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Harvard Historical Linguistics Workshop

Greek grave: tone and intonation

1 Grave basics

1. Three graphic accents
    i. Acute (´) = high (H), but debated whether H or LH on long vowels/diphthongs
    ii. Circumflex (ˆ) = falling (HL); only occurs on long vowels/diphthongs
    iii. Grave (`) = debated whether a lowered high (H^{L}, $^{!}$H, or M) or no tonal target (Ø)
2. In (now standard) orthography, a word-final (oxytone) acute becomes grave when immediately followed by an accented word within the intonation group (ι)
    (a) *barún* “low”
    (b) *barùn autón* “low itself”
3. Graving[1] does not occur before an enclitic
    - *barún te autón* “and low itself”
4. That is, graving affects only the ultima of a **maximal** prosodic word (PWd_{max})
    (a) (*barùn*) (*autón*)
    (b) (*barún te*) (*autón*)
5. Graving affects long vowels
    - *agorḕn dè ...* “but the market”
6. But never circumflex
    - *bê dè ...* “but went”
7. Nor interrogatives, viz. *tís* “who?” and *tí* “what?”
8. An acute before an elided vowel is not graved, even though it is (apparently) surface-final
    - /éntha álla/ → *énth’ álla* “there other things”
9. If a would-be grave vowel of a non-clitic word is elided, acute appears on the preceding syllable
    - /pollá álla/ → *póll’ álla* “many other things”

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[1] A.k.a. “lulling” (*koímisis*, *koimismós*). I’ll avoid “barytonesis,” which might imply retraction.

2 Philological background

1. Hellenistic rhetoricians identify the three accents as indicating tones, namely, high (*oksús*), low (*barús*), and falling (*oksúbarus*)
2. For them, *barús* applies not only to syllables that we would nowadays mark grave, but all unaccented syllables (Dieu 2022: 42f)
    - Dionysius of Halicarnassus (1st century BCE): “in polysyllables, however many syllables there are, the one with the high pitch (*oksùn*) is among many low-pitched ones (*bareíais*)” (trans. Probert 2003: 5)
    - Dionysius Thrax (2nd century BCE): “Lorsqu’il explique pourquoi le grave était appelé accent syllabique (*sullabikòs tónos*) chez les Anciens, il dit que c’est parce qu’il se plaçait sur toute syllabe qui n’est pas accentuée de l’aigu” (trans. Dieu 2022: 43)
3. Graved words are sometimes termed *enklinómena*
4. Accent marking is traditionally attributed to Aristophanes of Byzantium (c. 200 BCE), though the glyphs are attested earlier
5. It was only standardized (as found in modern editions) in the Byzantine period (c. 9th CE)
6. Early on, accents were marked sporadically, sometimes for disambiguation (in *scriptio continua*), or to flag melodic landmarks in cola for reading aloud (Nagy 1996, 2000)
7. E.g. a 2nd century BCE papyrus (Probert 2003: 12), modernized (including spaces and macrons) except for accents:

    tōi d’ ara Trōilon hōsei khrūson òreìkhálkōi tris ápephthon ḗdē Trōes Danaói t’ eróessan morphan mál’ eískon omoion

    (a) Here, acute is marked in about half of applicable words
    (b) Syllables that would nowadays be grave (*hōseì*, *khrūsòn*, *trìs*, *morphàn*) are always unmarked
    (c) The only use of grave is for disambiguation: *òreì-khálkōi* “brass,” cf. *órei* “mountain”
    (d) Grave flags the *absence* of accent, not the *presence* of a particular kind of accent[2]
8. Later papyri vary, but one common pattern is what I call the “not yet” system, where graves run up to (but not after) the acute/circumflex (cf. Probert 2006: 46, Dieu 2022: 44), e.g.
    (a) For modern $\underline{\sigma\acute{\sigma}\sigma}$
        - $\grave{\sigma}\acute{\sigma}\sigma$ or $\grave{\sigma}\sigma\sigma$
    (b) For modern $\underline{\sigma\sigma\acute{\sigma}}$ or $\underline{\sigma\sigma\grave{\sigma}}$
        - $\grave{\sigma}\grave{\sigma}\sigma$ or $\sigma\grave{\sigma}\sigma$
9. But other patterns occur (e.g. for $\underline{\sigma\sigma\grave{\sigma}}$, $\grave{\sigma}\grave{\sigma}\grave{\sigma}$ or modern-like $\sigma\sigma\grave{\sigma}$, but also $\sigma\sigma\acute{\sigma}$)

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[2] Similarly Nagy (2000): “the marking of syllables with the grave accent [in an example] indicates simply the postponement of acute accent rather than any accent *per se*.”

