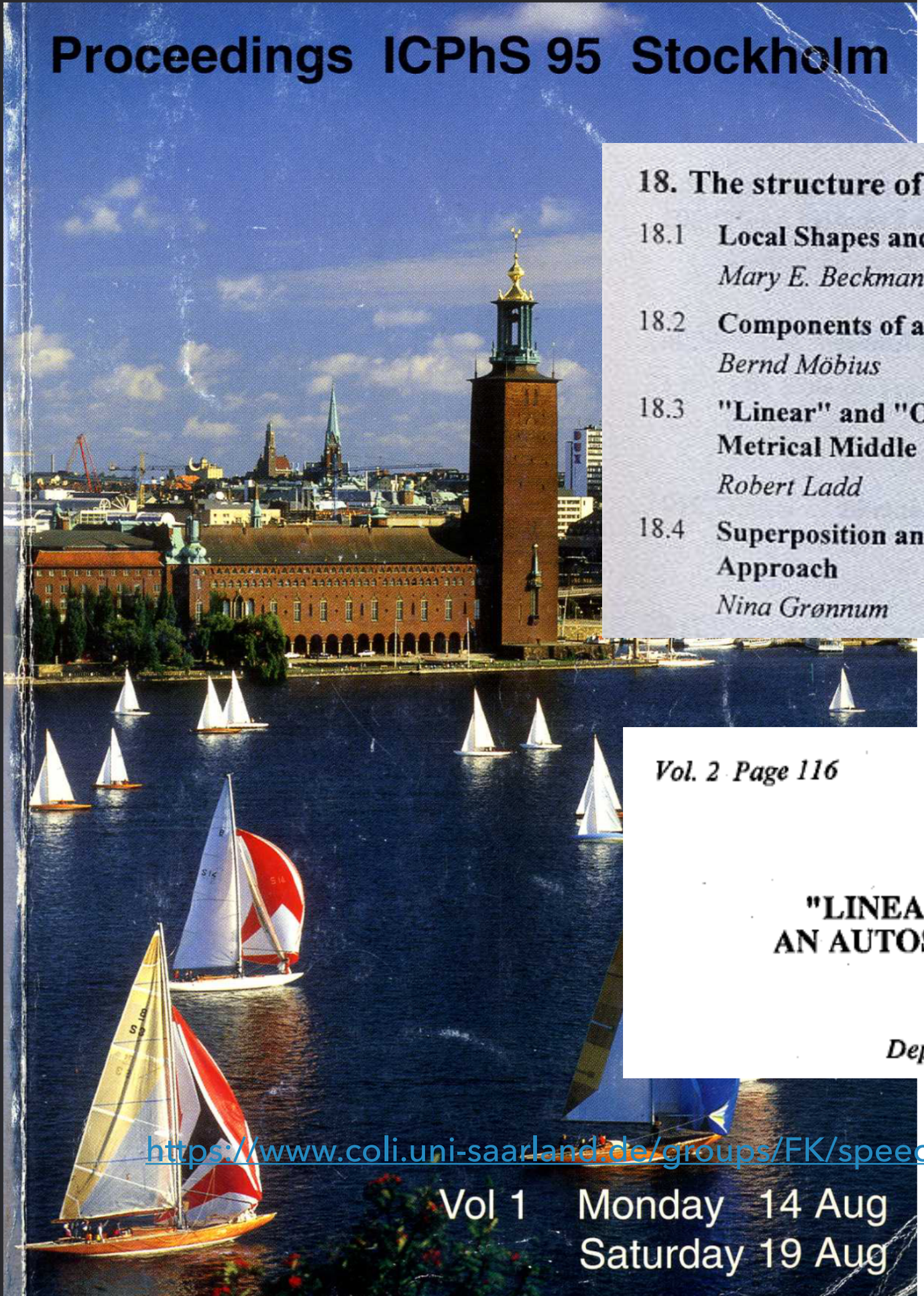
# PHONETIC EVIDENCE FOR SUPPORTING INTONATIONAL PHONOLOGICAL REPRESENTATIONS

YU

SEPTEMBER 24, 2026




**18. The structure of intonation - linear or superpositional**


18.1 **Local Shapes and Global Trends** 2:100
*Mary E. Beckman*

18.2 **Components of a Quantitative Model of German Intonation** 2:108
*Bernd Möbius*

18.3 **"Linear" and "Overlay" Descriptions: An Autosegmental-Metrical Middle Way** 2:116
*Robert Ladd*

18.4 **Superposition and Subordination in Intonation. A Non-Linear Approach** 2:124
*Nina Grønnum*




## "LINEAR" AND "OVERLAY" DESCRIPTIONS: AN AUTOSEGMENTAL-METRICAL MIDDLE WAY

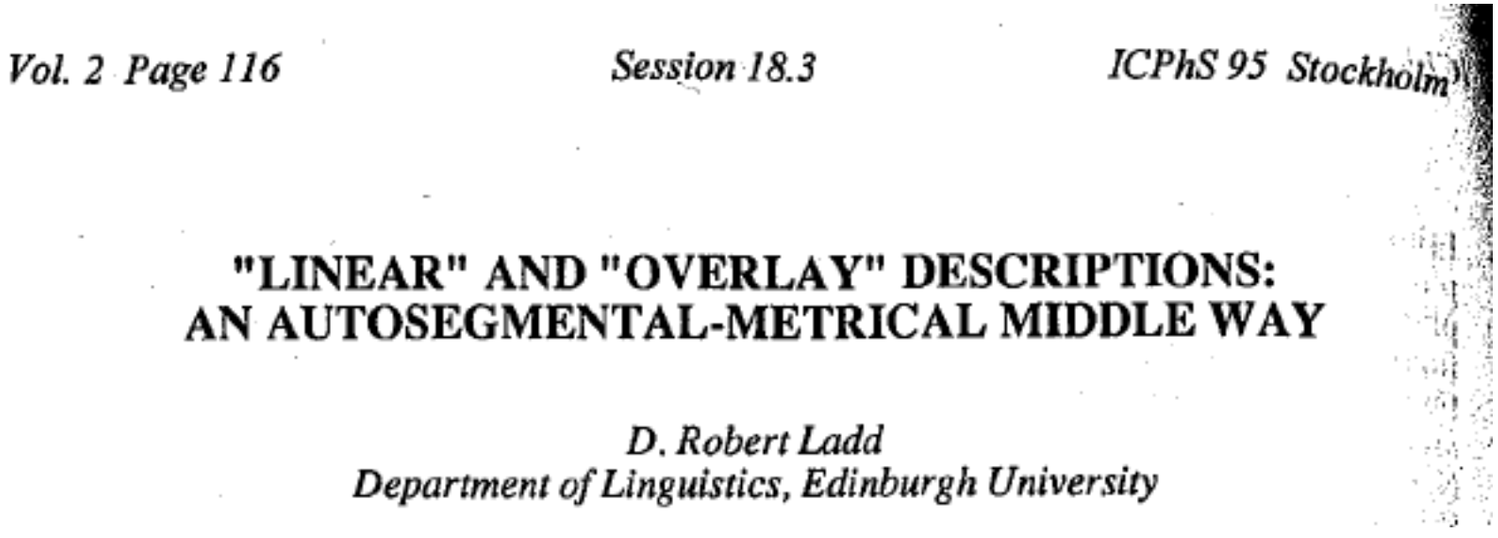
*D. Robert Ladd*
*Department of Linguistics, Edinburgh University*

https://www.coli.uni-saarland.de/groups/FK/speech_science/icphs/ICPhS1995/ICPhS1995.html

# WHAT IS INTONATION ANYWAY?

We can all at least agree that intonation includes cues to phrasing and prominence and sentence-type, but some of us want to describe these in terms of strings of phonological "events", while others want to model them as part of the general superpositional nature of F0.

Ladd (1995, p. 16)



*Vol. 2 Page 116* *Session 18.3* *ICPhS 95 Stockholm*

**"LINEAR" AND "OVERLAY" DESCRIPTIONS: AN AUTOSEGMENTAL-METRICAL MIDDLE WAY**

*D. Robert Ladd*
*Department of Linguistics, Edinburgh University*

**The linearity plus text-tune independence is what makes stretching/squishing make sense as a strategy!**

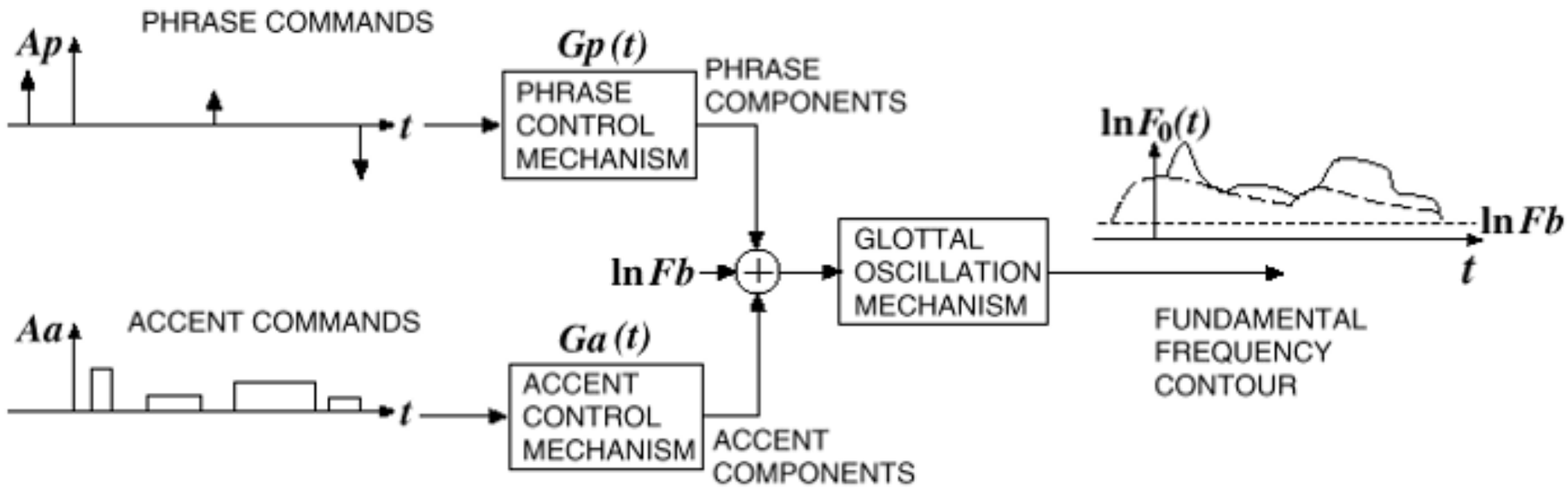
# CONTOUR INTERACTION MODELS: MANDARIN



*1.3.7. Intonation.* The question has often been raised as to how Chinese can have sentence intonation if words have definite tones. The best answer is to compare syllabic tone and sentence intonation with small ripples riding on large waves (though occasionally the ripples may be "larger" than the waves). The actual result is an algebraic sum of the two kinds of waves. Where two pluses concur, the result will be more plus; when a plus meets a minus, the algebraic addition will be an arithmetical subtraction. For example, in 你姓王,我姓陆。*Nii shinq Wang, woo shinq Luh.* 'Your name is Wang, my name is Luh.', the rising intonation in the further referring clause will make the rising 2nd Tone *Wang* rise higher than usual and the falling intonation on the falling 4th Tone *Luh* fall lower than usual (or, in this particular instance, since a 4th Tone falls to near the limit of the voice, the falling intonation will make it start lower and squeeze it narrower). But in *Woo shinq Luh, nii shinq Wang.*, *Luh* will be pitched higher as a whole, but still with a 4th Tone contour, and *Wang* will be pitched lower as a whole, but still with a 2nd Tone contour, without losing the identity of the tones, as a foreigner sometimes does when he lets the intonation mask the tone completely and thus seems to be saying 我姓卢,你姓望。*Woo shinq Lu, nii shinq Wanq.*

**Chao (1968: p. 64)**

# CONTOUR INTERACTION MODELS: JAPANESE




$$\ln F_0(t)=\ln F_{\min}+\sum_{i=1}^{I} A_{pi} G_{pi}(t-T_{0i}) + \sum_{j=1}^{J} A_{aj}\{G_{aj}(t-T_{1j})-G_{aj}(t-T_{2j})\}, \quad (1)$$

where

$$G_{pi}(t)=\begin{cases}\alpha_i^2\, t \exp(-\alpha_i t), & \text{for } t \geqq 0, \\ 0, & \text{for } t<0, \end{cases} \quad (2)$$

and

$$G_{aj}(t)=\begin{cases}\mathrm{Min}\,[1-(1+\beta_j t)\exp(-\beta_j t), \theta_j], & \text{for } t \geqq 0, \\ 0, & \text{for } t<0, \end{cases} \quad (3)$$

(1) The phrase commands are a set of impulses and the phrase components are the response of a critically-damped second-order linear system to these commands.

(2) The accent commands are a set of stepwise functions and the accent components are the response of another critically-damped second-order linear system to these commands.

(3) The phrase and accent components are superimposed and produce a proportionate change in the logarithm of $F_0$.

**Fujisaki and Hirose (1984)**

# EDGE TONES: THE AUTOSEGMENTAL-METRICAL CONTRIBUTION

embedded in larger intonational structures.

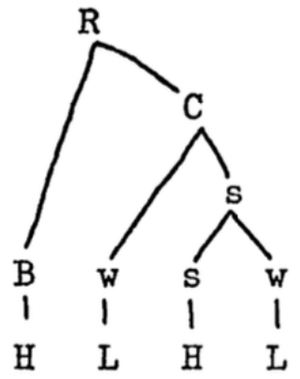
Notationally, such boundary tones will be represented as $\overset{B}{|}_{T}$. For the purposes of tune-text association, it will be assumed that corresponding boundaries exist in the text, and that congruence requires a matching of boundary to boundary. In the configuration $\overset{B}{|}_{T}$, the tone T is a terminal element, while the symbol B is a non-terminal. For purposes of grid alignment, the B positions are (redundantly) weak. In order to include these boundary elements in our metrical trees, non-boundary material will be called "content," symbolized by the node label C.

Thus the surprise/redundancy tune with "high pre-head" would be represented as in 2a, with its most likely parsing being that in 2b:

3.2.2/2a

| B | w | s | w |
|---|---|---|---|
| \| | \| | \| | \| |
| H | L | H | L |

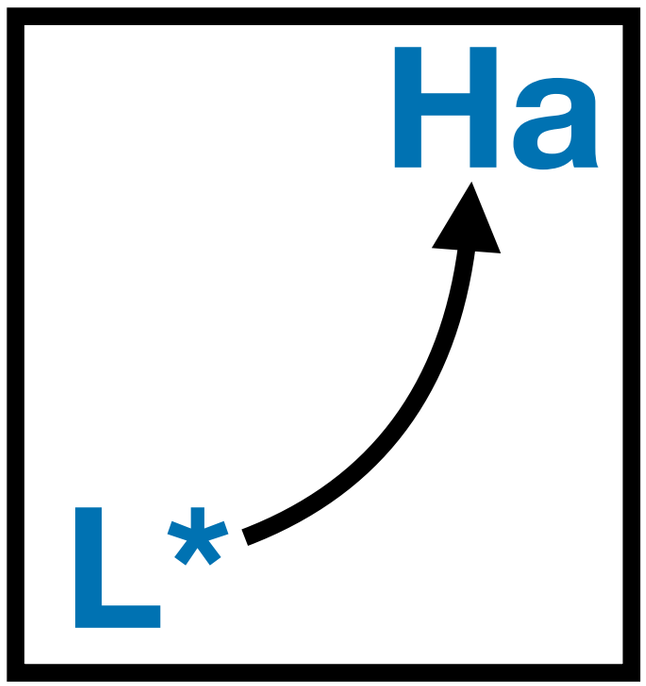
2b




We will represent the corresponding boundary in texts with the

# PITCH ACCENTS AND BOUNDARY TONES

**tone located at <u>stressed syllable</u> of AP-initial word**




**tone located at right <u>boundary</u> of Accentual Phrase (AP)**

(Labels on left brackets omitted for space)

**[[rúmu]$_{AP}$ [népaler]$_{AP}$ … [páre ni]$_{AP}$]$_{IP}$**

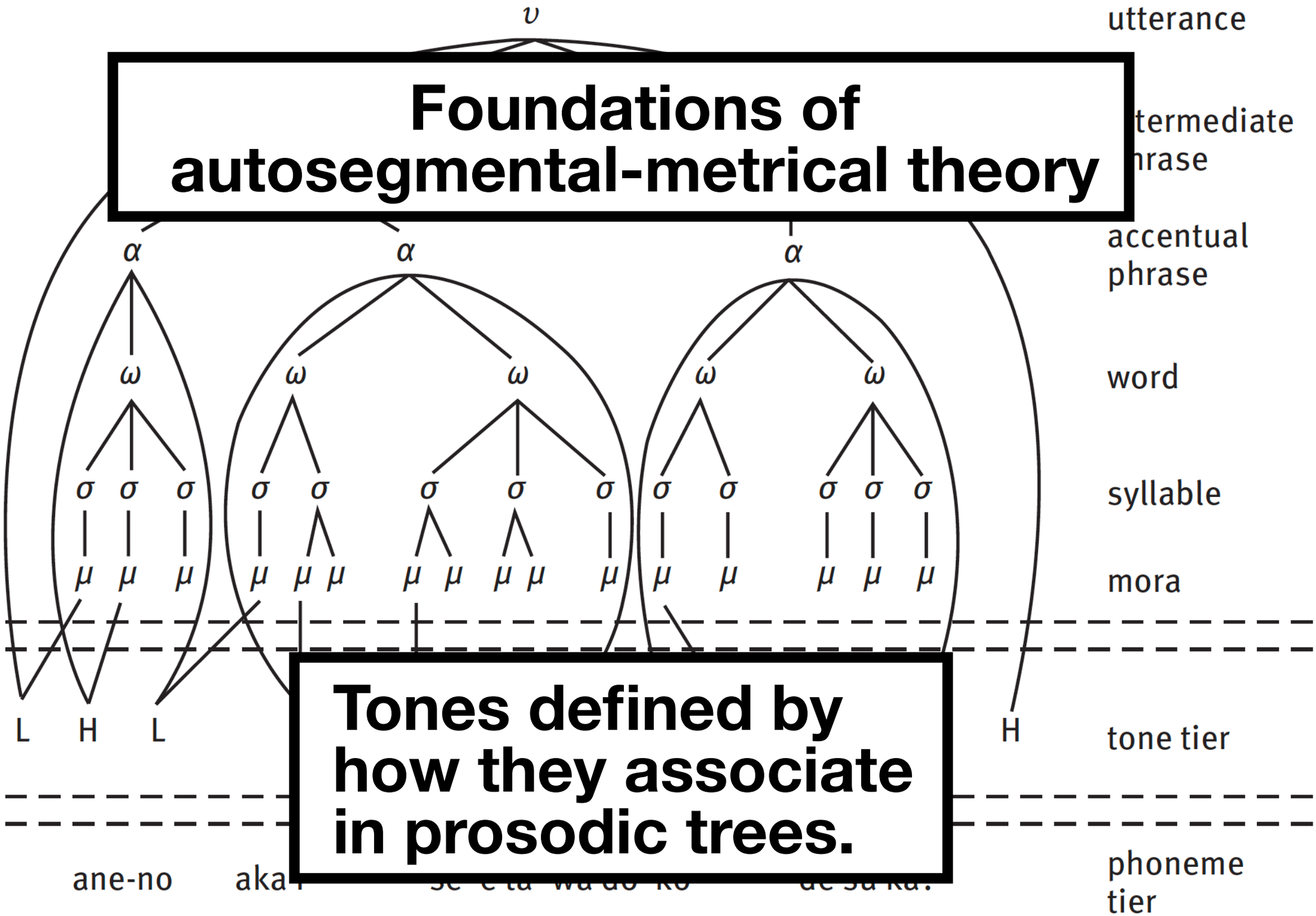
**L* Ha L* Ha L* HaL%**

**Khan (2008, 2014, et seq.); Hayes and Lahiri (1991)**

**Corresponding tree?**

# WHAT IS A BOUNDARY TONE?

**Foundations of autosegmental-metrical theory**



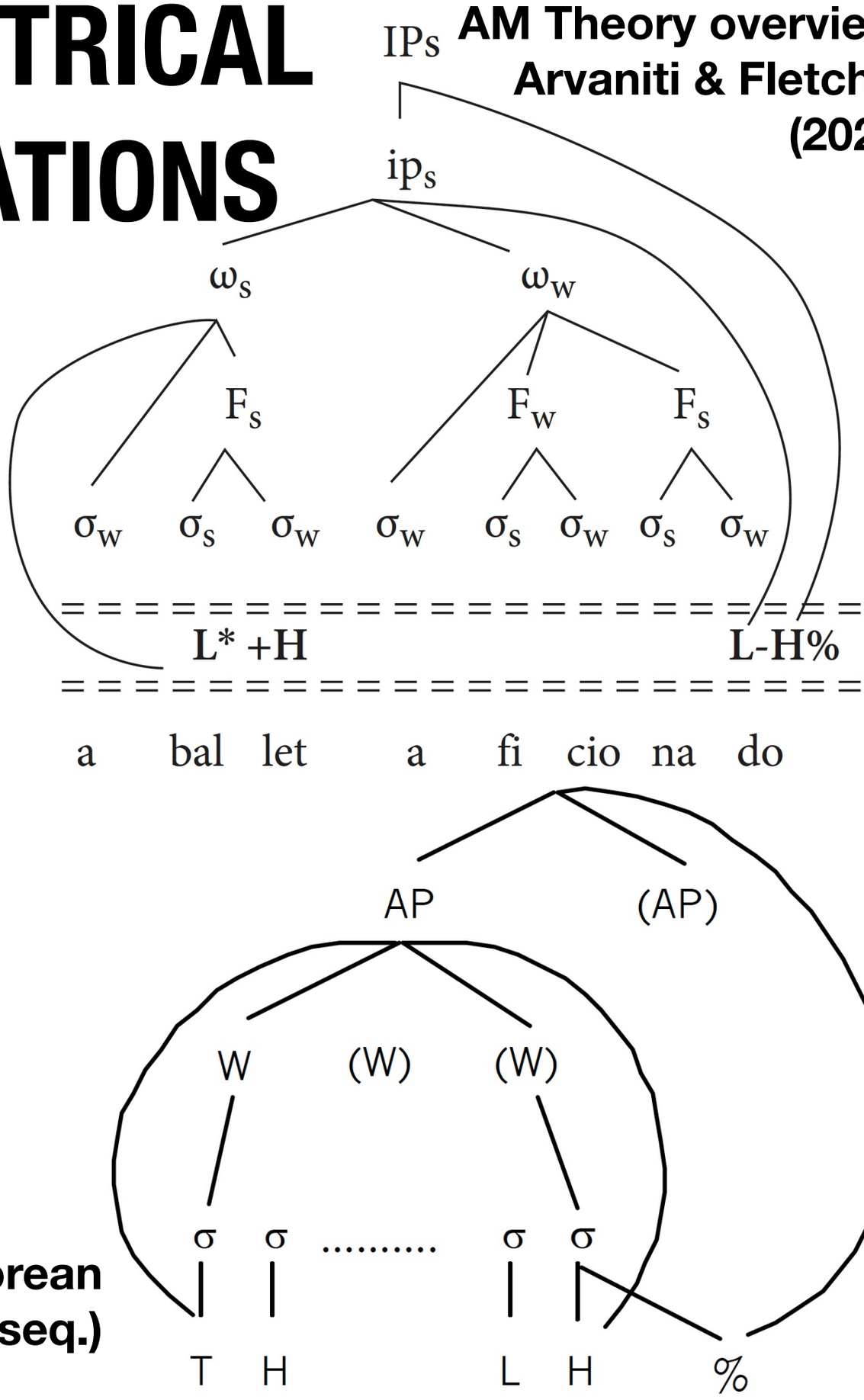

**Tones defined by how they associate in prosodic trees.**

Pierrehumbert & Beckman (1988)

# AUTOSEGMENTAL-METRICAL (AM) THEORY FOUNDATIONS

- **Tonal association to higher-level prosodic nodes**
- **Multiple tonal association to TBUs and higher-level prosodic nodes (multidominance)**

