

Yu, Kristine M. (2024). "The obligatory boundary tone hypothesis and prosodic typology". Speech Prosody 2024, Universiteit Leiden, The Netherlands, July 5, 2024. Keynote Address.

Note: slightly edited after presentation to include more citations.

See also [Yu \(2024\) SP24 proceedings](#), not identical but closely related

References cited throughout slides are clickable links; reference list also in appendix.

THE OBLIGATORY BOUNDARY TONE HYPOTHESIS AND PROSODIC TYPOLOGY

Kristine M. Yu

University of Massachusetts Amherst

Speech Prosody 2024, Universiteit Leiden

July 5, 2024

HARTELijk BEDANKT!!!

SP2024
Leiden

CHUNKS IN BENGALI

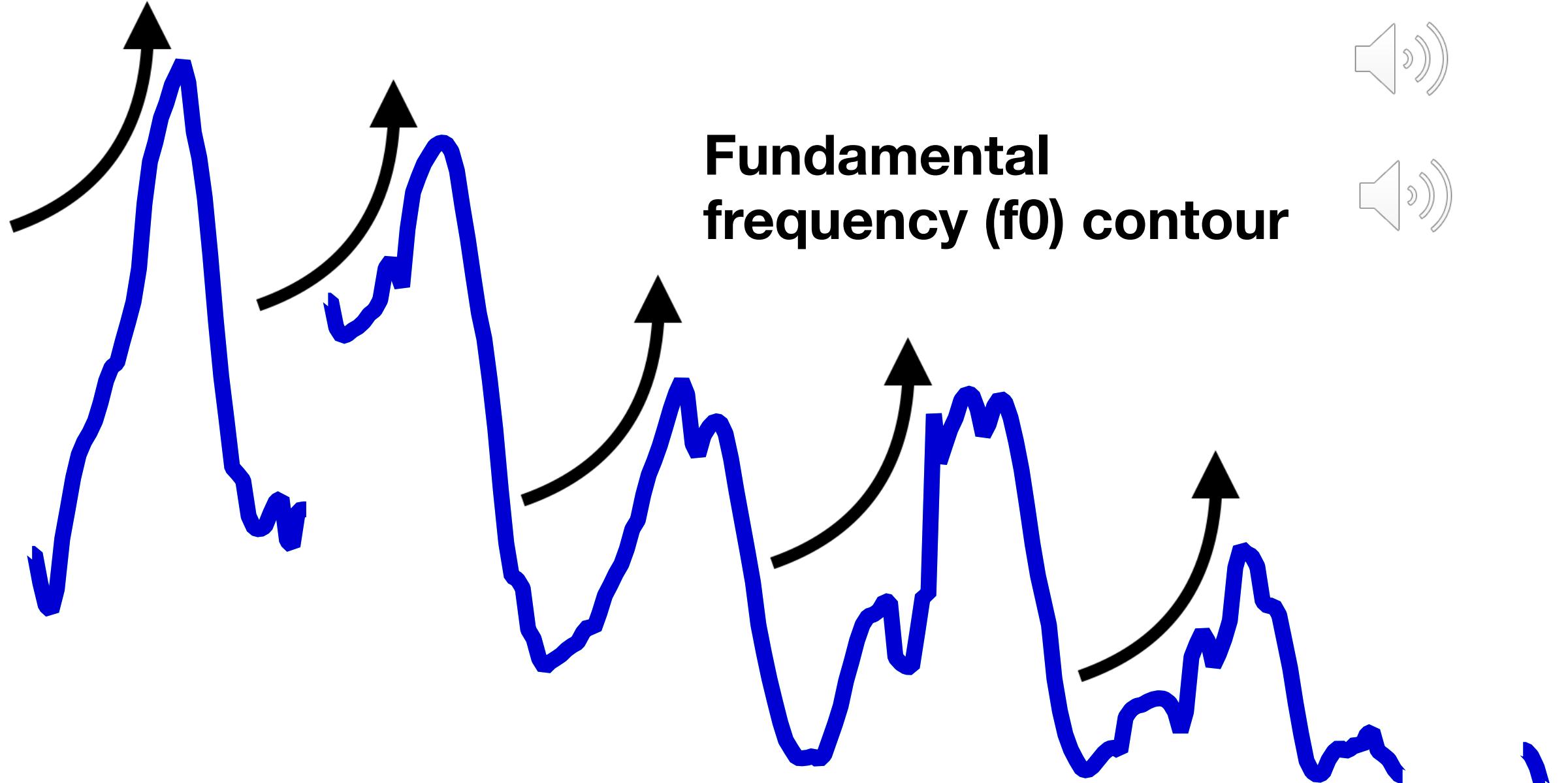


rumu nepaler ranir malider namgulo mone rakhte pare ni.

‘Rumu couldn't remember the names of the gardeners of the queen of Nepal.’

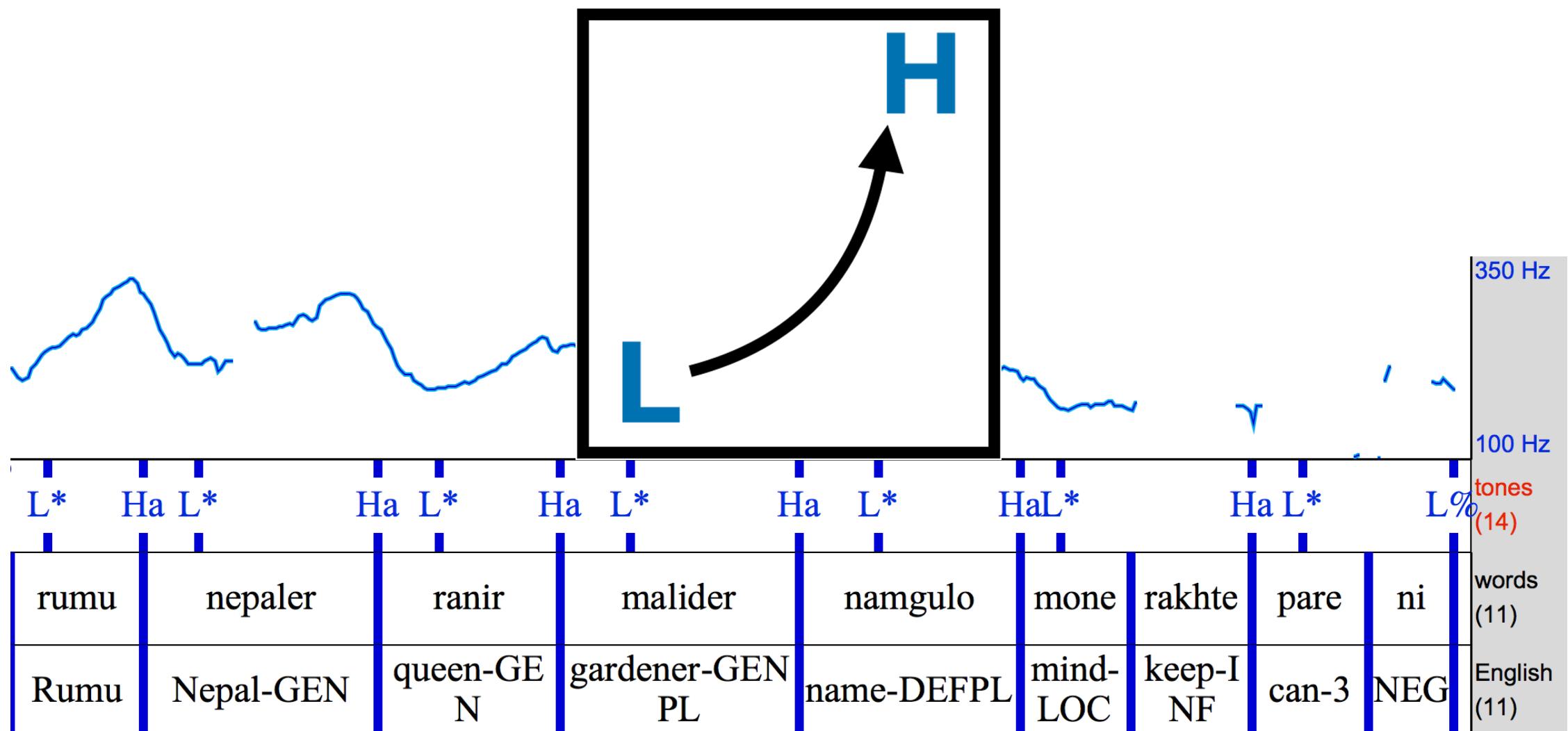
Khan ([2008](#), [2014](#), et seq.)

<https://www.reed.edu/linguistics/khan/B-toBI/>

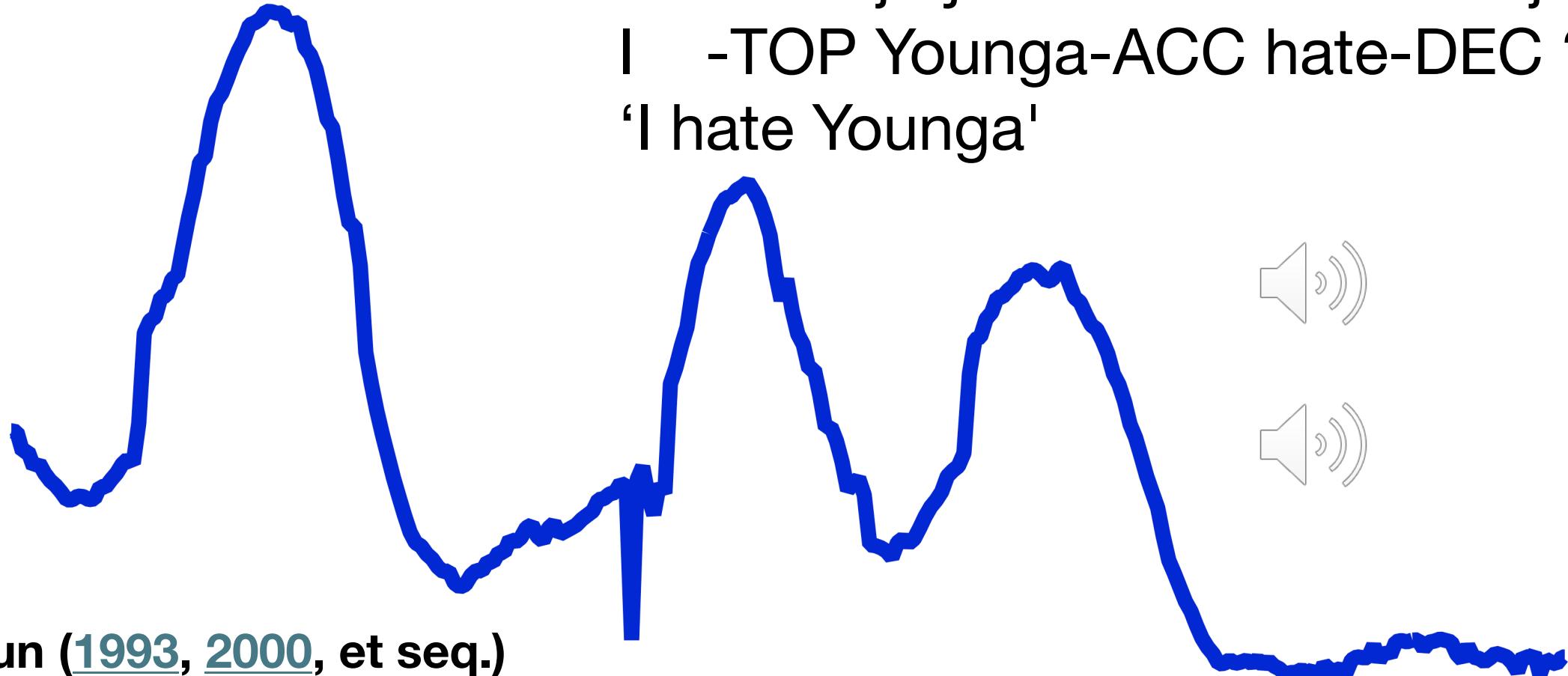


<https://www.reed.edu/linguistics/khan/B-toBI/tones.html#downtrend>

GENERALIZATION: TONES DELIMIT CHUNK



CHUNKS IN SEOUL KOREAN

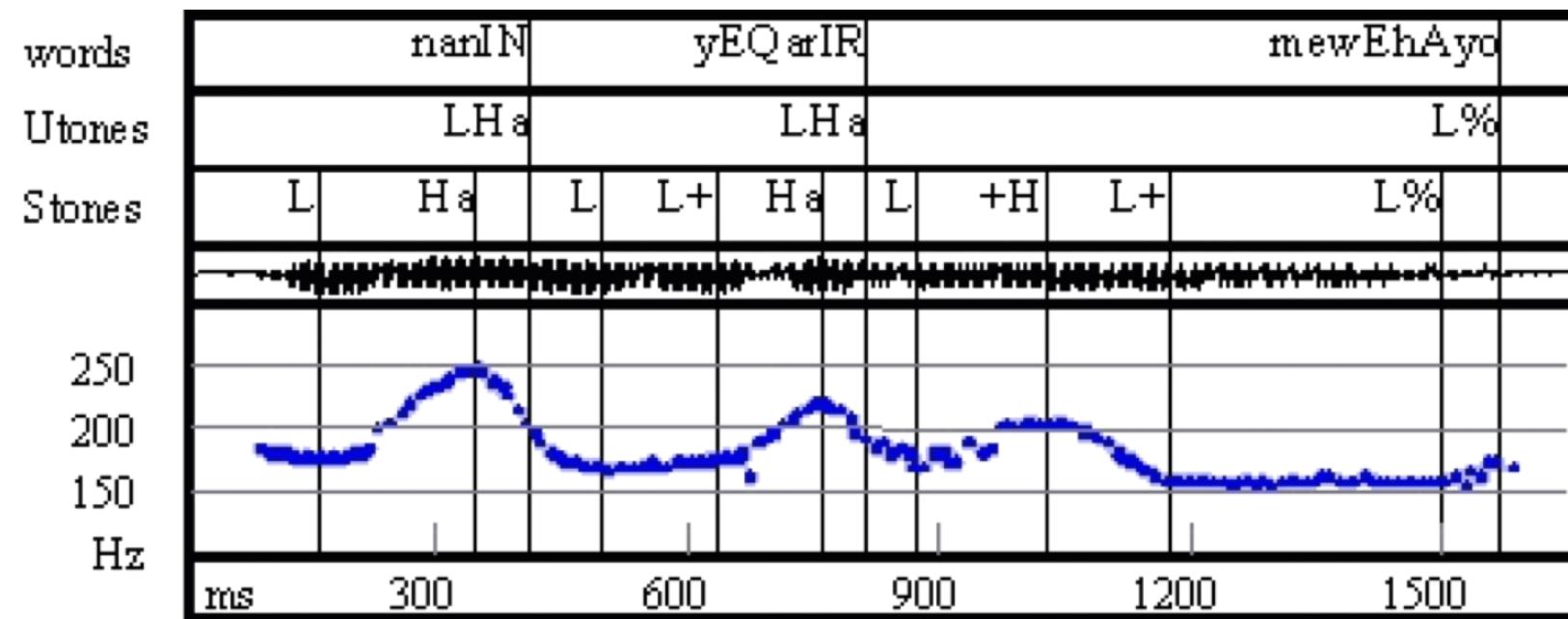
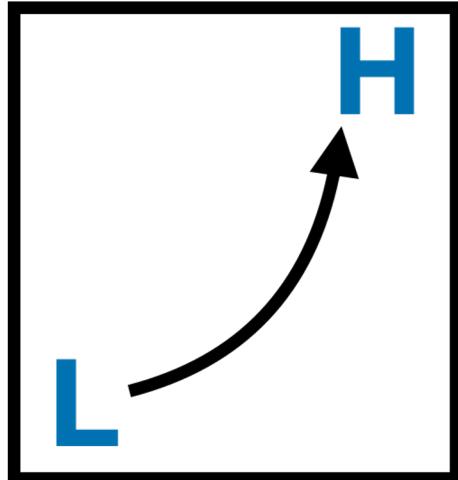


GENERALIZATION: TONES DELIMIT CHUNK

An “intonationally defined prosodic unit”

([K-ToBI guidelines](#), Jun 2000)

“The Accentual Phrase has a tonal pattern demarcating the beginning and the end of the phrase” ([Jun 1993](#))