10. Modern $\underline{\sigma\sigma\grave{\sigma}}$ as $\grave{\sigma}\grave{\sigma}\sigma$ might be taken to suggest that graved oxytones ended with a high of some kind (Wackernagel 1926: 59, Probert 2015: 938, Sandell 2023: 516, all cautiously)
    (a) However, in this system, ultimas are unmarked in general, even when definitely low (e.g. modern $\underline{\sigma\acute{\sigma}\sigma}$ as $\grave{\sigma}\acute{\sigma}\sigma$ or $\grave{\sigma}\sigma\sigma$)
    (b) Thus, the point of the "not yet" system is not to show the pitch level of every syllable, but rather to ensure that accent is not misplaced/premature
    (c) Further evidence
        i. The optionality of acute (e.g. $\underline{\sigma\acute{\sigma}\sigma}$ as $\grave{\sigma}\sigma\sigma$, leaving both H and L unmarked)
        ii. The optionality of grave(s) preceding the pretonic (e.g. $\underline{\sigma\sigma\acute{\sigma}\sigma}$ as $\sigma\grave{\sigma}\sigma\sigma$)
11. Homeric scholia frequently equate grave with unaccented, e.g. *phúgade mnɔ̃onto* read as *phúga dè mnɔ̃onto* (Dieu 2022: 48)
    (a) A proponent of grave = H^L might allow that function words like *dè* "but" are toneless (as other evidence corroborates)
    (b) To be clear, the competing hypotheses are now
        i. Grave represents either H^L or Ø, depending on word class
        ii. Grave represents Ø across the board

3 Musical evidence on grave

1. Nearly everyone nowadays thinks grave was realized as[3] either
    (a) A lowered high target or reduced acute (H^L, $^{!}H$, or M), at least in non-clitics
    (b) Tone deletion, i.e. the absence of a tonal target (Ø)
2. Most favor (a), with music (via e.g. Allen 1968, West 1992, Devine and Stephens 1994) being probably the most important evidence
    (a) Allen (1968: 116) is agnostic:

        > "the nature of the modification is unknown, and there seems little point in making mere guesses"

    (b) But Devine and Stephens (1994) influentially favor (a)
    (c) E.g. Probert's *Ancient Greek accentuation* (2006: 59) favors (a), citing only music:

        > "ancient Greek music [...] suggests that the grave was not simply the equivalent of an unaccented syllable. It is likely that the grave which replaces the acute on a final syllable indicates that the syllable is to be pronounced on a pitch higher than that of the preceding unaccented syllables"

3. I'll argue that the musical evidence actually favors (b)

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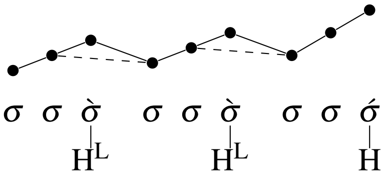
[3] Less anachronistically, "grave (as marked in modern editions) was realized as (in the ancient/Hellenistic language)."

4. Schematically, imagine that we could see a pitch track of a sequence of three oxytones, the first two graved: *σσσ̀ σσσ̀ σσσ́*

5. On the one hand, if grave is a high tonal target of some kind, we'd expect to see inflection points on it, either (a) local peaks or (b) elbows, e.g.

