

Segmental anchoring in the context of vocalic deletion

Evia Kainada & Mary Baltazani

ekainada@cc.uoi.gr & mbaltaz@cc.uoi.gr

Department of Linguistics, University of Ioannina

Introduction

- Two different levels of linking: phonological association and phonetic alignment, which have a complex relation (Ladd 1983)
- Research on the fine details of alignment has given rise to the *Segmental Anchoring Hypothesis* whereby tones align in a systematic way with specific segmental landmarks (Arvaniti et al. 1998, 2000)
- These results shed light on the distinction between discrete phonological association and gradient phonetic alignment; the former involves linking pitch accents to prosodic heads and edge tones to boundaries; the latter involves the detailed linking between tones and segments

Introduction

- However, despite the empirical evidence amassed from numerous studies, these distinctions are by no means well understood or uncontroversial
- There are still different interpretations on the empirical data of how melodic and segmental units are linked
- Several recent studies have shown variability in the text-tune linking within a dialect or across dialects. This variability has been attributed either to phonetic differences (e.g. Atterer and Ladd 2004; Arvaniti and Garding 2007) or phonological ones (e.g. Face and Prieto 2002; Prieto et al. 2005; Prieto and Torreira 2007)

Northern Greek

- Our case study looks at text-tune linking from a new perspective and offers new data that we hope will contribute to our better understanding

Northern Greek

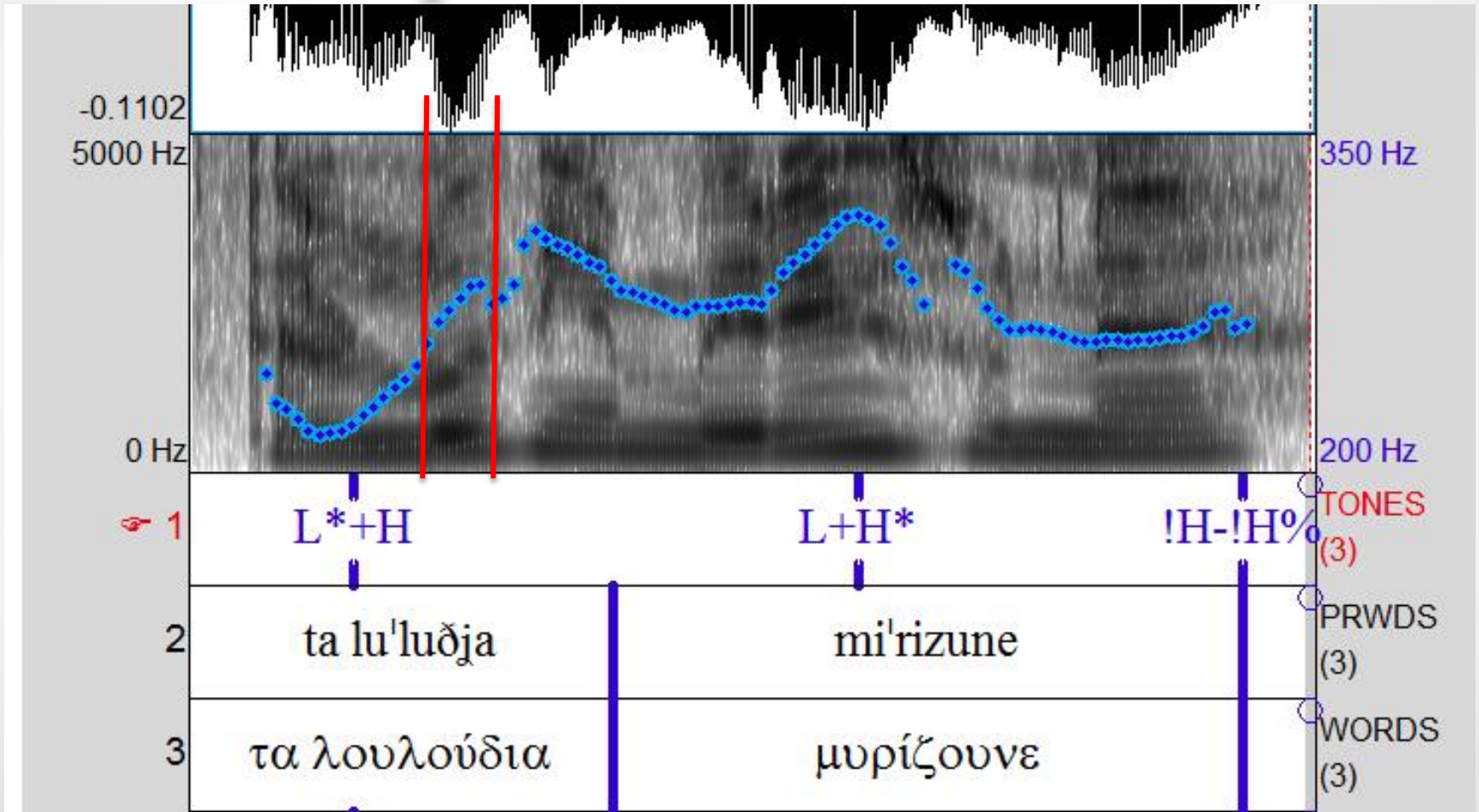
- Our case study looks at text-tune linking from a new perspective and offers new data that we hope will contribute to our better understanding (or further confusion!)
- Northern Greek (NG) allows us to observe how linking of the H tone of a L*+H pitch accent is resolved when the typical segment it links to is deleted

Standard Modern Greek (SMG)

L*+H: the predominant pitch accent choice for pre-nuclear positions in SMG (Arvaniti et al. 1998; Baltazani 2002; Arvaniti & Baltazani 2005)

- The L*+H is associated with the stressed syllable but has a complex alignment with the segmental string, necessitating two syllables, the stressed and the post-accentual one, for full realization
- Neither the L nor the H align with the stressed syllable
 - L: 5ms before the onset of the stressed syllable
 - H at the beginning of the post-accentual vowel
 - The alignment of these tones has been shown to be stable for Greek (and cross-linguistically)