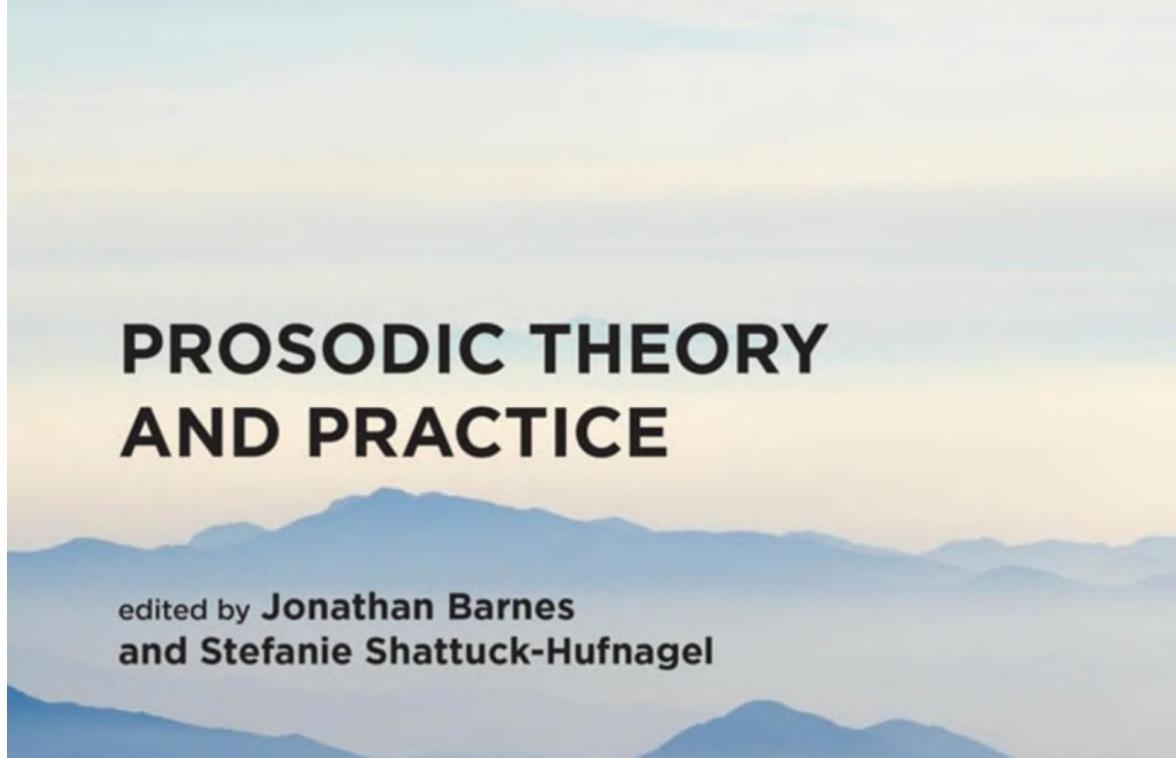


THE OBLIGATORY BOUNDARY TONE HYPOTHESIS

A span of segmental material is a phonological constituent if and only if it is delimited by at least one boundary tone.

THE OBLIGATORY BOUNDARY TONE HYPOTHESIS

Tacit assumption in practice of Autosegmental-Metrical (AM) prosodic analyses?



[Open access link to Prosodic Theory and Practice](#)

See Yu (2022) book review in Phonology

ROADMAP

1

The clustering hypothesis: beyond tonal patterns

2

Motivating the obligatory boundary tone hypothesis: is tone “different”?

3

Dangers of the obligatory boundary tone hypothesis: biases and opportunities

PROSODIC CHUNKS AND THE CLUSTERING HYPOTHESIS

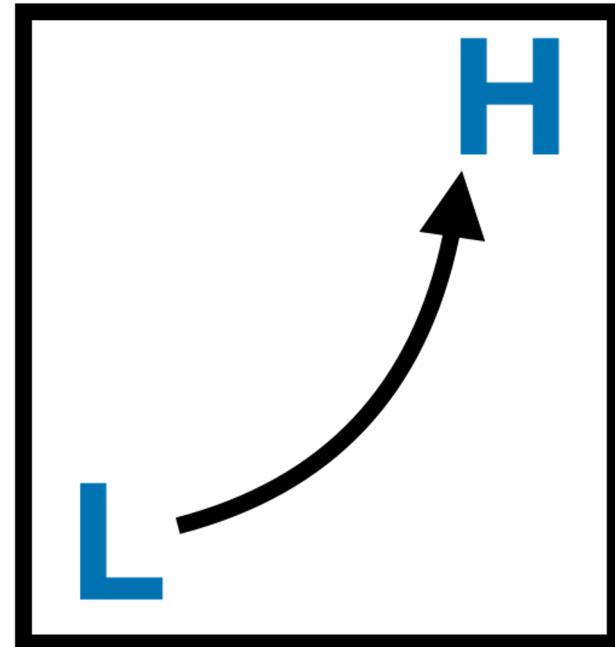
TWO CHUNKINGS IN KOREAN



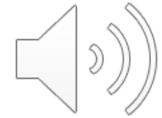
/kon.sa.ka.ta.man.ha.ta/



From [Cho \(2022\)](#), Example (1)



[Seung Suk \(Josh\) Lee](#)



/koŋ.sa.ka.ta.man̩.ha.ta/



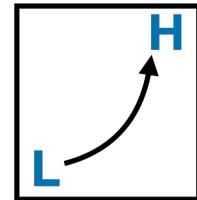
‘(Someone) is very busy with various public and private matters’



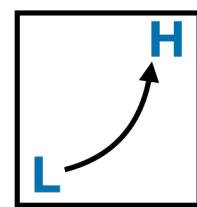
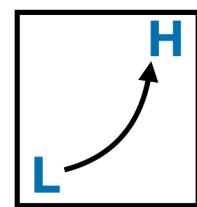
‘(Things) are messed up while going to a construction site’



All clipart from
www.irasutoya.com/ 13



L kon.sa.ka H ta. man̩.ha.ta



L kon.sa H ka. ta. H man̩.ha.ta



LENIS STOP VOICING (KOREAN)



kon.sa.**ga**.ta.man.ha.ta



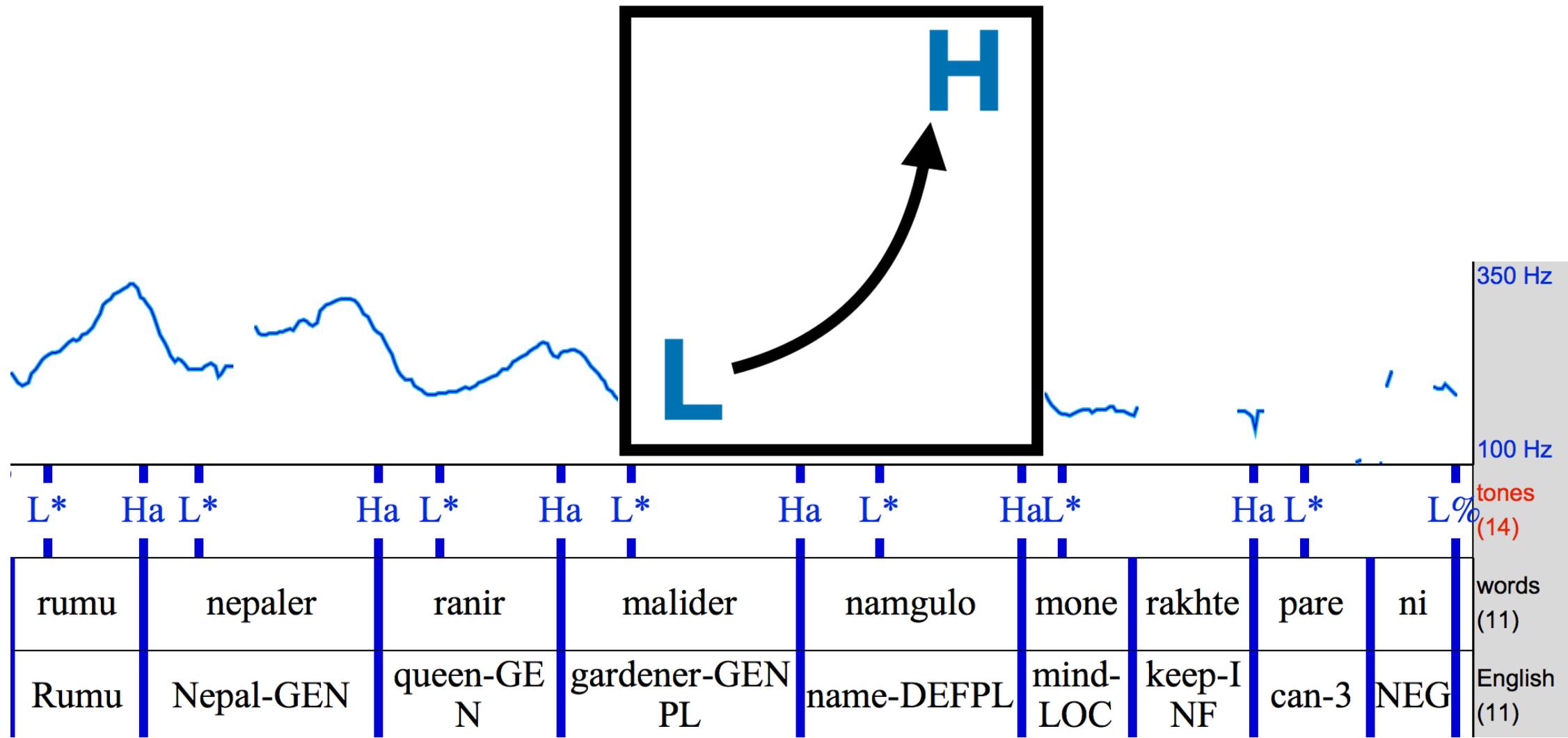
kon.sa.**ka.****da**.man.ha.ta



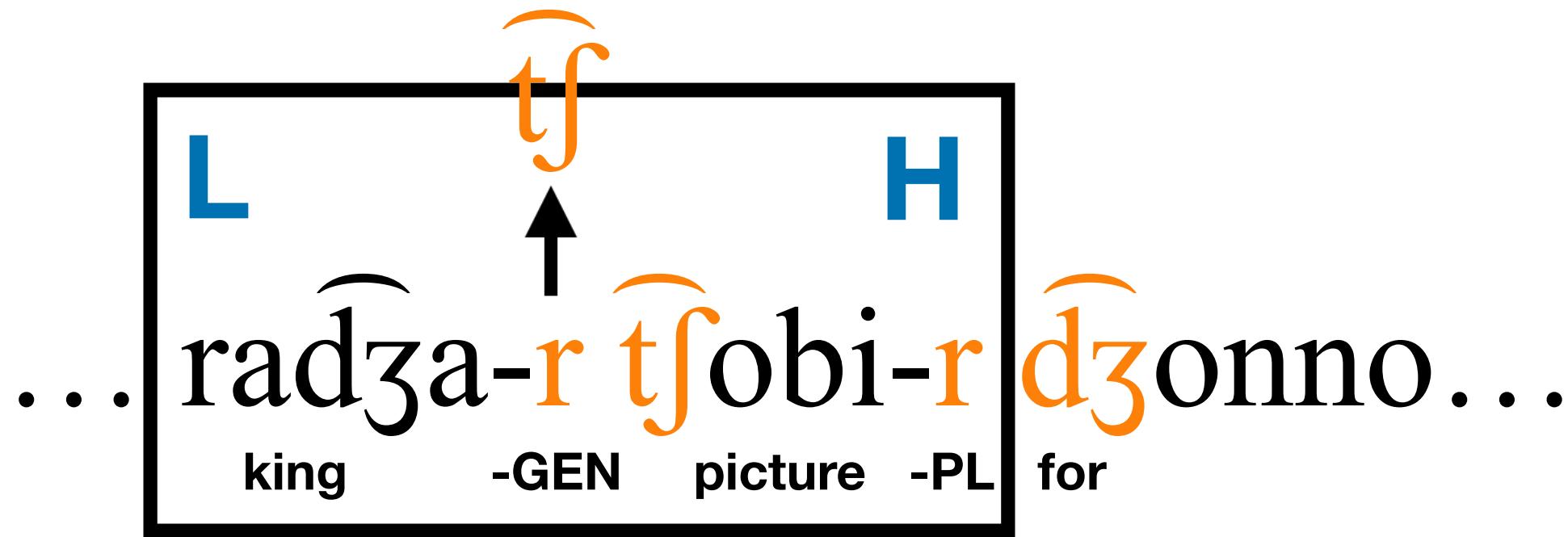
See [Jun \(1993, p. 77\)](#) and refs therein



BENGALI: TONES DELIMIT CHUNK



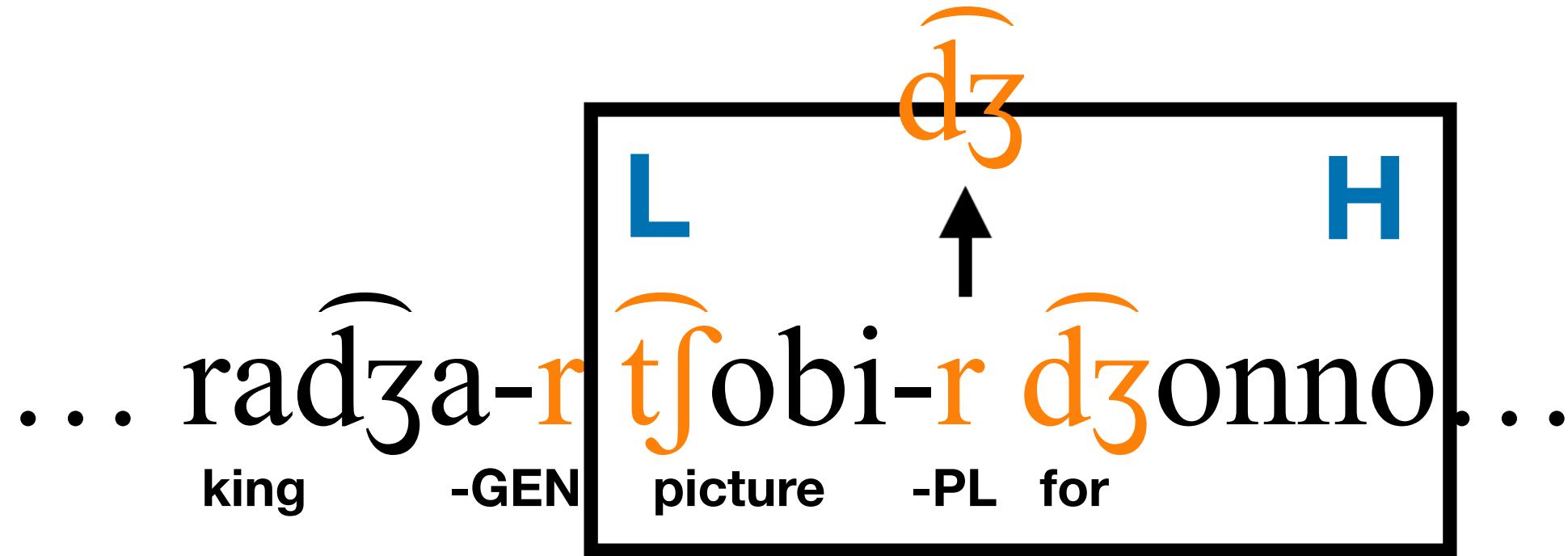
SAME CHUNKS BOUND SEGMENTAL PROCESSES!