**AM Theory overview: Arvaniti & Fletcher (2020)**

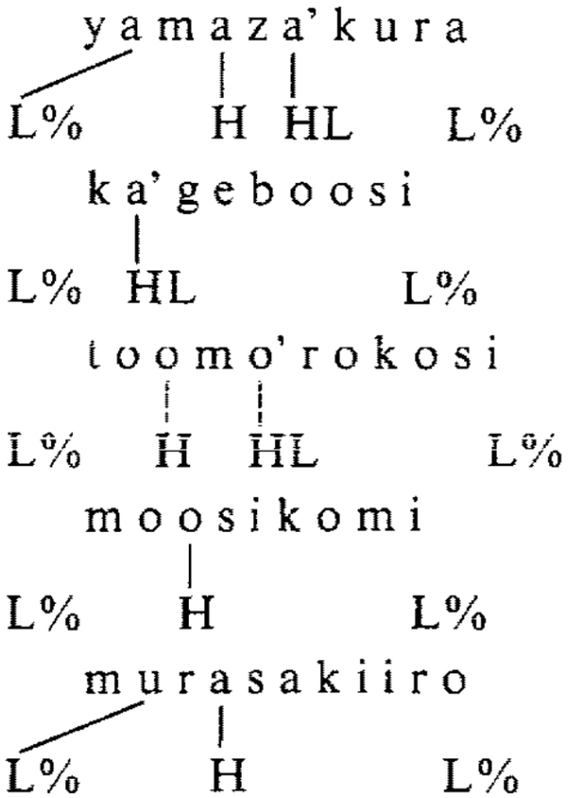



**Seoul Korean**
**Jun (1996 et seq.)**

# MULTIPLE TONAL ASSOCIATION EXAMPLES

**Pierrehumbert & Beckman (1988), p. 14**

**(could be helpful to add some tonal diacritics)**



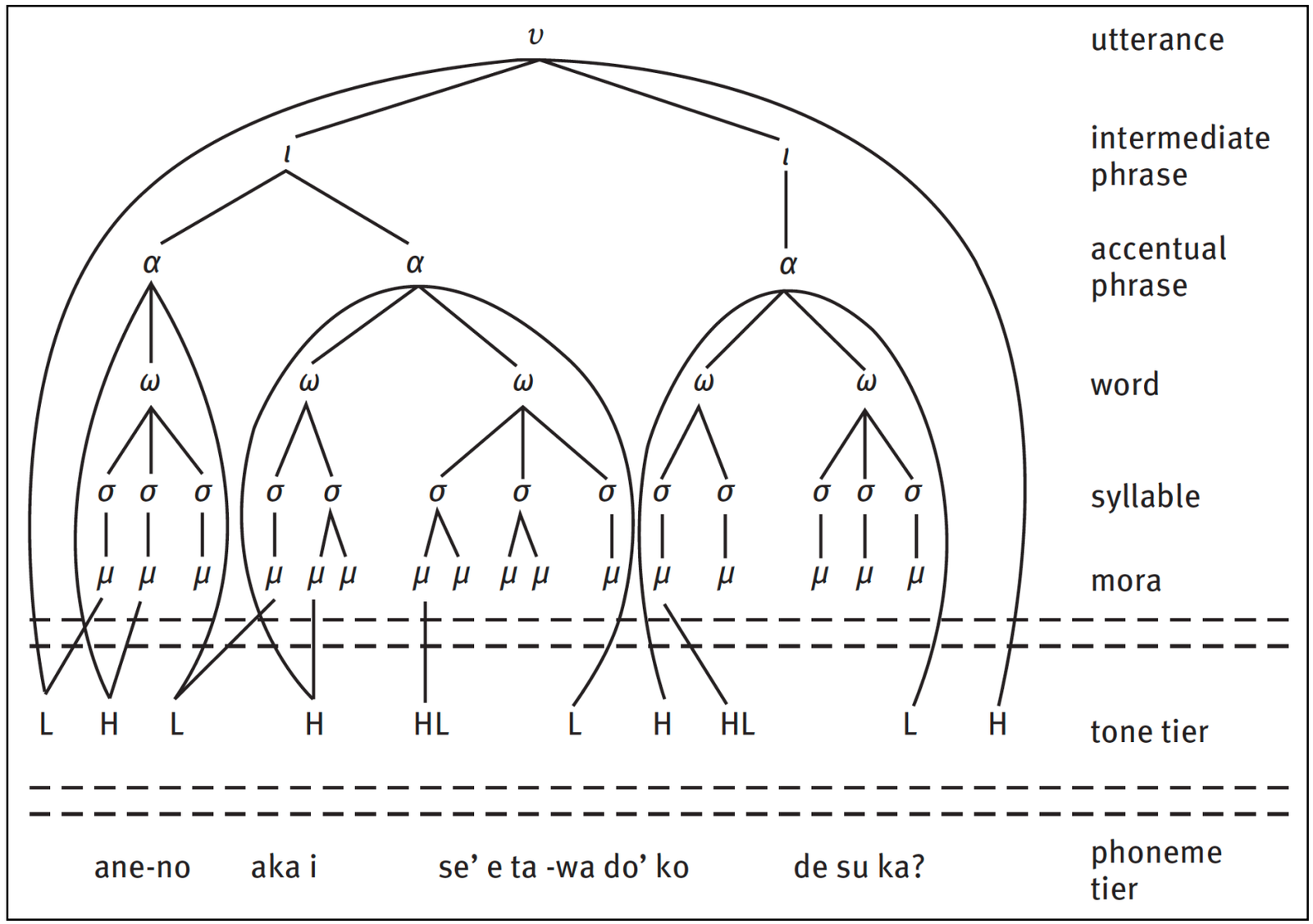



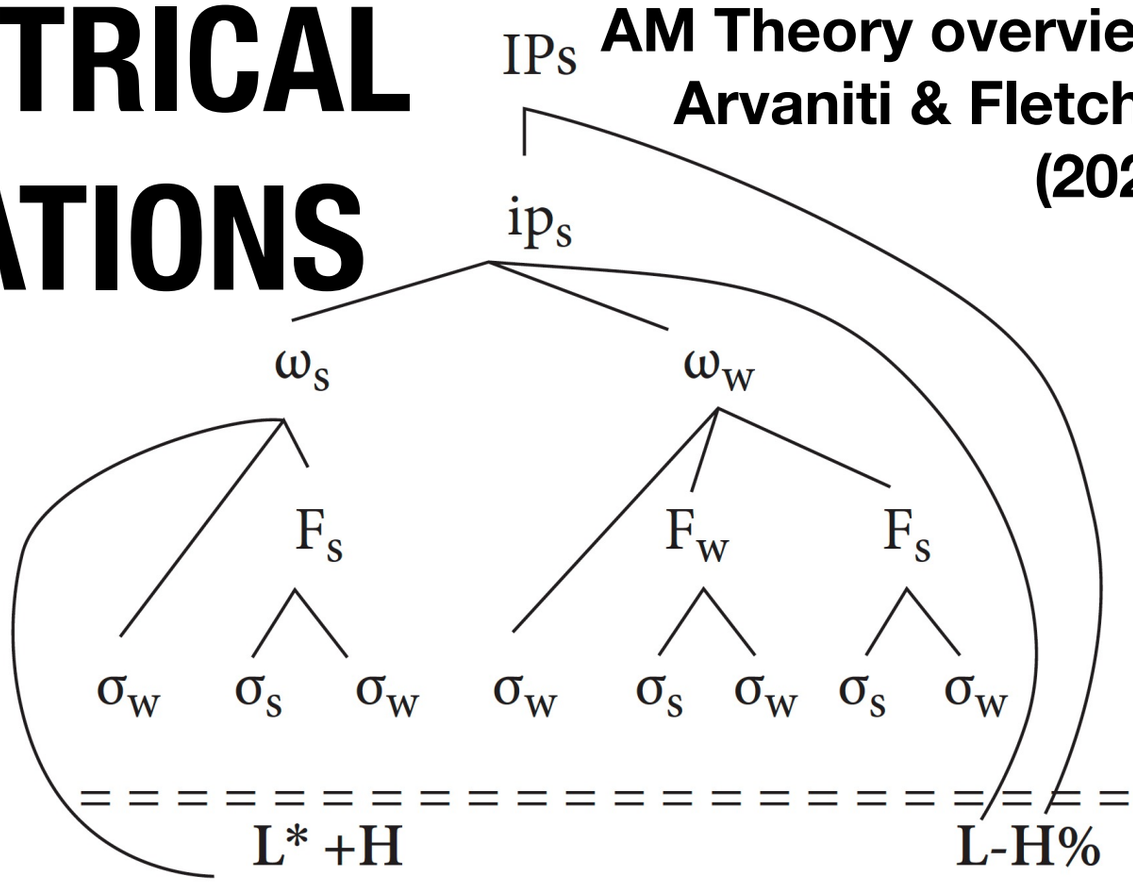

**Figure 1.2**
Transcription of proposed surface tone patterns for words in figure 1.1. in isolation.

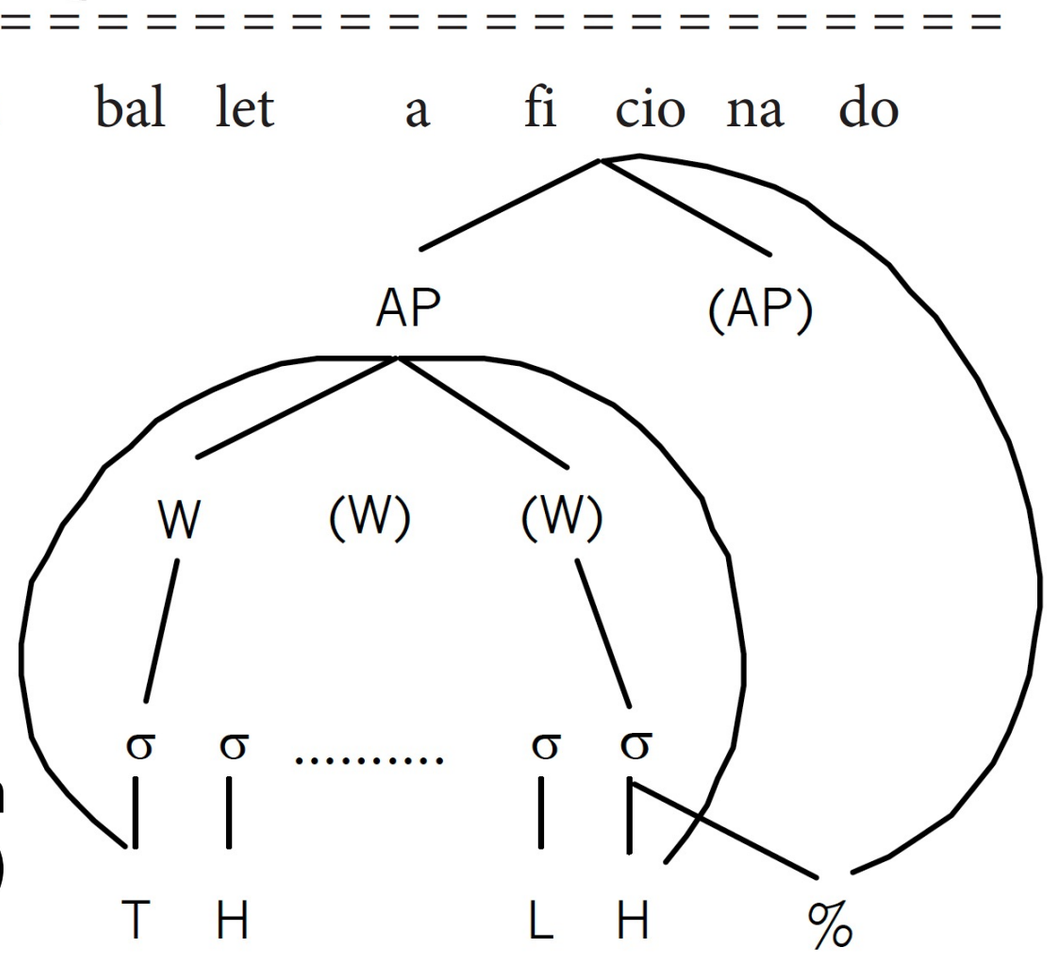
**single word in isolation: squished!**

# AUTOSEGMENTAL-METRICAL (AM) THEORY FOUNDATIONS

- **Tonal association to higher-level prosodic nodes**
- **Multiple tonal association to TBUs and higher-level prosodic nodes (multidominance)**

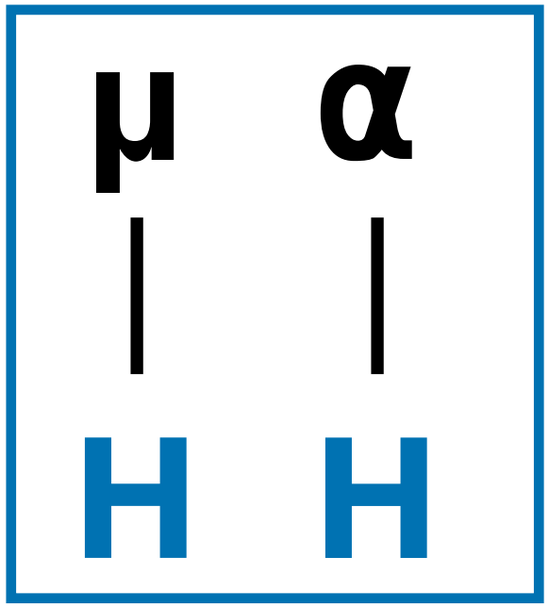
**AM Theory overview: Arvaniti & Fletcher (2020)**

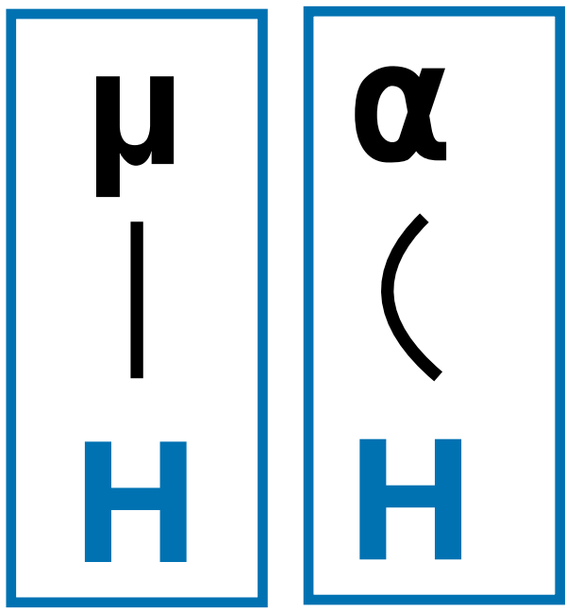



**Seoul Korean**
**Jun (1996 et seq.)**

# ASSOCIATION TO TBUs vs. HIGHER-LEVEL NODES



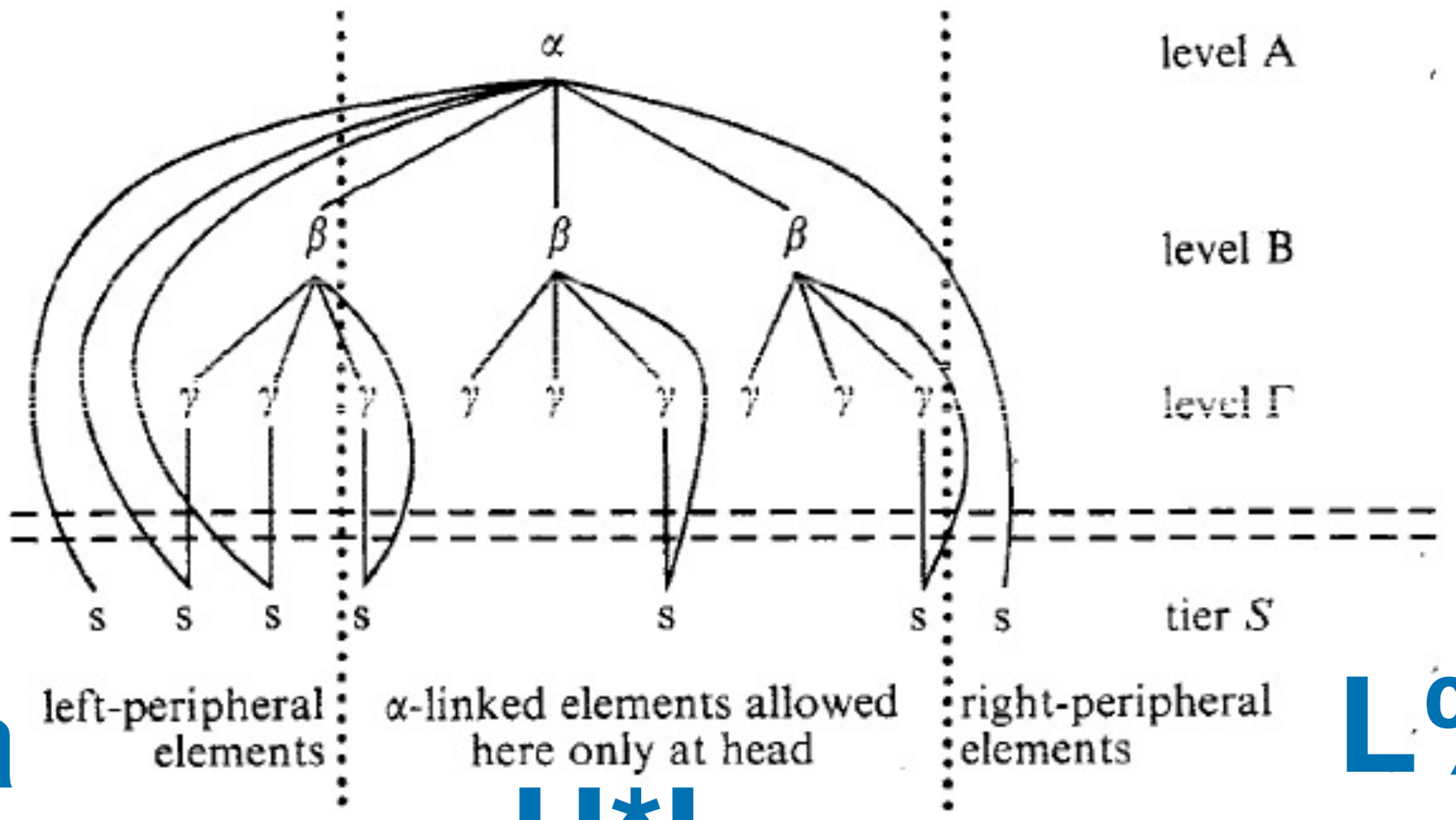

**TBUs are prosodic nodes too**

$$Cat = \{\mu, \sigma, \omega, \alpha, \iota\}$$

**But tones associated to higher-level nodes are *peripheral, at the edge***

Pierrehumbert & Beckman (1988) stipulation

# LINEARIZATION OF TONES




La

H*L

L%

**Figure 5.12**
Permissible associations between an element on a substantive tier and daughters of the prosodic constituent to which it originally belongs.

**Pierrehumbert & Beckman (1988)**

# PROBLEM FOR ASSOCIATION TO NODES

**What does association to a node imply for sequencing of boundary tones?**

Pierrehumbert & Beckman (1988, Ch. 6): stipulate **boundary tones at the periphery**

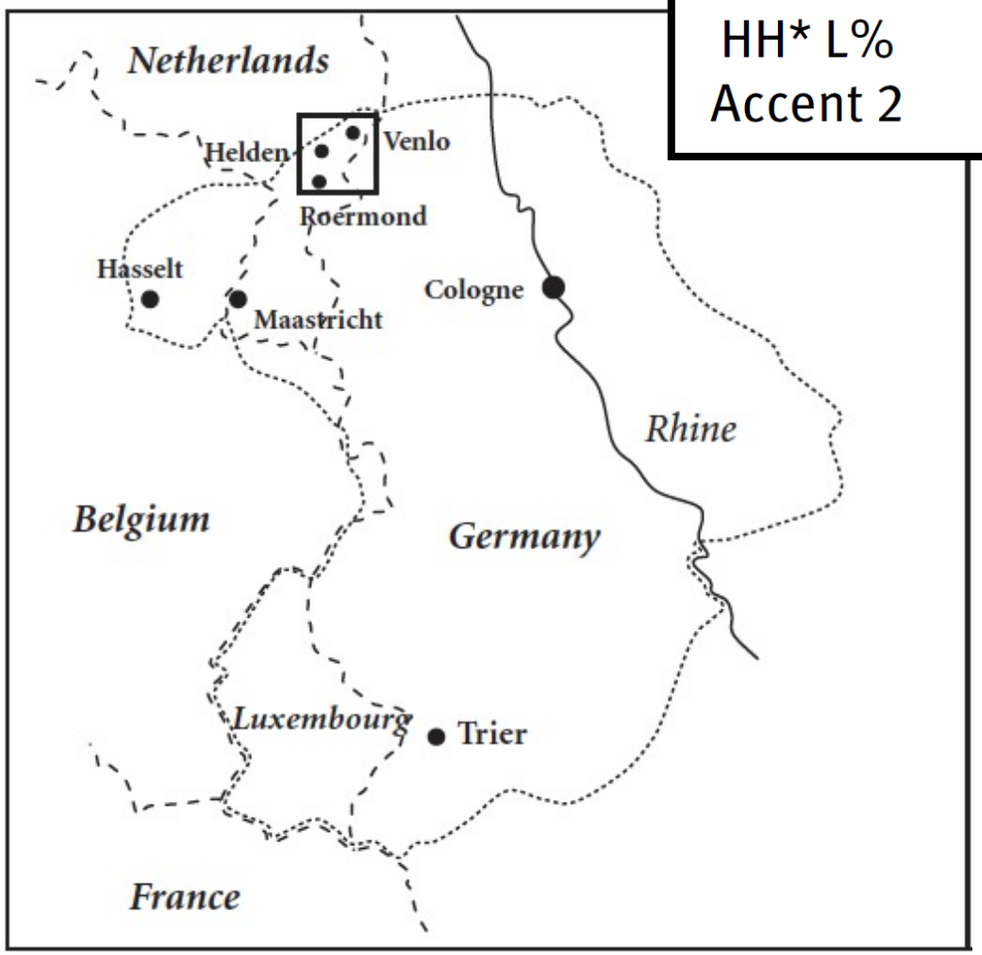
**But non-peripheral boundary tones in Roermond Limburgish:**

**L% *before* lexical accent H.**

**Move to violable *Align* constraints of floating tones rather than association to nodes**

**(Gussenhoven 2000, 2004 Ch. 12, 2018)**

# “INFIXATION” OF BOUNDARY TONE




HH* L%
Accent 2

H* L%
Accent 1

| | Roermond | Helden | Venlo |
|---|---|---|---|
| Acc 1 | H* $L_ι$ | H* $L_ι$ | H* $L_ι$ |
| Acc 2 | $HL_ι$ *H* | H**L* $L_ι$ | H**L* $L_ι$ |

**(Gussenhoven 2015)**

**Align ($T_{Lex}$, Right, Syll, Right) >>**
**Align (T%, Right, IntP, Right)**

**(Gussenhoven 2000)**



**String-based approach**

# STRETCHING: PITCH ACCENTS VS. EDGE TONES; BRUCE (1977)

# SAMOAN SENTENCE TYPE

| na | momoli | le | meleni | a | enele: |
|---|---|---|---|---|---|
| past | send | the | melon | of | Henry |

## Declarative

‘I sent Henry’s melon.’




## Y/N question

‘Did you send Henry’s melon?’

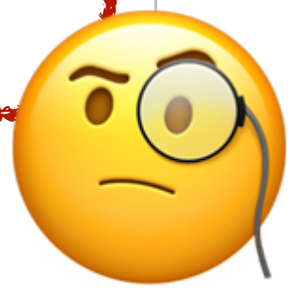



Orfitelli & Yu (2009), Howard (2018), Yu (to appear)

# SAMOAN SENTENCE TYPE

| Segments | Stress position | Category | Meaning |
|---|---|---|---|
| /enele:/ | Final | Noun | Henry |

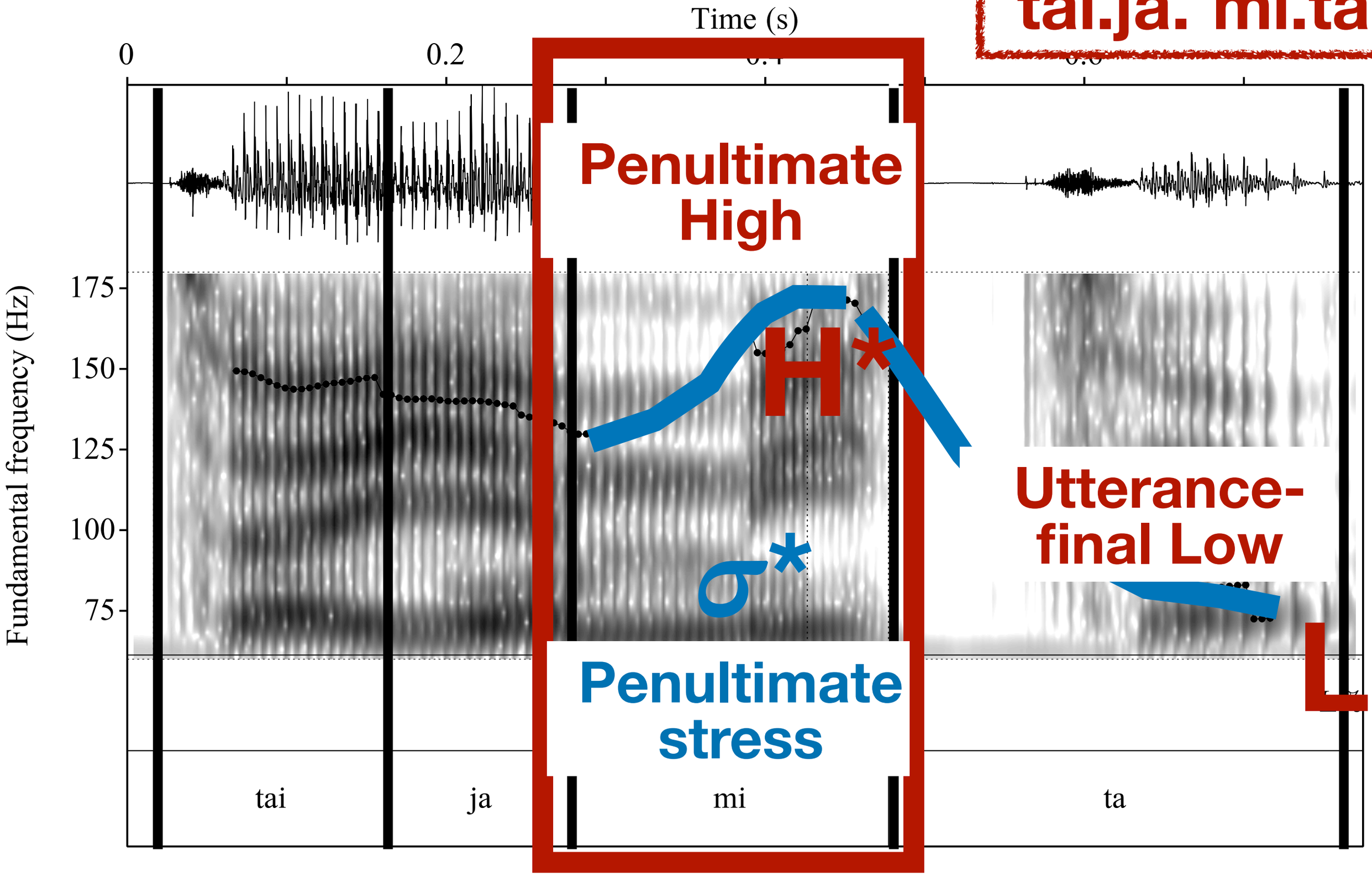
| Tone | Tone position | Category | Meaning |
|---|---|---|---|
| Low | Final | Sentence type | Declarative |
| Low | Final | Sentence type | Y/N question |



# SAMOAN STRESS POSITION AND TONE



tai.ja.ˈmi.ta



# SAMOAN STRESS POSITION AND TONE



tai.ˈja.mi.ta

Antepenult High

H*

σ*

Antepenult stress

Utterance-final Low

L%

Time (s)

0

0.6

Fundamental frequency (Hz)

175

150

125

100

75

tai

ja

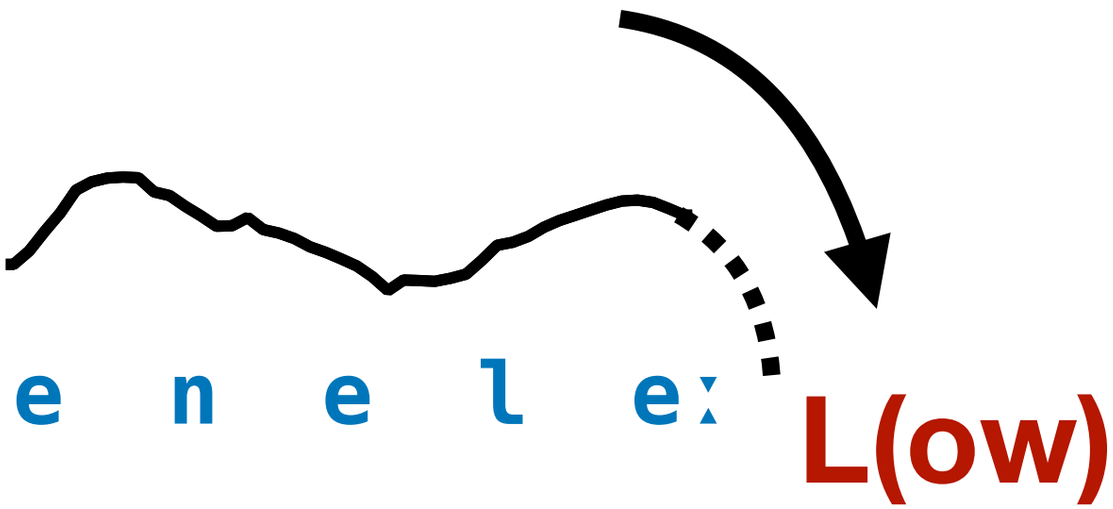
mi

ta

# REMINDER: SAMOAN SENTENCE TYPE

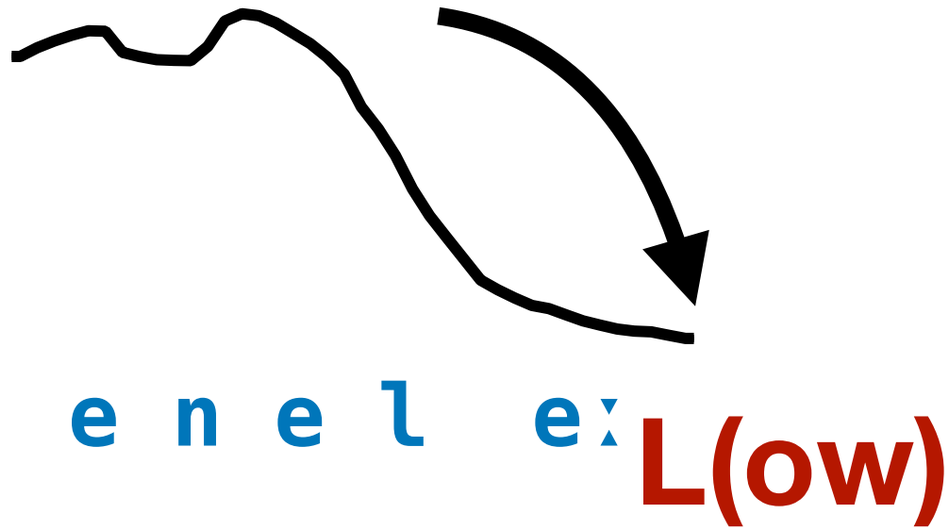
## Declarative

‘I sent Henry’s melon.’