Example: L*+H in SMG



Northern Greek (NG) V Deletion

- Deletion of unstressed high vowels /i, u/, e.g. /malóni/ → [malón] ‘scolds’ in NG dialects (Topintzi & Baltazani 2012). It does not always apply, and it is gradient, but it is more likely in word-final position (cf. Brazilian Portuguese, Meneses and Albano earlier today)
- Deletion can obliterate the V which the H tone links to
- Experimental question: Where does the H move to after vowel deletion?
- Different predictions can be made, depending on whether one views the rule which links the H tone to the text as phonological or phonetic

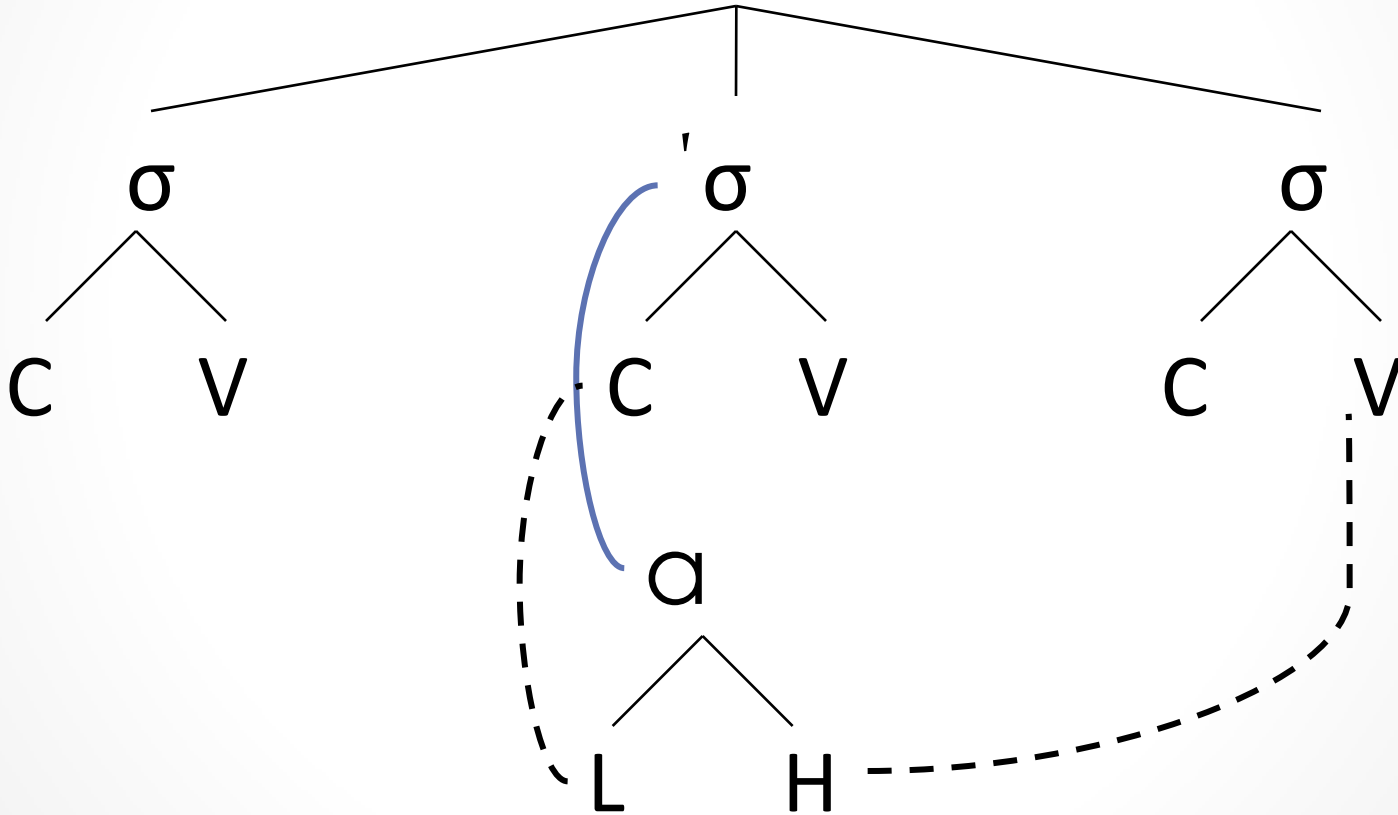
Hypotheses

SMG phonological association of H

If the H-linking rule is phonological it should refer to a syllable (or a mora). Given that the H in L^*+H typically appears at the onset of the first post-accentual vowel, we expect that the rule will make reference to a nucleus left edge:

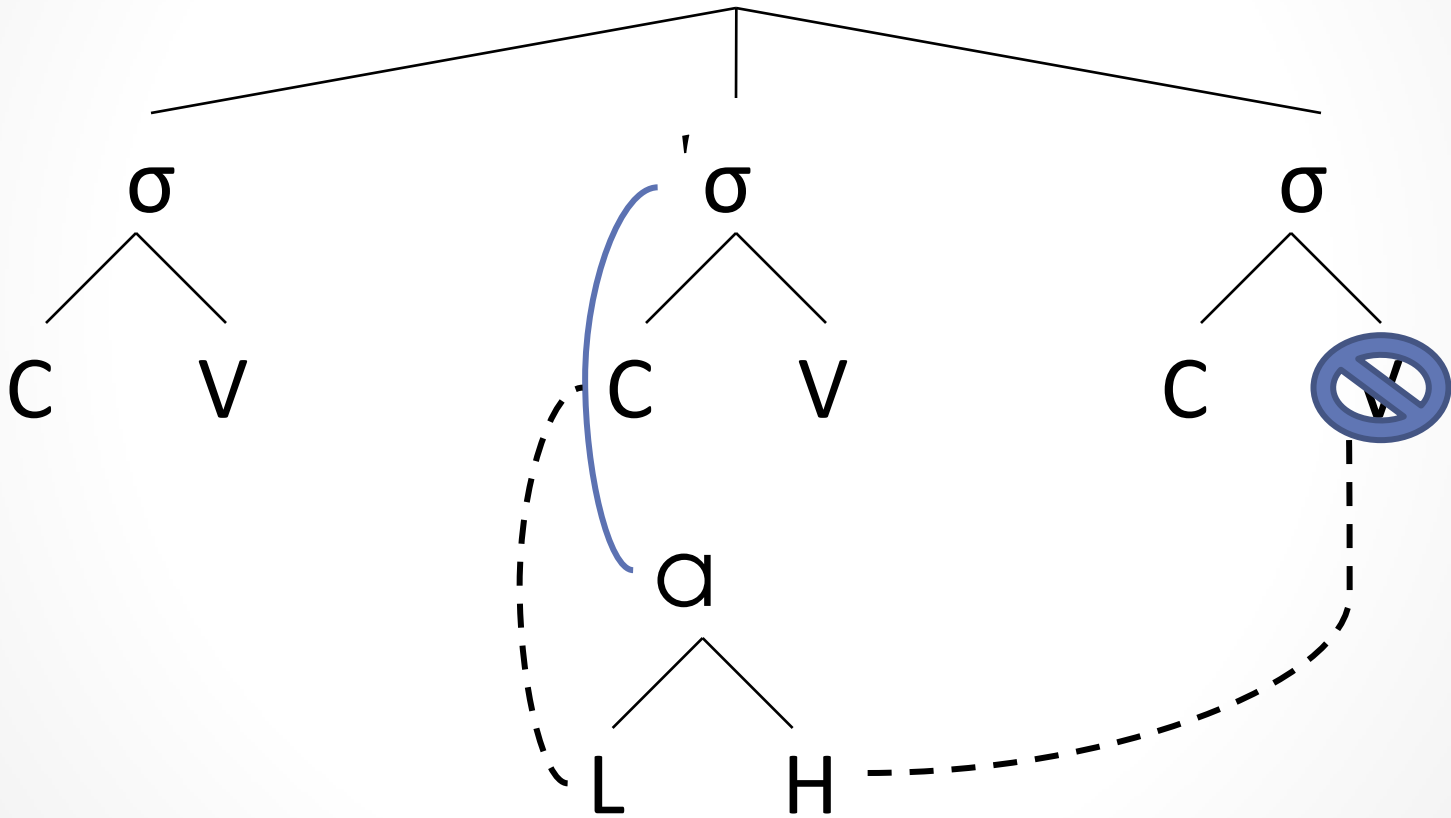
- Attach the H at the left-edge of first available post-accentual nucleus
 - H1: If the remaining C becomes a coda, link H to the V of the following word (cf. Arvaniti et al. 1998)
 - H2: If the remaining C is syllabic, link H to its left edge

Phonological association

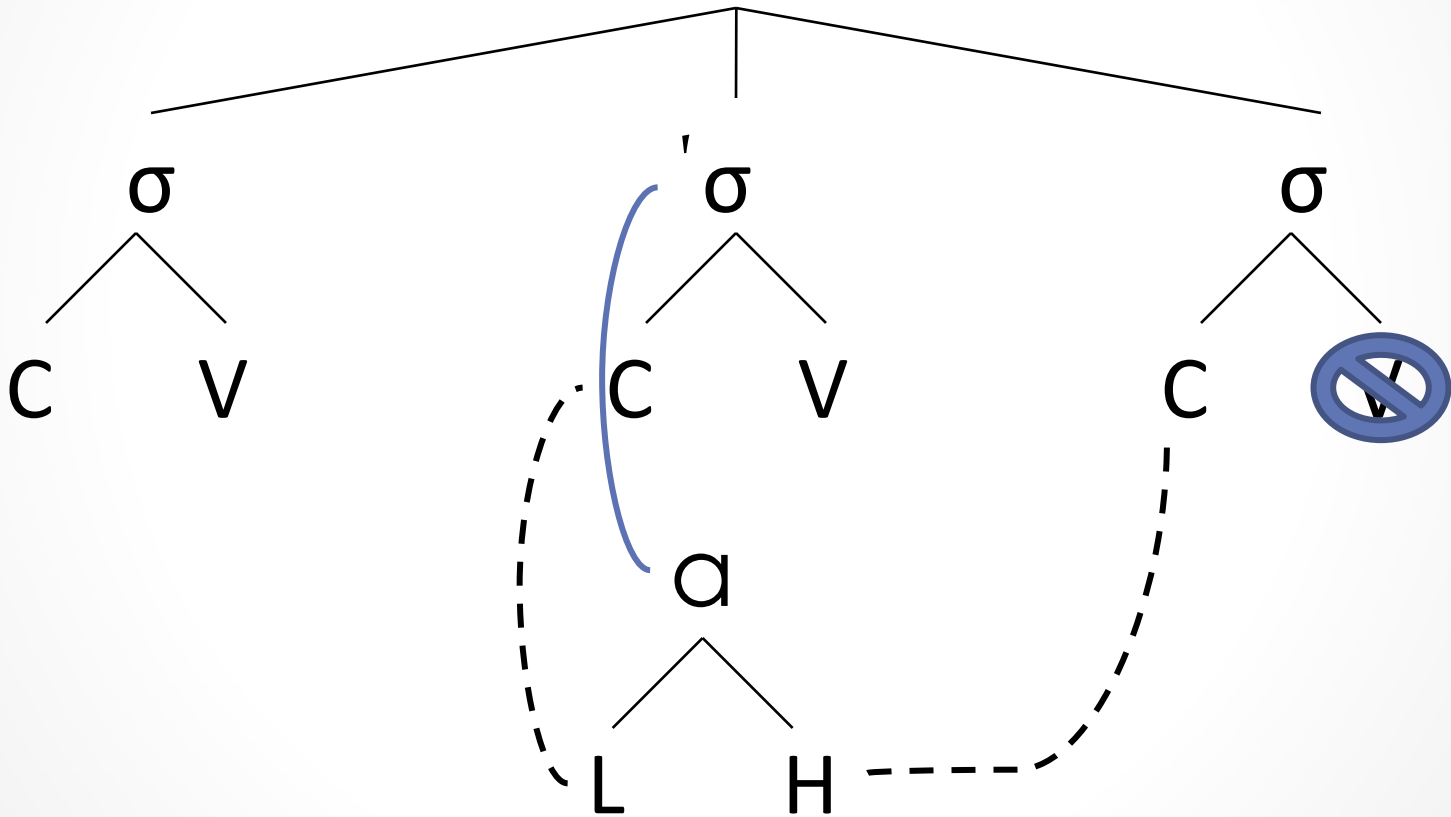


Adapted from Ladd (2008)

Phonological association



Phonological association



H2: Treat C as syllabic and move to onset of available nucleus

•

Phonetic alignment of H

- If the H-linking rule is phonetic we expect any point in the segmental string can substitute for the lost anchor, without necessary reference to a left edge
- Segmental anchoring hypothesis: we expect stability of the substitute anchoring point