/r/ assimilates to following coronal consonant
only when both inside same tonal chunk

Hayes and Lahiri (1991, (49-50)) on Kolkata Bengali

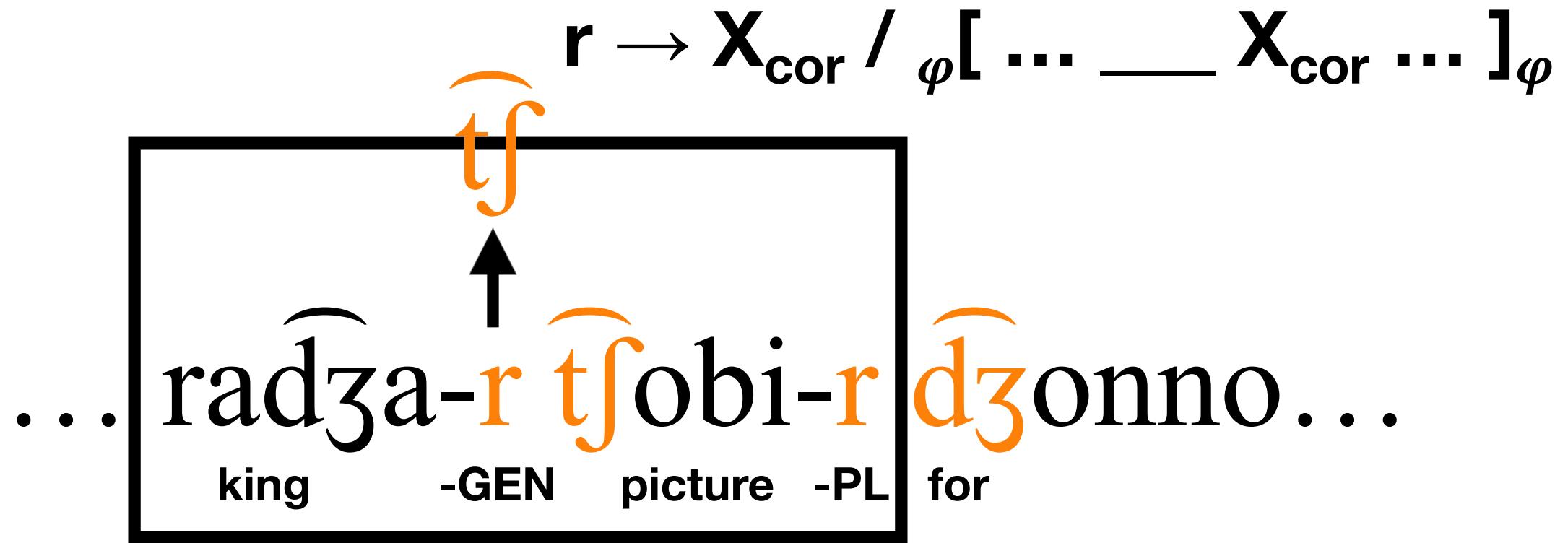
SAME CHUNKS BOUND SEGMENTAL PROCESSES!



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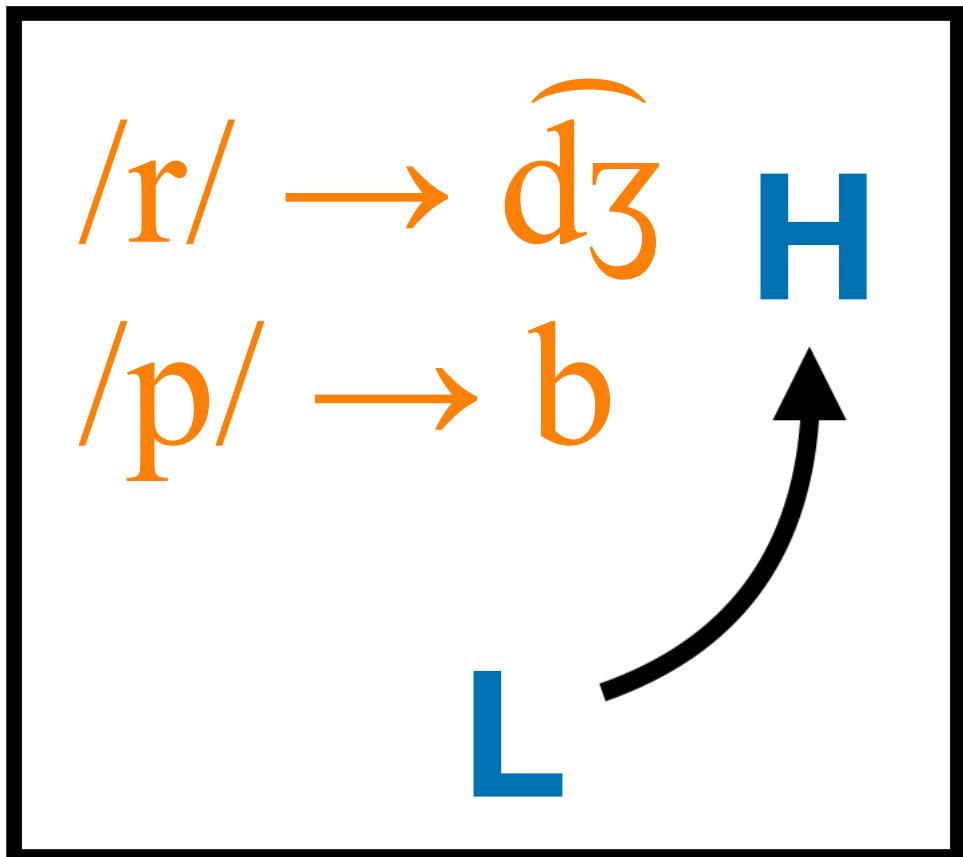
SANDHI RULES: DOMAIN SPAN RULE



**/r/ assimilates to following coronal consonant
only when both inside same tonal chunk**

(Rule types: Selkirk 1980, [Vogel 1985](#), Hayes 1989, p. 202-203)

THREE CHUNK-BASED PHONOLOGICAL GENERALIZATIONS



- rising f0 melody
- /r/-assimilation
- voicing assimilation

*Converging
evidence!*

CHUNKING SENSITIVE TO SPEECH RATE



L ɔmor	H tʃador	L tara-ke	H dietetse
Amor	scarf	Tara - OBJ	gave



L ɔmo	tʃ	tʃador	H L tara-ke	dietetse
----------	----	--------	-------------------	----------

L ɔmor	H tʃado	t tara-ke	H dietetse
-----------	------------	--------------	---------------

L ɔmo	tʃ	tʃado	t tara-ke	H dietetse
----------	----	-------	--------------	---------------

Hayes & Lahiri (1991, (54a))

CHUNK = PHONOLOGICAL CONSTITUENT

1

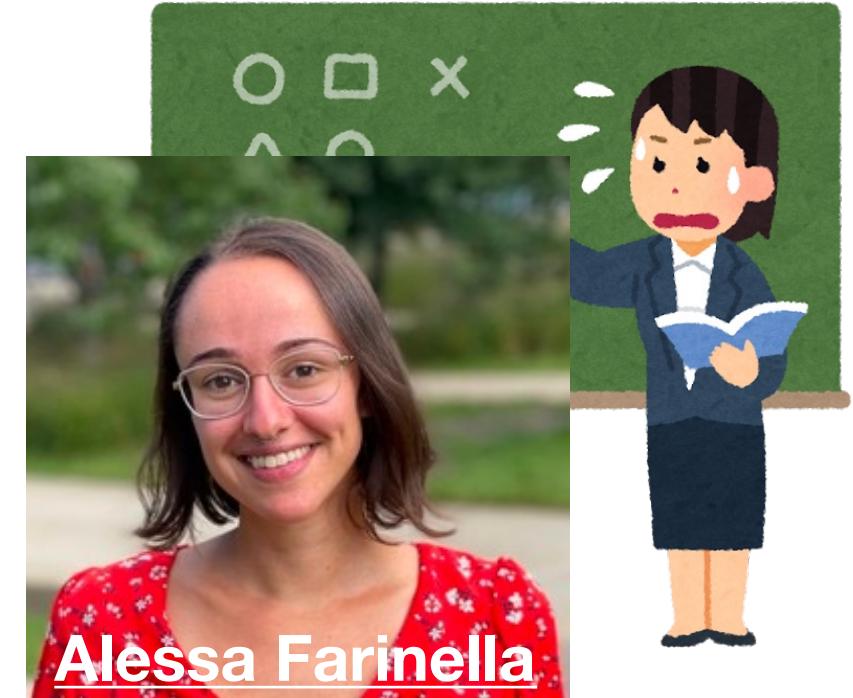
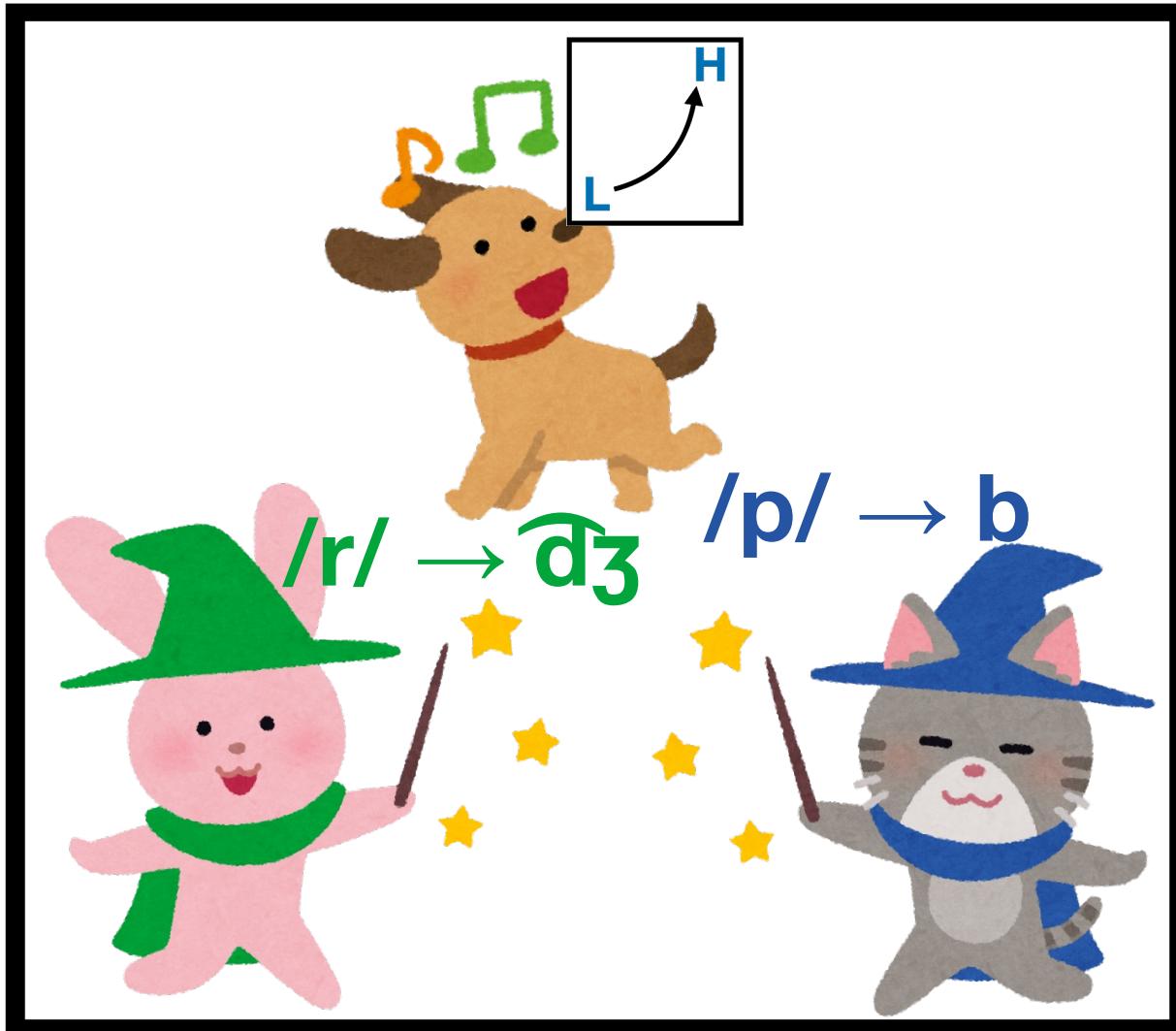
Phonological patterns cluster on the same chunk span/edges (tonal melody, segmental assimilation)

2

Not clear how chunks can be identified as *morphosyntactic* in a natural way* (insensitive to syntactic categories, sensitive to factors like speech rate, length)

* but see proposals like a more flexible syntax, e.g., [Wagner \(2010\)](#) and phase-based approaches, e.g., [Pak \(2008\)](#)

PHONOLOGICAL PATTERNS CLUSTER



*Motivation for
prosodic
constituents!*

1981

Selkirk (1978/1981, p. 136)

ON PROSODIC STRUCTURE AND ITS RELATION TO SYNTACTIC STRUCTURE

Elisabeth O. Selkirk

There is thus a whole complex of phonological phenomena which take the intonational phrase as their domain. The intonational phrase is not merely that sequence over which an intonational contour is distributed; it is a rhythmic entity as well, and one which has a special status with respect to other segmental and suprasegmental rules. This means of course that where one finds variable phrasing, one expects to encounter the entire host of related phenomena working in tandem: if the corresponding to the subject noun phrase is an I, it will have an intonational melody associated with it, have prepausal lengthening at the end, and so on. By postulating the I as a structural unit, as a category of prosodic structure which defines a particular type of domain, one expects this sort of correspondence of seemingly disparate phenomena. The convergence is, in this sense, explained. It should go without

Elisabeth O. Selkirk

66 ***There is thus a whole complex of phonological phenomena which take the intonational phrase as their domain....***



Selkirk (1978/1981, p. 136)

Nordic Prosody II, ed. Thorstein Fretheim.

Tromsø: TAPIR, 111-140.

1981

ON PROSODIC STRUCTURE AND ITS RELATION TO SYNTACTIC STRUCTURE

Elisabeth O. Selkirk

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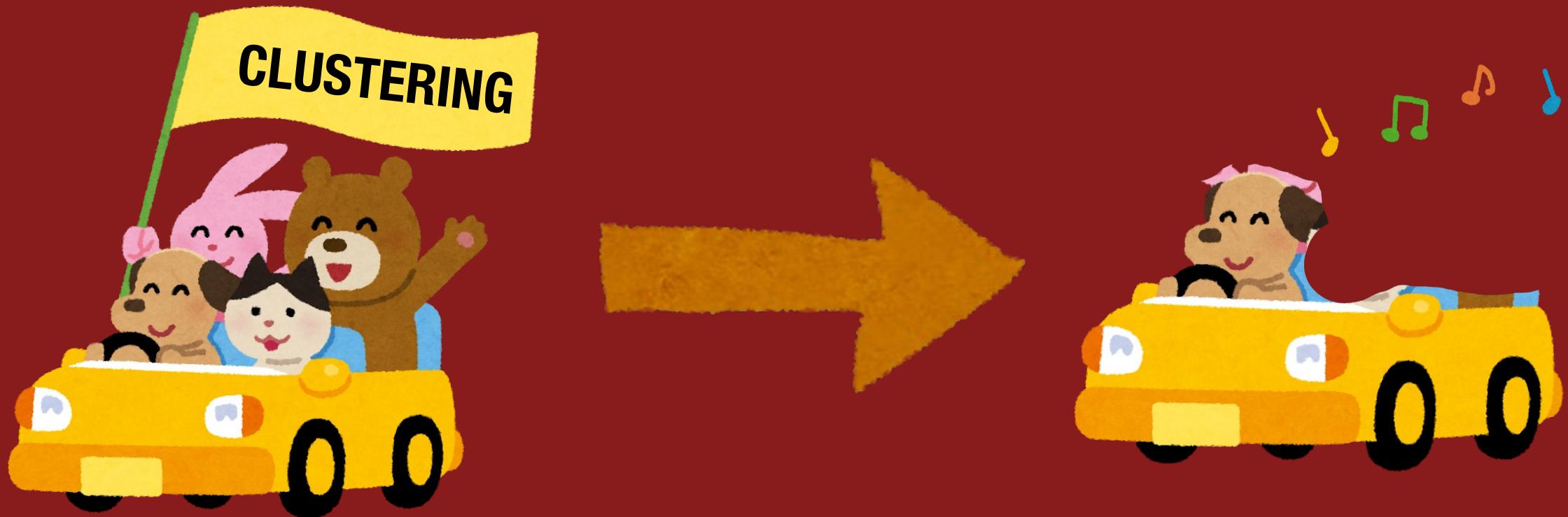
By postulating the [intonational phrase] as a structural unit, as a category of prosodic structure which defines a particular type of domain, one expects this sort of correspondence of seemingly disparate phenomena. The convergence is in this sense, explained.