## Y/N question

‘Did you send Henry’s melon?’




**Word-final stress on /enele:/ means stress position is also utterance-final, so we can’t disentangle stress-position tones from utterance-final sentence type tones**

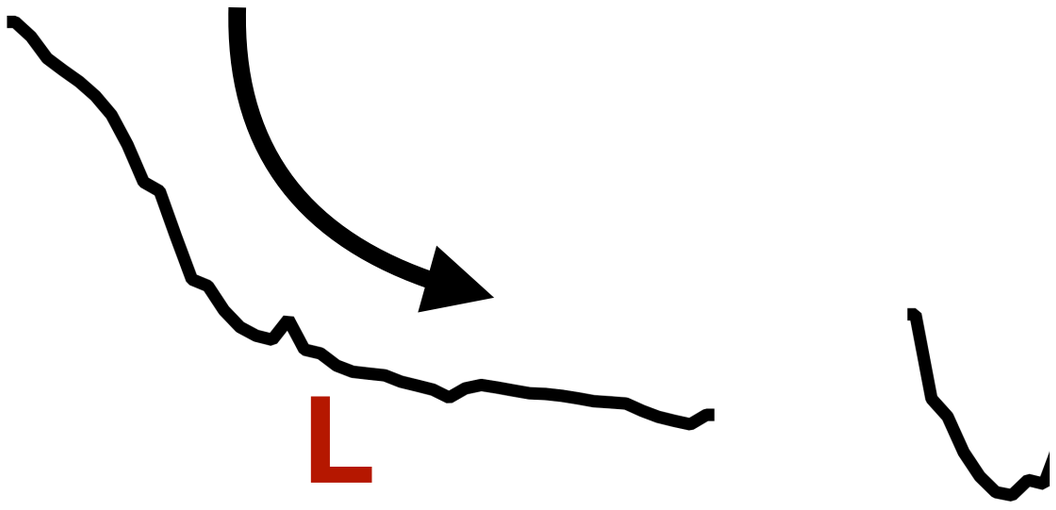
# SAMOAN SENTENCE TYPE

| na | laŋona | e | taiamita |
|---|---|---|---|
| past | perceive | erg | Diameter |

## Antepenultimate stress

‘Did Diameter perceive (it)?’

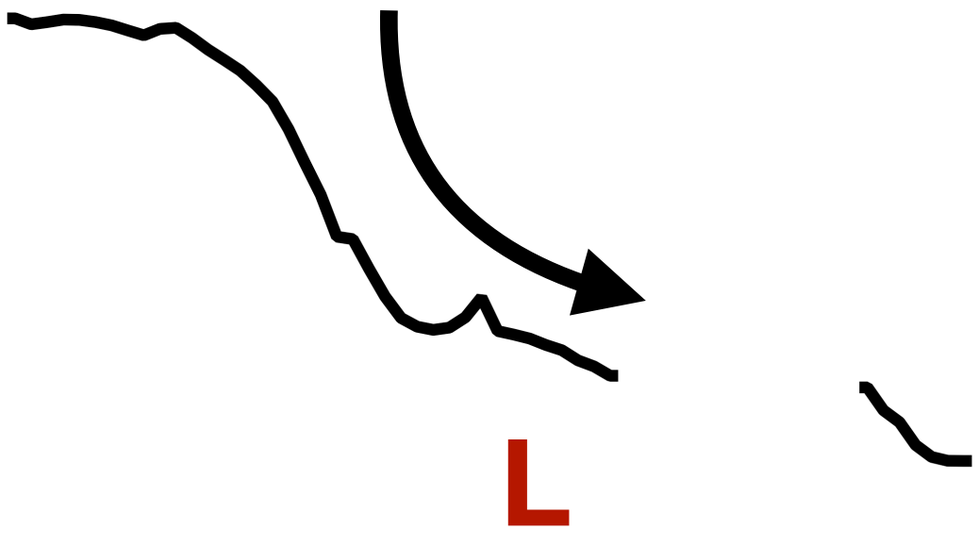
**tai.ˈja.mi.ta**




## Penultimate stress

‘Did Diameter perceive (it)?’

**tai.ja.ˈmi.ta**



# SAMOAN SENTENCE TYPE

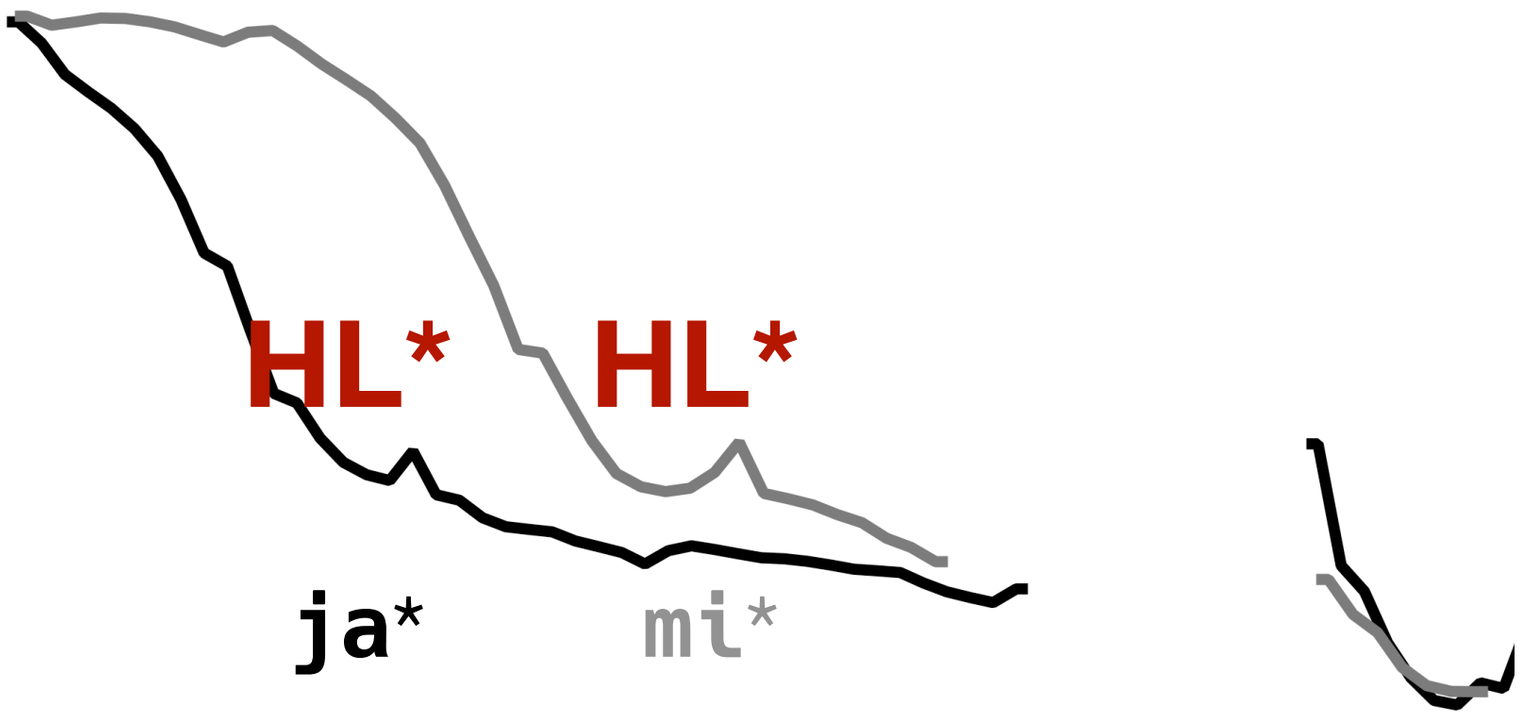
| na | laŋona | e | taiamita |
|---|---|---|---|
| past | perceive | erg | Diameter |

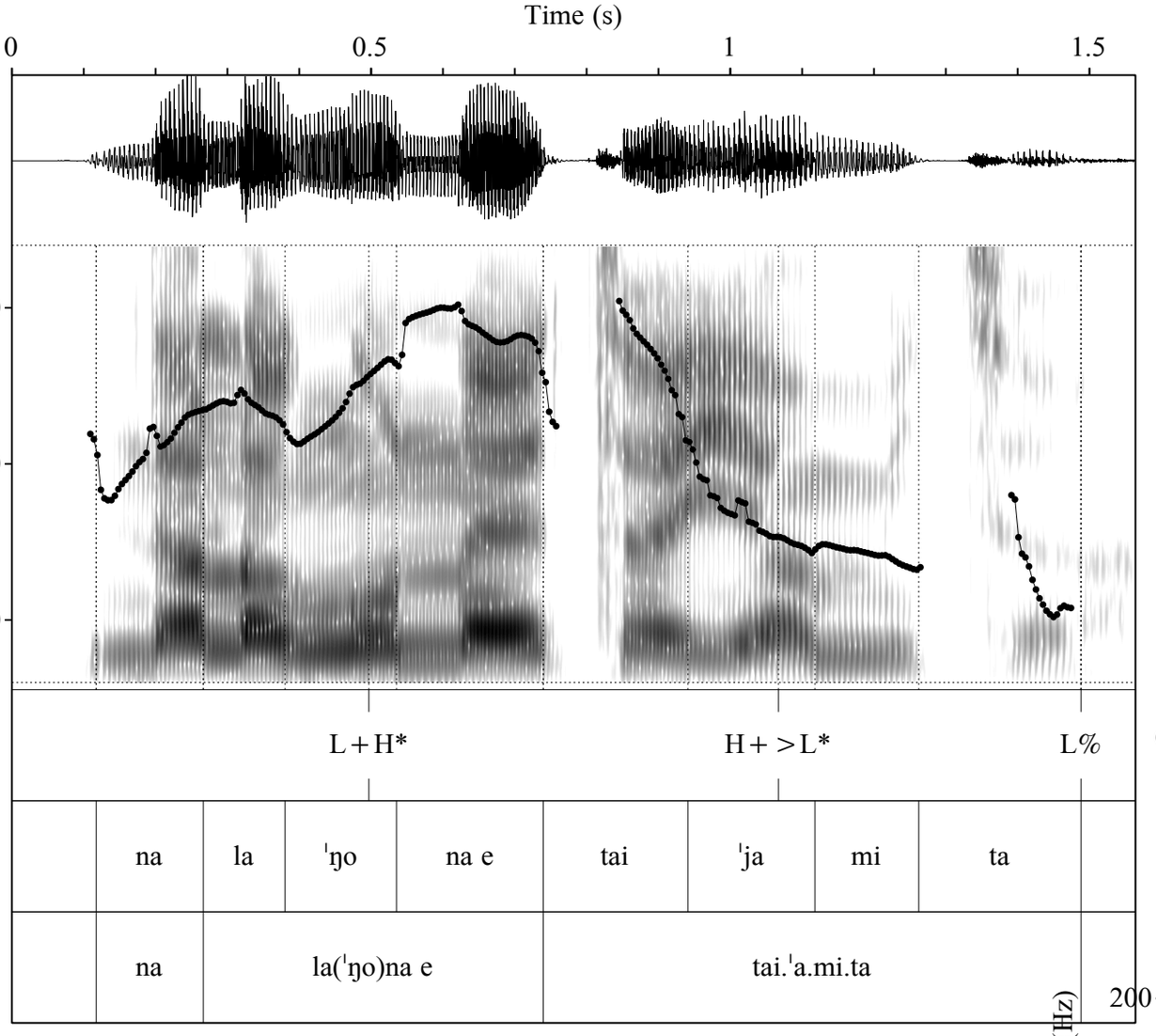
**Antepenultimate stress**

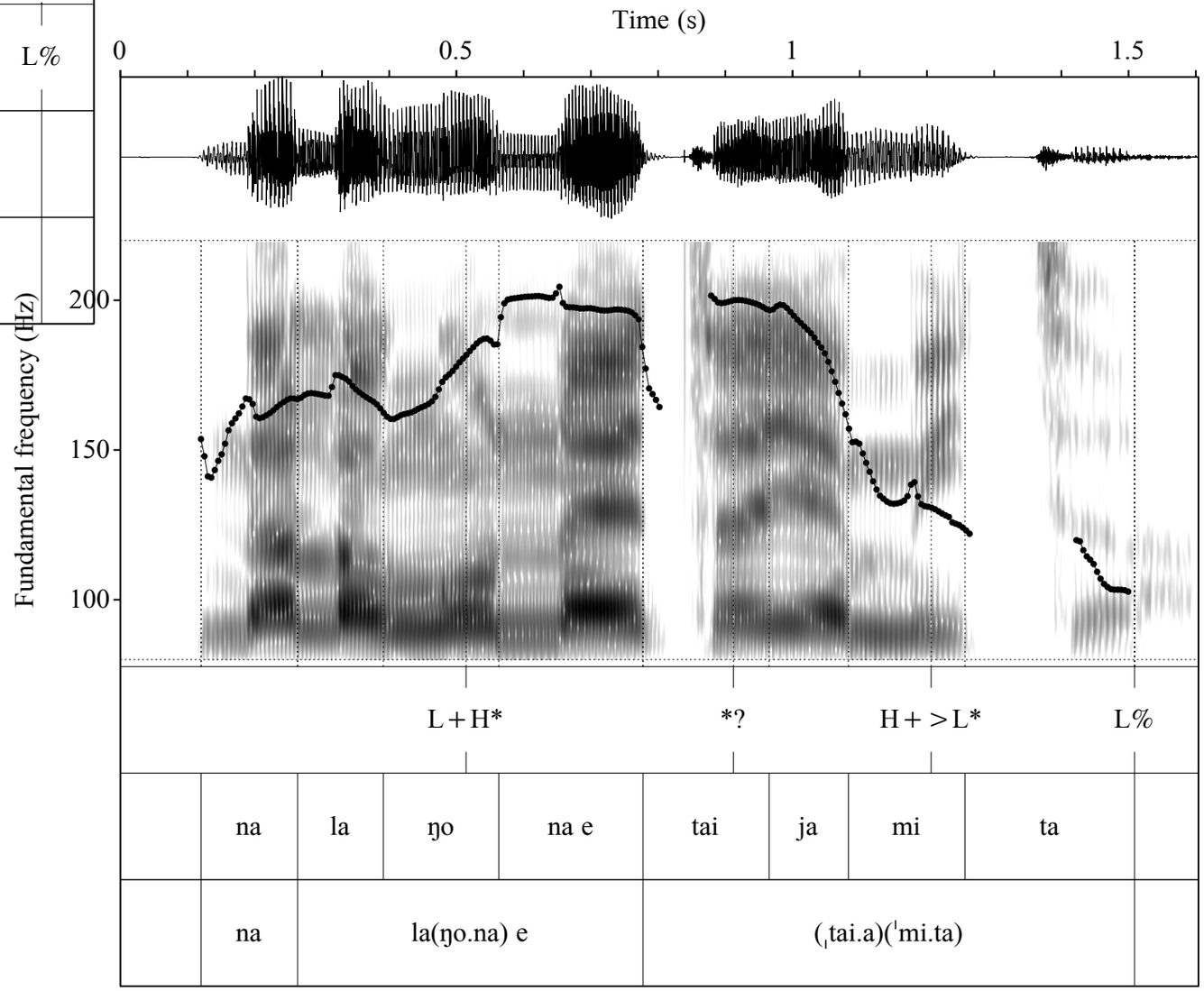
**tai.ˈja.mi.ta**

**Penultimate stress**

**tai.ja.ˈmi.ta**




Time (s)
0
0.5
1
1.5
Fundamental frequency (Hz)
200
150
100
L+H*
H+>L*
L%
na
la
ˈŋo
na e
tai
ˈja
mi
ta
na
la(ˈŋo)na e
tai.ˈa.mi.ta


Time (s)
0
0.5
1
1.5
Fundamental frequency (Hz)
200
150
100
L+H*
*?
H+>L*
L%
na
la
ŋo
na e
tai
ja
mi
ta
na
la(ŋo.na) e
(ˌtai.a)(ˈmi.ta)

# SAMOAN SENTENCE TYPE

| Segments | Stress position | Category | Meaning |
|---|---|---|---|
| /enele:/ | Final | Noun | Henry |
| /taiamita/ | Antepenult, penult | Noun |  |

σ*

| Tone | Tone position | Category | Meaning |
|---|---|---|---|
| High (LH*) | Stress position | Sentence type | Declarative |
| Low (HL*) | Stress position | Sentence type | Y/N question |
| Low | (Utt-) Final | Pragmatics | Belief |

**“Accent”**

# STRETCHING IN SWEDISH: ROOTS OF AM THEORY

# LINEAR MODELS: SWEDISH (BRUCE 1977)

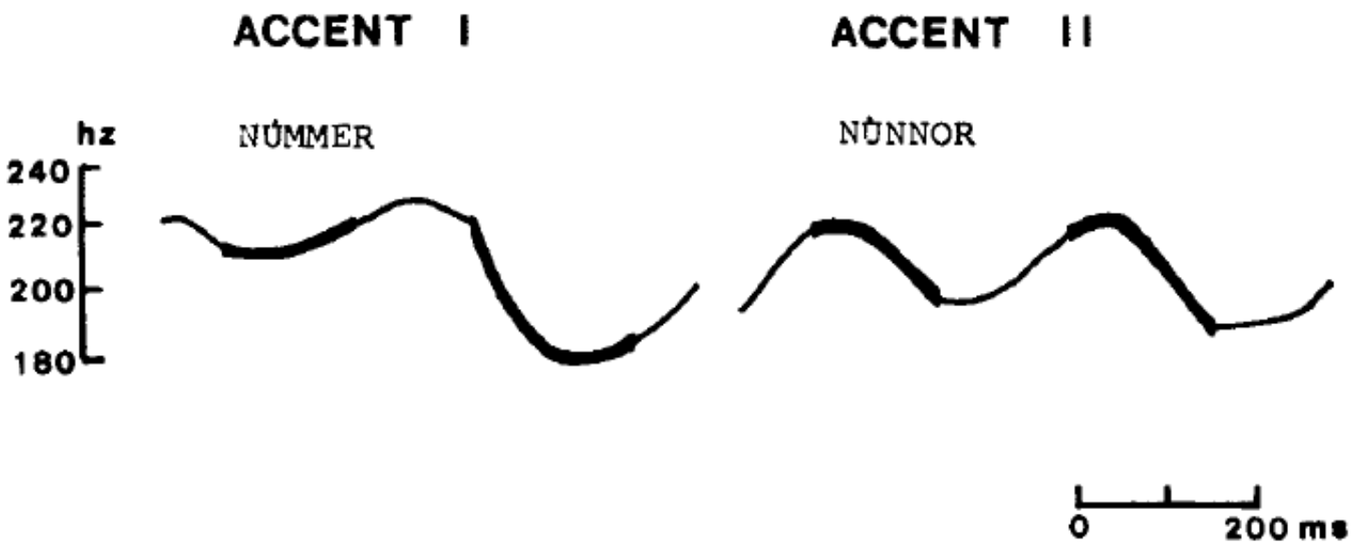
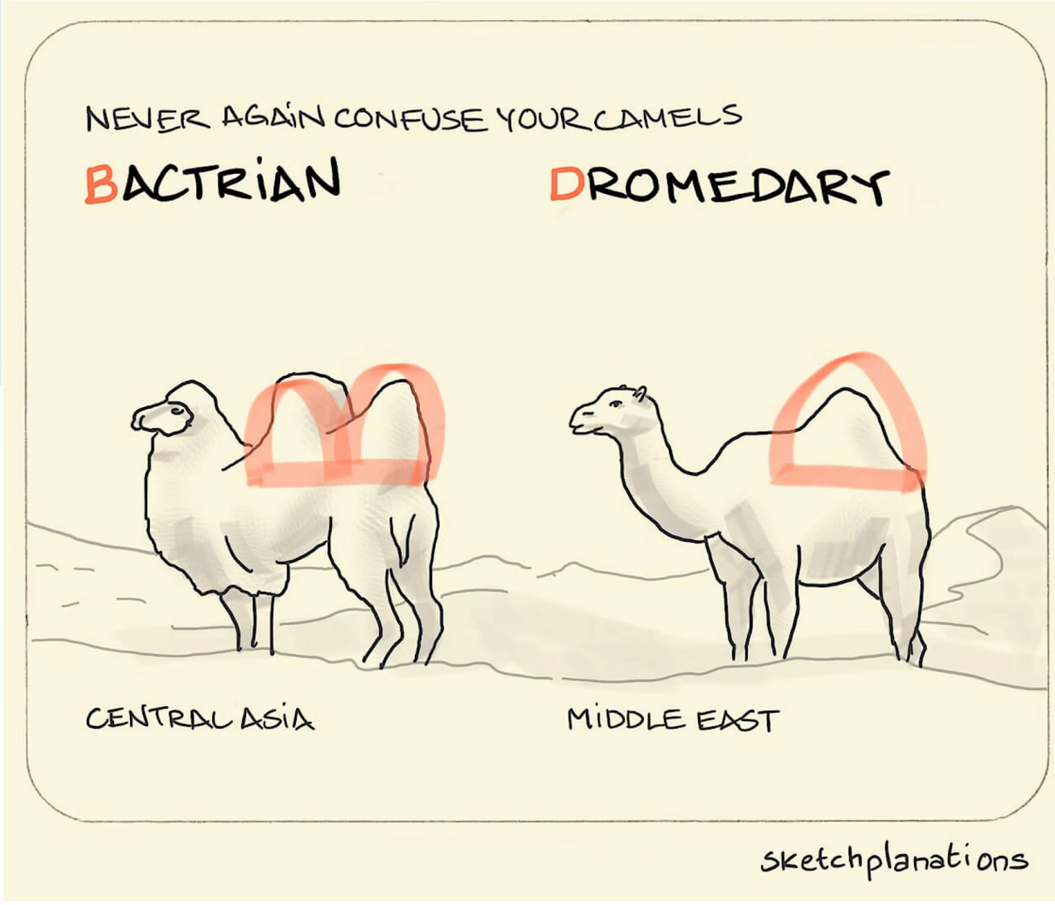



Figure 2. The citation forms of the word accents. Fo-contours of one accent I- and one accent II-word. Vowel segments are drawn in thick lines and consonant segments in thin lines in the figures. Focus is indicated by capital letters and non-focus position by small letters.

**Bruce (1977, p. 38)**




https://sketchplanations.com/bactrian-or-dromedary-camel

# EXPERIMENTAL DESIGN

**Bruce (1977, p. 42)**

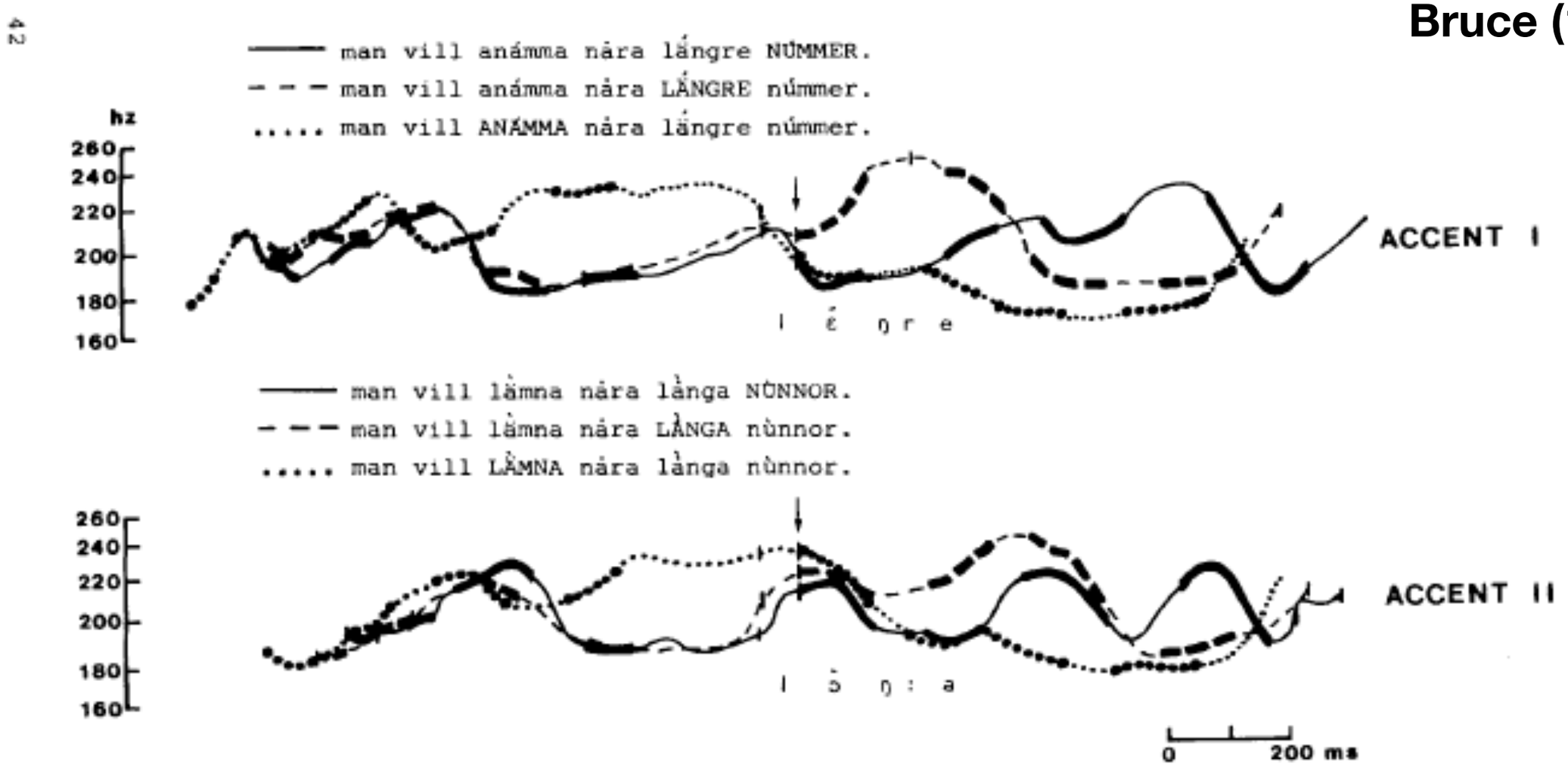



Figure 5. The effect of the placement of sentence accent. Fo-contours of full sentences, one with accent I-words and another with accent II-words. The line-up point is at the CV-boundary of the stressed syllable in the second position.