Method

Participants

- Twelve native NG speakers were recorded (5 females, 7 males, 45-70 years old)
- Semi-spontaneous speech (see next slides)
- Recordings took place at the participant's homes, or at a café where locals frequent (in a separate as much as possible quiet room)

Elicitation method

Speakers were asked (by a dialectal speaker) to answer a question regarding a picture they saw

Stimulus: *What is Giannis using to cut the onions?*

Expected response: *Giannis is using a knife to cut the onions.*

We did not use a reading task mainly to avoid interference from SMG



Materials

- 20 sentences, each containing 2 words inducing deletion of the post-accentual vowel (L*+Hdel condition)
- 20 sentences not involving deletion (L*+H condition)
- The test words formed near-minimal pairs, e.g. rub`ni – rub`na
- Post-accentual C: 20 sonorants [n, l, r]; 20 obstruents [v, ð, z, ʒ]

Condition	Stimulus and expected response
L*+Hdel	S: me p`on ðialè`ji to rub`ni i eleni? <i>'Who is Eleni choosing the ruby with?'</i>
	R: i eleni ðialè`ji to rub`ni me to jani <i>'Eleni is choosing the ruby with John'</i>
L*+H	S: me p`on ðialè`yun ta rub`na ta koritsia? <i>'Who are the girls choosing the rubies with?'</i>
	R: ta koritsia ðialè`yun ta rub`na me to manoli <i>'The girls are choosing the rubies with Manolis'</i>

Materials

- Penultimate stress words ending in –i were chosen for L*+Hdel condition to increase chances of [i] deletion
- We constructed the materials to avoid tonal crowding even after the (possible) deletion, i.e. at least 3 syllables between stresses
- Most tokens were followed by [to] ‘the’ or [me] ‘with’
- Focus away from target words

Condition	Stimulus and expected response
L*+Hdel	S: me pçon ðialè <i>j</i> i to rubì <i>i</i> i eleni? <i>‘Who is Eleni choosing the ruby with?’</i>
	R: i eleni ðialè <i>j</i> i to rubì <i>i</i> me to jani <i>‘Eleni is choosing the ruby with John’</i>
L*+H	S: me pçon ðialèyun ta rubìna ta koritsia? <i>‘Who are the girls choosing the rubies with?’</i>
	R: ta koritsia ðialèyun ta rubìna me to manoli <i>‘The girls are choosing the rubies with Manolis’</i>

Measurements

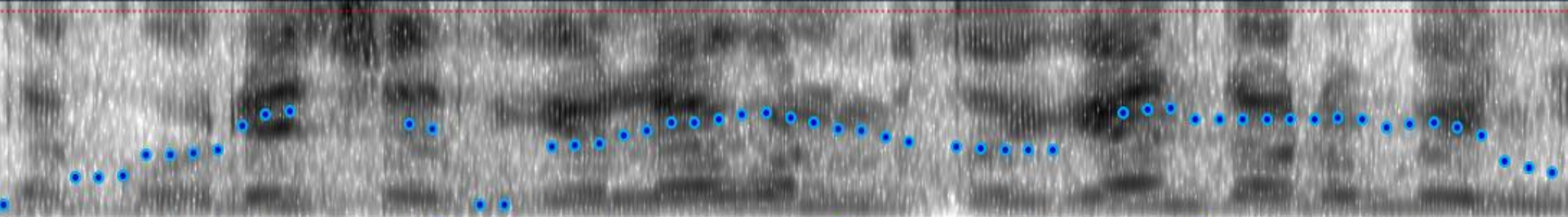
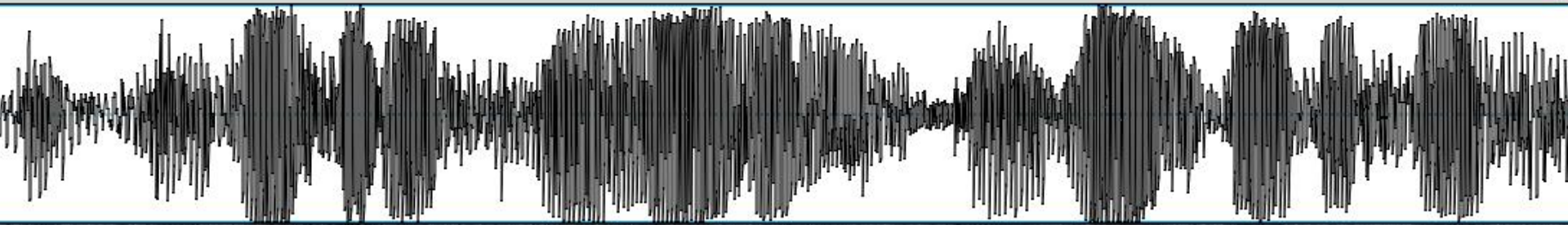
The alignment of tones in L^*+H_{del} and L^*+H tokens was compared. The test words were manually segmented and labeled

Measurements:

- Duration of all segments: C0, V0 = stressed syllable;
C1, V1 = post-accentual syllable
- Distance (ms) between L and C0 onset
- Distance (ms) between H and V1 onset (L^*+H)
- Distance (ms) between H and C1 onset (L^*+H_{del})
- Scaling of L and H (normalized through natural log)
- Distance (ms) between L and H
 - Locating the L was not easy; large standard deviation in L measurements—they should be viewed with caution

Example of measurement points:

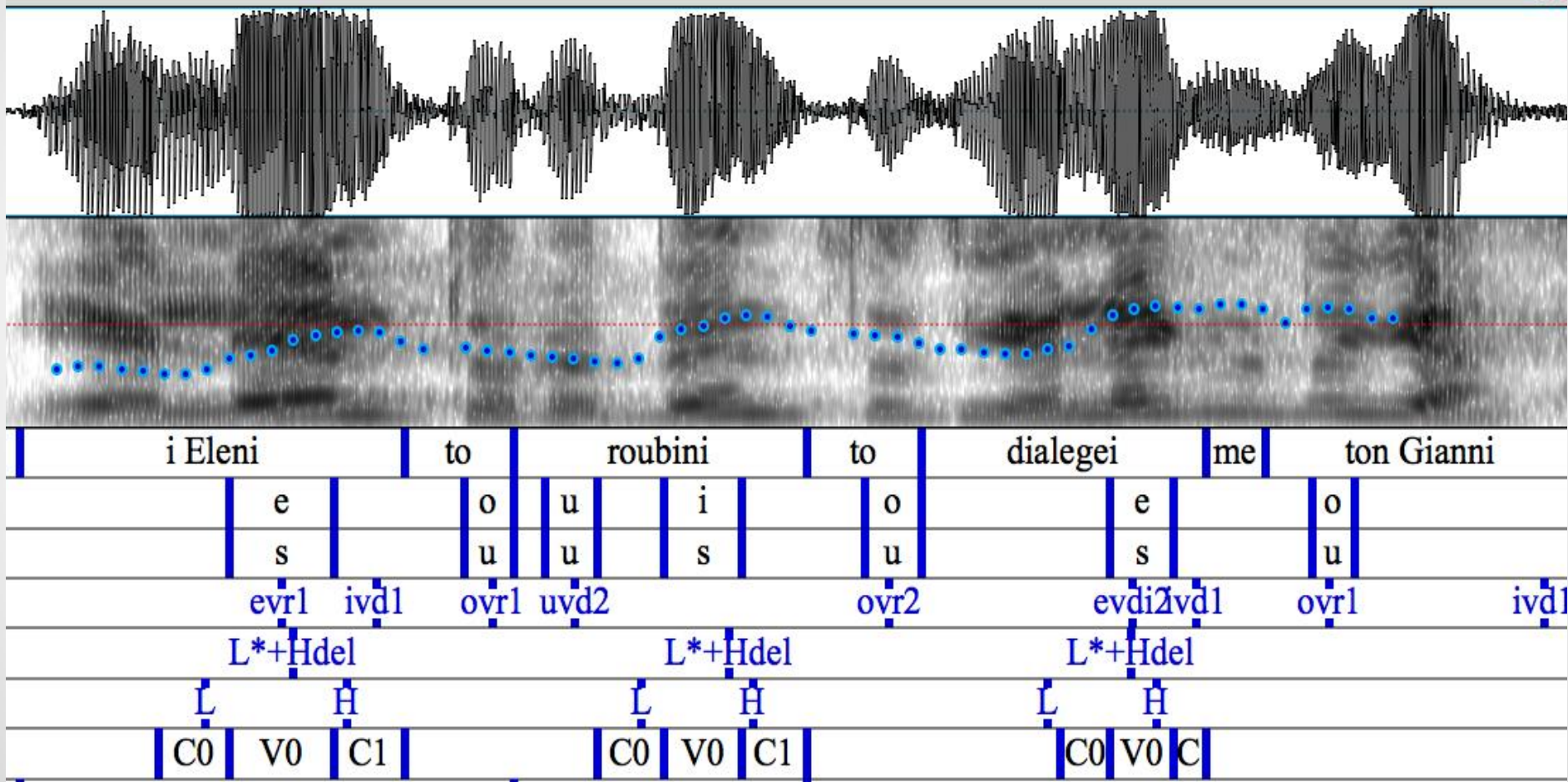
L^*+H



ta koritsia				dialeoun				me to Gianni				ta roubinia				
a	o	i		e	u			o				a	u	i		
u	u	s		s	u			u				u	u	s		
ovr1				evdi2	uvd2			evr1	ovr2	ivd1		uvd2				
$L+H^*$				L^*+H				L^*+H_{del}								
L	H			L	H			L	H							
C	V0	C1	V1	C0	V0	C	V	C	V0	C						

Example of measurement points:

L*+Hdel



Results

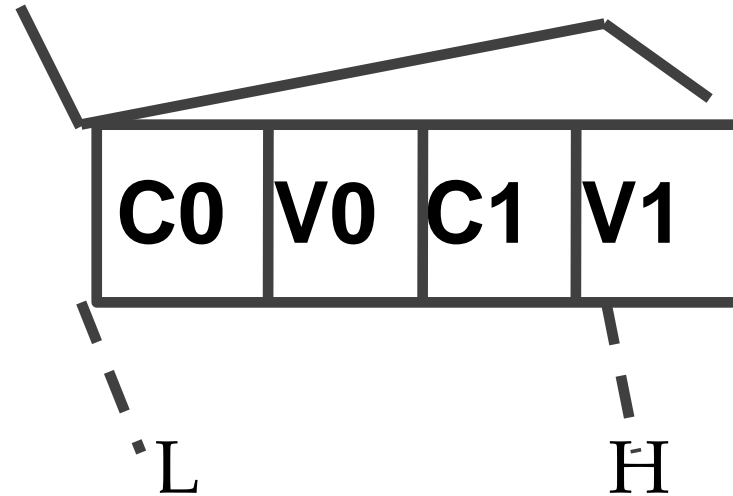
A lot of discarded data

- We had to discard a lot of data, especially in the L*+Hdel condition
 - Speaker used different pitch accent (mainly L+H*)
[i elen đialèj to rubìn me to jan]
 - Speaker paused after the target word
[u jans tu kremið tu kaθariz mi tu maçèr]
 - Speaker did not delete [i]
- Kept 140 out of 480 tokens of L*+Hdel
- Data not balanced, so we could only perform t-tests
- Nevertheless the differences between the two conditions are clear



Differences in L*+H between SMG and NG

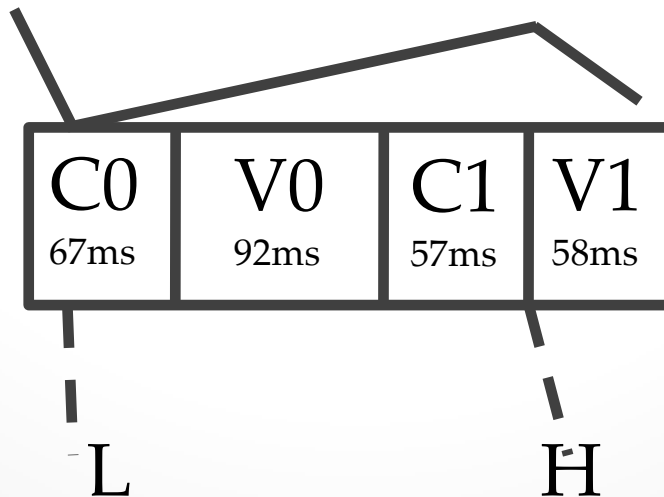
Same targets in both dialects but difference in alignment details
(Cf. Atterer and Ladd 2004, Arvaniti and Garding 2007, Prieto et al. 2005)