99

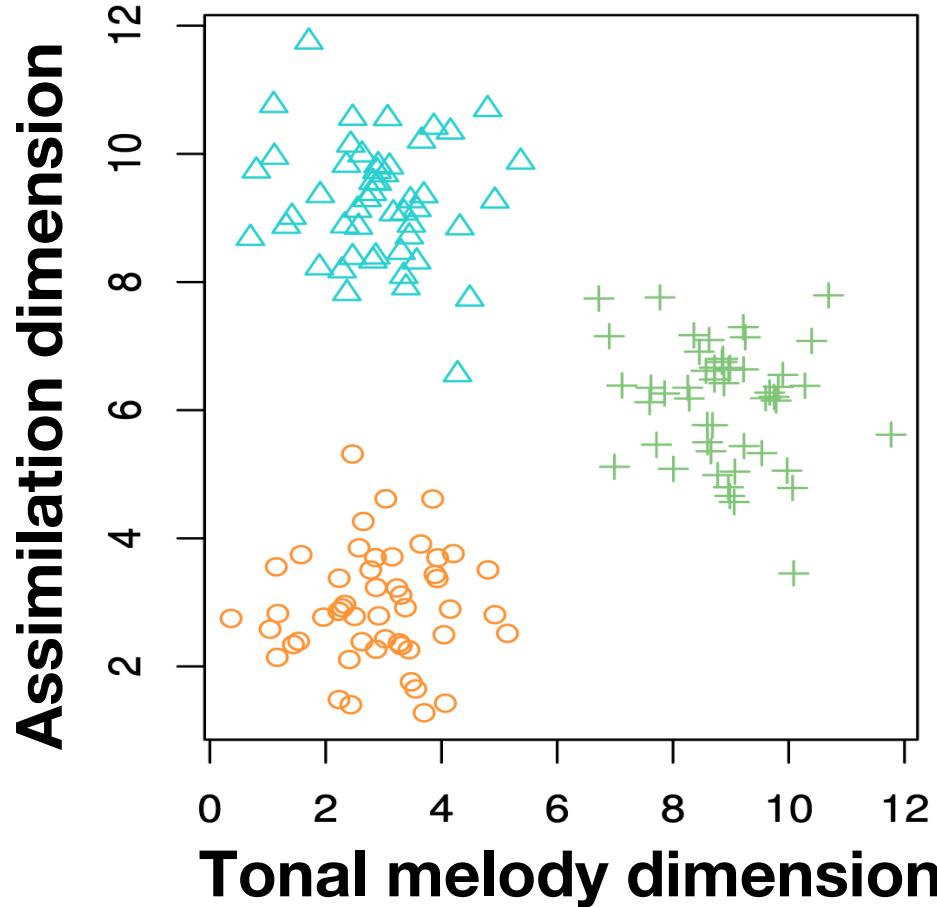
See also Hayes (1988, 1990), Pierrehumbert & Beckman (1988), Inkelas (1989), Raffelsiefen (2005), Bickel et al. (2009), Schiering et al. (2010) i.a.



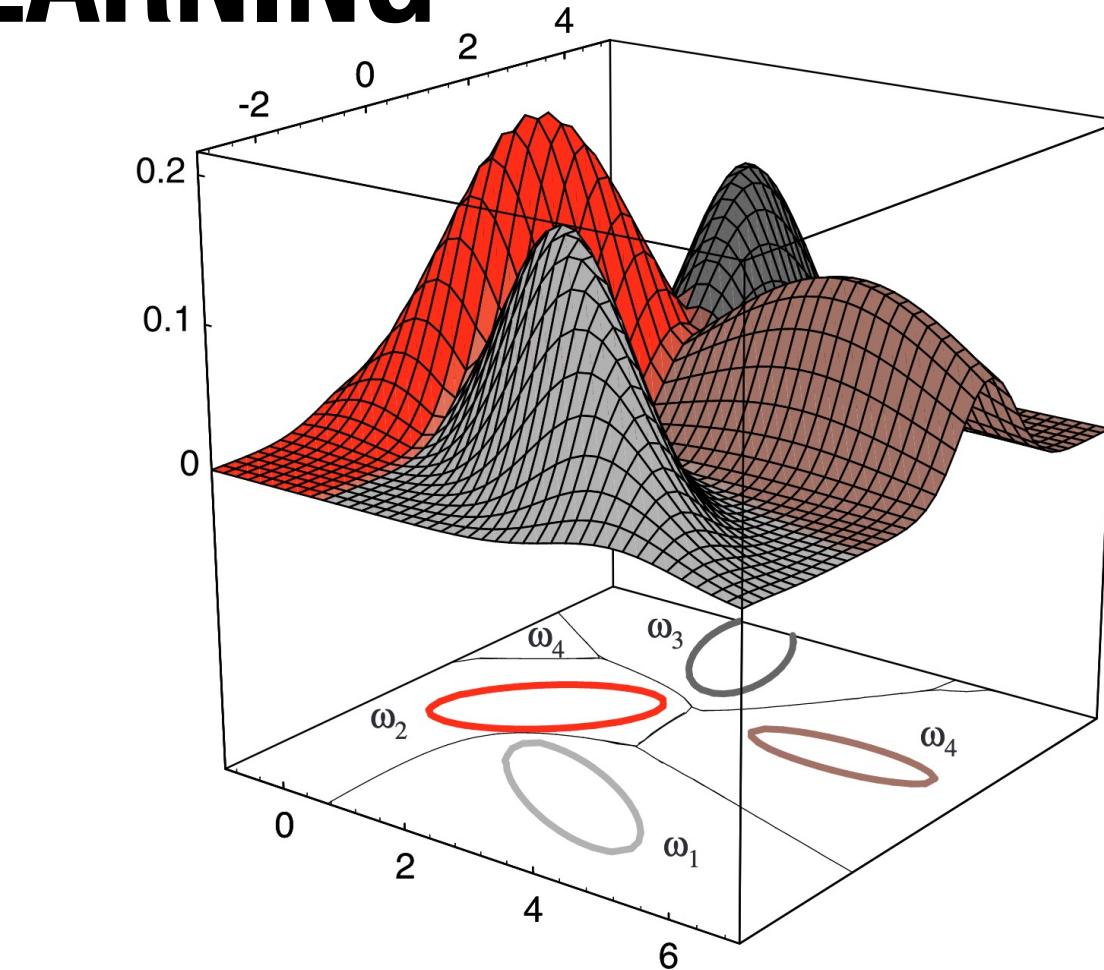
CHALLENGES TO THE CLUSTERING HYPOTHESIS: THE RISE OF TONE POWER



INFERRING CHUNK TYPES FROM CLUSTERS: DISTRIBUTIONAL LEARNING

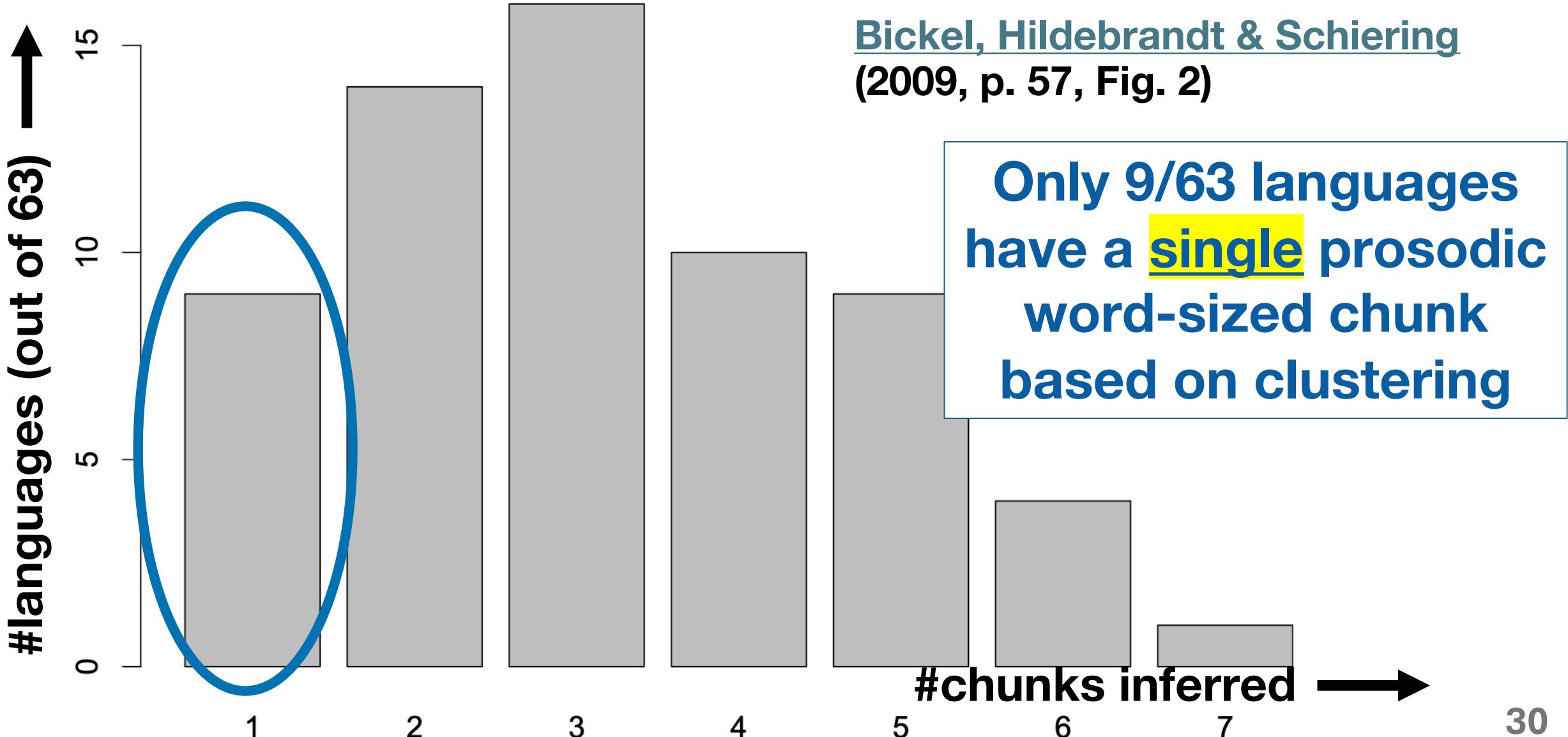


Adapted from [James et al. 2021](#)
Fig. 2.8, p. 27



[Duda, Hart, and Stork \(2001, Fig. 2.16\)](#) [pdf]

CHUNK INFERENCE \Rightarrow CHUNK PROLIFERATION



CHUNK INFERENCE \Rightarrow CHUNK PROLIFERATION

The facts on the ground: Limbu (Kiranti, Sino-Tibetan)

P

Phrase: voicing assimilation, e.g. /p/ \rightarrow [b]

I

pe:kma? bo:n 'it's time to go'

ω

Slide from Bickel et al. (2007)

ϕ

Foot: trochaic rhythm (secondary stress)

|

?a?'oŋ, ne: 'my brother in law!'

σ

Syllable: C(G)V(C)

WHAT HAPPENED TO THE SEGMENTS?



2007 foreword to reprint of Nespor and Vogel (1982)
Prosodic Domains and External Sandhi Rules

While the Intonational Phrase was originally proposed in the present work as a domain for the application of phonological rules, it subsequently became identified as the domain over which intonation contours are spread (e.g. Nespor – Vogel [1986]). It is particularly **with regard to the intonation contours that the interest in this domain expanded.**



GROWTH OF INTONATIONAL APPROACH: INTONATIONAL PROSODIC HIERARCHY

- “**Intonational approach**” (discussion in [Jun 1998](#), [Frota 2000](#)): intonation gets privileged status in defining prosodic constituents, i.e. “**tone-first**”
 - [Pierrehumbert \(1980\)](#), [Beckman \(1986\)](#), [Beckman & Pierrehumbert \(1986\)](#), [Pierrehumbert & Beckman \(1988\)](#)...
- Sometimes organization of tonal chunks proposed to be separate from other chunks (e.g., [Hyman, Katamba and Walusimbi 1987](#), [Gussenhoven 1992](#), [Gussenhoven 1990](#), [Gussenhoven and Rietveld 1992](#))

IS TONE “DIFFERENT”?

Hyman (2018), Linguistic Society of America presidential address slides



¡VIVE LA DIFFERENCE!!

THE OBLIGATORY BOUNDARY TONE HYPOTHESIS

A span of segmental material is a phonological constituent if and only if it is delimited by at least one boundary tone.



THE OBLIGATORY BOUNDARY TONE HYPOTHESIS

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THE OBLIGATORY BOUNDARY TONE HYPOTHESIS

A span of segmental material is a phonological constituent if and only if it is delimited by at least one boundary tone.

tone-first

prosodic chunk \Rightarrow tone(s) at edge

tone(s) at edge \Rightarrow prosodic chunk

tone-only

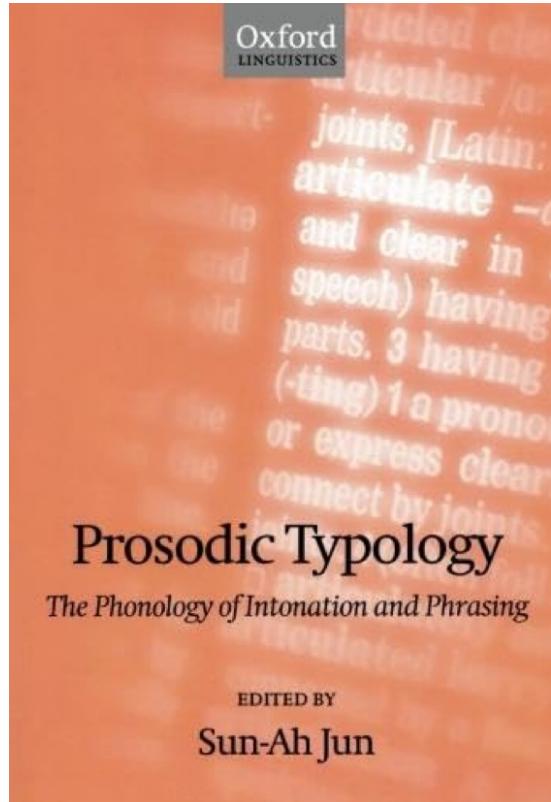
prosodic chunk \Leftrightarrow tone(s) at edge

NEGLECT OF SEGMENTAL ALLOPHONY?

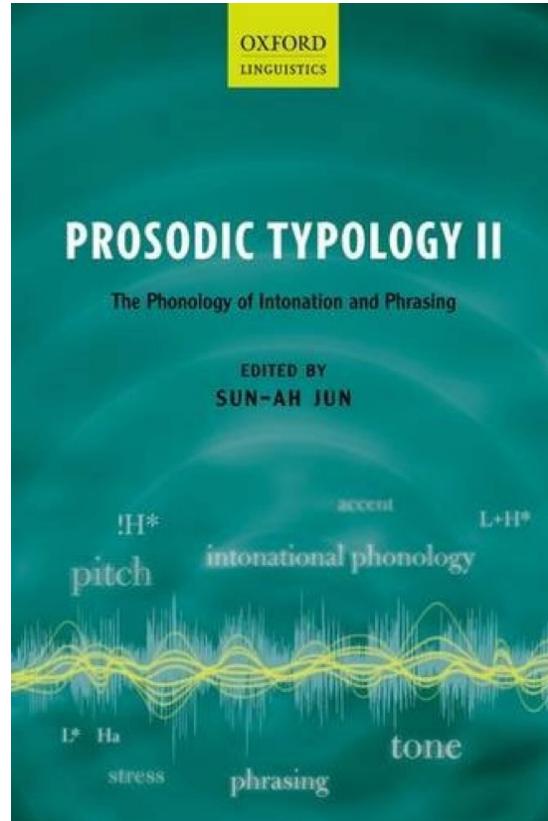
If prosodic constituents *defined* on basis of tones:

- Tonal insertion at prosodic boundaries vacuously obligatory (in contrast to segmental sandhi and other patterns)
- Less attention to documenting segmental sandhi processes

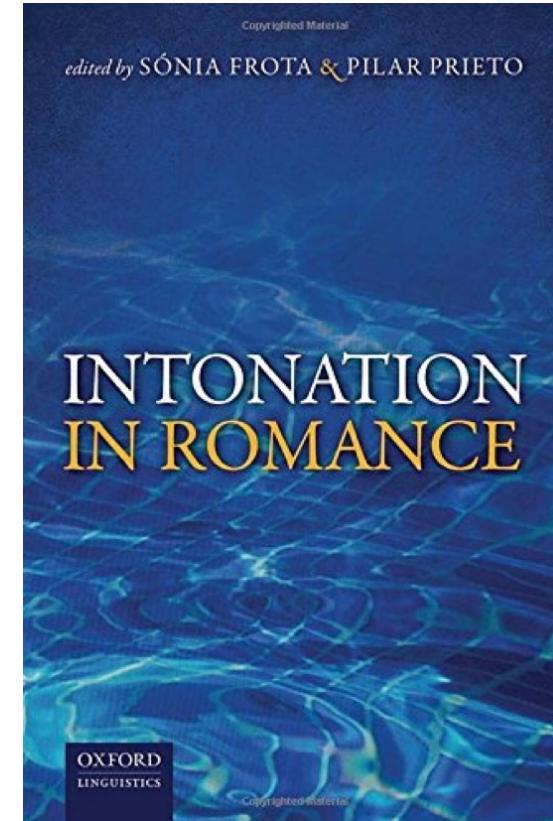
GROWTH OF INTONATIONAL APPROACH: INTONATIONAL PROSODIC HIERARCHY



Jun (2005)



Jun (2014)



Frota & Prieto (2015) 39

NEGLECT OF SEGMENTAL ALLOPHONY?