# THE WORD ACCENT CONTRAST

**Bruce (1977, p. 48)**

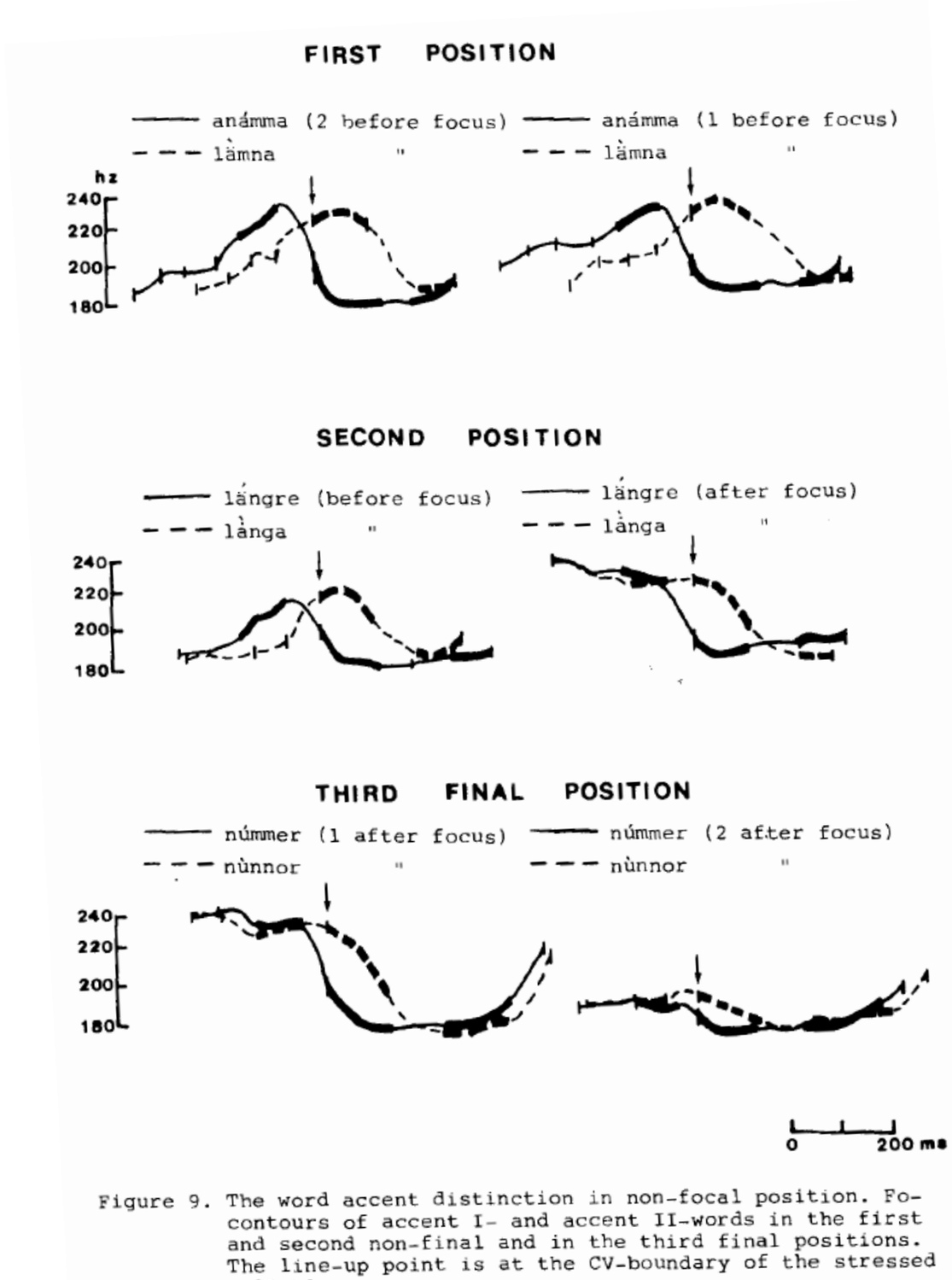



Figure 9. The word accent distinction in non-focal position. Fo-contours of accent I- and accent II-words in the first and second non-final and in the third final positions. The line-up point is at the CV-boundary of the stressed syllable.

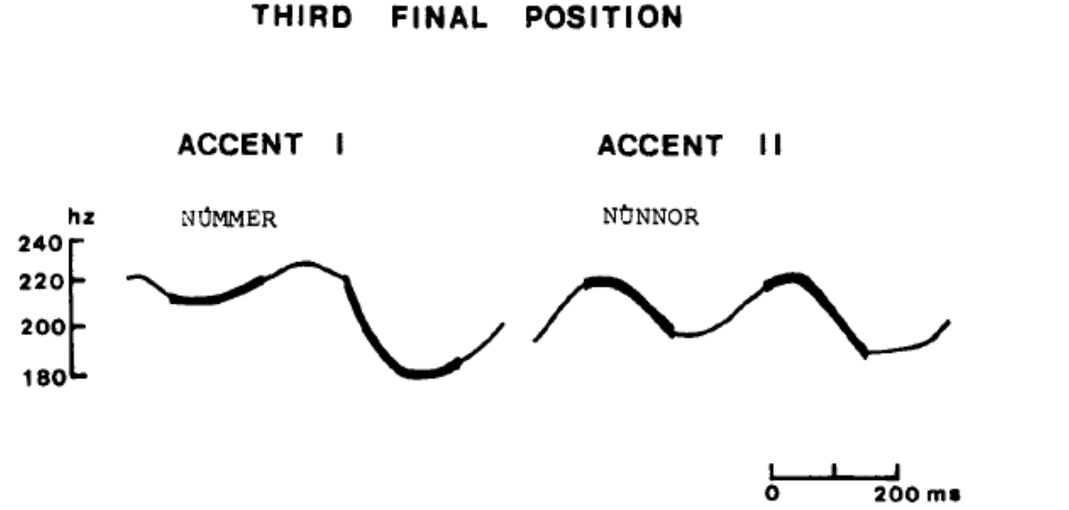



Figure 2. The citation forms of the word accents. Fo-contours of one accent I- and one accent II-word. Vowel segments are drawn in thick lines and consonant segments in thin lines in the figures. Focus is indicated by capital letters and non-focus position by small letters.

# THREE INDEPENDENT TONAL EVENTS

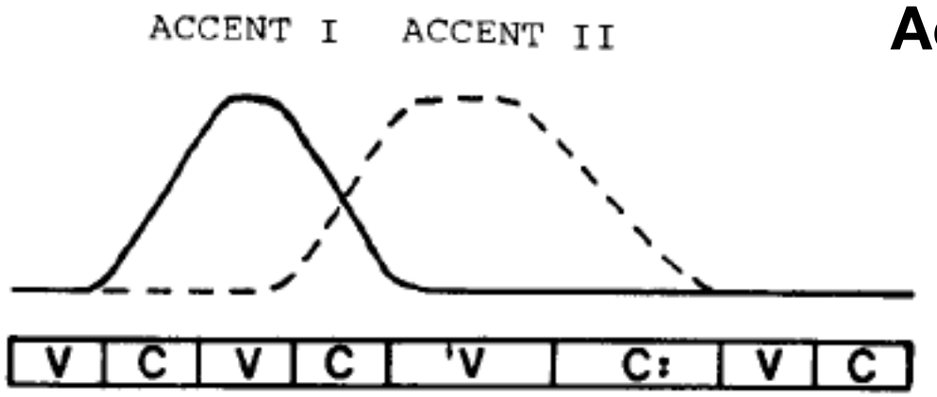



Figure 17. The basic contours of the two word accents. Schematized Fo-contours of accent I (unbroken line) and accent II (broken line) in pre-focal position.

**Accent I = H L*, Accent II = H* L (Bruce 1987)**

**lexical (associated to stressed syllable)**

**(Focal H, “floating”, see Bruce 1987)**

**pragmatic**

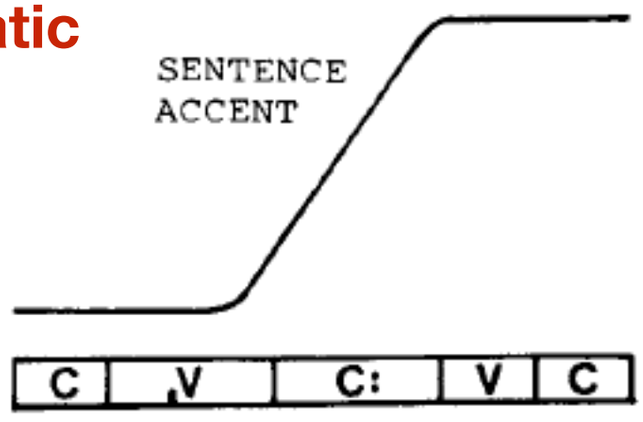



Figure 18. The basic contour of sentence accent. Schematized Fo-contour of sentence accent in the secondary-stress syllable of a compound in non-final position.

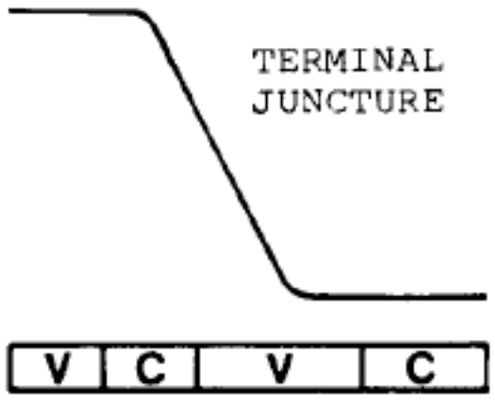



Figure 19. The basic contour of terminal juncture. Schematized Fo-contour of terminal juncture in the utterance-final syllable of a non-oxytonic word.

**Fall**

**prosodic boundary (and sentence type?)**

**Bruce (1977, p. 64, 69, 72 )**

# ALL TONAL EVENTS SPREAD OUT



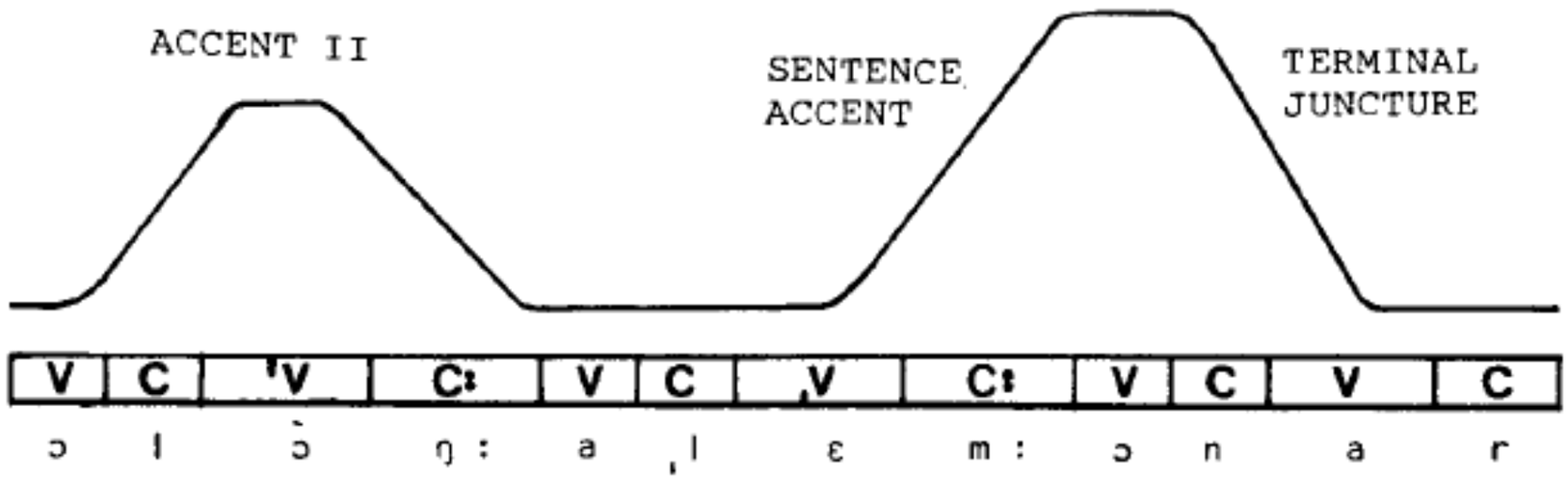



Figure 20. The basic contours of accent II, sentence accent and terminal juncture combined in a compound word. Schematized Fo-contour of the compound <u>làngaˌlemmonar</u>.

**Bruce (1977, p. 72 )**

# TONAL CROWDING: LINEAR SEQUENCING

**Bruce (1977, p. 93-94)**

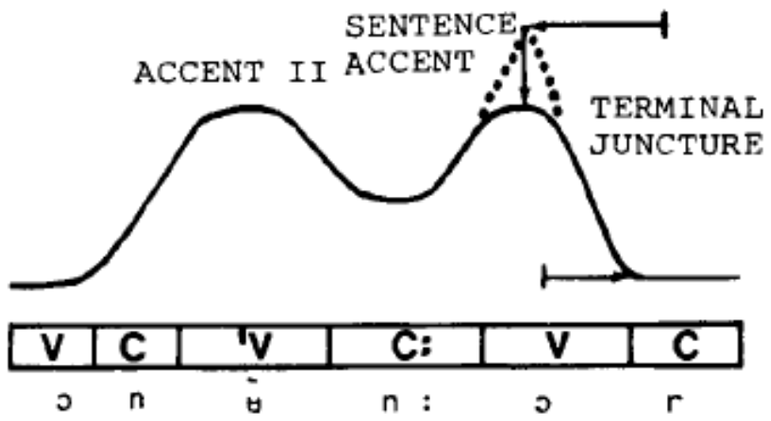



Figure 25. Interplay of sentence accent and terminal juncture for accent II. Schematized Fo-contour of a disyllabic accent II-word. The extent of the anticipation of the sentence accent rise, particularly the end-point of the rise, is indicated by the arrow pointing to the left, the undershooting of the sentence accent maximum by the arrow pointing downward, and the delay of the terminal juncture fall by the arrow pointing to the right. The dotted line represents contours prior to adjustment.

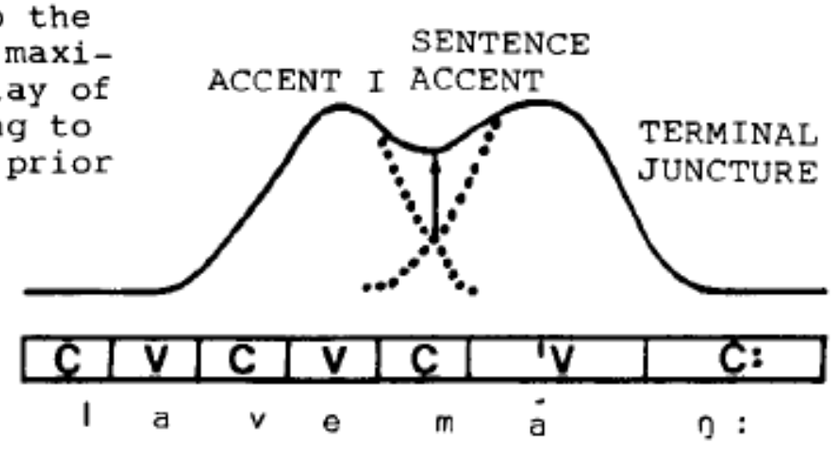



Figure 26. Interplay of word accent, sentence accent and terminal juncture for accent I. Schematized Fo-contour of an oxytonic accent I-word. The anticipation of the sentence accent rise, the undershooting of the sentence accent maximum, and the delay of the terminal juncture fall illustrated in figure 24 for the oxytonic compound are all presupposed in the present figure. The extent of the undershooting of the word accent minimum is indicated by the arrow pointing upward. The dotted line represents contours prior to adjustment.



# THE ORIGIN OF ONE HUMP VS. TWO HUMPS

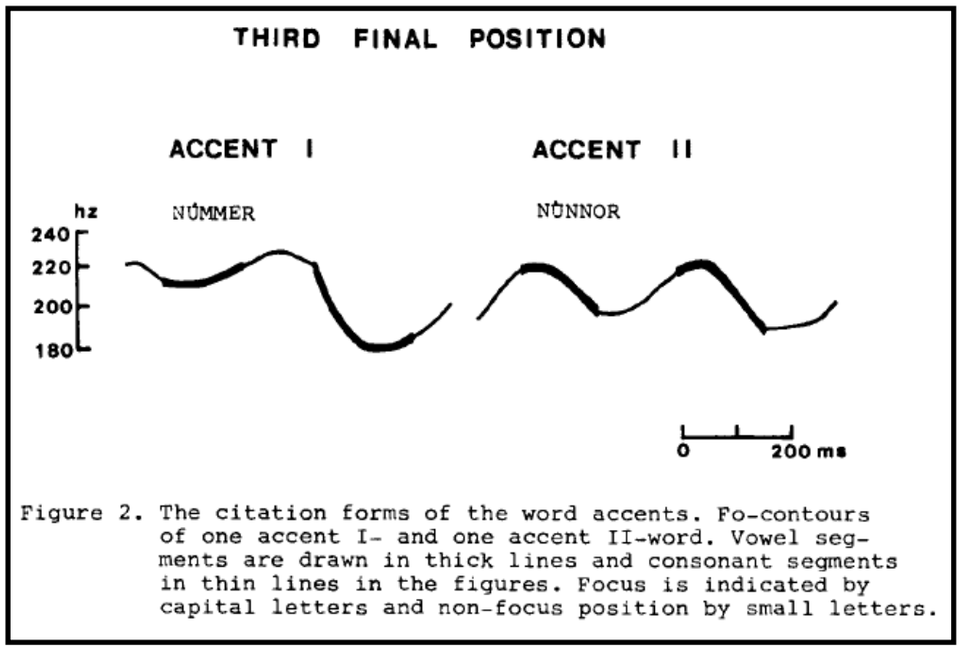



Figure 2. The citation forms of the word accents. Fo-contours of one accent I- and one accent II-word. Vowel segments are drawn in thick lines and consonant segments in thin lines in the figures. Focus is indicated by capital letters and non-focus position by small letters.

**Bruce (1977, p. 50)**

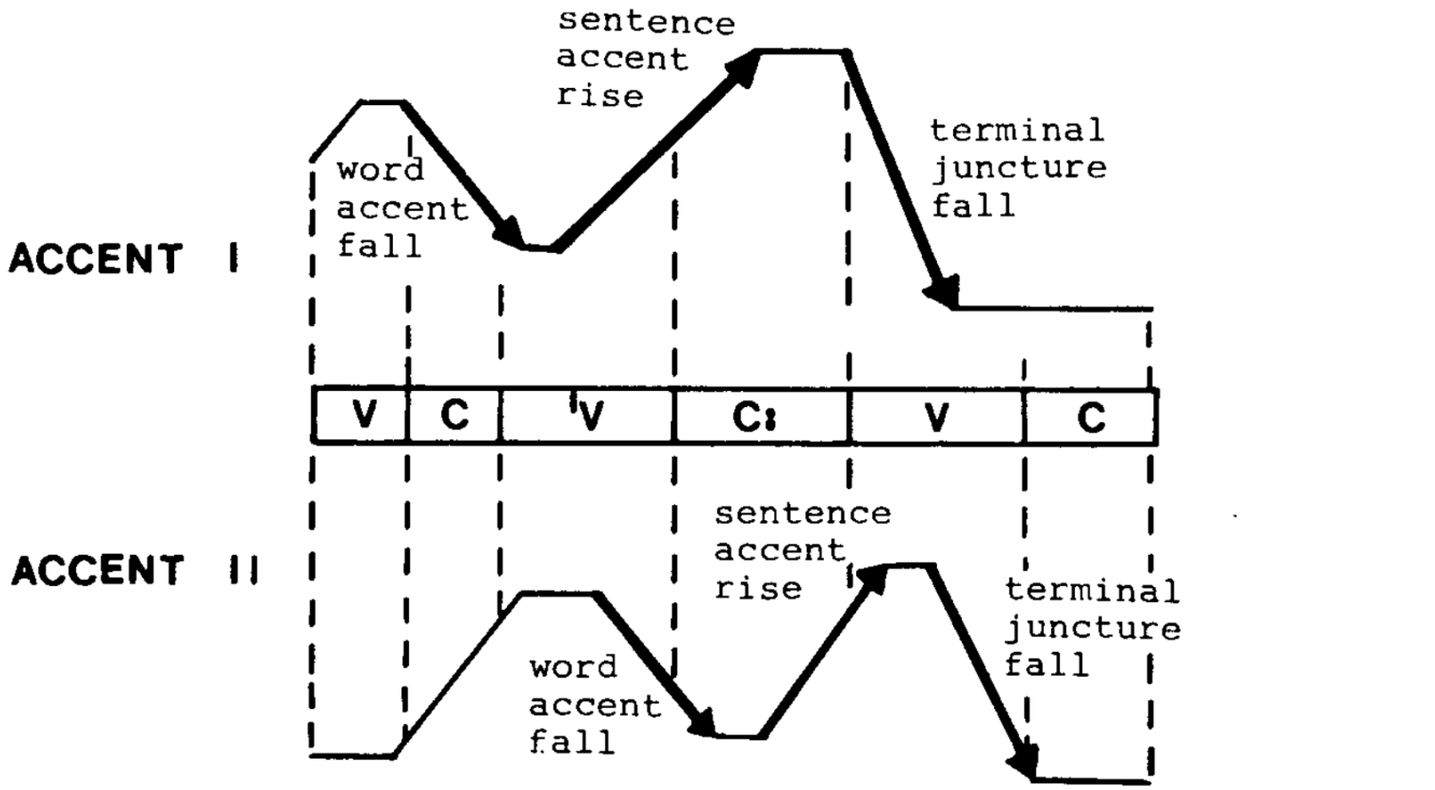



Figure 10. The Fo-contributions of word accent, sentence accent and terminal juncture. Schematized contours of one accent I- and one accent II-word. The arrows, drawn in thick lines, indicate word accent fall, sentence accent rise and terminal juncture fall.

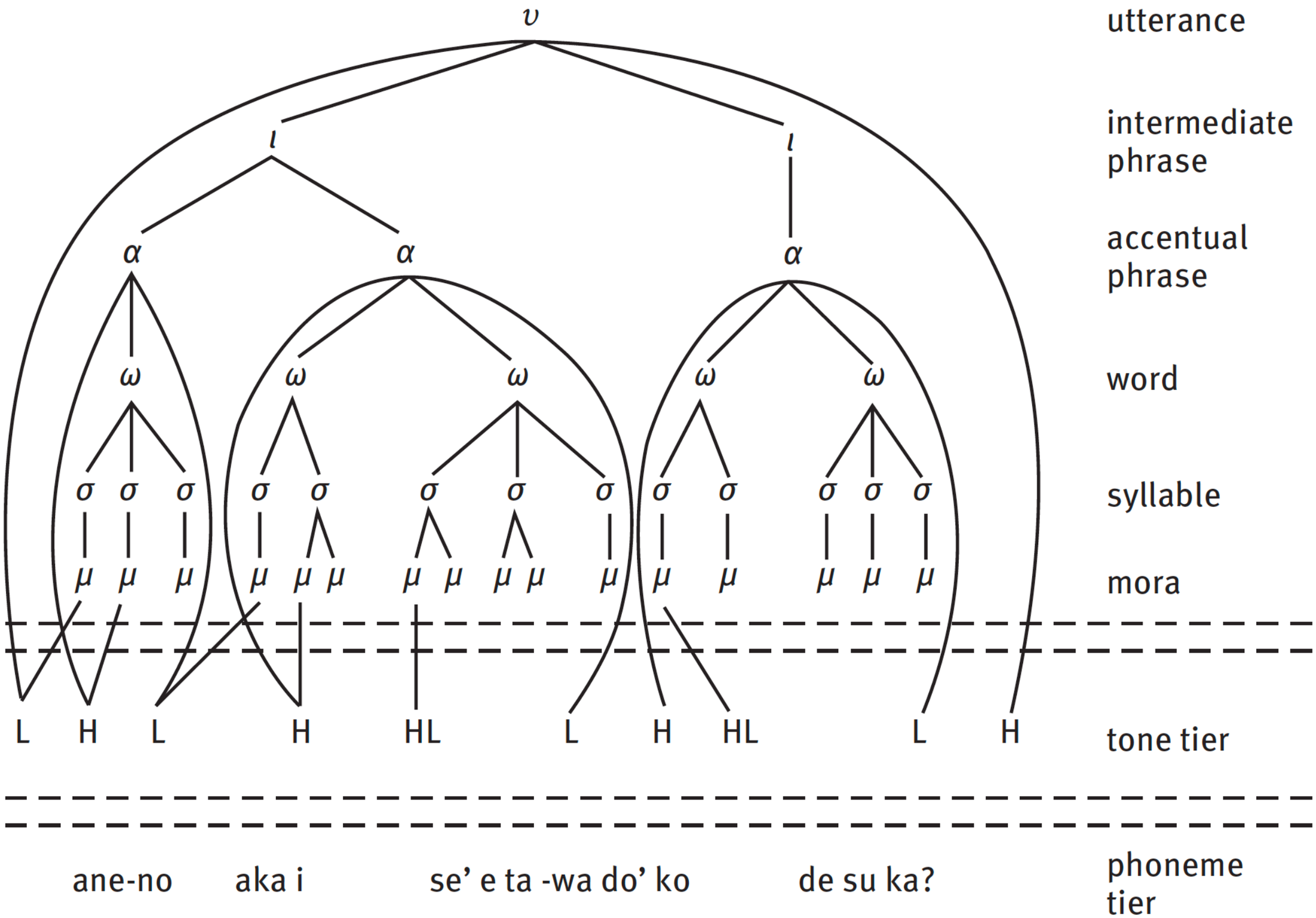
**The peak for Accent I H+L* is so early you don't even really see it when the stressed syllable is initial like in *nummer*. The peak you do see is from sentence accent rise + terminal juncture fall.**

# PB88: WEAK LOWS IN TOKYO JAPANESE?

# DELETION OR TWO ALLOPHONES OF Lα?

- **Sometimes no AP-"initial" L (“traditional description”):**
  - No AP-initial L if AP-initial word is either accented or starts with long vowel
- **Two allophones of AP-"initial" L (Pierrehumbert & Beckman 1988, Sec 2.1)**
  - Always have AP-initial L, but different phonological association patterns resulting in two allophones; “weak” and “strong”.
  - Note: point of confusion! PB88 seem to use L% for both the left-edge utterance-level tone, and for right edge AP level tones.
  - Note: point of confusion! I put "initial" in square quotes because the L actually belongs to the previous AP

# LOOK AT THE TREE...




**Pierrehumbert & Beckman (1988)**

# COUNTEREVIDENCE TO AP-INITIAL L DELETION

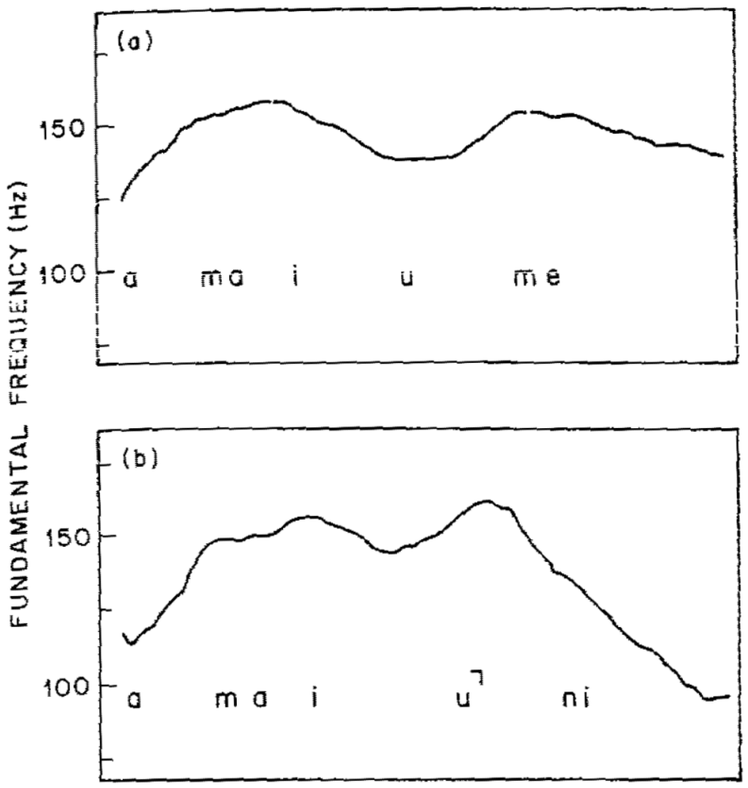



**Figure 2.1**
$F_0$ contours for utterances of (a) *amai ume* 'sweet plum' and (b) *amai u'ni* 'sweet sea-urchin', produced by speaker OF.

