred?
   - Could the post-shift contour be closer to falling tones in contact languages? There is ample evidence of contact between Chamic and other languages during this time (Thurgood 1999).
   - The expected tone inventory where the falling tone starts at the same point as the low level tone is a possible, stable tonal inventory. This state matches what is reported for Cantonese (Yip 2002).

3 – Sound change from an Evolutionary Phonology perspective

Tonogenesis in Evolutionary Phonology

Evolutionary Phonology (EP; Blevins 2004, 2013) is a phonological framework that attempts to explain synchronic sound patterns as the result of phonetically-natural sound change.

In this way, EP seeks to bridge synchronic grammars to the diachronic processes that result in them.

EP divides sound change into a typology of three categories:

1. CHANGE, phonologization of a misperceived speech stream.
2. CHANCE, reanalysis of a speech stream that is ambiguous between two or more underlying representations.
3. CHOICE, reanalysis of a sound pattern due to a difference between speaker and listener in which of a set of surface variants is considered primary.

Tonogenesis in Evolutionary Phonology

Of these three, two are primarily involved in tonogenesis.

2. CHANCE: segmental features (such as VOT) may have pitch perturbations or other phonetic effects that dominate a larger domain in the speech stream than the segment itself. This feature may be reanalyzed as a long-domain feature phonologically.

   An example of this would be languages where onset laryngeal features were reanalyzed as tone due to the pitch perturbations ni their articulation.

Tonogenesis in Evolutionary Phonology

Of these three, two are primarily involved in tonogenesis.

3. CHOICE: features that are reanalyzed as tone often have a range of surface variants, some of which are more prone to reanalysis than others.

   For example, languages with a voicing contrast may not maintain voicing during the closure of every token with a voiced stop. If a token where stop voicing may not be present but there is a noticeable pitch perturbation is taken as primary, the contrast may be reanalyzed as tone.

Evolutionary Phonology

Evolutionary Phonology model with example from Utsat *$t\underset{\cdot\cdot}{u}ʔ$ > tuʔ$^{[HL]}$ “cough”:

Speaker		Listener
/[tuʔ]$_{\sigma}^{[\text{breathy voice}]}$/		/[t$\underset{\cdot\cdot}{u}$ʔ]$_{\sigma}^{[H\ L]}$/
↓1		↑3
[[t$\underset{\cdot\cdot}{u}$ʔ]$_{\sigma}^{[L\ XL]}$...]$_{Vi}$	2→	[[t$\underset{\cdot\cdot}{u}$ʔ]$_{\sigma}^{[L\ XL]}$...]$_{Vj}$

In this model, a monosyllable in the breathy voice register with a coda glottal stop is reanalyzed as the same segmental sequence with a falling tone.

The process happens in three steps.

Evolutionary Phonology

CHANCE model with example from Utsat *$t\underset{\cdot\cdot}{u}ʔ$ > tuʔ$^{[HL]}$ “cough”:

Speaker		Listener
/[tuʔ]$_{\sigma}^{[\text{breathy voice}]}$/		/[tṳʔ]$_{\sigma}^{[H\ L]}$/
↓1		↑3
[[tṳʔ]$_{\sigma}^{[L\ XL]}$...]$_{Vi}$	2→	[[tṳʔ]$_{\sigma}^{[L\ XL]}$...]$_{Vj}$

1. The UR is filtered through phonological rules and uttered. Because of the breathy voice and glottal stop, the pitch contour starts low and dips to extra-low at the end.
2. The listener perceives the speech stream correctly.

Evolutionary Phonology

CHANCE model with example from Utsat *$t\underset{\cdot\cdot}{u}ʔ$ > tuʔ$^{[HL]}$ “cough”:

Speaker		Listener
/[tuʔ]$_{\sigma}^{[\text{breathy voice}]}$/		/[t$\underset{\cdot\cdot}{u}$ʔ]$_{\sigma}^{[H\ L]}$/
↓1		↑3
[[t$\underset{\cdot\cdot}{u}$ʔ]$_{\sigma}^{[L\ XL]}$...]$_{Vi}$	2→	[[t$\underset{\cdot\cdot}{u}$ʔ]$_{\sigma}^{[L\ XL]}$...]$_{Vj}$

3. The listener reanalyzes the phonetic material, associating a falling HL tone with the lexical item.

But why should an H tone be phonologized from a phonetic environment with **no H tone**? Phonologized material should correspond to some feature in the input.

4 – Phonologization in Utsat and its implications for the representation of tone

Implications for phonological representation

According to the autosegmental analysis of contour tones, the Utsat falling tone is an [H L] contour.

However, no high-pitch environment was present at the time of phonologization.

Utsat tonogenesis patterns as a **natural sound change** if the phonologized feature is not assumed to be *tone height* but the negative *tone differential.*

- In this case, a *falling* F_0 contour at the phonetic level is phonologized as a phonological *falling* tone.

This suggests that there *is* a need to accommodate unitary contour tones in the grammar.

How can both autosegmental contours and unitary contour tones be represented?

Adapting the autosegmental model

One way would be to allow for targets within a contour to be relative along some parameter. This way, the relationship between targets within a contour can be maintained even if targets are unspecified. Ex:

	Autosegmental Phonology	
	Goldstein 1976	Macaulay 2014
	$[T_1\ T_2]$	$[(T_1)\ Op_f\ (T_2)]$
Utsat falling tone	[H L]	$[\quad >_{tone}\ (L)]$

Revised EP model of falling tone

Adapted CHANCE model with example from Utsat *$t\underset{\cdot\cdot}{u}ʔ$ > tuʔ$^{[HL]}$ “cough”:

Speaker		Listener
/[tuʔ]$_{\delta}$$^{[\text{breathy voice}]}$/		/[t$\underset{\cdot\cdot}{u}$ʔ]$_{\delta}$$^{[\text{ >tone (L)}]}$/
↓1		↑3
[[t$\underset{\cdot\cdot}{u}$ʔ]$_{\delta}$$^{[L\ XL]}$...]$_{Vi}$	2→	[[t$\underset{\cdot\cdot}{u}$ʔ]$_{\delta}$$^{[L\ XL]}$...]$_{Vj}$

1. Using relative targets allows for targets to be unspecified.
2. In this case, what is phonologized is the relative tone height within the contour.
3. This allows for a falling tone to be phonologized without having discrete H and L targets in the original phonetic environment.
4. No element is phonologized that was not present in the original phonetic environment.

Conclusions

Relativity and underspecification of targets allows for contours to be phonologized from phonetic environments that do not necessarily contain the same targets.

- In Utsat, a falling "HL" tone was phonologized when there was no H tone in the original phonetic environment.
- This process is better represented by what the phonetic environment and phonologized tone have in common: a **fall** in F_0/tone height.

This may be a useful tool for other types of contours that have resisted representation with fully-specified targets.

- For example, what is the structure of diphthongs? English /ai~aɪ~aj/ etc.

Conclusions

Sound change gives insight to phonological structures referenced by speakers during phonologization. These structures coexist with structures evidenced by synchronic phenomena.

An efficient model of synchronic phonology may not be the result of phonetically-natural sound change. For this reason, both synchronic and diachronic evidence are important tools for investigating the structure of synchronic phonology.

Evidence from the diachrony can give insight to the structure of languages that lack traditional sources of evidence such as isolating languages.

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Thank you!

Please ask questions!