SMG

L = 5ms before onset C0

H = 10.6ms after onset V1



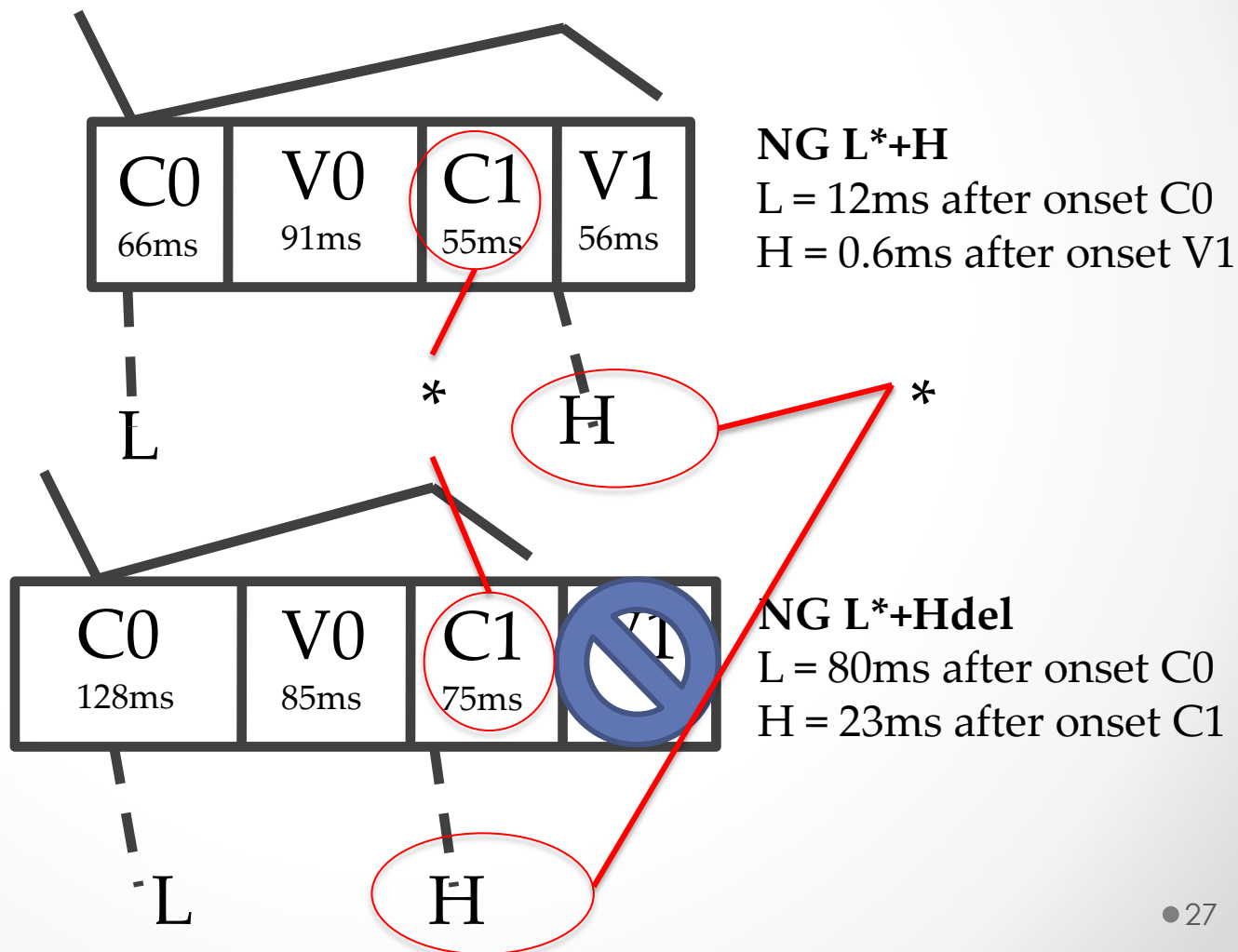
NG

L = 14ms after onset C0

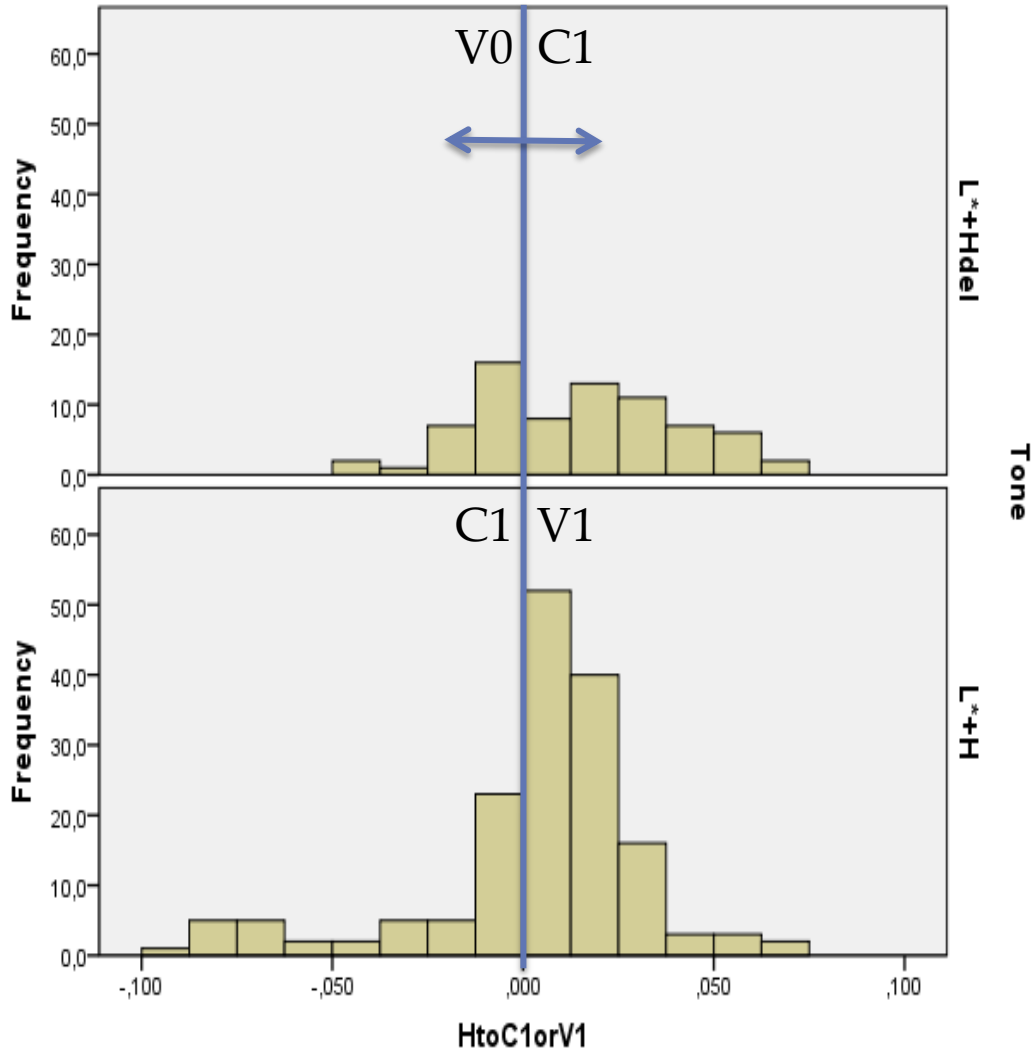
H = 0.6ms after onset V1

L*+H vs L*+Hdel in NG

Significant difference in the alignment of H between L*+H and L*+Hdel (measurement: distance from left edge of V1 or C1)



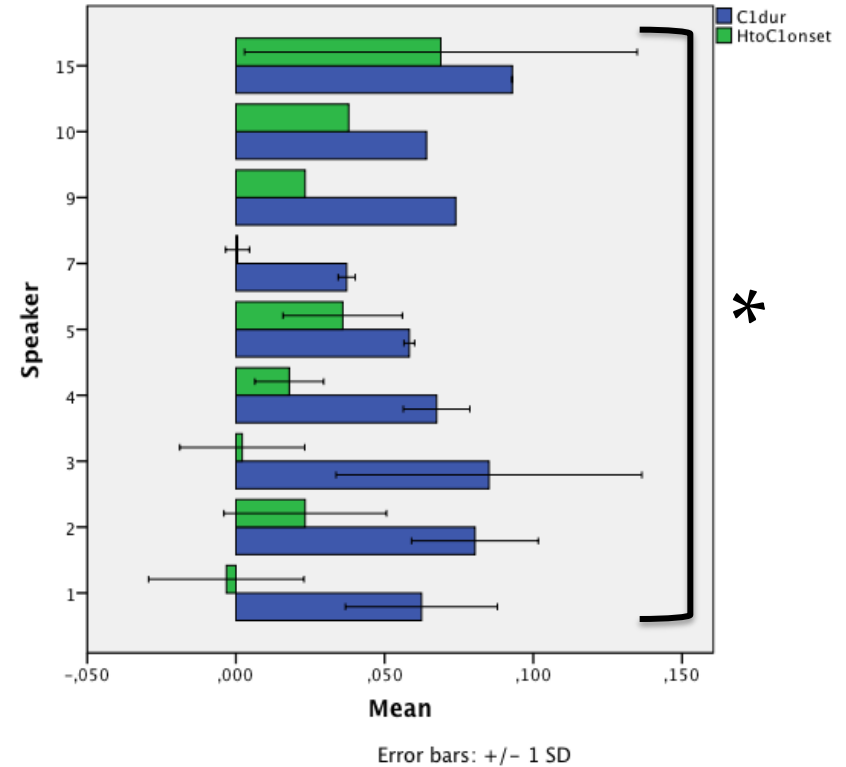