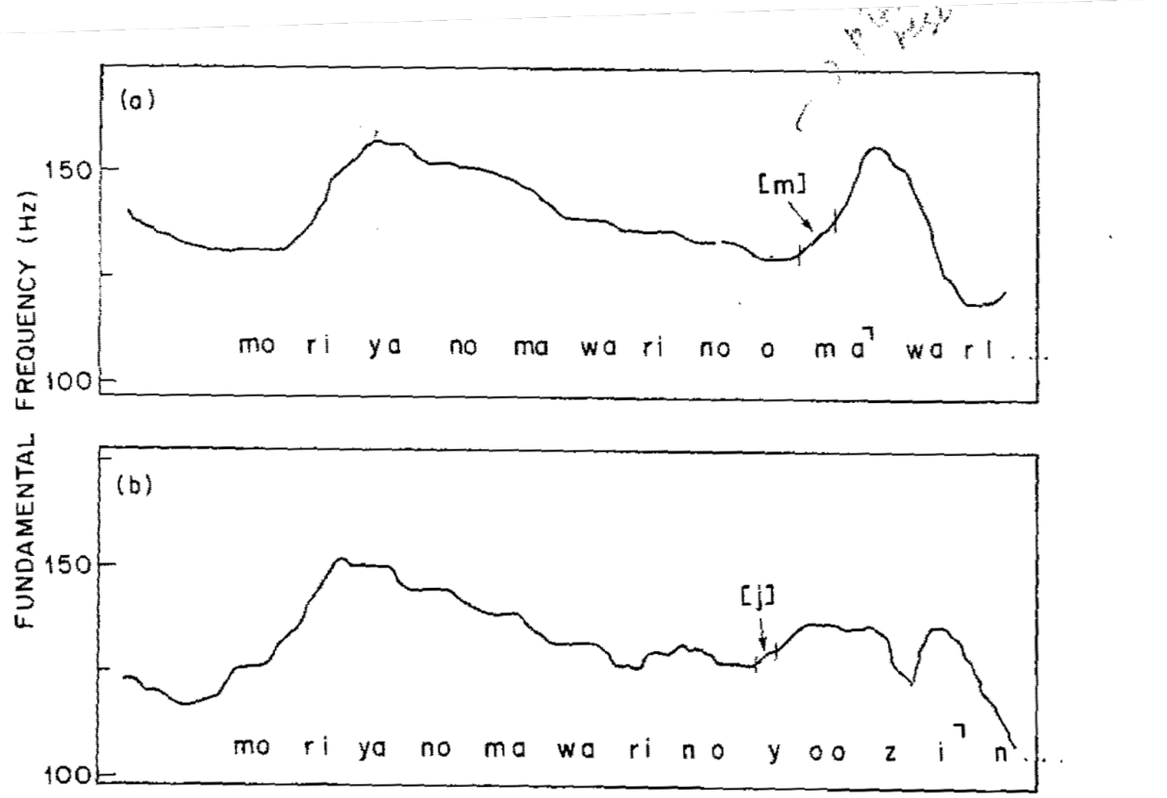



**Figure 2.2**
$F_0$ contours for utterances of (a) *moriya-no mawari-no oma'warisan* 'the policeman of the Forrests' neighborhood' and (b) *moriya-no mawari-no yoozi'nboo* 'the watchman of the Forrests' neighborhood', produced by speaker OF.

**F0 rises for both unaccented and accented, two APs**

**Pierrehumbert & Beckman (1988, p. 27)**

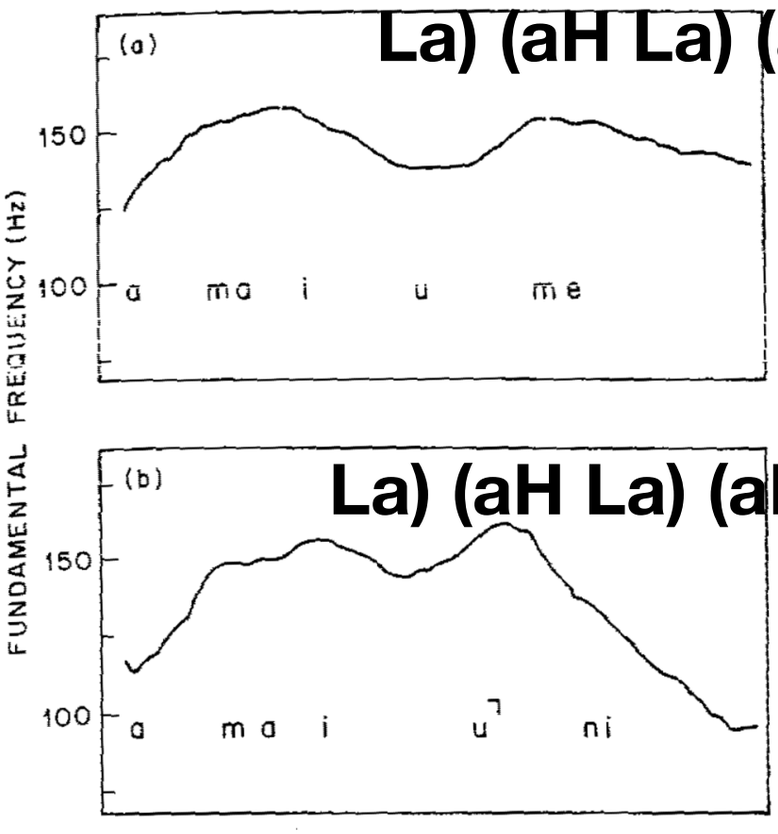
**F0 rises for both short (oma'warisan) and long vowels (yoozi'nboo)**

# PROPOSAL: ALL AP MELODIES HAVE L H...

**Pierrehumbert & Beckman (1988, p. 27-28)**

## 2 APs + preceding La

**La) (aH La) (aH La)**

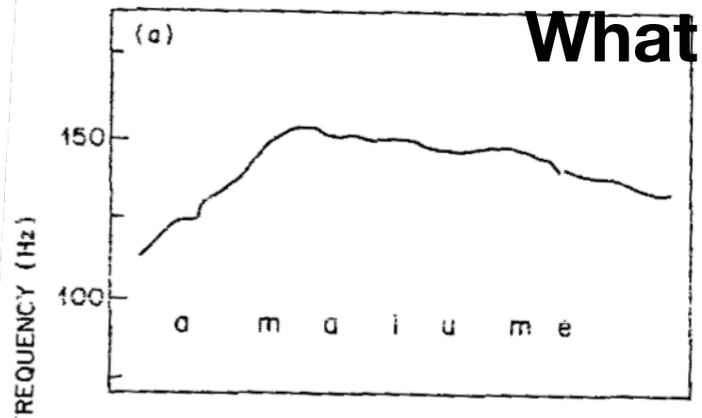



**La) (aH La) (aH H*L La)**

**Figure 2.1**
$F_0$ contours for utterances of (a) *amai ume* 'sweet plum' and (b) *amai u'ni* 'swee
sea-urchin', produced by speaker OF.

## single AP + preceding La

**What's the melody?**




**What's the melody?**

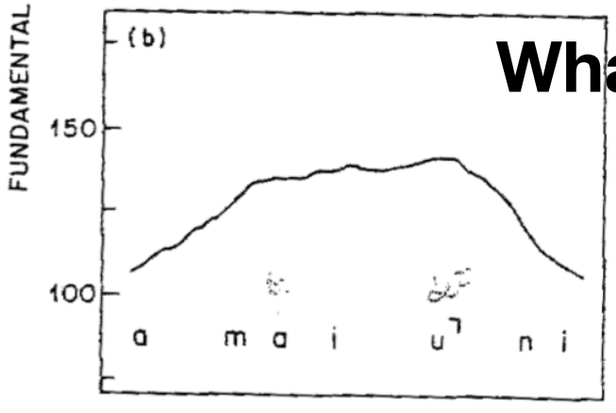



**Figure 2.3**
$F_0$ contours for utterances of (a) *amai ume* and (b) *amai u'ni*, with no phrase break before *ume* or *u'ni*, produced by speaker OF.

*"Figures 2.1a and 2.1b show a typical pair of utterances involving accentual phrase boundaries where traditional accounts would and would not posit a L tone [KY: why?]. They illustrate f0 contours for the noun phrases amai ume 'sweet plum' and amai u'ni 'sweet sea-urchin'* ***spoken in the same larger phrasal context that has broad focus over both the adjective amai 'sweet' and the head noun ume 'plum' or u'ni 'sea-urchin'****." (cf. Fig 2.3, narrow focus on amai)*

# WEAK VS. STRONG ACCENTUAL L

(stronger) La

unaccented

"weak" La

initial accent

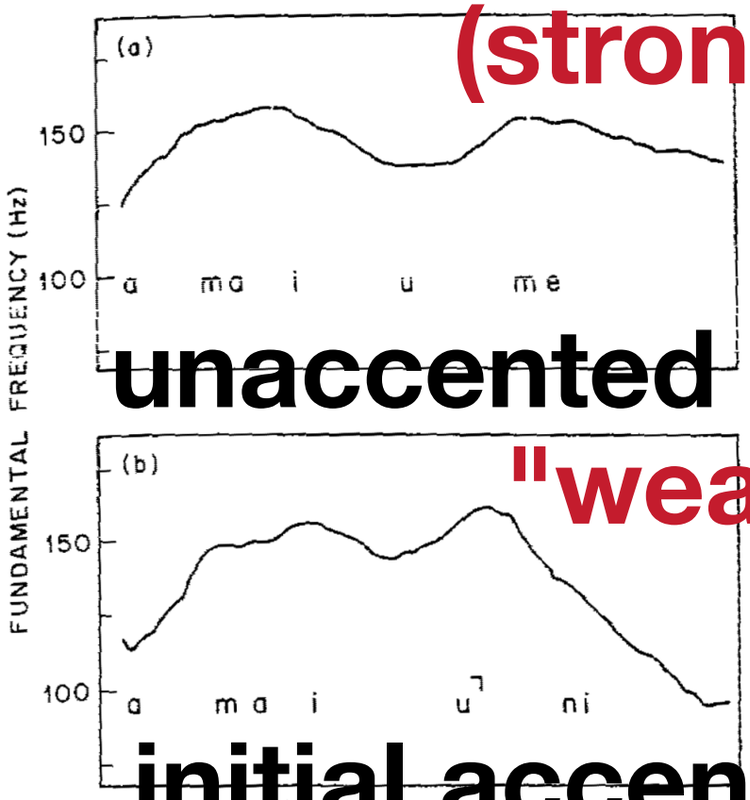



**Figure 2.1**
$F_0$ contours for utterances of (a) *amai ume* 'sweet plum' and (b) *amai u'ni* 'sweet sea-urchin', produced by speaker OF.

(stronger) La

short vowel

"weak" La

long vowel

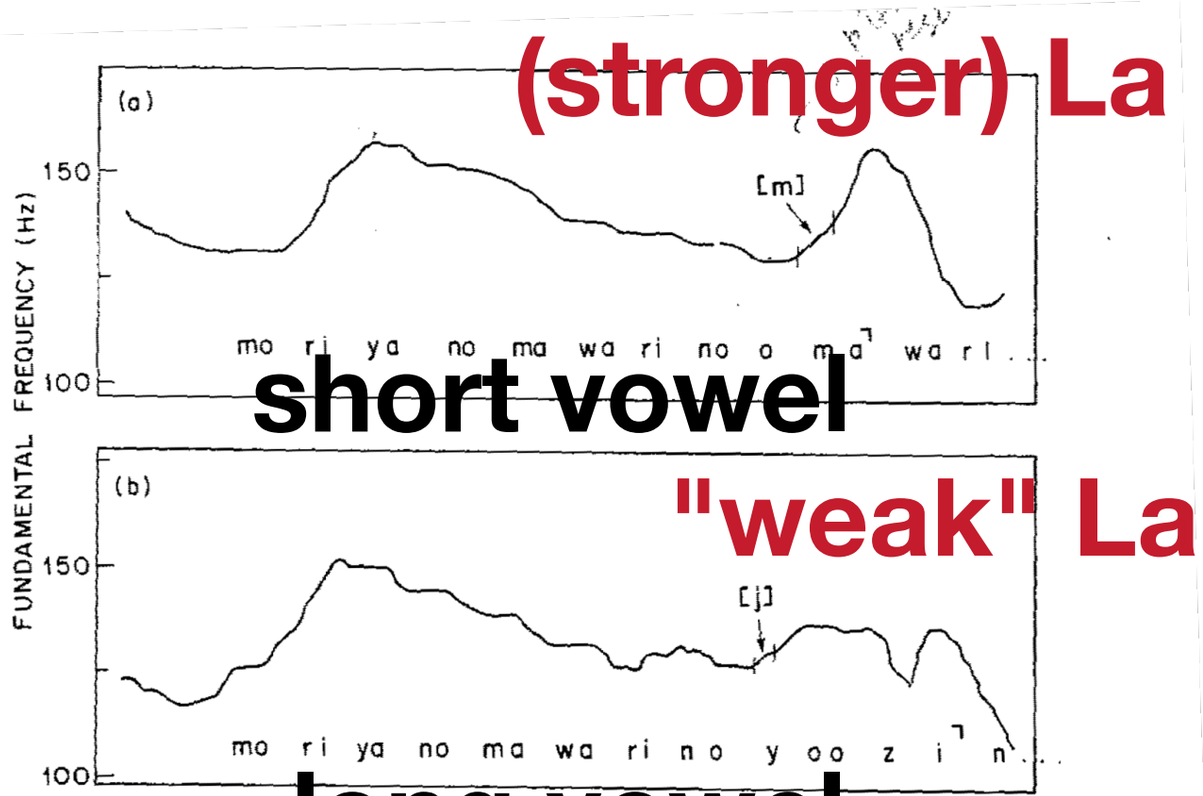
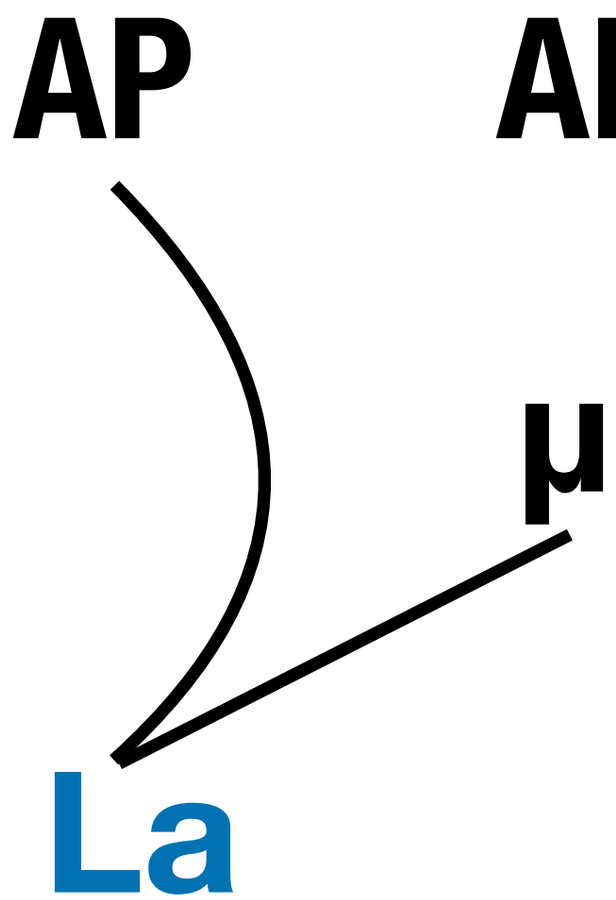



**Figure 2.2**
$F_0$ contours for utterances of (a) *moriya-no mawari-no oma'warisan* 'the policeman of the Forrests' neighborhood' and (b) *moriya-no mawari-no yoozi'nboo* 'the watchman of the Forrests' neighborhood', produced by speaker OF.

"weak" La: shorter rise, higher F0 valley/smaller drop into L
"stronger" La: longer rise, lower F0 valley, bigger drop into L

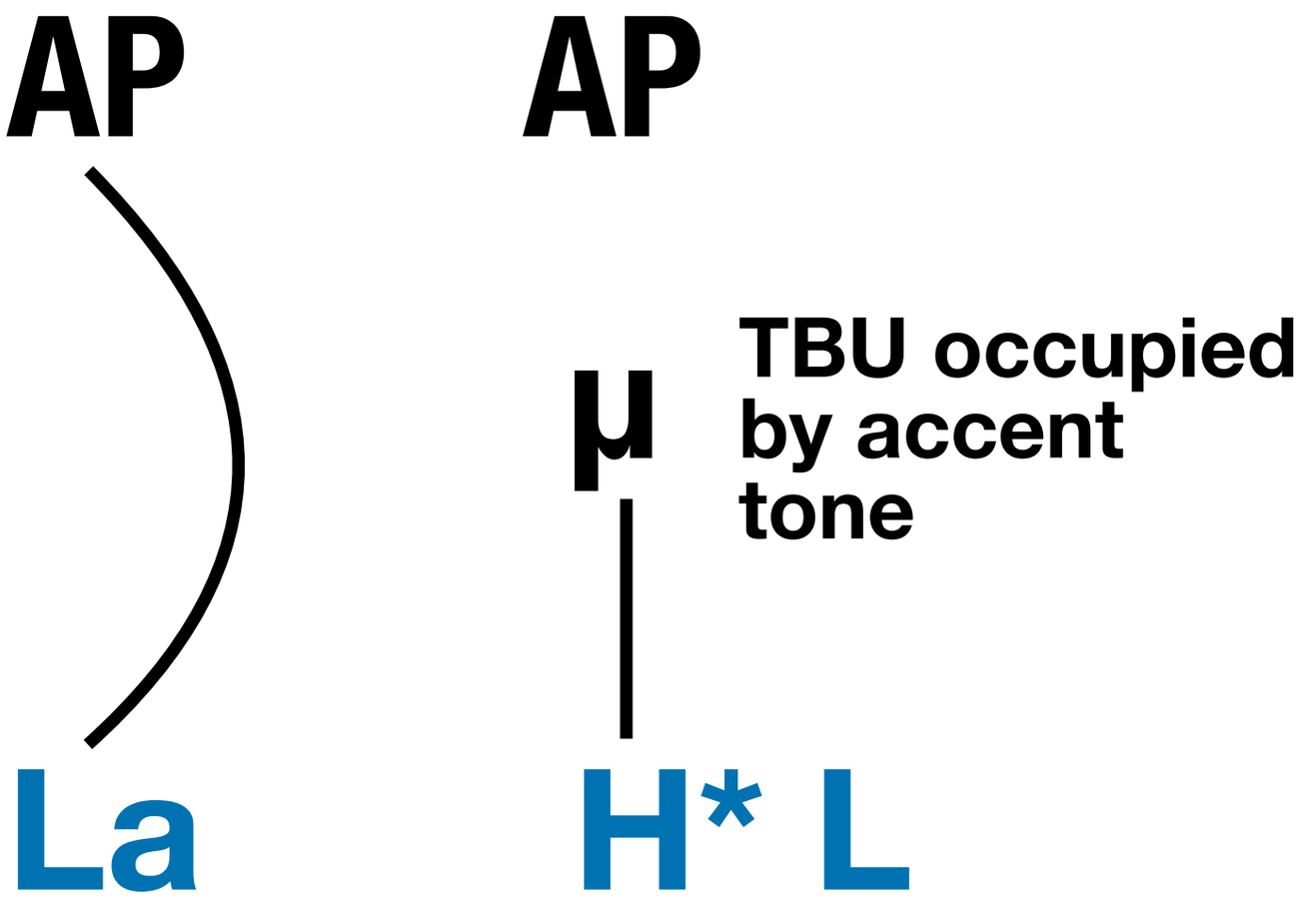
# MULTIPLE TONAL ASSOCIATION AND DISTINCT PHONETIC REALIZATIONS

## La associated to TBU and Accentual Phrase




(strong) La

## La associated only to Accentual Phrase




weak La

# BRUCE 1977 AND PB88: (LINEAR?) INTERPOLATION

# TONAL TARGETS: BASIC RULES

**Bruce (1977, p. 133)**

8.3.5 Basic pitch rules

A basic pitch rule represents the tonal command for a prosodic feature, when it is not influenced by other tonal commands (cf. the basic Fo-contours, chapter 4). For each prosodic feature (except for word accent) the basic pitch rule specifies one tonal point - one HIGH or one LOW. For word accent (accent I and accent II) the basic pitch rule will specify two tonal points - one HIGH and one LOW. The tonal points prescribed by the basic pitch rules are distributed over successive syllables.

The basic pitch rules are the following. (They are exemplified in figure 36.)

ACCENT I: HIGH in the pre-stress syllable, LOW in the stressed syllable.

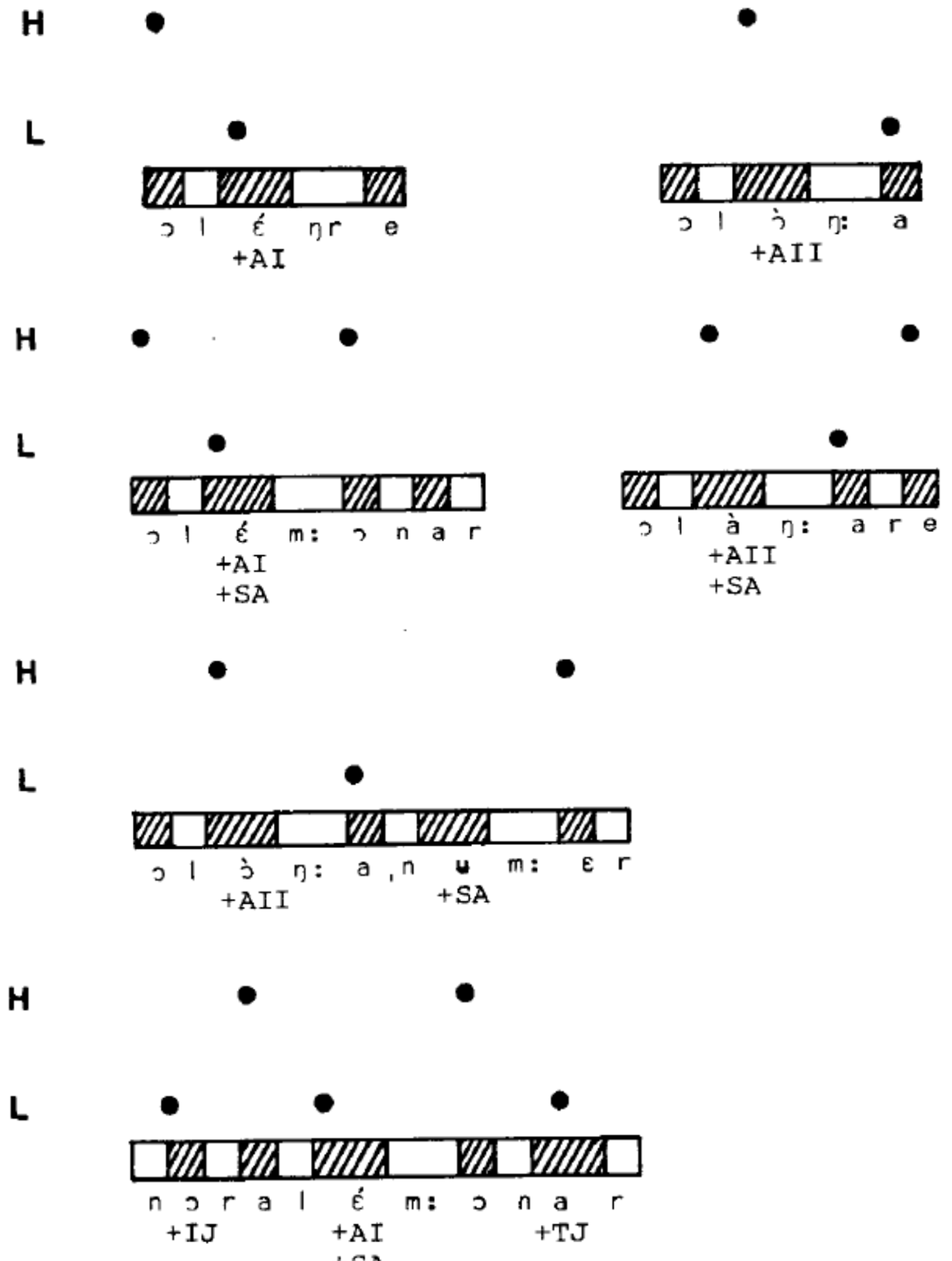
ACCENT II: HIGH in the stressed syllable, LOW in the post-stress syllable.

SENTENCE ACCENT: HIGH in the post-stress syllable.
(Accent I, Compounds)

SENTENCE ACCENT: HIGH in the syllable following the post-stress syllable.
(Accent II)

INITIAL JUNCTURE: LOW in the utterance-initial syllable.

TERMINAL JUNCTURE: LOW in the utterance-final syllable.



# CONTEXT-DEPENDENT RULES

**Bruce (1977, p. 135)**

8.3.6 Context-dependent pitch rules

When tonal commands occur adjacent to each other, they will normally influence each other (cf. the interplay, chapter 5). This influence often involves a temporal displacement of the tonal point of a command relative to the basic pitch rule, depending on the particular context. The context-dependent pitch rules replace the basic pitch rules in certain, specified contexts. Thus the basic pitch rules will apply to those contexts not specified by the context-dependent pitch rules.