In those three prosodic typology volumes:

- About 36 contributions covering over 30 different languages (+multiple varieties thereof)
- Segmental sandhi diagnostics briefly mentioned for smallest break index juncture (within word) for Mainstream American English, Serbo-Croatian
- Some detailed discussion of segmental sandhi for Chickasaw, Greek, Korean, Portuguese, Catalan

CHALLENGES TO THE CLUSTERING HYPOTHESIS: UNRELIABLE SANDHI?



IS TONE “DIFFERENT”?

***Segmental allophony hasn't been neglected:
tone is a reliable chunk indicator, while
segmental sandhi/allophony is not.***



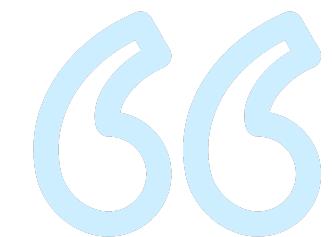
LACK OF RELIABILITY OF GREEK SANDHI

(Arvaniti & Baltazani 2005)

The examination of our own corpus allows us to make the following observations regarding sandhi. First, several types of sandhi **apply across larger constituents than has previously been suggested**... Second, the application of some rules presented in Kaisse (1985) and Nespor and Vogel (1986) **depends on the lexical items used**... Third, sandhi **does not appear to be obligatory** at any level, as Nespor and Vogel suggest about certain rules; the speaker may choose to apply a particular rule, or she may not. Finally, it appears that at least some of the rules involve **gradient, rather than categorical, changes**.

LACK OF RELIABILITY OF GREEK SANDHI

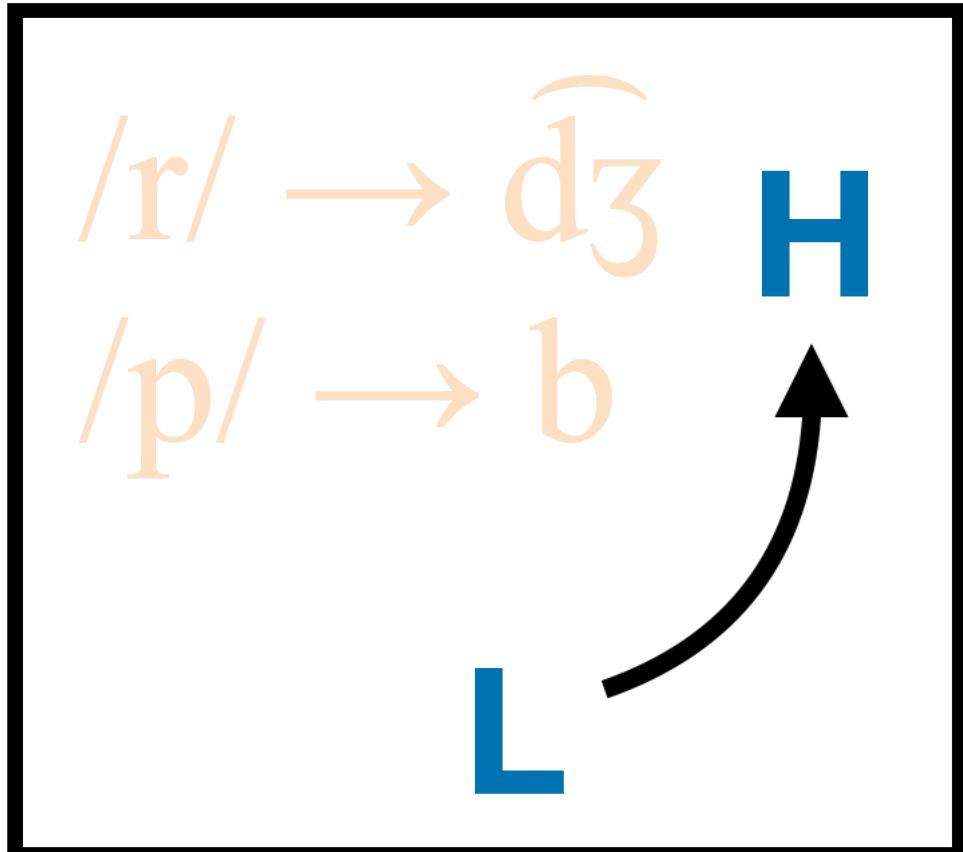
(Arvaniti & Baltazani 2005)



These findings are not surprising...they strongly suggest **the necessity of empirically re-examining** the phonological descriptions of Greek sandhi in particular, and of **the reliability of sandhi as a phrasing marker** in general.



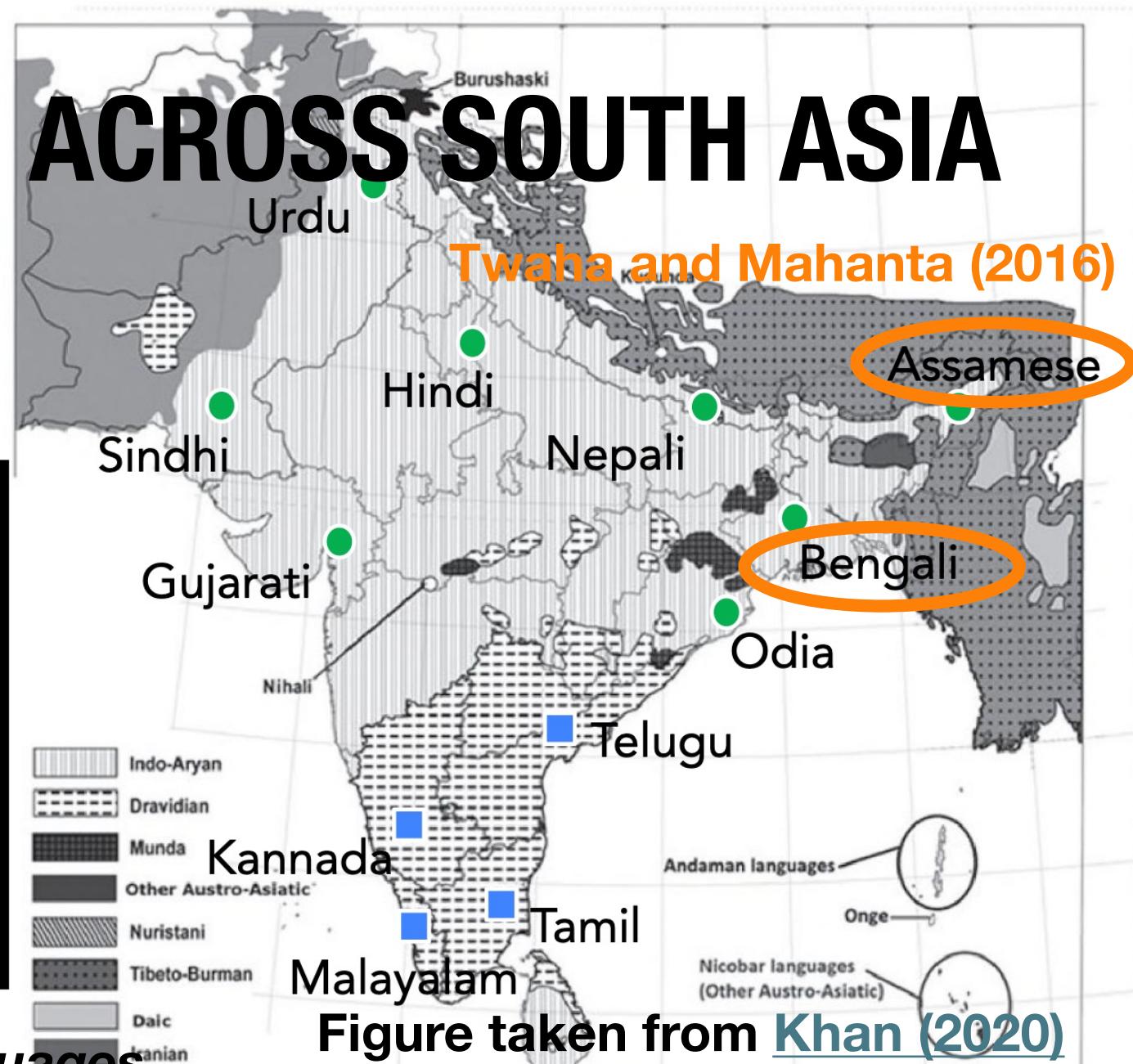
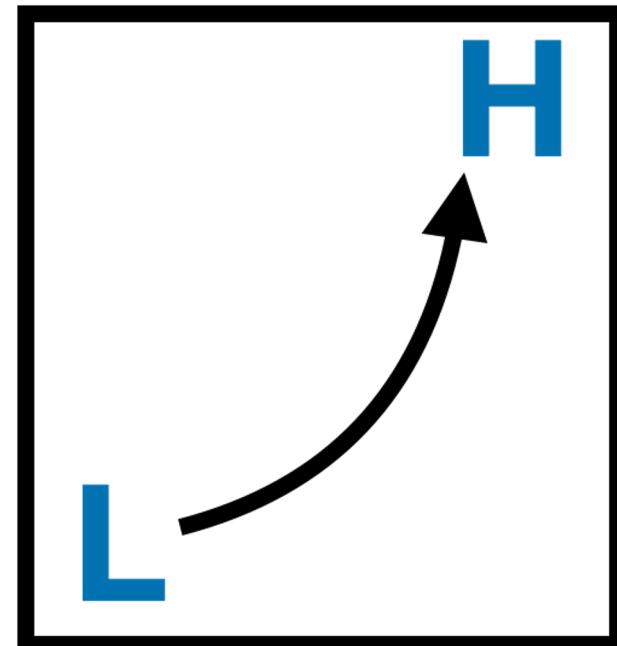
BENGALI CLUSTERING: THE FINE PRINT



- the segmental processes are “optional” in **Kolkata Bengali** ([Hayes & Lahiri 1991](#))
- “not regularly applied” at all for Khan’s speakers of **Bangladeshi Standard Bengali** ([Khan 2008](#), p. 58), and not reported on

RISING MELODIES ACROSS SOUTH ASIA

Khan (2016, 2020, et seq.) on
InTraSAL, “an intonational
model for South Asian
Languages”



See also Féry (2010) on *Indian Languages*
as *Intonational Phrase Languages*

Interactive Atlas of the Prosody of Portuguese

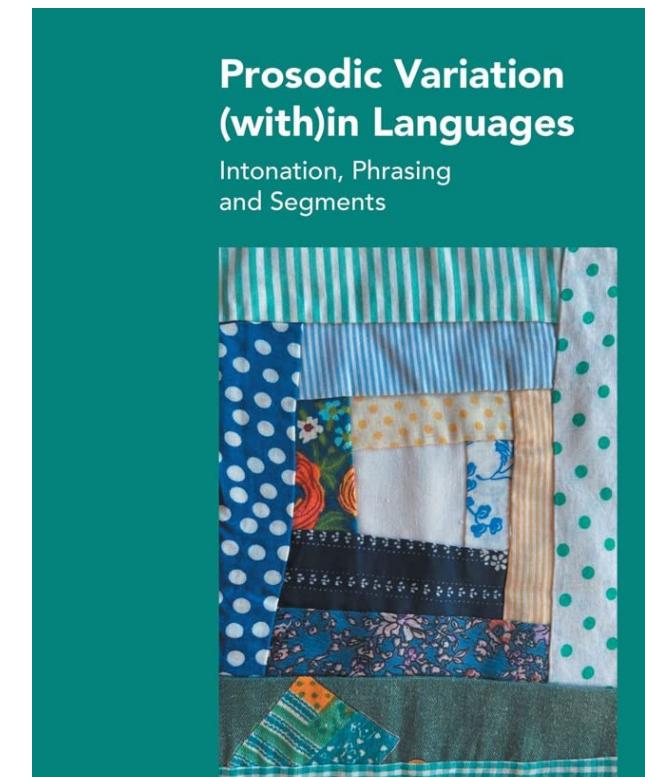
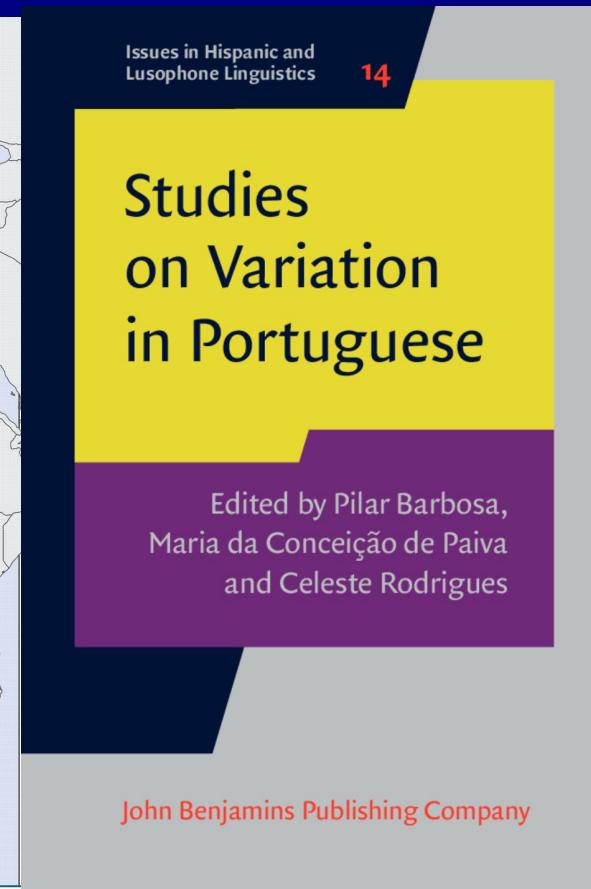
Team

Methodology

European Portuguese

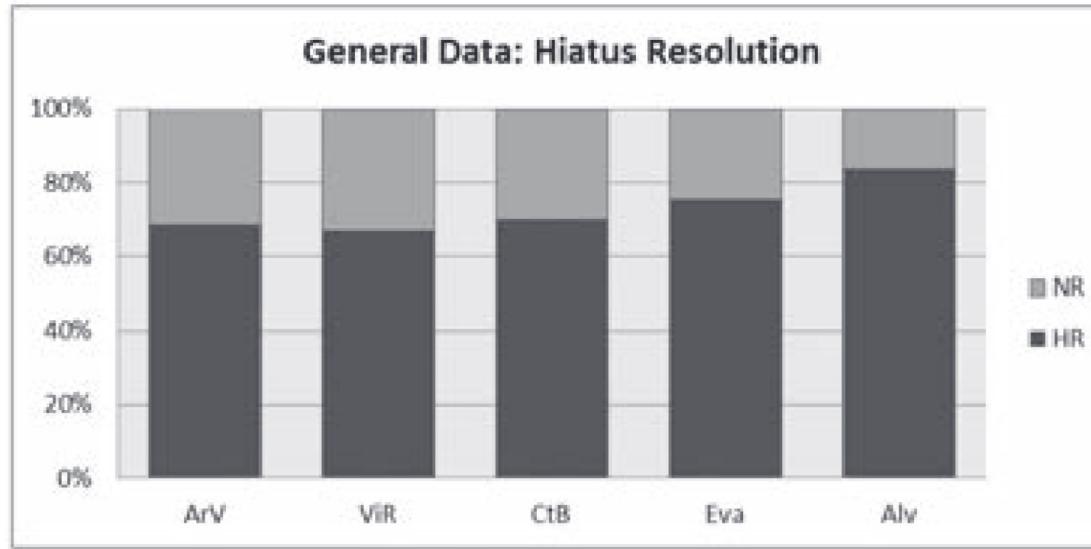
Brazilian Portuguese

Portuguese of Africa



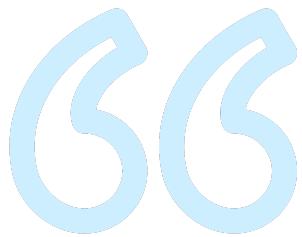
<http://labfon.letras.ulisboa.pt/InAPoP/index.html>