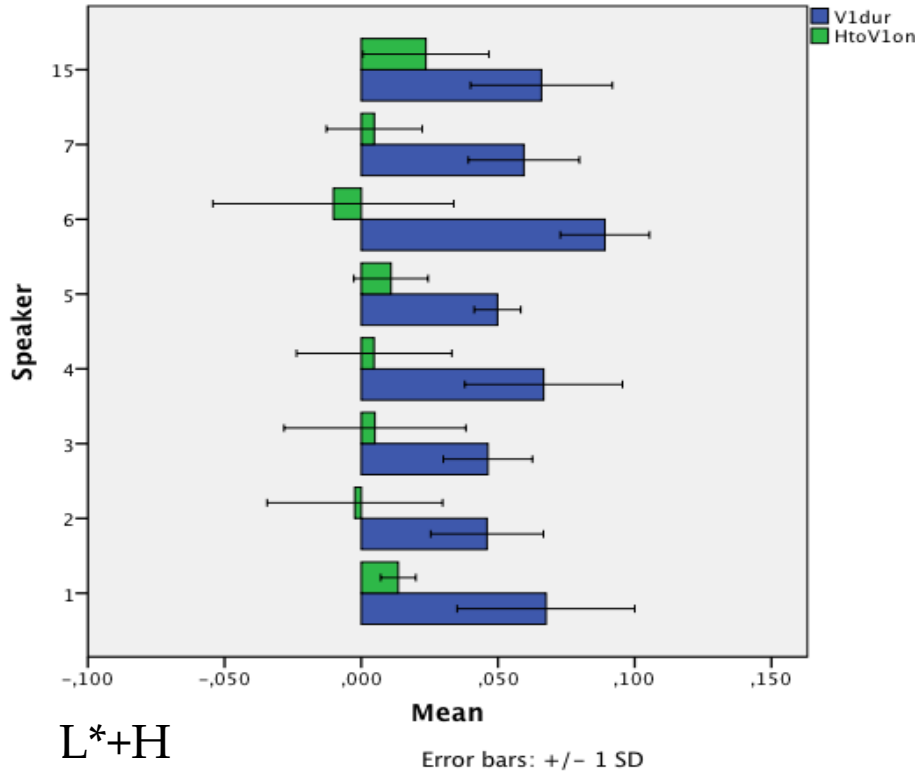
Variation in H alignment



Greater variability was observed in the H alignment for L^*+H_{del} .

76% of tokens are at or ± 3 ms from V1 onset in L^*+H . Very stable alignment.

Speaker variation



Significant cross-speaker difference in H alignment for L*+Hdel ($F(0,16, 0,42) = 4,151, p = <.001$) but not for L*+H.