The following context-dependent pitch rules are assumed to compl ment the basic pitch rules. (They are exemplified in figure 37.)

| | |
|---|---|
| SENTENCE ACCENT: (Accent I, Compounds) | HIGH in the stressed syllable, if the post-stress syllable has accent I or terminal juncture (LOW), or if there is no post-stress syllable. |
| SENTENCE ACCENT: (Accent II) | LOW in the stressed syllable, HIGH in the post-stress syllable, if the following syllable has accent I or terminal juncture (LOW), or if there is no following syllable. |

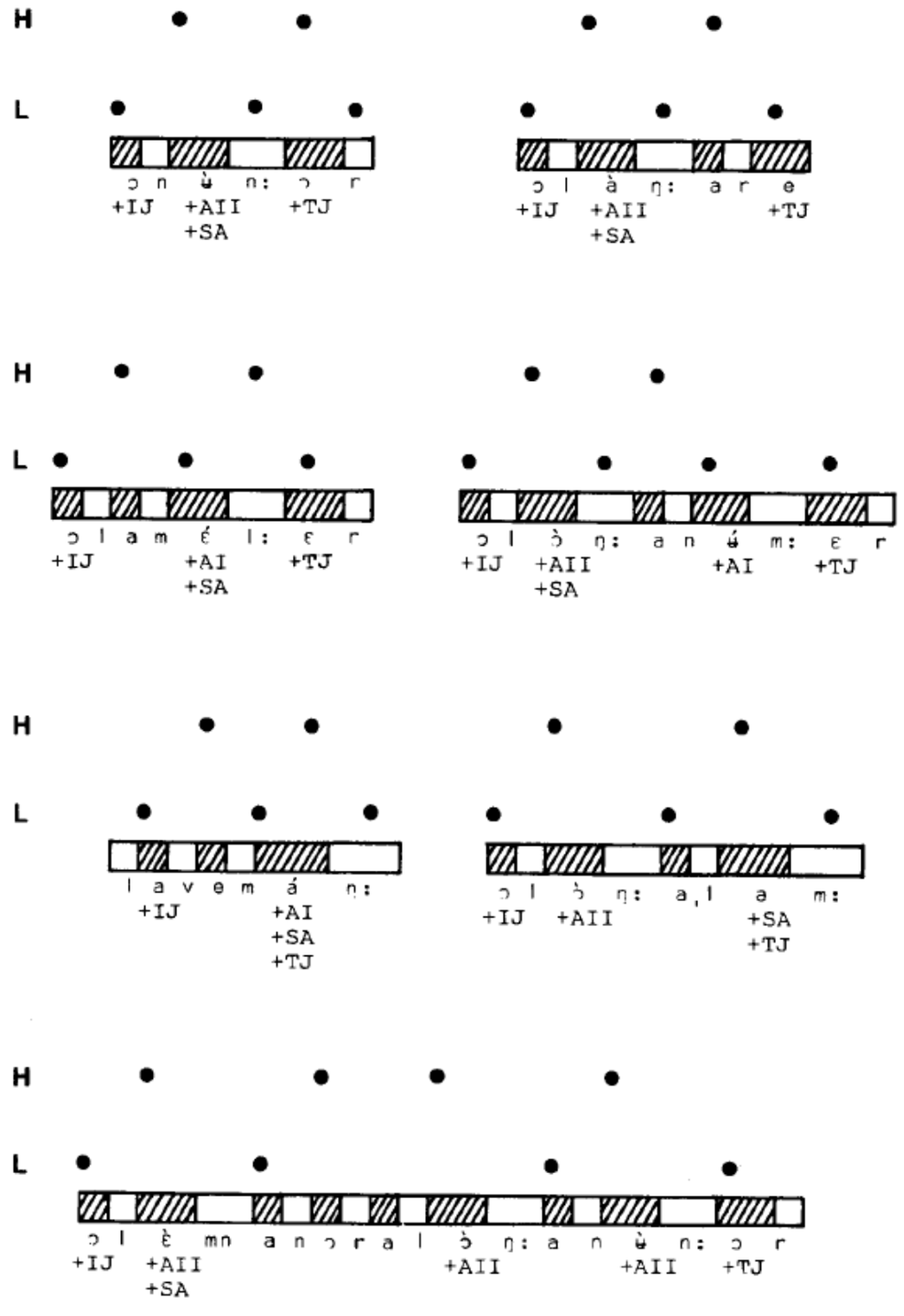



Figure 37. The effect of basic and context-dependent pitch rules. Tonal points with reference to two pitch levels - HIGH (H) and LOW (L) - with indications about their relative temporal locations.

# FO IMPLEMENTATION RULES

**Bruce (1977, p. 138-9)**

HIGH will be specified as Fo-level:

4 for word accent, when it directly follows HIGH for sentence accent

for sentence accent

3 for word accent

for sentence accent, when it occurs in the same syllable as LOW for terminal juncture

2 for word accent, when it directly follows LOW for word accent after focus

LOW will be specified as Fo-level:

1 for word accent

for initial juncture

for terminal juncture

2 for word accent, when it directly precedes HIGH for sentence accent

for word accent, when it directly follows HIGH for sentence accent plus HIGH for word accent and directly precedes HIGH for word accent



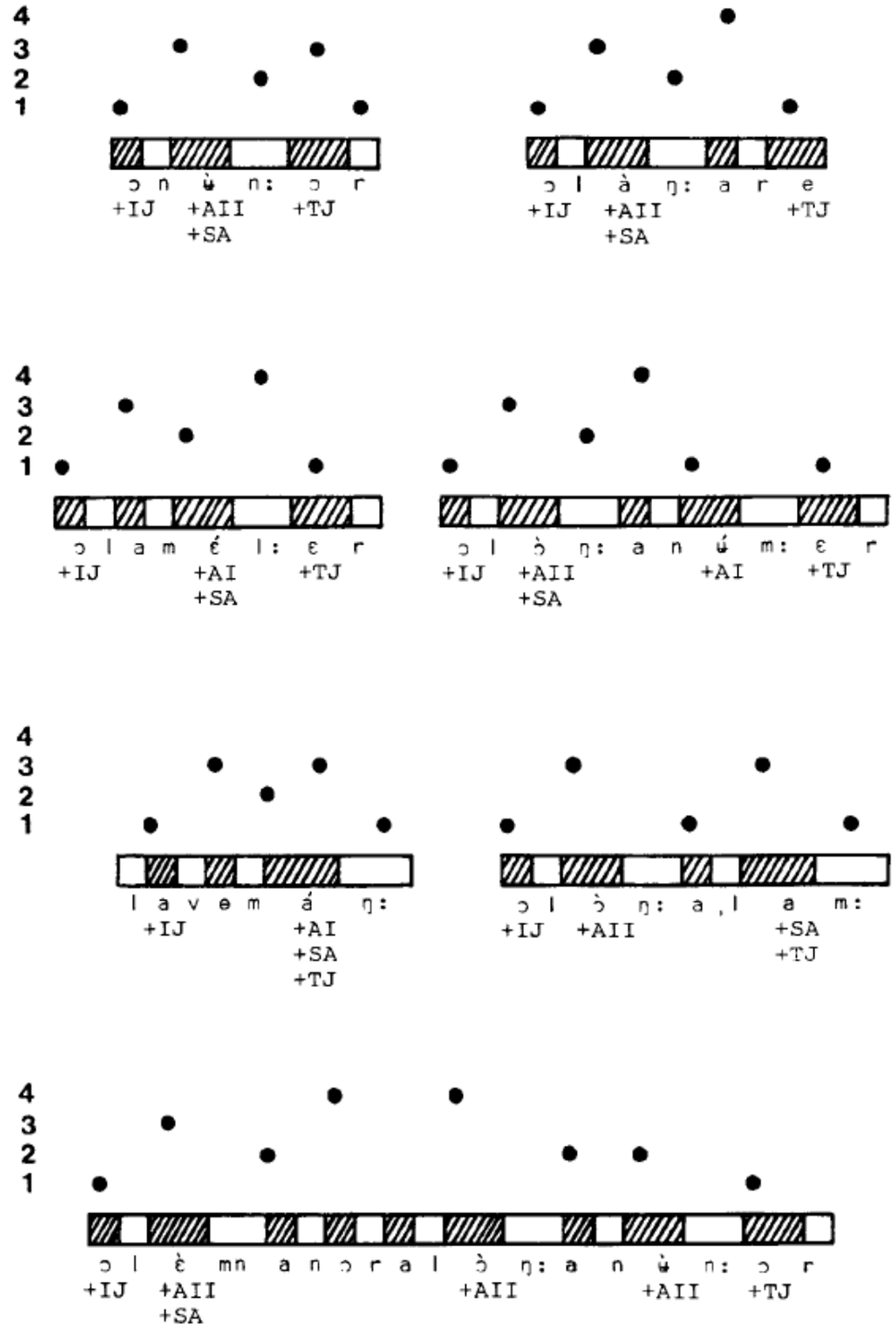



Figure 38. The effect of Fo-rules. Fo-points with reference to 4 Fo-levels with indications about their relative temporal locations.

# FO TRANSITIONS!

**Bruce (1977, p. 140-1)**

8.5 Join rules

In order to receive a continuous Fo-contour of an utterance the Fo-points defined by the pitch rules and the Fo-rules have to be interconnected. This is taken care of by the join rules. By these rules the rises, falls, plateaus and troughs of the Fo-contours will be filled out. The following join rules will be used. (The output of the join rules is exemplified in figure 39.)

Copy rule: Copy the Fo-level of a syllable on to the following syllable, if nothing else is indicated.

Join rule: Connect the Fo-points by a linear interpolation.

The copy rule will provide certain Fo-turning-points, which are not defined by the pitch rules or the Fo-rules. The join rule will then simply connect the Fo-points by a basically linear interpolation. There seems to be no apparent constancy

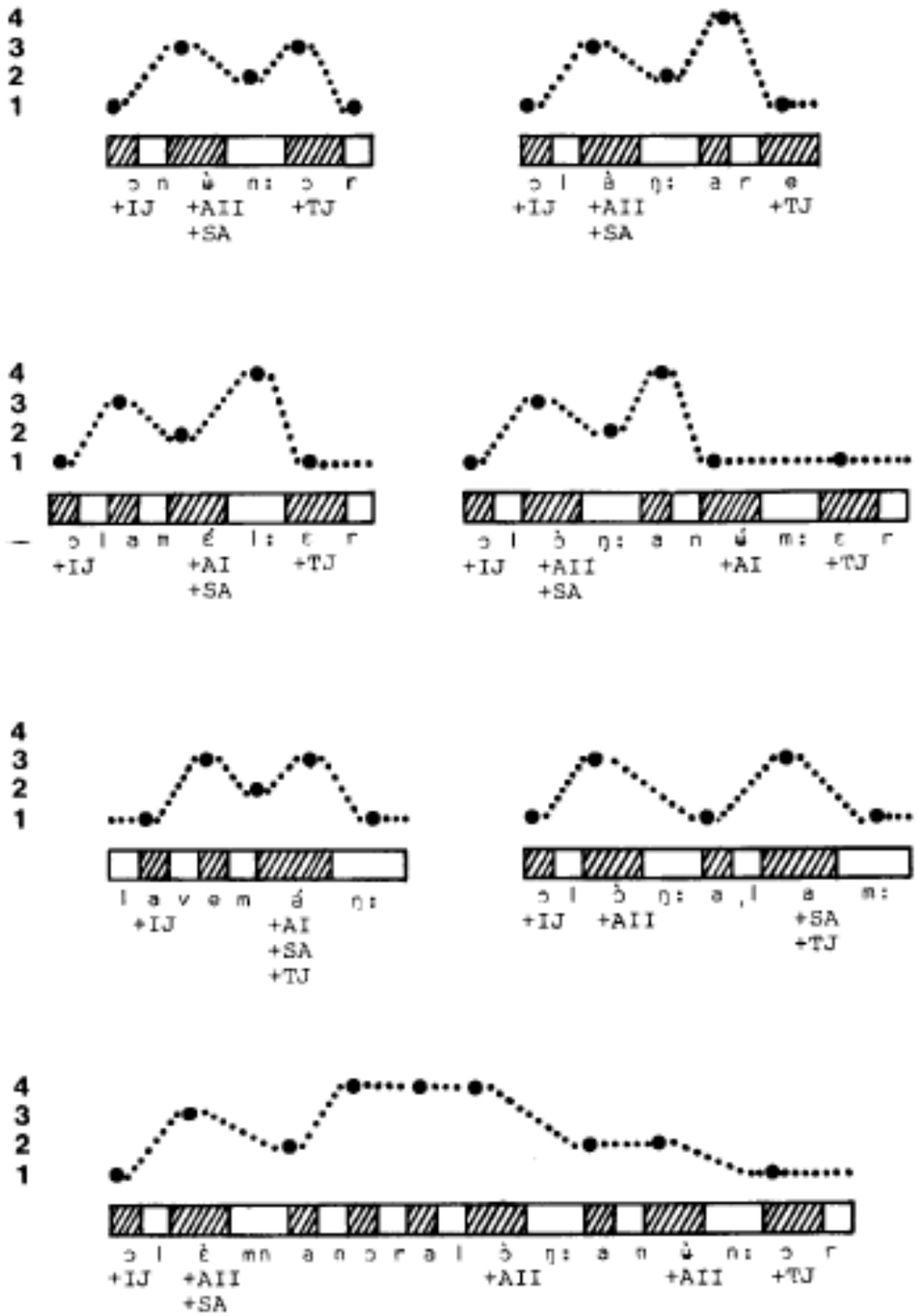



Figure 39. The effect of join rules. Fo-contours (dotted) containing Fo-points with reference to 4 Fo-levels with indications about their relative temporal locations.

**Bruce (1977, p. 142)**

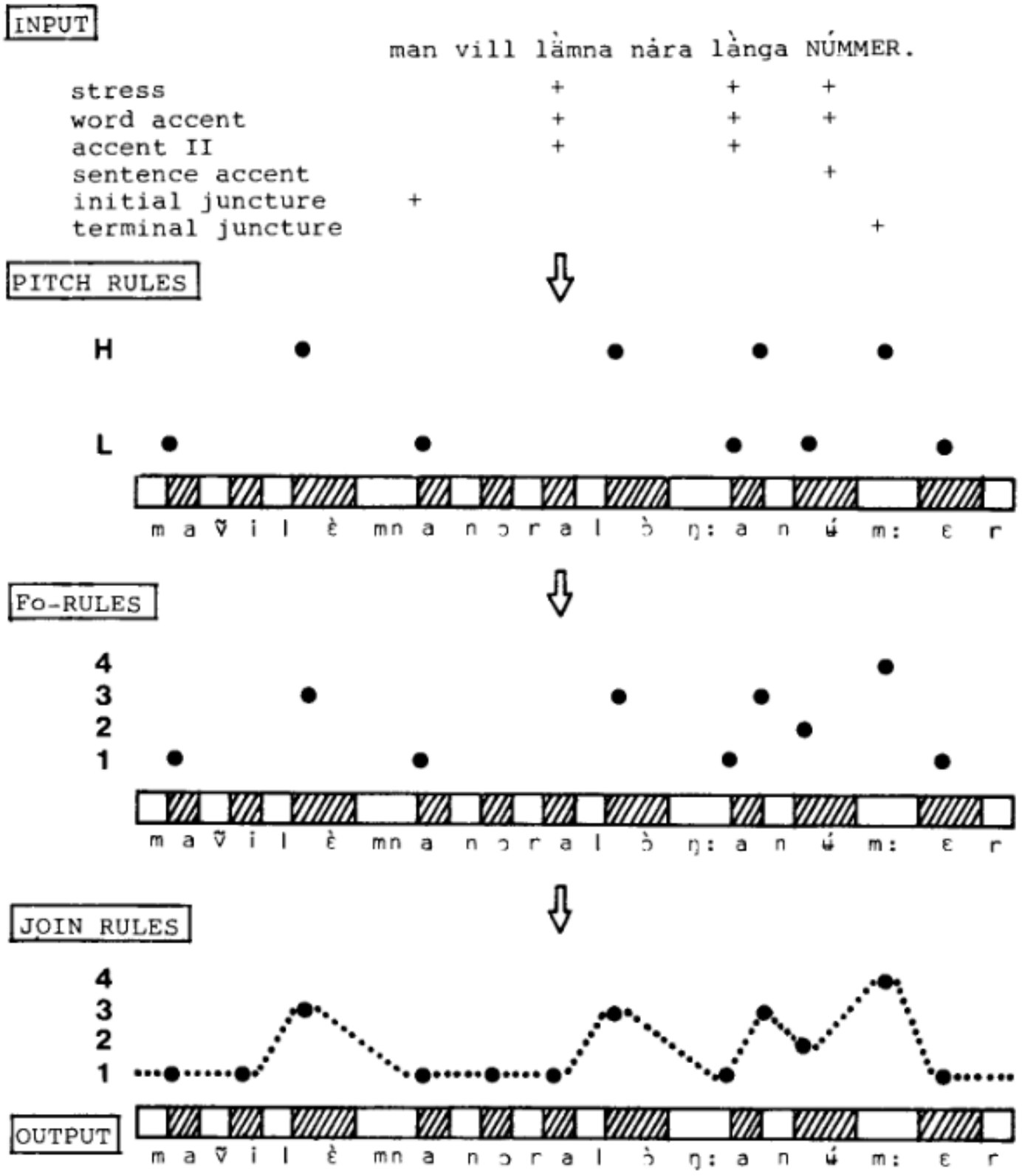



Figure 40. Derivation of the sentence man vill lämna nära långa NÚMMER according to the model.

# PB88: SPREADING OR UNDERSPECIFICATION?

- **H tone spreading (Fig 2.7)**
  - The Ha or H* spreads rightward to the La at the end of the AP
    - Prediction: (i) high f0 plateau rightwards from Ha/H*, or (ii) declination of H, with constant slope across AP regardless of AP length
- **Underspecification**
  - No tones are specified between the Ha/H* and the La at the end of the AP
    - Prediction: interpolation between Ha/H* and La targets, with downward slope across AP varying by AP length

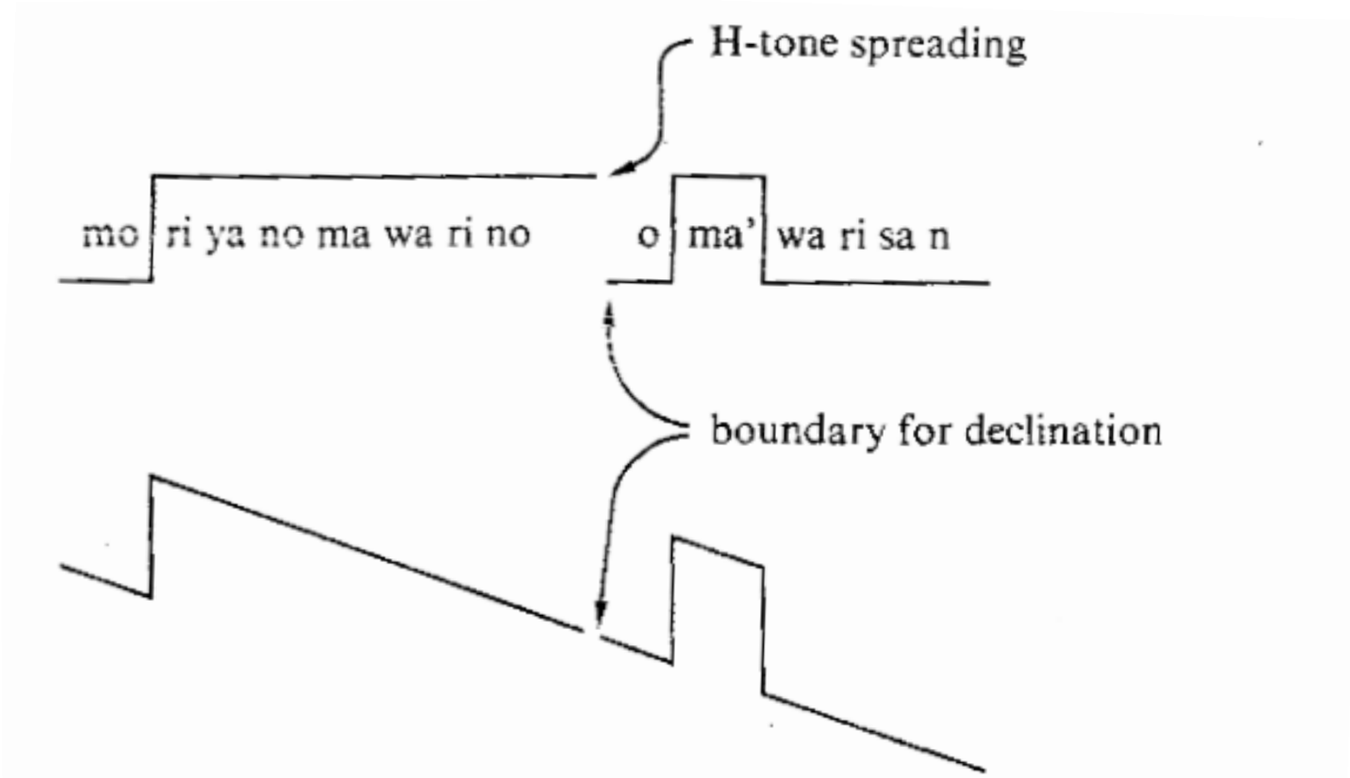



**Figure 2.7**
A declination-based analysis of downtrend in the sentence fragment shown in figure 2.2a.

"We define declination as a downtrend that is not phonologically triggered but instead lowers the pitch range gradually through time without regard to what tones may be present." (p. 35)

# EXPERIMENTAL DESIGN (PB88, P. 37)

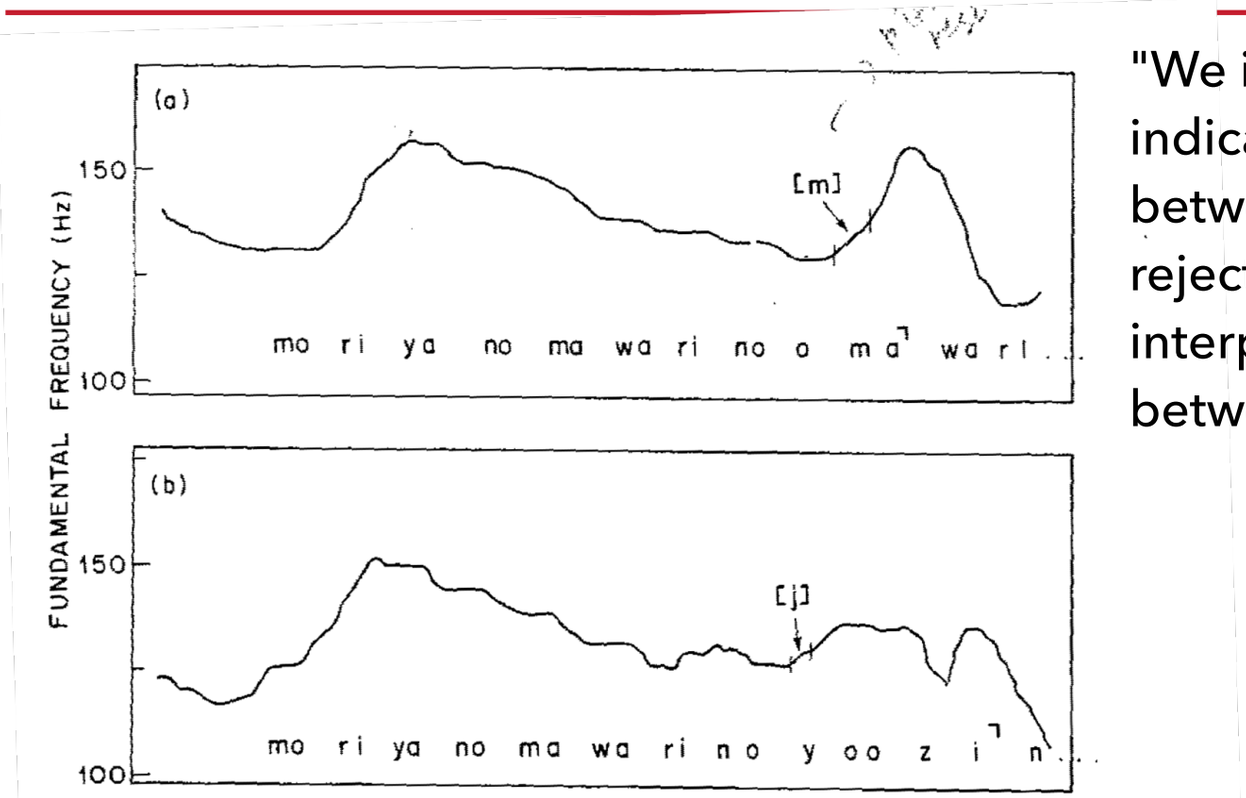



**Figure 2.2**
$F_0$ contours for utterances of (a) *moriya-no mawari-no oma'warisan* 'the policeman of the Forrests' neighborhood' and (b) *moriya-no mawari-no yoozi'nboo* 'the watchman of the Forrests' neighborhood', produced by speaker OF.