OPTIONALITY OF HIATUS RESOLUTION

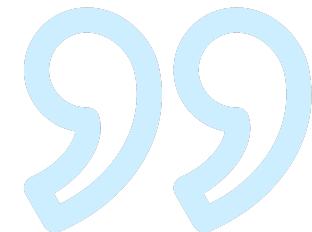


**Hiatus resolution applies (within Int. Ph.)
70-80% of the time in Eur. Portuguese**

VARIATION IN HIATUS RESOLUTION



Our data seem to support Cruz et al.'s (2017) observations that **variation in non-prosodic (i.e. segmental) features is more dependent on geography than variation of prosodic (i.e. suprasegmental) properties.**



Maps of Portugal: Cruz et al. (2017)

50

● Urban areas considered

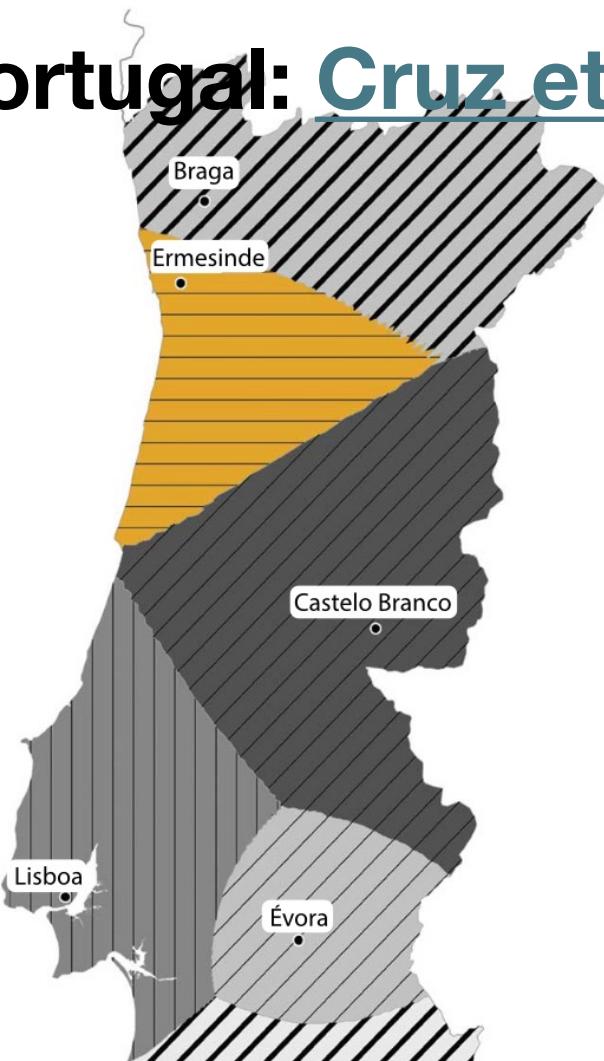
Main contour

-  L* H%
-  (H+) L* LH%
-  H+L* LH%
-  H*+L L%
-  L*+H H%

Alternative contour

Type

-  H+L* L%
-  H+L* LH%
-  L*+H HL%

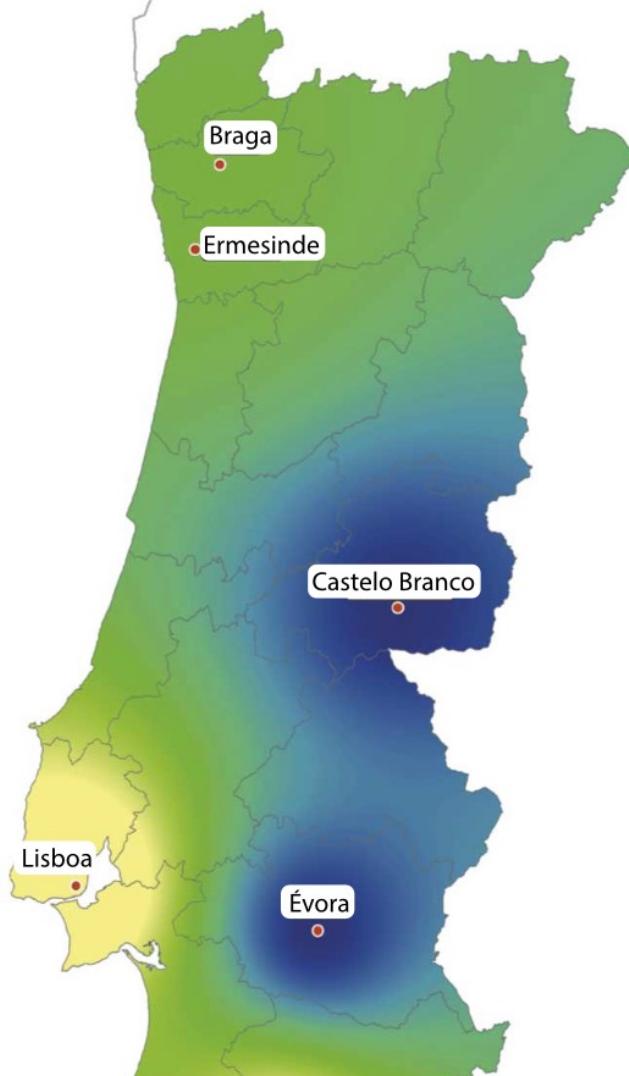


● Urban areas considered

%V* Δ%C

stress-timed

syllable-timed



Tonal patterns discontinuous, segmental ones continuous and don't match tonal ones

IS TONE “DIFFERENT”?

Tonal patterns across varieties are more robust? independent of geography? while segmental patterns are not.



LENIS STOP VOICING RULE (KOREAN): THE FINE PRINT

[-cont, -asp, -tense] [+voice] / (φ ... [+voice] ____ [+voice] ...)φ

Adapted from Jun (1993, p. 78, (3))

A Lenis stop becomes voiced
intervocally within a phonological
phrase (or accentual phrase)

Described as optional and gradient in
literature (see Jun 1993, 1994)



/p → b /

LEE (2024, LabPhon 19):

- Seoul Corpus (Yun et al. 2015)
- Spontaneous speech from over 40 speakers, from casual interview, 24.2 hours of speech
- 91,112 intervocalic lenis obstruents
- Quantitative, acoustic measures of: voicing, duration, and intensity drop



Seung Suk (Josh) Lee

[Link to poster \(Lee 2024, LabPhon 19\)](#)

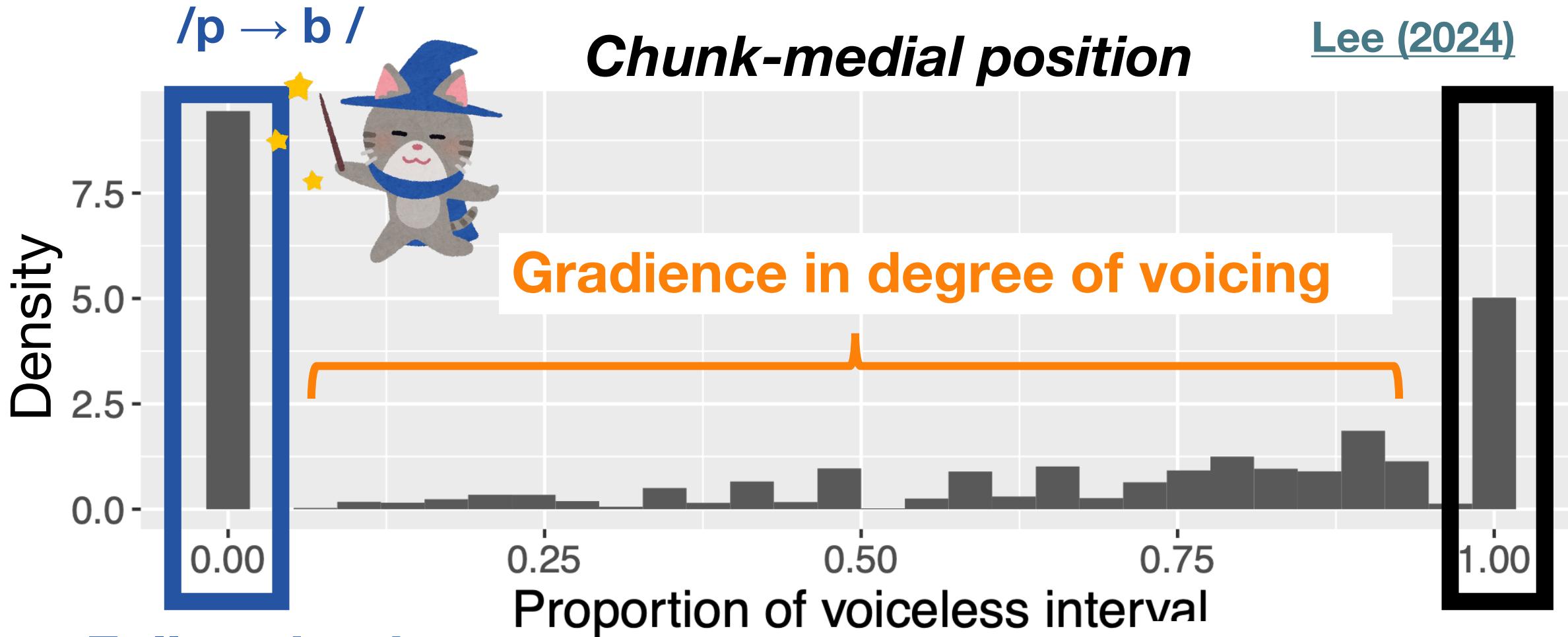
LENIS VOICING OPTIONAL AND GRADIENT...

/p → b /



Chunk-medial position

Lee (2024)



Fully voiced
as expected

Gradience in degree of voicing

But also fully
voiceless

...BUT LENIS RELIABLY REDUCED

**Lenis obstruents reliably reduced in medial position
relative to initial position (shorter, bigger intensity drop)**

- 70% of chunk-medial voiceless tokens follow partially or fully devoiced vowel (cf. “continuity lenition”, [Katz 2016](#))
- Remaining voiceless ones still more reduced relative to chunk-initial position

[Lee \(2024\)](#)

“PHONETIC” SEGMENTAL SANDHI?

Is all segmental allophony best characterized via direct mapping to phonetic measures without intervening symbols?

- See domain-initial strengthening literature
- See [Liberman \(2018\)](#)’s proposed null hypothesis: “a theory that entirely eliminates the symbolic treatment of allophonic variation and makes postlexical representations subject to direct phonetic interpretation, without any intervening symbol manipulation”
- [Katz \(2021, *Intervocalic lenition is not phonological*\)](#)

DATABASES OF SANDHI RULES?

1

P-base: Mielke (2008); Brohan & Mielke (2014)

Database of 4560 phonological patterns in 537 languages, but scant detail on prosodic domains, e.g., #

2

AUTOTYP: Bickel, Hildebrandt & Schiering (2009)

70 typologically diverse languages, 382 sub-phrasal patterns fully general across lexicon (across 63 languages), focused on word-level

DATABASES OF SANDHI RULES?

3

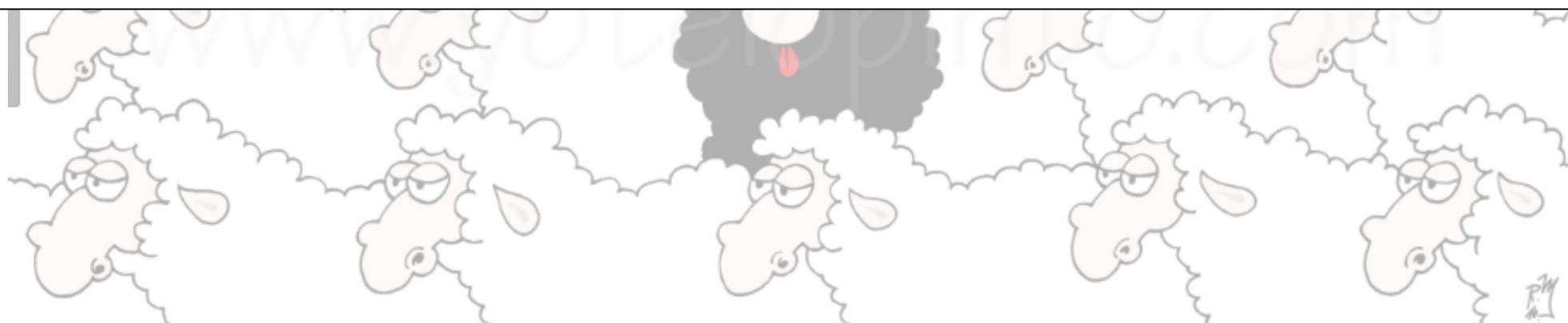
Work in progress at UMass with Charlotte Kaiser!



Charlotte Kaiser

IS TONE “DIFFERENT”?

***Segmental allophony hasn't been neglected:
tone is a reliable chunk indicator, while
segmental sandhi/allophony is not unless
represented as directly outputting phonetic
values.***



F0 CONTOURS AS REPRESENTATIONS

In other languages, rules which alter tonal values or delete tones can apply to such a representation.

English appears to lack such rules, with the result that the underlying and derived phonological representations of intonation are identical. The rules of interest are thus **the rules which assign phonetic values to tones and construct the F0 contour between one tone and the next.**

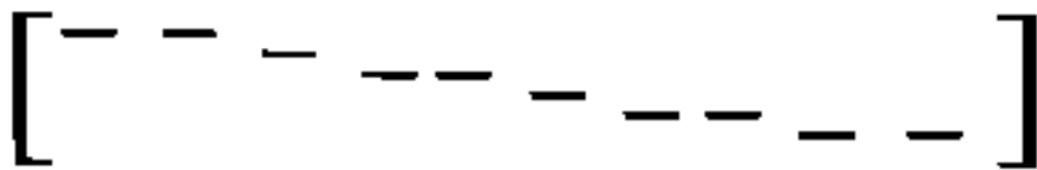
Pierrehumbert (1980, p. 11)

RULES OPERATING ON F0 VALUES: DOWNSTEP IN MIYA

HIGH REGISTER SETTING: Set H following any tone one register step lower than that of a preceding H.

H H H H H H
| | | | | |
'án ta dérwétli má vóna kámuw

 <i>tákən tatsiya mədə</i>	→ [- - - - - -]	<i>tákən tatsiya mədə</i> 'this tendon of a goat'



**'The wife of the leopard is not
in front of the house.'**

TOOLS FOR ACCESSING FO CURVE SHAPE

But also, phonological perspectives can help us understand how boundary tones interact with other processes

-1

<https://github.com/gavinsimpson/intro-gam-webinar-2020/blob/master/resources/basis-fun-anim.gif>

0.00

0.25

0.50

0.75

1.00

x

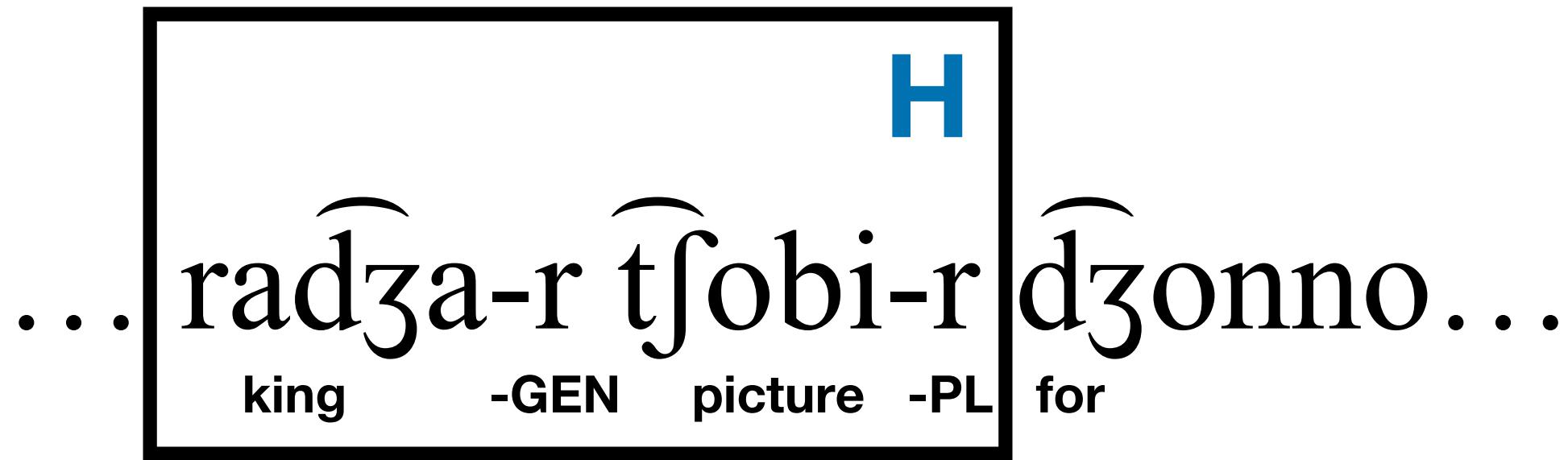
IS TONE “DIFFERENT”?