Scaling

- No difference in L or H scaling between L*+H (mean = 269.12 Hz) and L*+Hdel (mean = 274.14 Hz)
- Deletion does not affect tone scaling

Discussion

- Across languages speakers rely on different tactics to cope with segmental pressure, among which are truncation, undershoot and compression (Ladd 2008)
- In NG, speakers do not employ truncation (=both tones survive) or undershoot(=no difference in scaling was found between L*+H and L*+Hdel)
- Instead they seem to use compression of the pitch accent to cope with the pressure from V deletion:
 - The L-to-H distance in L*+Hdel (149ms, SD=39ms) is shorter than in L*+H (202ms, SD=49ms)
 $t(220)=8,036, p<.001$

Discussion: phonology or phonetics?

Our results give more support to a phonetic linking between tones and segments

1. Cross dialectal use of L*+H (in SMG and NG): In non deletion environments the alignment of L*+H uses the same targets in SMG and NG, albeit with some small timing differences.
→ It is more economical to assume one phonological entity in both dialects which is realized differently in its phonetic details

Discussion: phonology or phonetics?

Our results give more support to a phonetic linking between tones and segments

2. Significant difference in H alignment between L*+H and L*+Hdel:
 - L*+H: the H attaches precisely at the left edge of the V
 - L*+Hdel: the H attaches 1/3 into the C
- This pattern indicates lack of reference to a left edge as a phonological target, since the anchor differs

Discussion: phonology or phonetics?

Our results give more support to a phonetic linking between tones and segments

3. Inter-speaker variability

→ Adds to the overall picture of variability, which should not occur for a phonological rule

Discussion: lack of stability?

- The segmental anchoring hypothesis expresses a regularity empirically observed in many languages—the stability of the segmental landmark. Does the variability uncovered in our Hdel data mean lack of stability?
- We calculated intra-speaker variance homogeneity between the two conditions, which showed no difference in dispersion (L^*+H mean = 22ms, SD=9.950; L^*+Hdel mean = 25ms, SD=19.7; $t(6)=-.382$, $p=.715$)
- Despite great cross-speaker variability, individual speakers show as stable an alignment of H in L^*+Hdel as in L^*+H

Discussion: lack of stability?

- This result suggests that segmental anchoring is operative, but that different speakers employ different strategies to cope with the vowel-anchor loss
- Variability in alignment of H between speakers has also been shown for L*+H in SMG, where segment type affected alignment somewhat differently for each speaker (Arvaniti et al. 1998), but it is more pronounced in our data
- We postulate a connection between high cross-speaker variability and the variability in [i] deletion application, which prevents the existence of a uniform phonetic rule
 - How can we test this? An articulatory study might provide a solution (?)

Future directions

- The L*+Hdel occurred word-finally. There might be a confound of pressure from the upcoming word boundary
 - We need to study the L*+Hdel behavior also away from word boundaries
- V deletion is a gradient process ranging from V retention to complete deletion, with intermediate stages of partial deletion, i.e. vowel shortening (Topintzi & Baltazani 2012)
 - Examine the L*+Hdel behavior in cases of partial V deletion
- Complete V deletion often creates C clusters in NG
 - Examine the L*+Hdel behavior with C clusters

Conclusions

- Our results have given us evidence in support of a phonetic rule regulating the linking of the H tone to the segmental string since differences between deletion and non deletion environments are continuous, not discrete
- The shift of the anchor point in deletion environments seems to be due to a compression strategy employed by the speakers to cope with the loss of the vowel
- Cross speaker variability was found and needs to be further investigated

Invitation

Suggestions are very welcome indeed!

Thank you

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References

- Arvaniti A. & M. Baltazani 2005. Intonational Analysis and Prosodic Annotation of Greek Spoken Corpora. Chapter in *Prosodic Typology: The Phonology of Intonation and Phrasing*, Jun, S-A (ed.), Oxford University Press, 84-117.
- Arvaniti, A. and G. Garding 2007. Dialectal variation in the rising accents of American English. In J. Cole & J. H. Hualde (eds.), *Papers in Laboratory Phonology 9*, pp. 547-576. Berlin, New York: Mouton de Gruyter.
- Arvaniti, A., Ladd, D. R. & Mennen, I. 1998. Stability of tonal alignment: the case of Greek prenuclear accents. *Journal of Phonetics* 26:3-25.
- Arvaniti, A., Ladd, D. R. & Mennen, I. 2000. What is a starred tone? Evidence from Greek. In M. Broe & J. Pierrehumbert [editors], *Papers in Laboratory Phonology V: Acquisition and the Lexicon*. CUP, 119-131.
- Atterer, M. and D. R. Ladd 2004. On the phonetics and phonology of “segmental anchoring” of F0: evidence from German. *Journal of Phonetics* 32: 177–197.
- Baltazani, M. 2002. *Quantifier scope and the role of intonation in Greek*. PhD dissertation, UCLA.
- Face, T. and Prieto, P. (2007). Rising accents in Castilian Spanish: a revision of Sp-ToBl. *Journal of Portuguese Linguistics* 6,1 (special issue on Prosody of Iberian Languages, ed. by G. Elordieta and M. Vigário), p. 117-146.

References

- Ladd, D. R. 1983. Phonological features of intonational peaks. *Language* 59: 721– 759.
- Ladd, D. R. (2008). *Intonational Phonology*, 2nd Edition Cambridge University Press.
- Prieto, P. & Torreira, F. (2007). The segmental anchoring hypothesis revisited. Syllable structure and speech rate effects on peak timing in Spanish. *Journal of Phonetics* 35(4):473-500.
- Prieto, P. M. D'Imperio and B. Gili Fivela, 2005. Prenuclear and nuclear rising accents in Romance: tonal alignment and primary and secondary associations with metrical structure. *Language and Speech*, Special Issue: Intonation in Language varieties, guest editor Paul Warren, Kingston Press, London, 48(4):359-396.
- Topintzi, N. & M. Baltazani 2012. The acoustics of high-vowel loss in a Northern Greek dialect and typological implications. In *Consonant Clusters and Structural Complexity*, P. Hoole, L. Bombien, M. Pouplier, Ch. Mooshammer, and B. Kühnert (eds.), Interface Explorations series, de Gruyter:369-398.