"We interpret f0 patterns at places not occupied by the indicated tones as arising from the phonetic transitions between the assigned target values for these tones. We reject tone spreading as a means of providing an interpretation for the realization of pitch in the regions between these few specified tones." (p. 14-15)

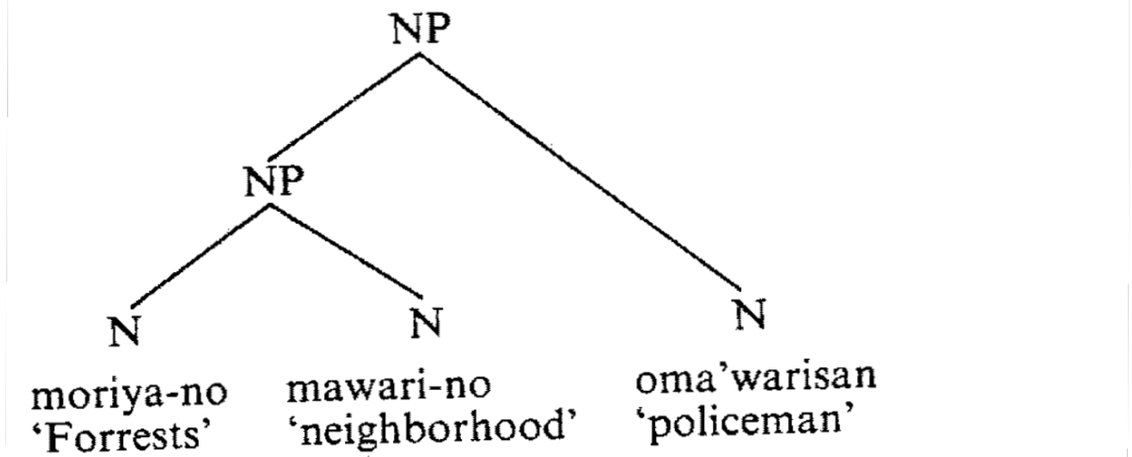



**Figure 2.6**
Syntactic structure for sentence fragment shown in figure 2.2a.

- **Distance between f0 peaks (vary length of AP1), 3-8 syllables**
- **Accentedness of AP1: Accented or not**
- **AP2 initial syllable length: long or short (controls whether weak or strong La present between the two APs)**

Associated La

Floating La (weak)

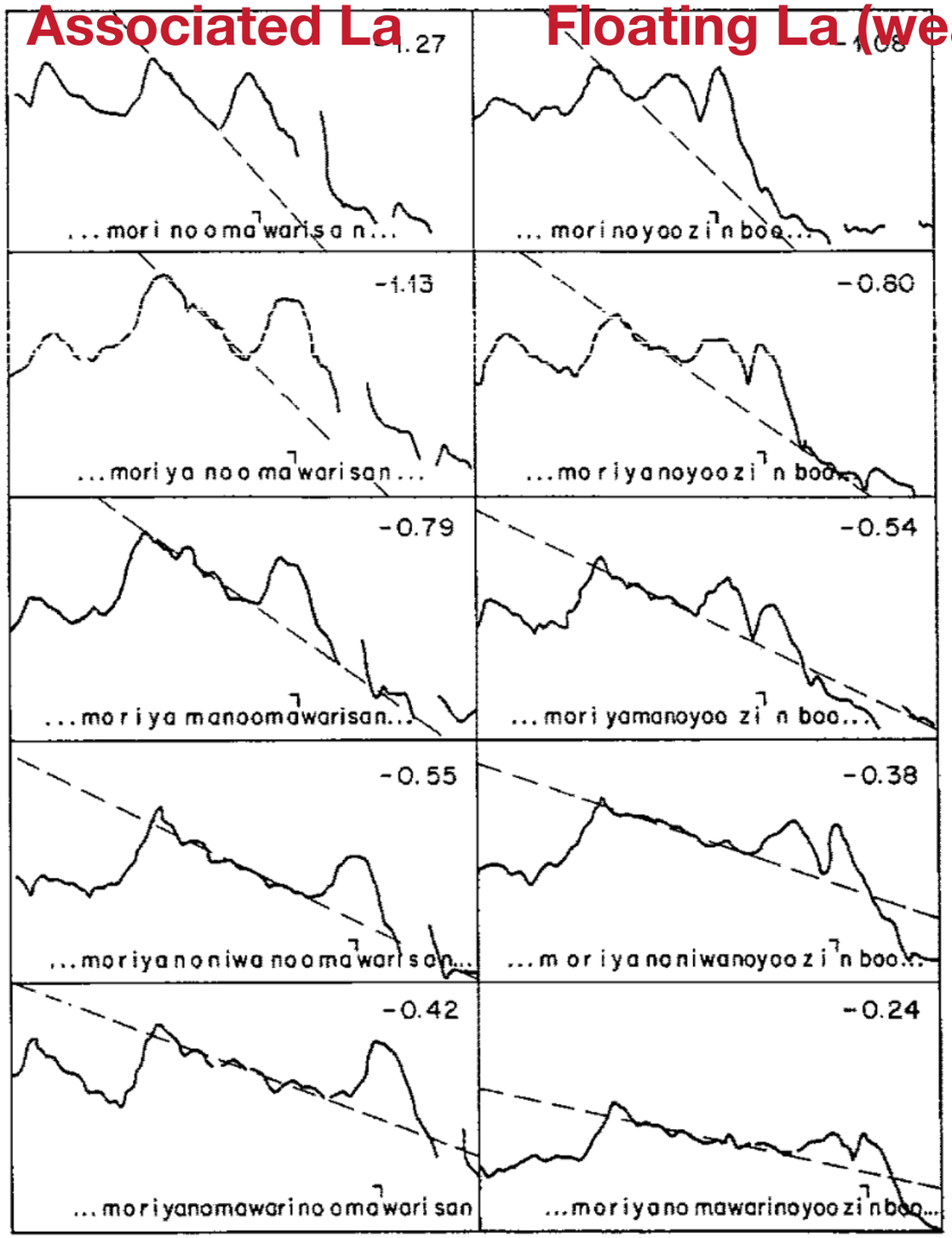



**Figure 1.3**
Unaccented phrases with 3, 4, 5, 7, and 8 morae before accentual-phrase boundaries with two different allophones of L%. The dashed line in each panel is a regression line fitted to all $f_0$ values between the peak for the phrasal H in the first phrase and the minimum for the interphrasal L%. The number in the upper right-hand corner is the slope of the regression line. Here and in subsequent figures a right corner in the transcription indicates the location of an accent.

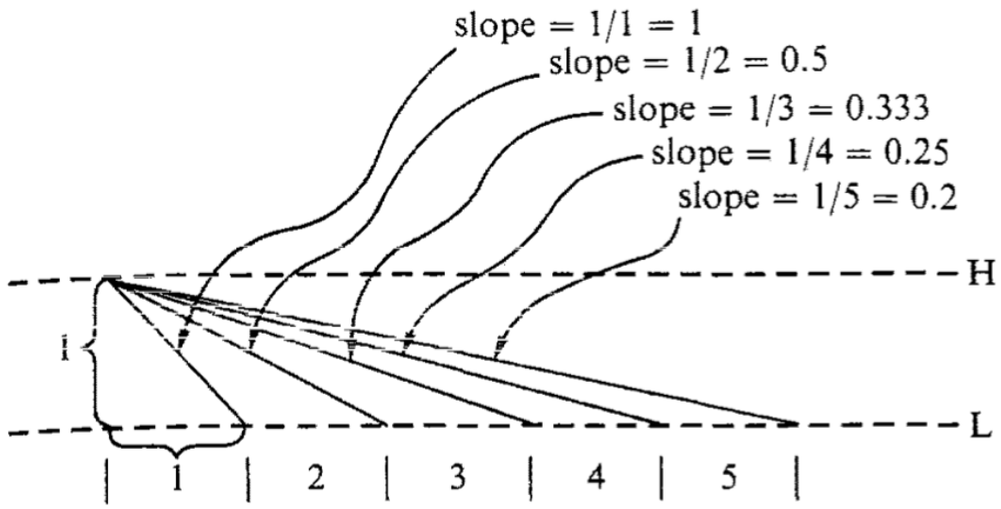



**Figure 2.10**
Schematic representation of $f_0$ contour slopes in a linear interpolation model of downtrend within unaccented accentual phrases of various lengths.

**Slope of H in AP1 to La in AP2**

oma'warisan

yoozi'nboo

La aH? H*

La aH H*

Steeper slope

Shallower slope

**Pierrehumbert & Beckman (1988, p. 15, 38, 41; Fig 1.3 on p. 15 repeated as Fig 2.8 on p. 38)**

# UNLIKE TONES AND SQUISHING: GUSSENHOVEN (2014) ON TOKYO JAPANESE

# LEFT VS. RIGHT EDGE?

- **Alternative 1 (Pierrehumbert and Beckman 1988):**
  - Initial L% (Lι), Lα at right edge of AP, IntP/Utt has no right edge tone for declarative, but an H% if interrogative
- **Alternative 2 (Gussenhoven 2004, 2014)**
  - No initial L% (Lι), Lα Hα at left edge of AP, IntP ends in L% (declarative) or H% (interrogative)

(1)

| { | ( | ) | ( | ) | ( | ) | } |
|---|---|---|---|---|---|---|---|
| | Lι Hα | | Lα Hα | | Lα Hα | | Lα (H%) |

(2)

| { | ( | ) | ( | ) | ( | ) | } |
|---|---|---|---|---|---|---|---|
| | LαHα | | LαHα | | LαHα | | L% *or* H% |

# EVIDENCE BEARING ON EDGE TONE ANALYSIS

**Gussenhoven (2014, p. 58-59)**

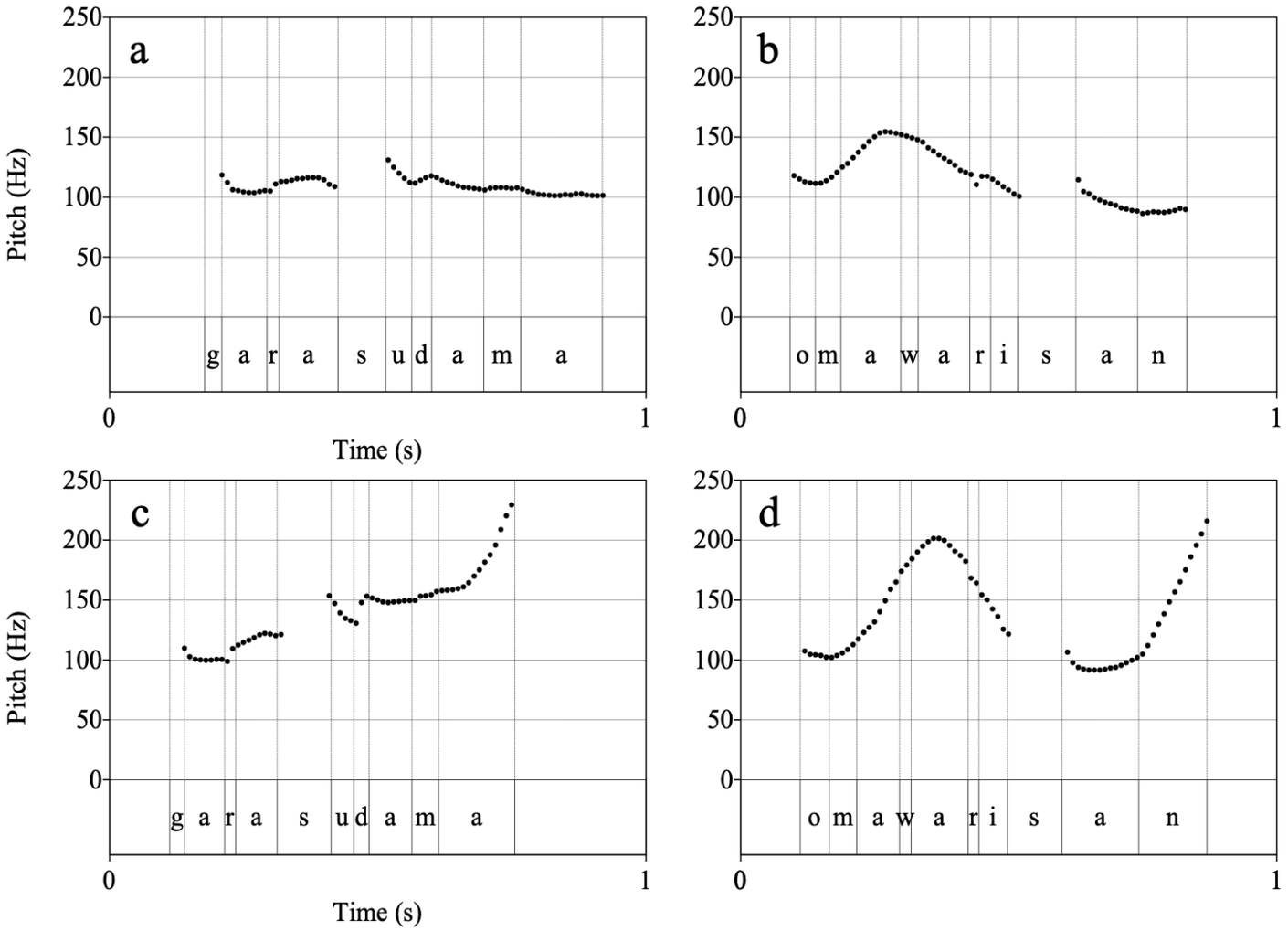



Figure 1. Pitch contours of *garasudama* 'glass beads' (panels a and c) and *omáwarisan* 'policeman' (panels b and d) in declarative (panels a and b) and interrogative (panels c and d) intonation; speaker SK

**Declarative**

**Interrogative**

(24) **Gussenhoven (2004, p. 203)**

a. { ( garasudama }  b. { ( o mawarisan ) }

$L_\alpha H_\alpha$ $H_\upsilon$ $L_\alpha$ H*L $H_\upsilon$

(1) { ( ) ( ) ( ) }
Lι Hα Lα Hα Lα Hα Lα (H%)

(2) { ( ) ( ) ( ) }
LαHα LαHα LαHα L% *or* H%

# PHONOLOGICAL ANALYSIS OF ACCENT?

- **Alternative 1 (Pierrehumbert and Beckman 1988):**
  - H* associates to first mora of accented syllable, trailing L (floating) has target timed at fixed distance following H*
- **Alternative 2 (Gussenhoven 2004, 2014)**
  - H* associates to first mora of accented syllable, trailing L associates to next mora (not floating)

# EVIDENCE BEARING ON ACCENT ANALYSIS

## Declarative

a.
{ ( *hi* ) }
LαHα L%
'day/sun'

b.
{ ( *hi* ) }
LαHα H*(L) L%
'fire'

c.
{ ( *san* ) }
LαHαL%
'three'

d.
{ ( *san* ) }
LαHαH*L L%
'acid'

## Interrogative

a.
{ ( *hi* ) }
LαHα H%
'day/sun?'

b.
{ ( *hi* ) }
LαHα H*(L)H%
'fire?'

c.
{ ( *san* ) }
LαHαH%
'three?'

d.
{ ( *san* ) }
LαHα H*L H%
'acid?'

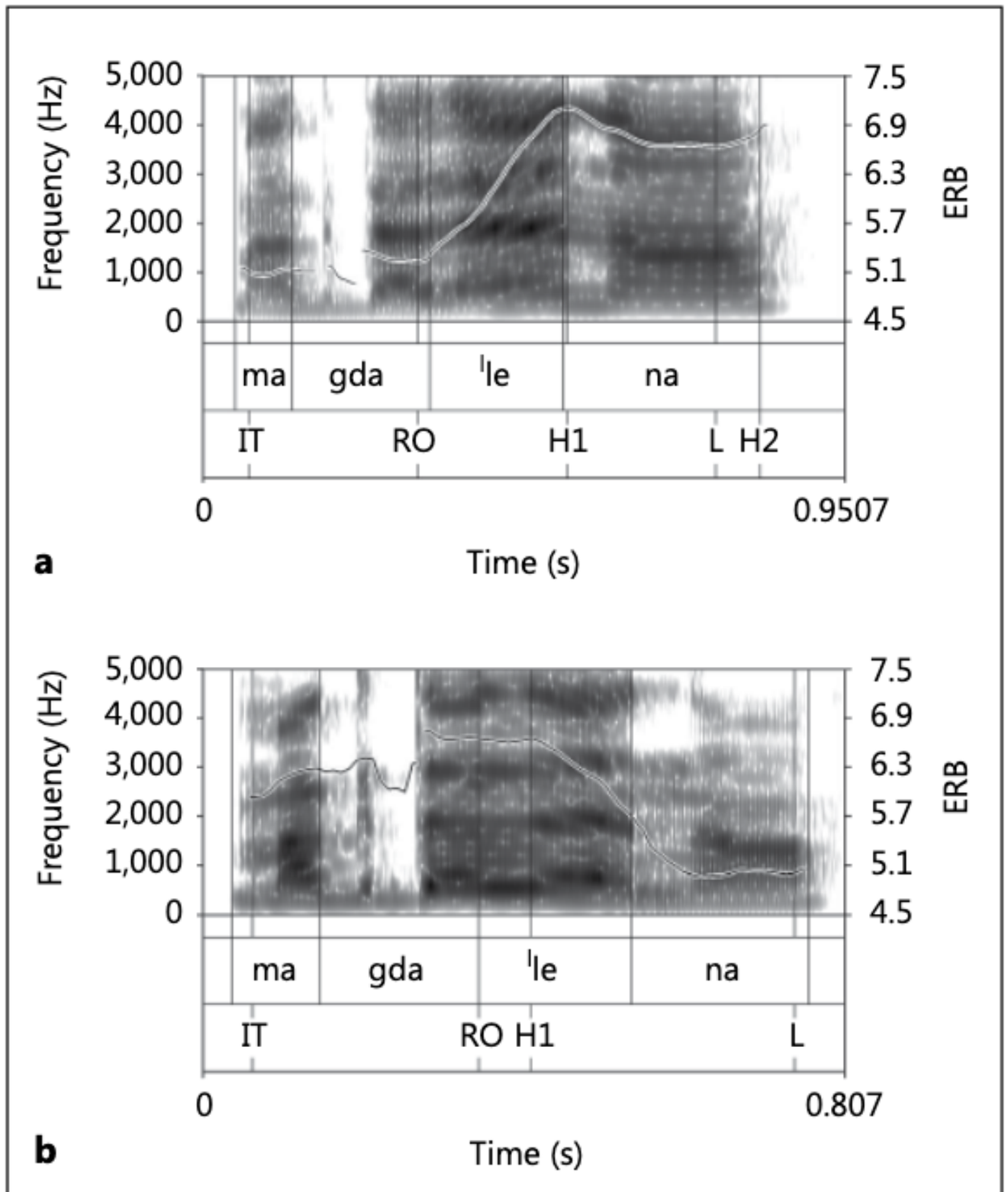
**"…any nonperipheral tone that lacks an association line is deleted."**

**Gussenhoven (2014, p. 60-61)**

# MORE SQUISHING:

# ARVANITI ET AL. (2017) ON POLISH CALLING MELODIES

# TWO POLISH CALLING CONTOURS




**Routine**

***How are these different?***

**Urgent**

**Figure 2 from Arvaniti et al. (2017, p. 340)**

# THE EFFECT OF TONAL CROWDING

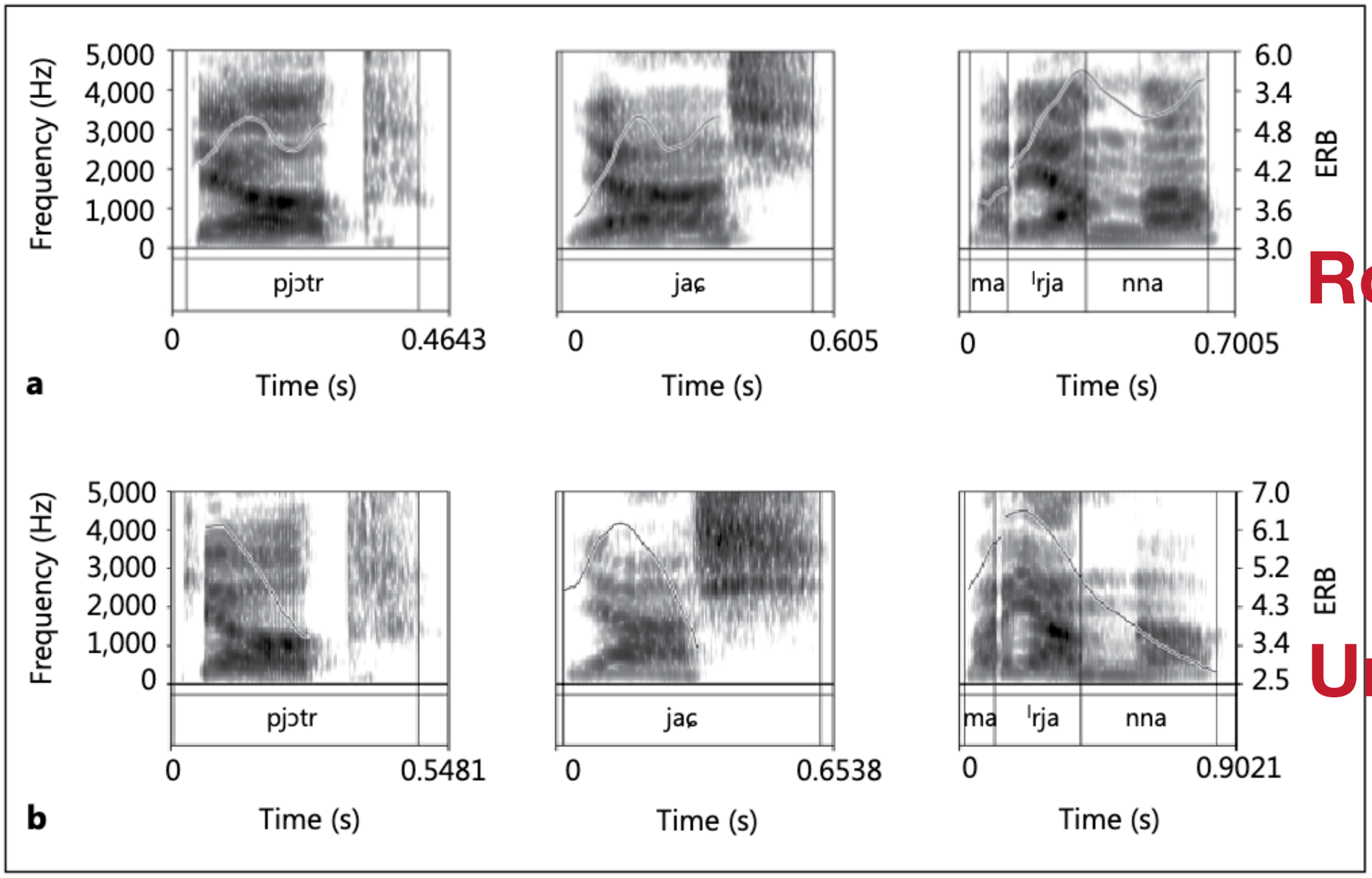
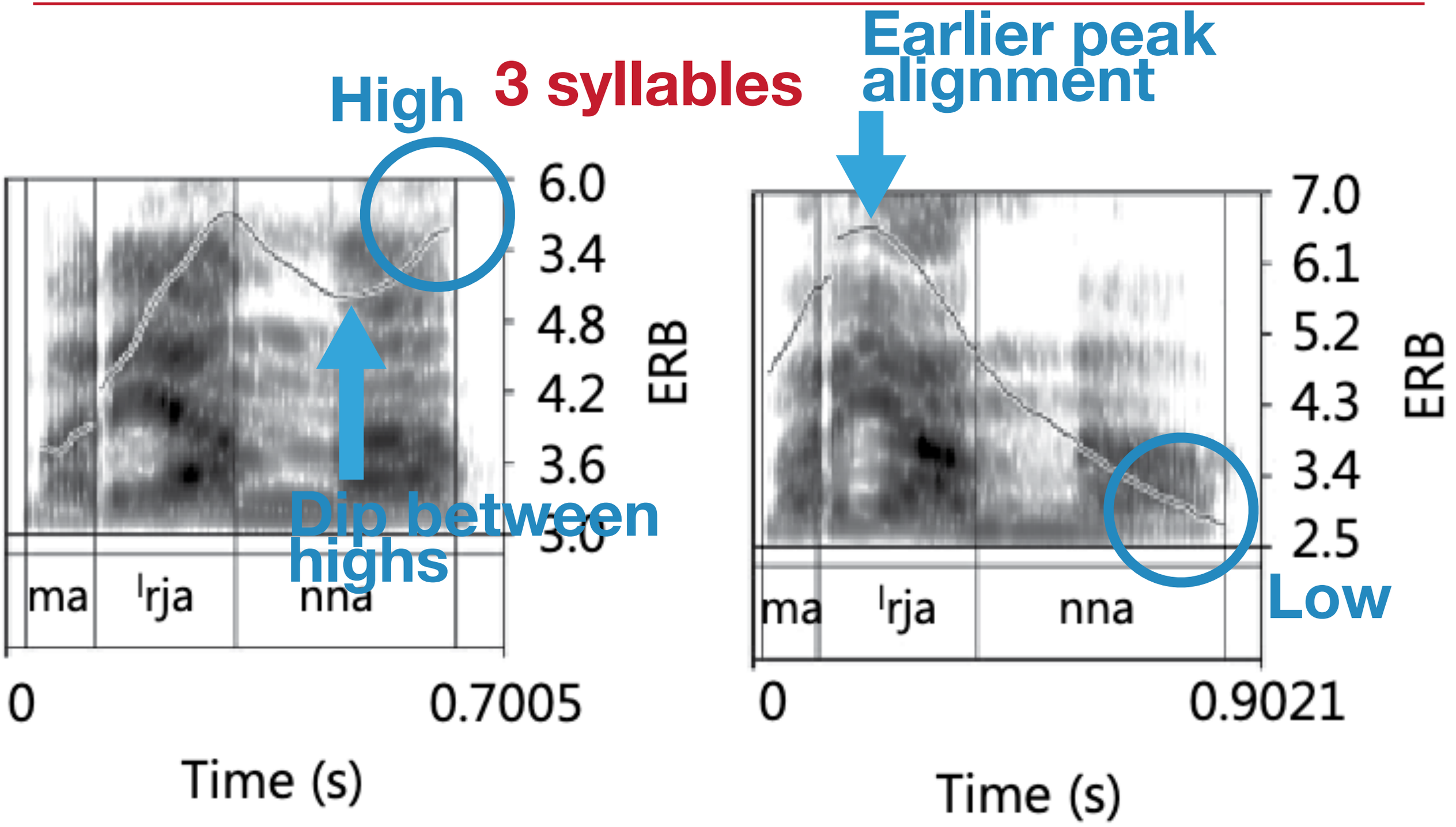



**Fig. 1.** Illustration of the routine call (**a**) and the urgent call (**b**) in monosyllabic words [pjɔtr] and [jaɕ], and a three-syllable word [maˈrjanna] exhibiting different degrees of tonal crowding.