Prosodically-conditioned tonal pattern processes can output tone categories, while segmental sandhi processes directly output phonetic trajectories.



SANDHI RULES: DOMAIN LIMIT/EDGE RULE

$$\emptyset \rightarrow H / \varphi [\dots _]_\varphi$$



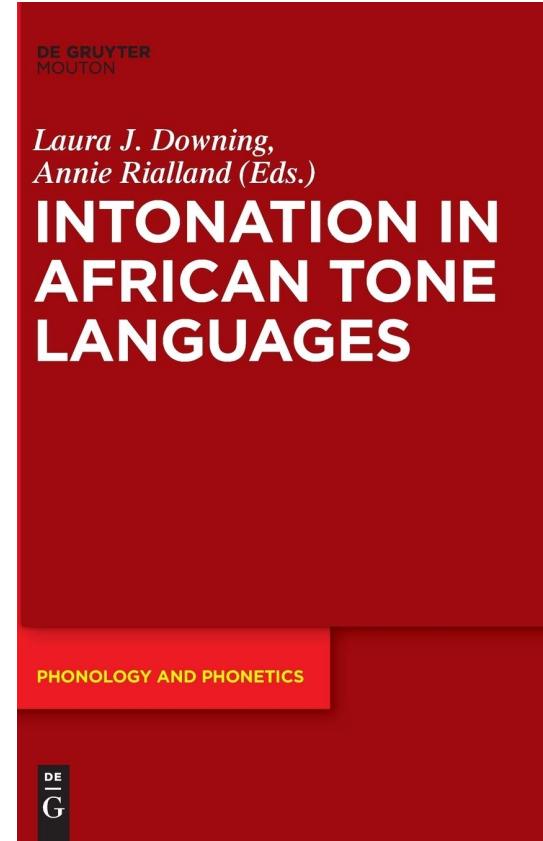
H tone is inserted at right edge of phonological phrase
(roughly), cf. “phrasal tone insertion” (Odden 1987)

(Rule types: Selkirk 1980, Vogel 1985, Hayes 1989, p. 202-203)

BOUNDARY TONES JUST ONE COMPONENT OF GRAMMAR: NOT STATIC!

(6) Languages distinguishing Phonological Phrase and Intonation Phrase

Language (Source)	Phonological Phrase domain	process	Intonation Phrase domain	process
Bàsàá (Hamlaoui and Makasso 2019)	(V O)(O)	High tone spread	{(S}{V O O)}	Falling Tone Simplification
Bemba (Kula and Bickmore 2015, Kula and Hamann 2017)	(V O)(O)	High tone spread	{(S}{V O O)}	Intonation boundary tones: L% following subject; Final Lowering at the end of the sentence
Chimwiini (Kisseberth 2017)	(V O)(O)	High tone assignment, shortening	{V O O}	High tone “agreement”
Kimatuumbi (Odden 1987, 1990, 1996; Truckenbrodt 1995, 1999)	(V O)(O)	vowel shortening	{(S}{V O O)}	Phrasal Tone Insertion (PTI) on non-final Intonation Phrase
Tsonga (Kisseberth 1994, Selkirk 2011)	(V O)(O)	High tone spread	{(S}{V O O)}	Penult lengthening
Tumbuka (Downing 2017)	(V O)(O)	High tone assignment, penult lengthening	{S V O O}	Final Lowering



Downing (2021)
<https://osf.io/8vung/download>

DANGERS OF THE OBLIGATORY BOUNDARY TONE HYPOTHESIS



THE OBLIGATORY BOUNDARY TONE HYPOTHESIS

A span of segmental material is a phonological constituent if and only if it is delimited by at least one boundary tone.



DANGERS

1

Prosodic constituents as a side effect of edge tones

2

Narrow vision of what a “boundary tone” can be

LICIT NULL BOUNDARY TONES

Ladd (2022, p. 251)

In Ladd (1983), I proposed that **boundary tones need not be part of a well-formed tonal string** and argued that the absence of a final rise or fall in phrases ending on steady level pitch was best seen as a reflection of the **absence of a boundary tone.**

See proposals of tonal melodies without boundary tones in English in Gussenhoven (1983, §6, 7), Grabe 1998, also in Dutch intonation in Gussenhoven (1988), discussion in Gussenhoven (2002, p. 278)

CLOSING OFF AVENUES OF INVESTIGATION

In my view, our understanding of intonational phonology is actually still fairly primitive, and a standard transcription that purports to be based on a correct phonological analysis prematurely closes off avenues of investigation and theoretical debate.

(Ladd 2022, p. 253)

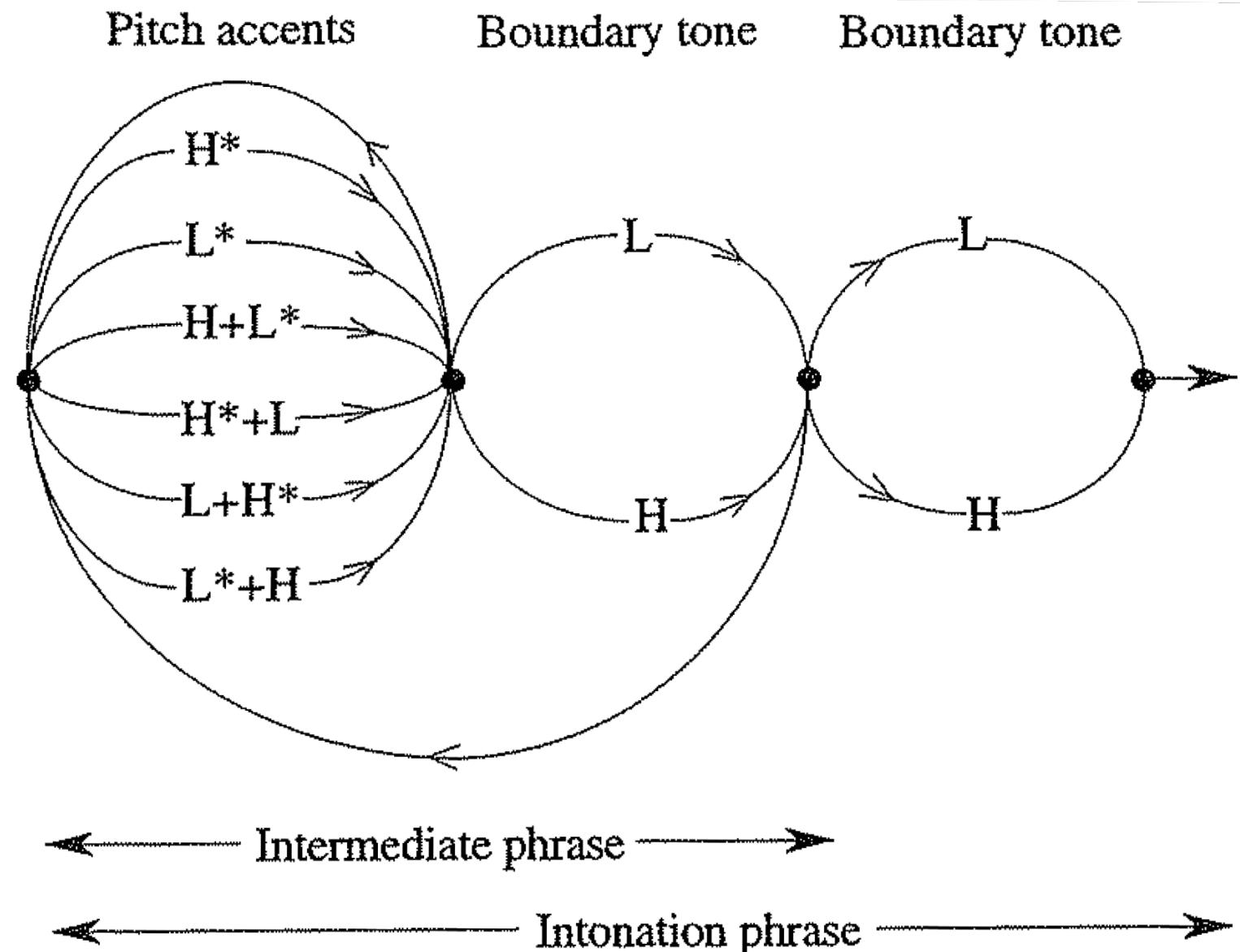
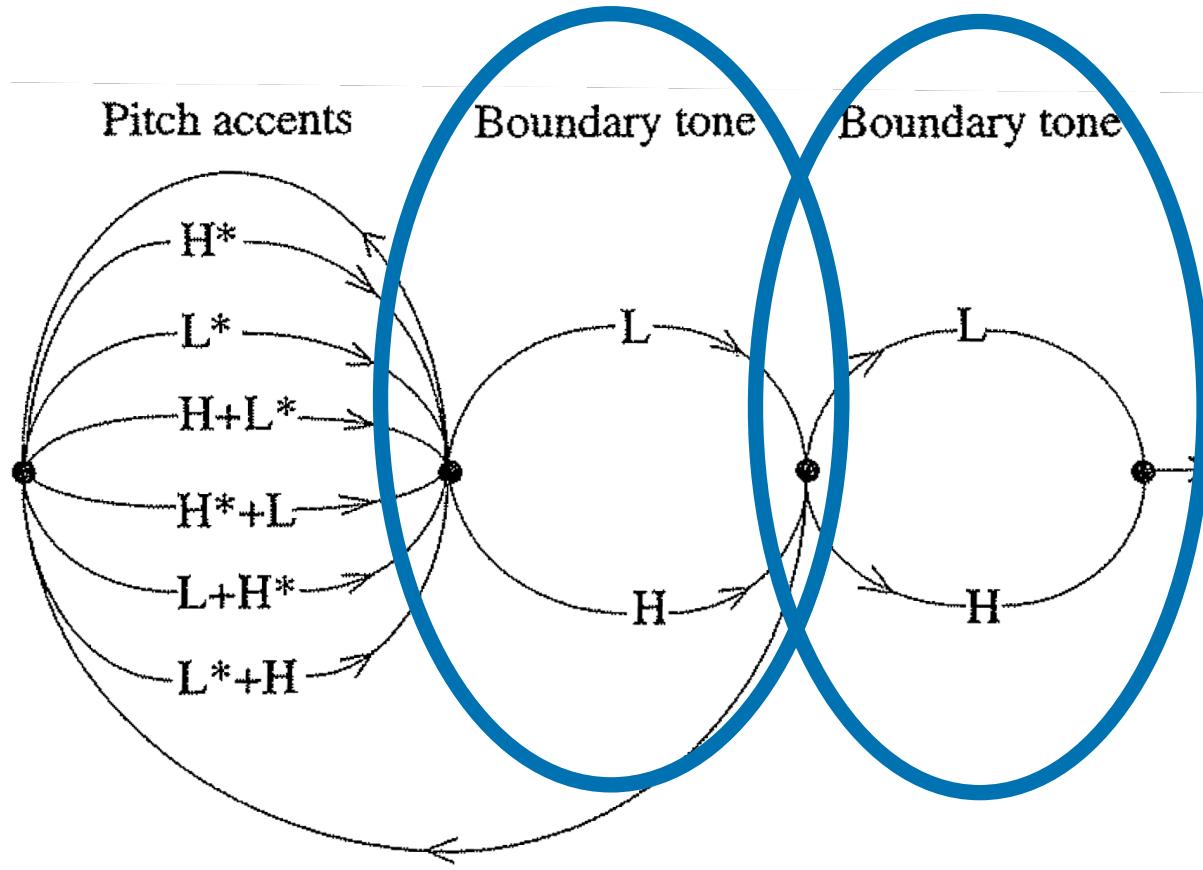


Figure 6. The grammar of English intonation patterns, according to Beckman and Pierrehumbert (1986).

Pierrehumbert (2000, p. 22)



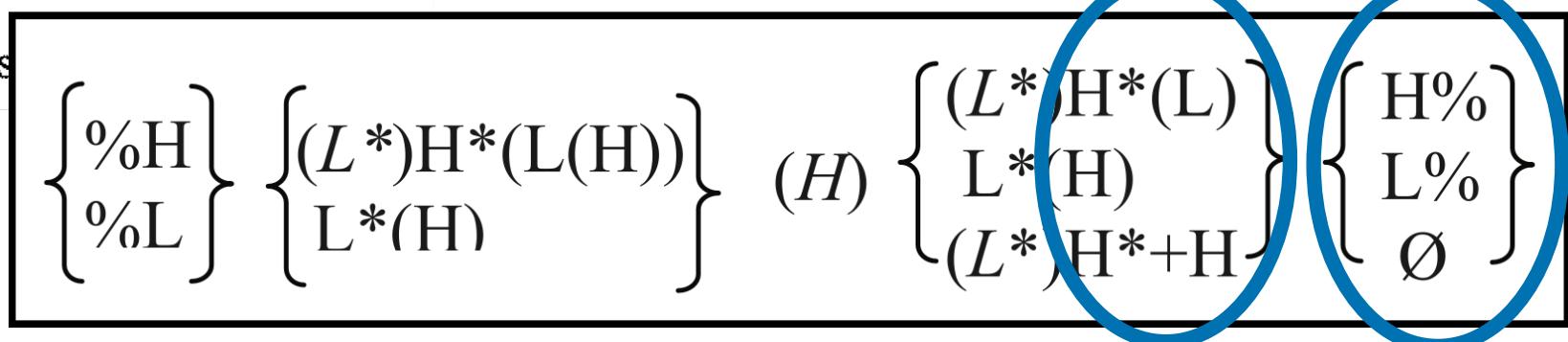
1

Licit absent Intonation Phrase tone

2

Absent constituent (Intermediate Phrase)

(Gussenhoven 2004, p. 305 (23), slightly simplified)



PROSODIC CONSTITUENTS AS A SIDE EFFECT OF EDGE TONES

In this first intonational analysis of Samoan (Orfitelli and Yu, 2009), we were certainly influenced by having our first exposure to intonational analysis and AM theory via MAE-ToBI, thinking—**a tone that regularly appears sentence-medially that isn't a pitch accent. . . since it isn't sentence-final, it can't be an intonational phrase tone, so it must be an intermediate phrase tone, and so, aha, Samoan must have an intermediate phrase!**

(Yu, to appear)

PROSODIC CONSTITUENTS AS A SIDE EFFECT OF EDGE TONES

(Orfitelli and Yu 2008, [2009](#))

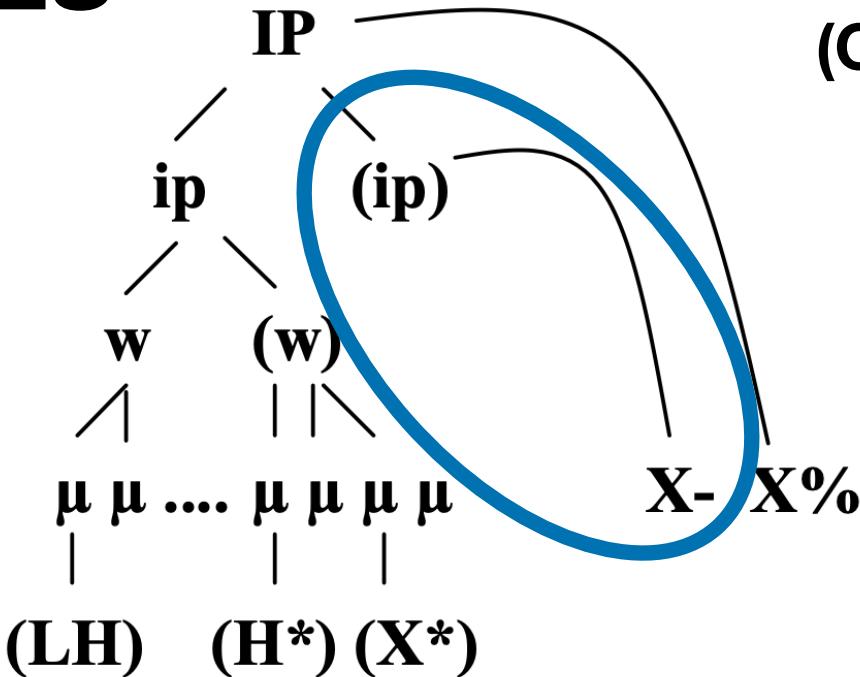


Figure 6. Samoan prosodic structure and tone affiliation.