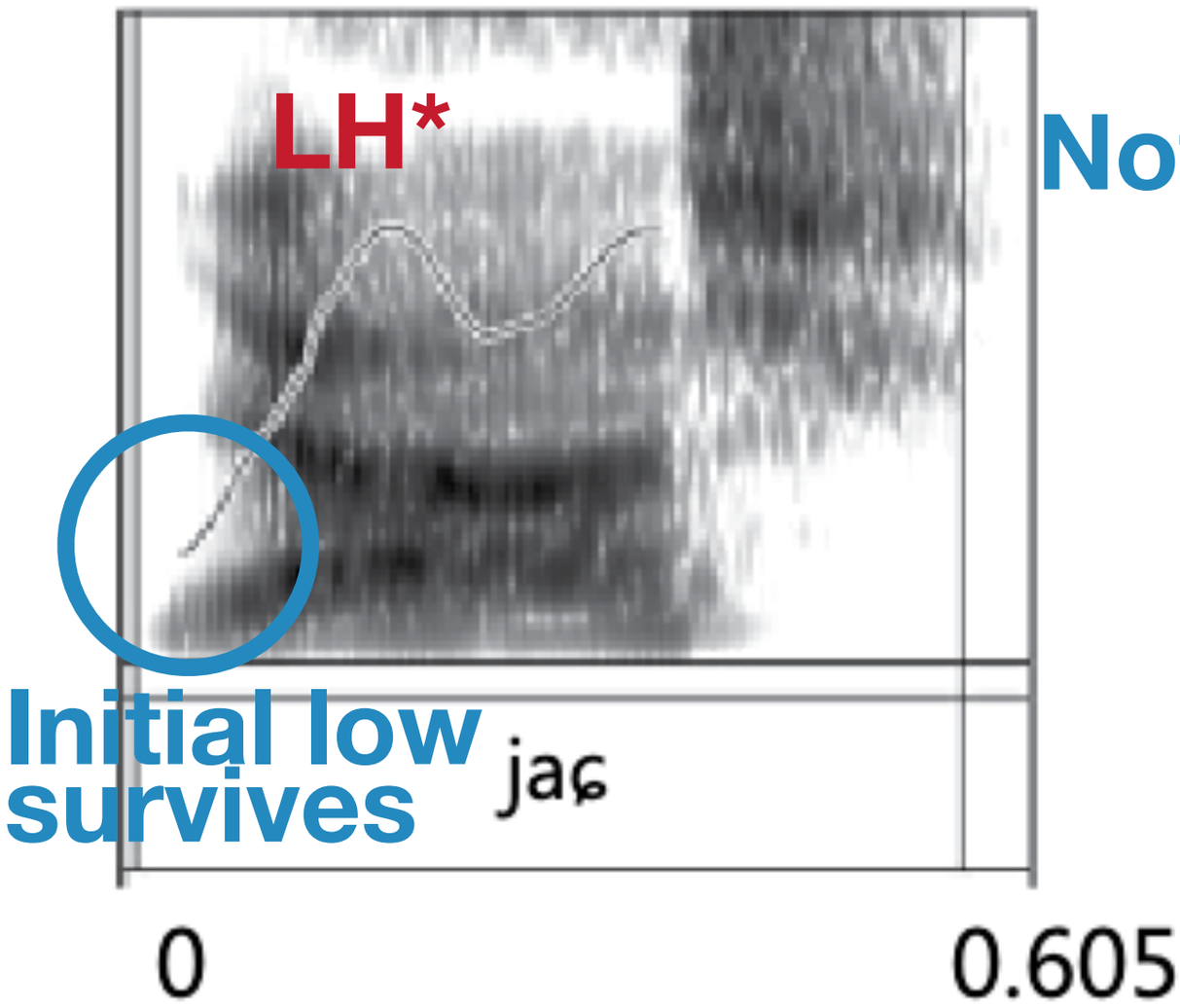
**Figure from Arvaniti et al. (2017, p. 340)**

# ZOOMING IN: EFFECT OF TONAL CROWDING

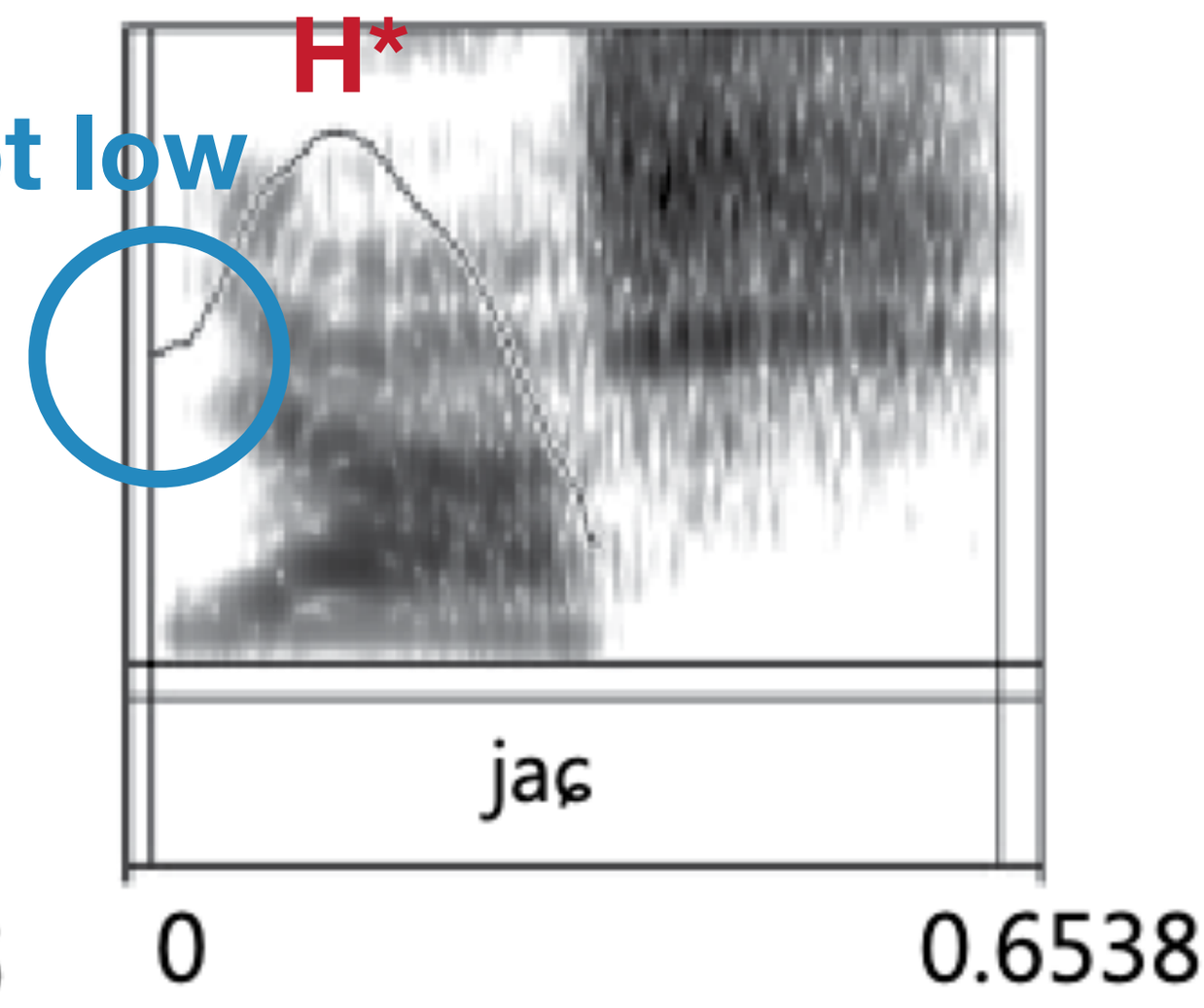


# ZOOMING IN: EFFECT OF TONAL CROWDING

## 1 syllable



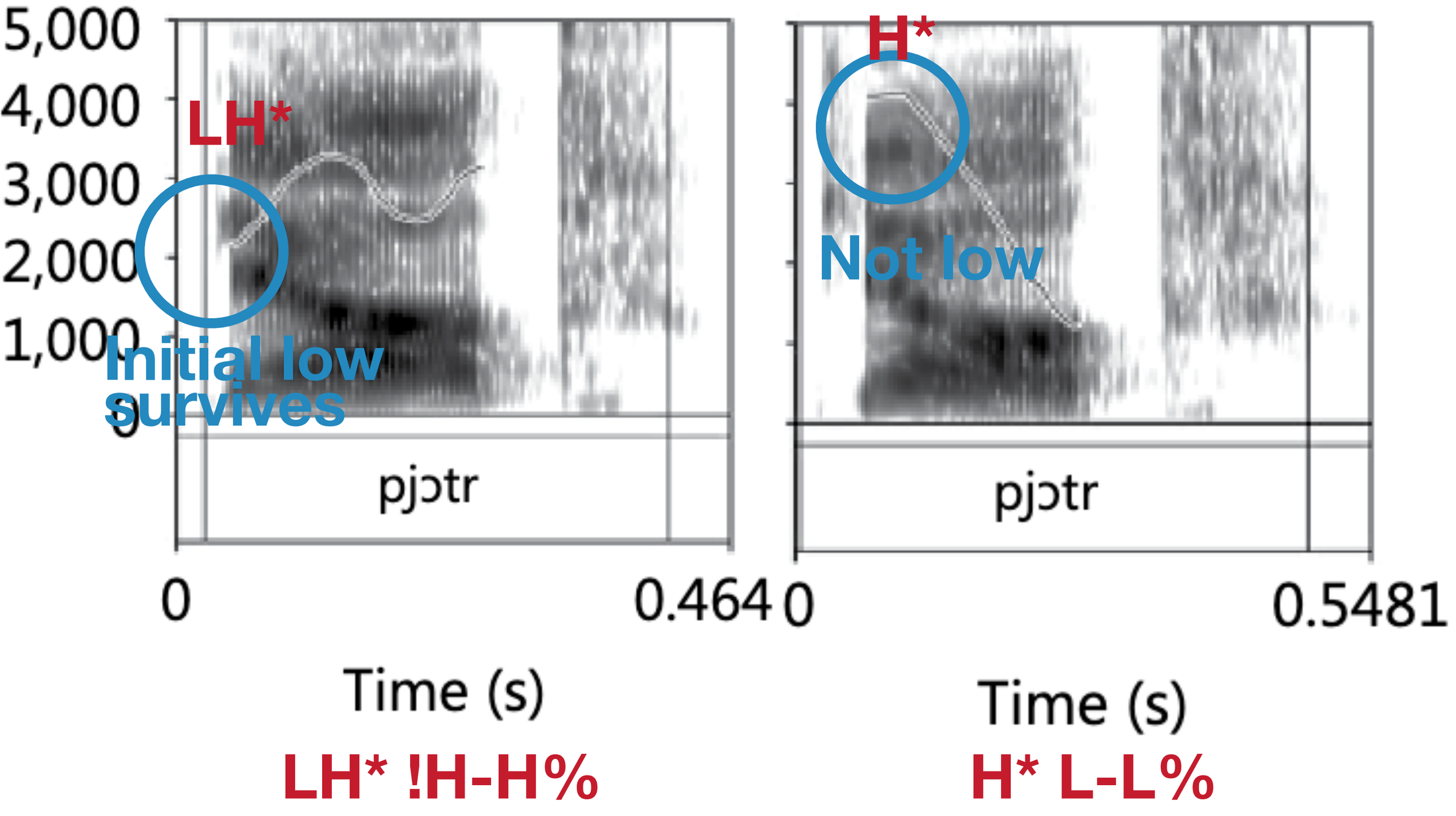

LH* !H-H%




H* L-L%

# ZOOMING IN: EFFECT OF TONAL CROWDING

## 1 syllable, even less sonorant material




**LH* !H-H%**

**H* L-L%**

# OTHER CROWDING EFFECTS: LENGTHENING

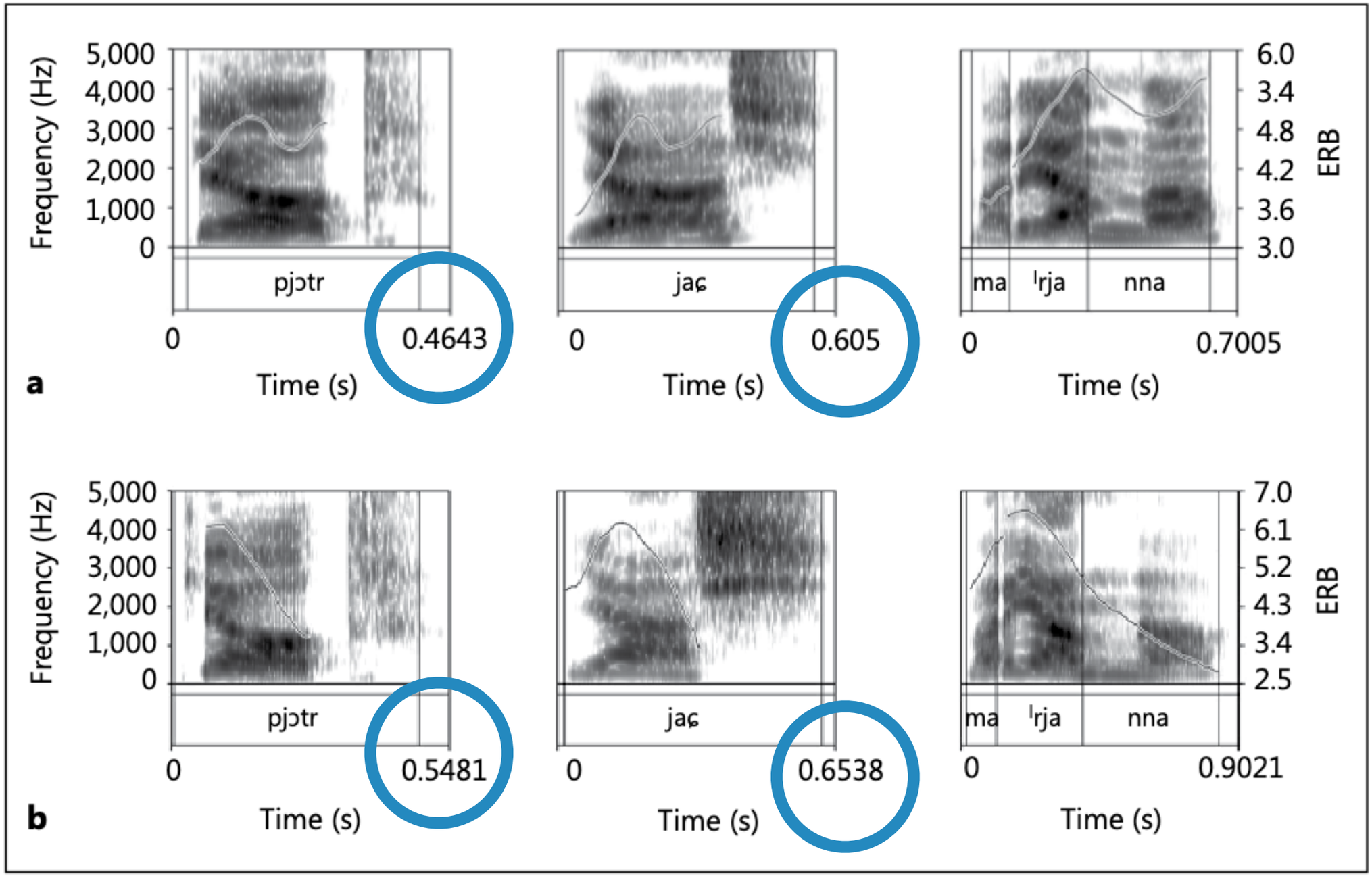



**Fig. 1.** Illustration of the routine call (**a**) and the urgent call (**b**) in monosyllabic words [pjɔtr] and [jaɕ], and a three-syllable word [maˈrjanna] exhibiting different degrees of tonal crowding.

# TRUNCATION VS. COMPRESSION

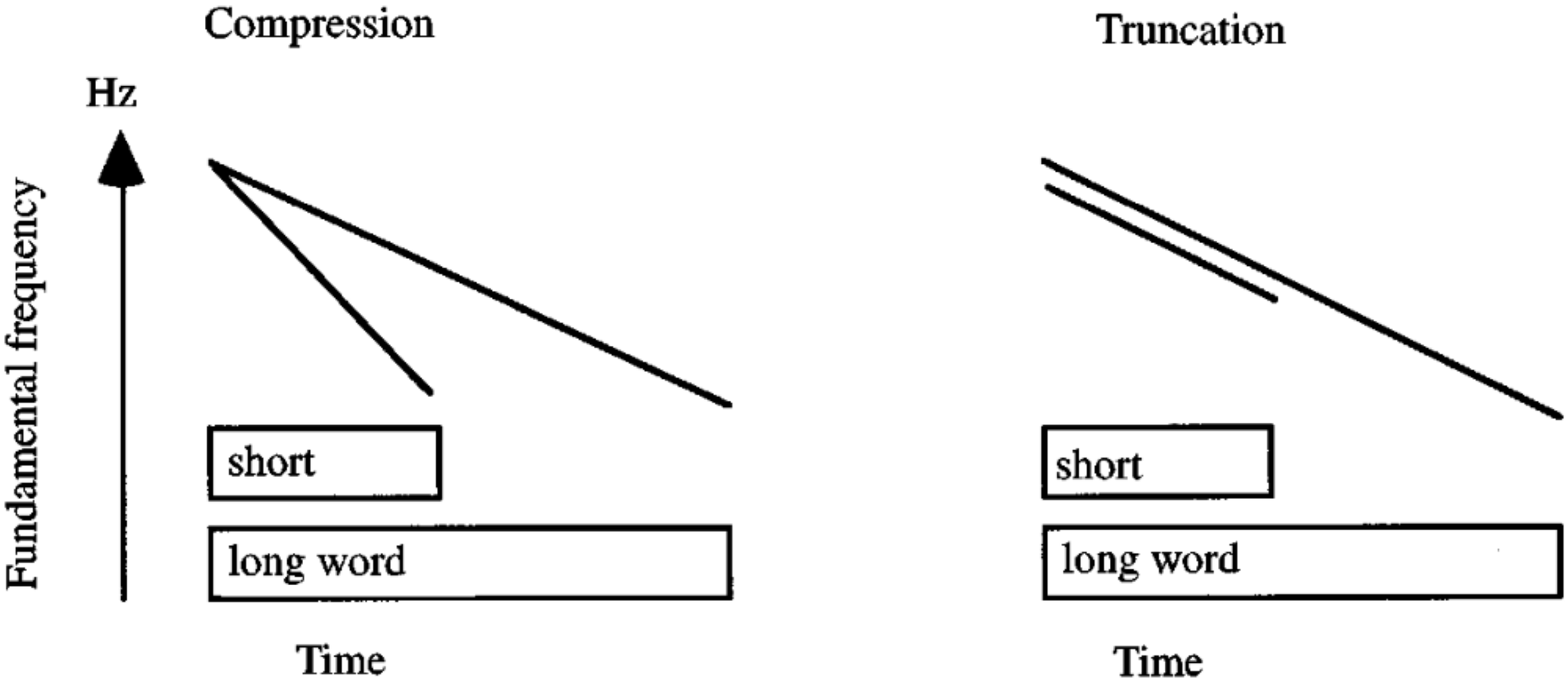



**Figure 1.** Schematic representation of fundamental frequency compression (left) and truncation (right) on words of different length.

**Figure from Grabe (1998), p. 131**

# TRUNCATION VS. COMPRESSION

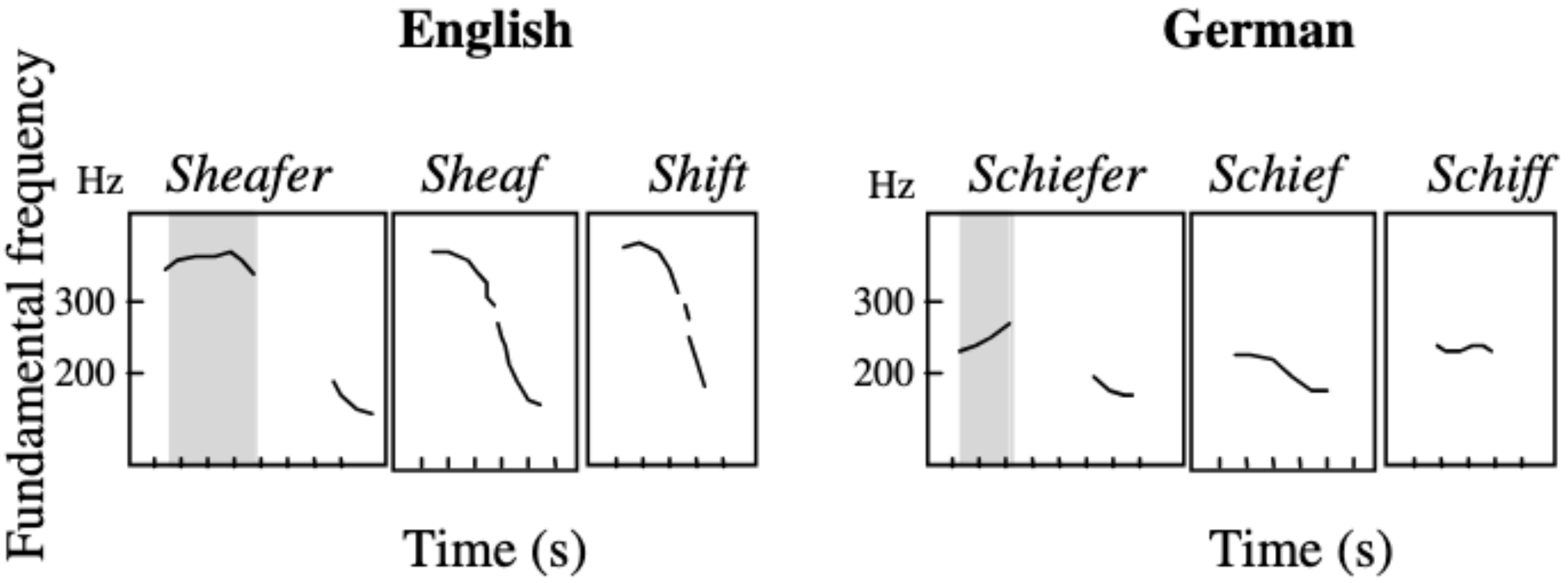



**Fig. 1.7** Representative $F_0$ traces of falls in British English and German on a pre-final syllable, on a final syllable with a long vowel, and a final syllable with a short vowel followed by an obstruent. The shaded area indicates the stress vowel of a disyllabic word. German truncates falls on final rhymes like *-iff*, but English does not (cf. *shift*). From Grabe (1997: 163).

**Figure from Gussenhoven (2004), p. 10**

# TRUNCATION: (TARGET UNDERSHOOT)

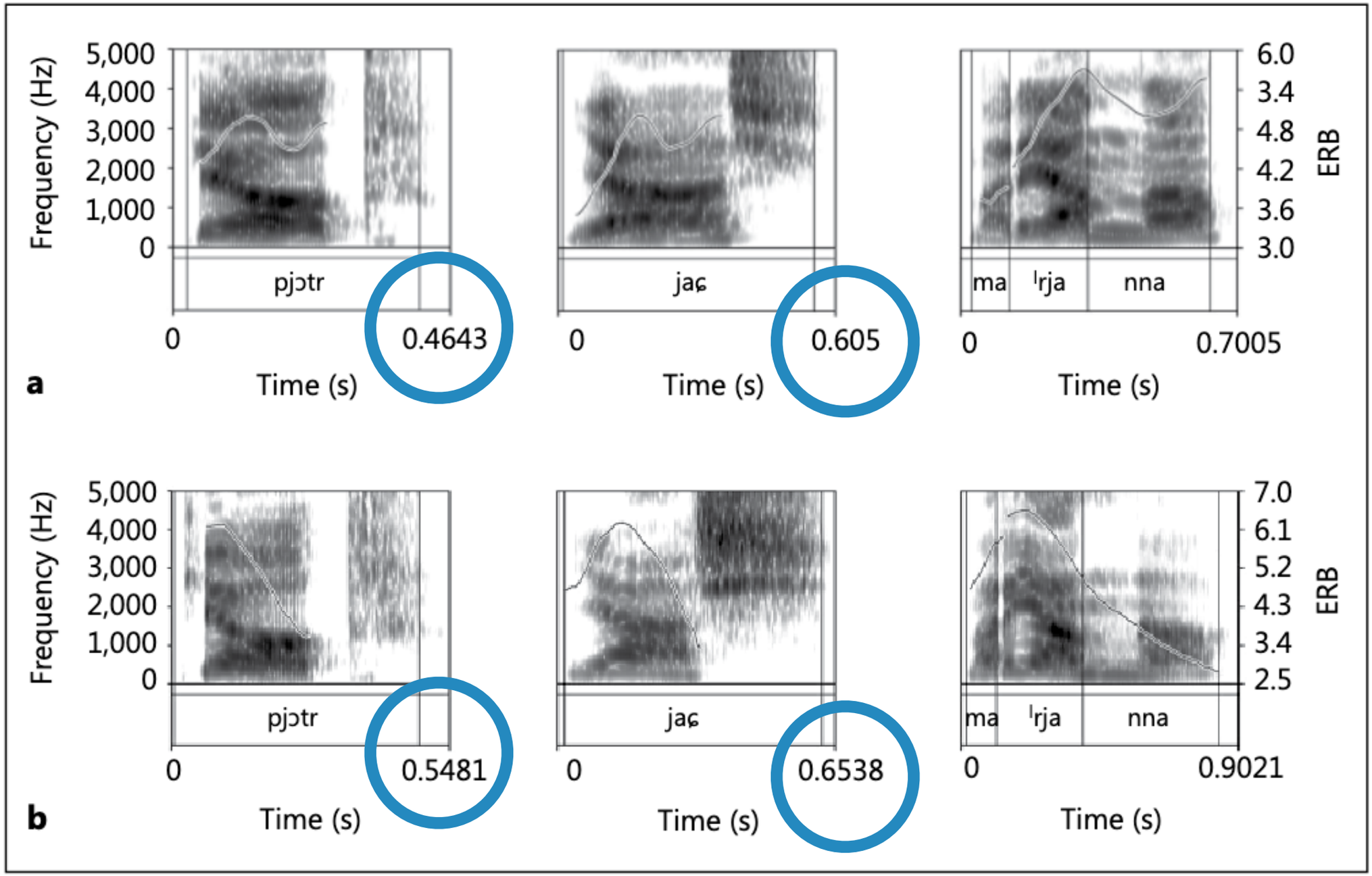



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# TRUNCATION VS. COMPRESSION IN POLISH?

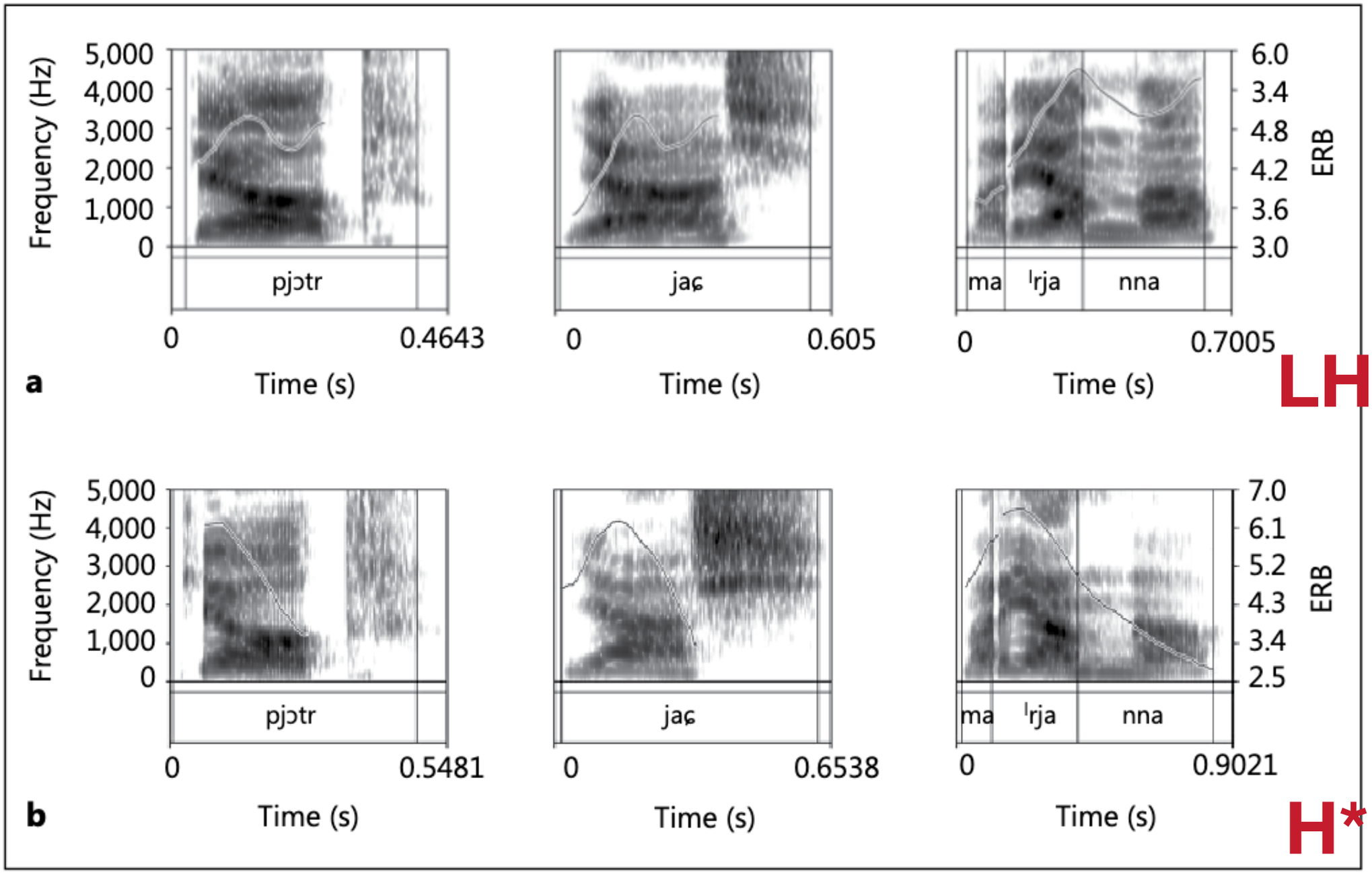



**Fig. 1.** Illustration of the routine call (**a**) and the urgent call (**b**) in monosyllabic words [pjɔtr] and [jaɕ], and a three-syllable word [maˈrjanna] exhibiting different degrees of tonal crowding.