IP: Intonation Phrase

ip: Intermediate Phrase

w: word

μ: mora

X* = LH, !H*

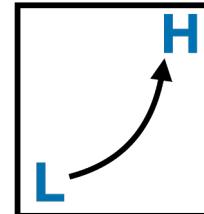
X- = H-, L-

X% = H%, L%

SAMOAN CASE-MARKING PATTERNS



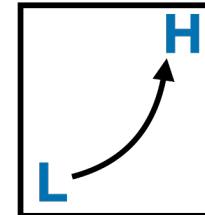
ergative-absolutive



na lalaŋa e le malini le mamanu

past weave erg the marine the design

‘The marine wove the design’



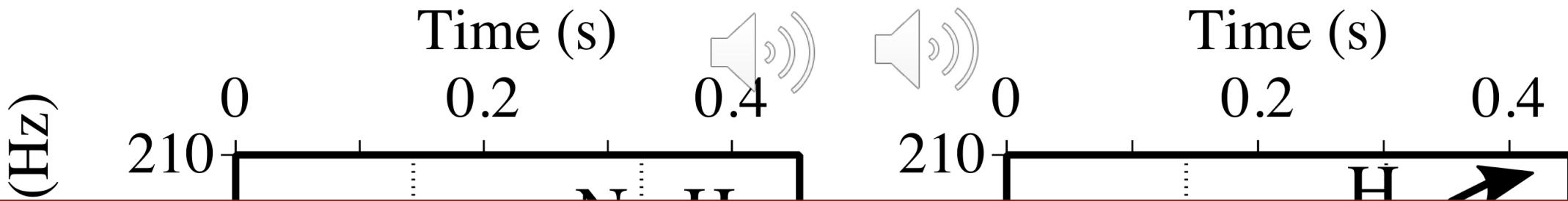
absolutive-oblique

na ŋalue le malini i le mamanu

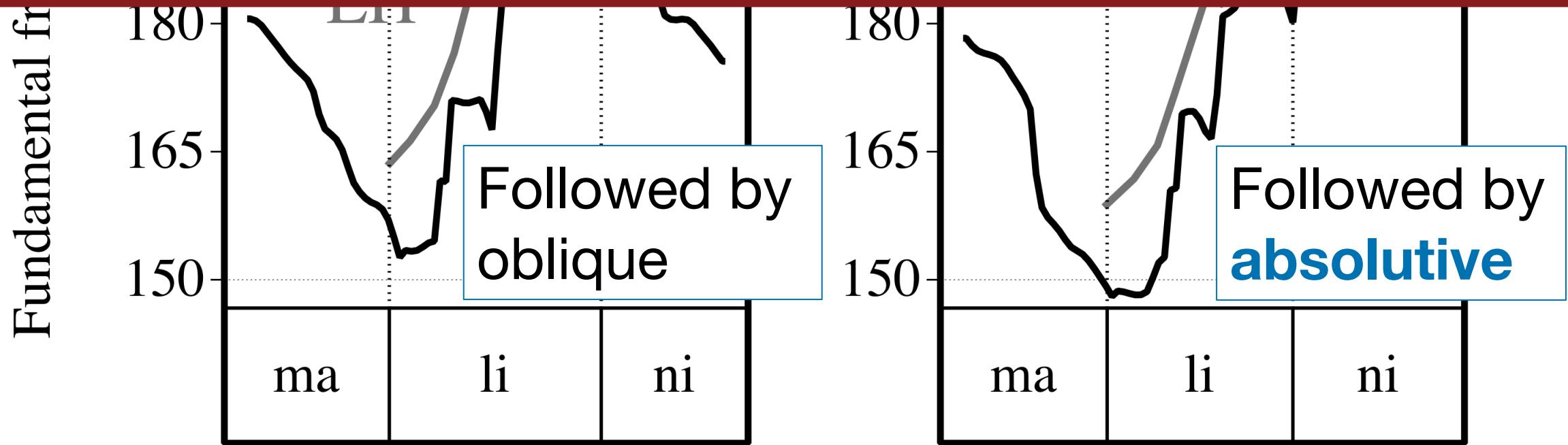
past work the marine obl the design



‘The marine worked on the design’

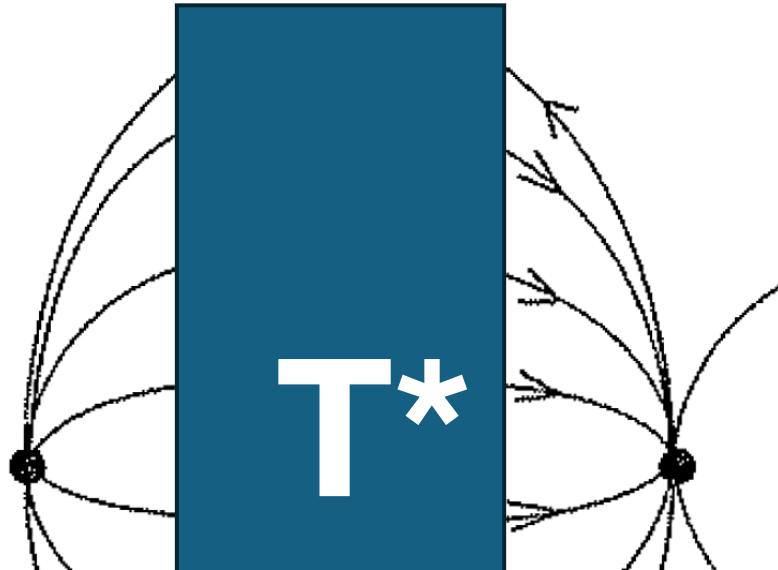


**Hypothesis: source of edge tone is
morphosyntactic spellout of absolute case**

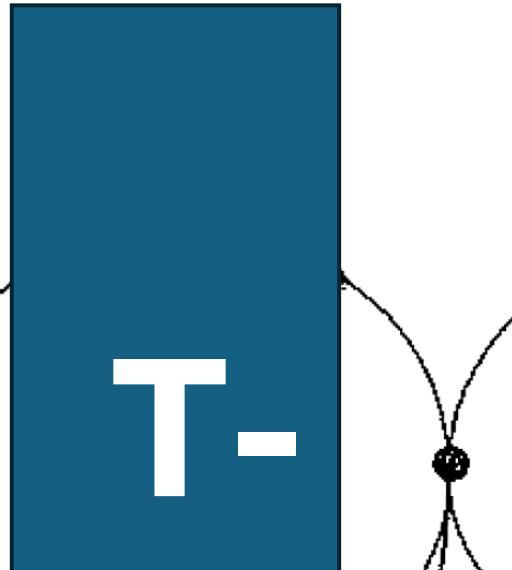


CLUSTERING OF TONAL PATTERNS

Pitch accents



Boundary tone



Boundary tone

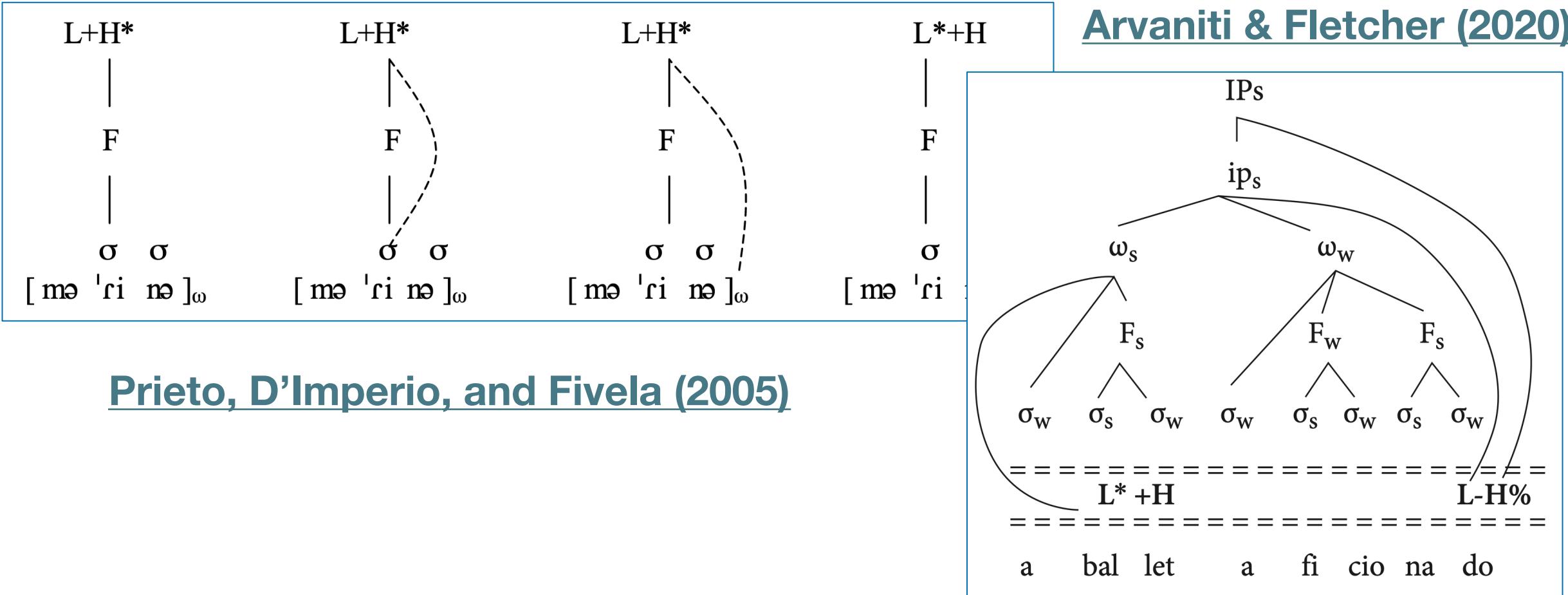


Obligatory Boundary Tone Hypothesis fails to recognize T^* clusters

Pierrehumbert (2000, p. 22)



GENERALIZING “BOUNDARY” TONES



Computational perspective: see Yu (2021, 2022)

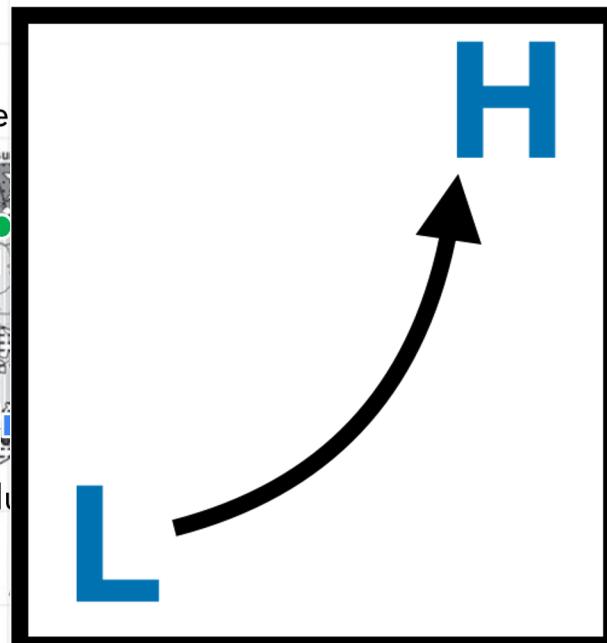
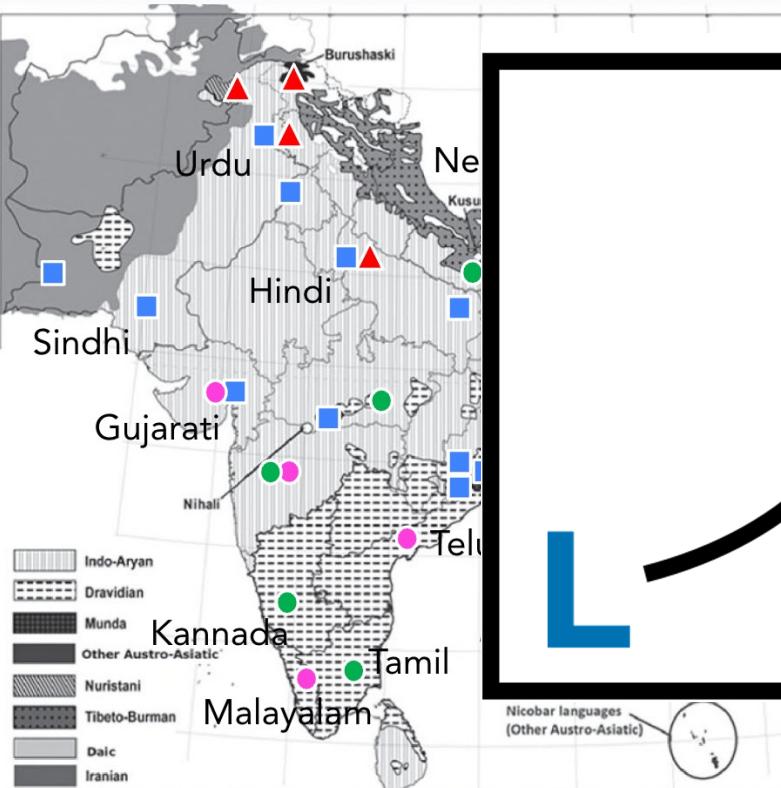
RISING MELODIES ACROSS SOUTH ASIA: THE FINE PRINT

<https://www.reed.edu/linguistics/khan/B-toBI/>

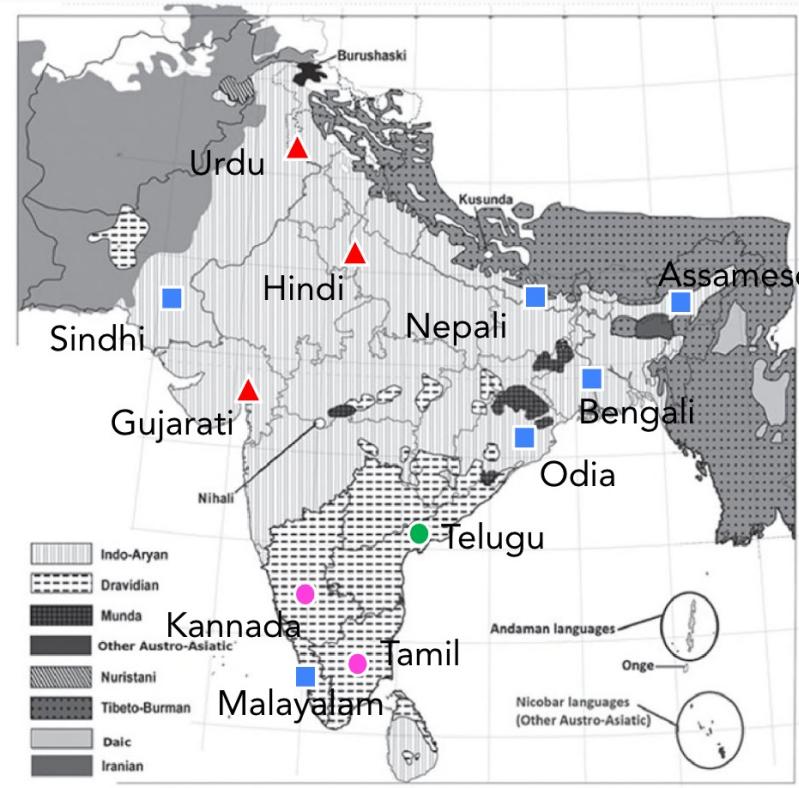
Slides taken from Khan (2020)

Accent location
(Hock 2016:398-400):

- initial
- initial+weight
- penult+weight
- ▲ contrastive



l in stems
atched in:
ora
ora
ole
ttested
s have
alignment
s have
moraic alignment



GENERALIZING “BOUNDARY” TONES

Grice (2022, p. 65)

Cross-linguistic preferences for relating association properties of tones to their function have led to over-optimisation in AM models towards the typical case. This can in fact be a straightjacket for the analysis of new languages, and even for the analysis of new phenomena within languages already under investigation. **Allowing for tones to have associations to a constituent in the prosodic structure, without necessarily further specifying head or edge association, in addition to separating the association properties from the function, provides a more powerful and flexible tool for the analysis of a wider set of phenomena.** This is especially important, given that we still know little about the prosodic systems of the majority of the world’s languages.

CONCLUSION

1

The clustering hypothesis: beyond tonal patterns
Don't forget segments (including phonotactics)!

2

Motivating the obligatory boundary tone hypothesis: is tone “different”? Maybe!

3

Dangers of the obligatory boundary tone hypothesis: biases and opportunities
Many sources of tone, not just phonological chunks!

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