(a)



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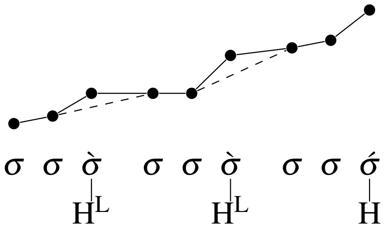
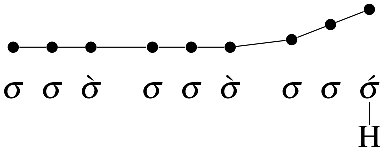


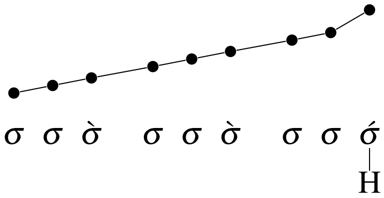
   - In either (hypothetical) case, grave rises above the **interpolation line** (dashed)
   - If it didn't, there'd be no reason to posit a high target of any kind

6. On the other hand, if grave has no tonal target, we'd expect it to interpolate, e.g.

(a)



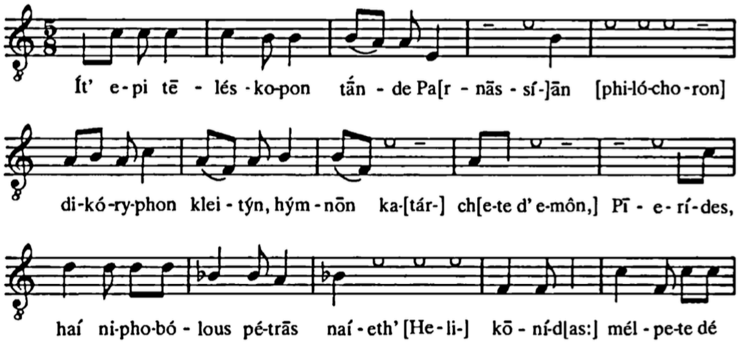
(b)



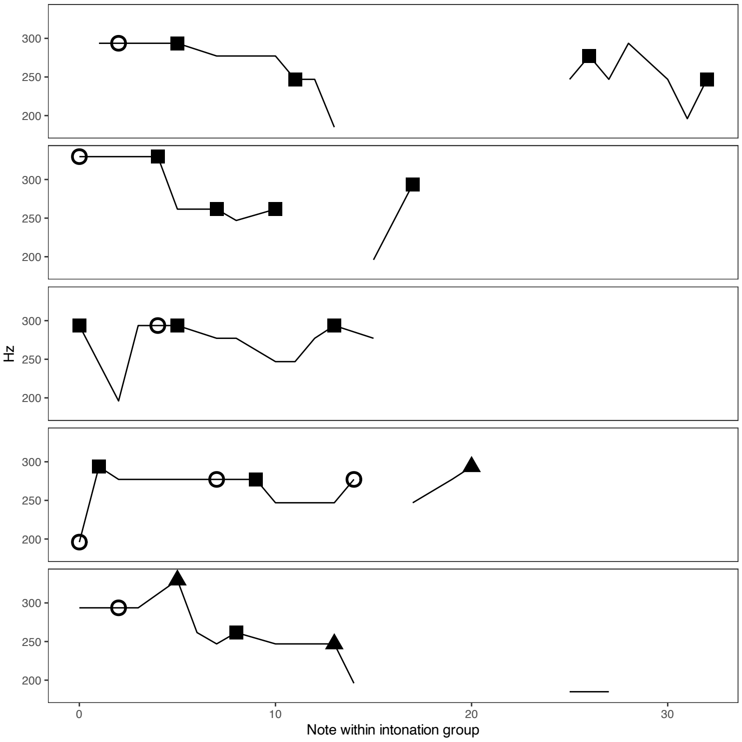
   - In (b), grave is the highest in its word; still, no tonal target is justified
   - Just as none is justified on the penult, which is higher than the initial

7. Music corpus: Delphic hymns *Athenaeus* and *Limenius* (DAGM 20–21; 127 BCE, Pöhlmann and West 2001), as annotated by Dieter Gunkel

8. Beginning of *Limenius* (here showing West 1992: 293, but updated)



9. First few big ιs of *Limenius* (■ = acute, ▲ = circumflex, ◯ = grave; gaps = lacunae)



(a) [ít'] epì tēléskopon tā̃nde Par[nāsí]ān [philókhoron] dikóruphon kleitún

(b) haì niphobólous pétrās naí[eth' Heli]kōní[das]

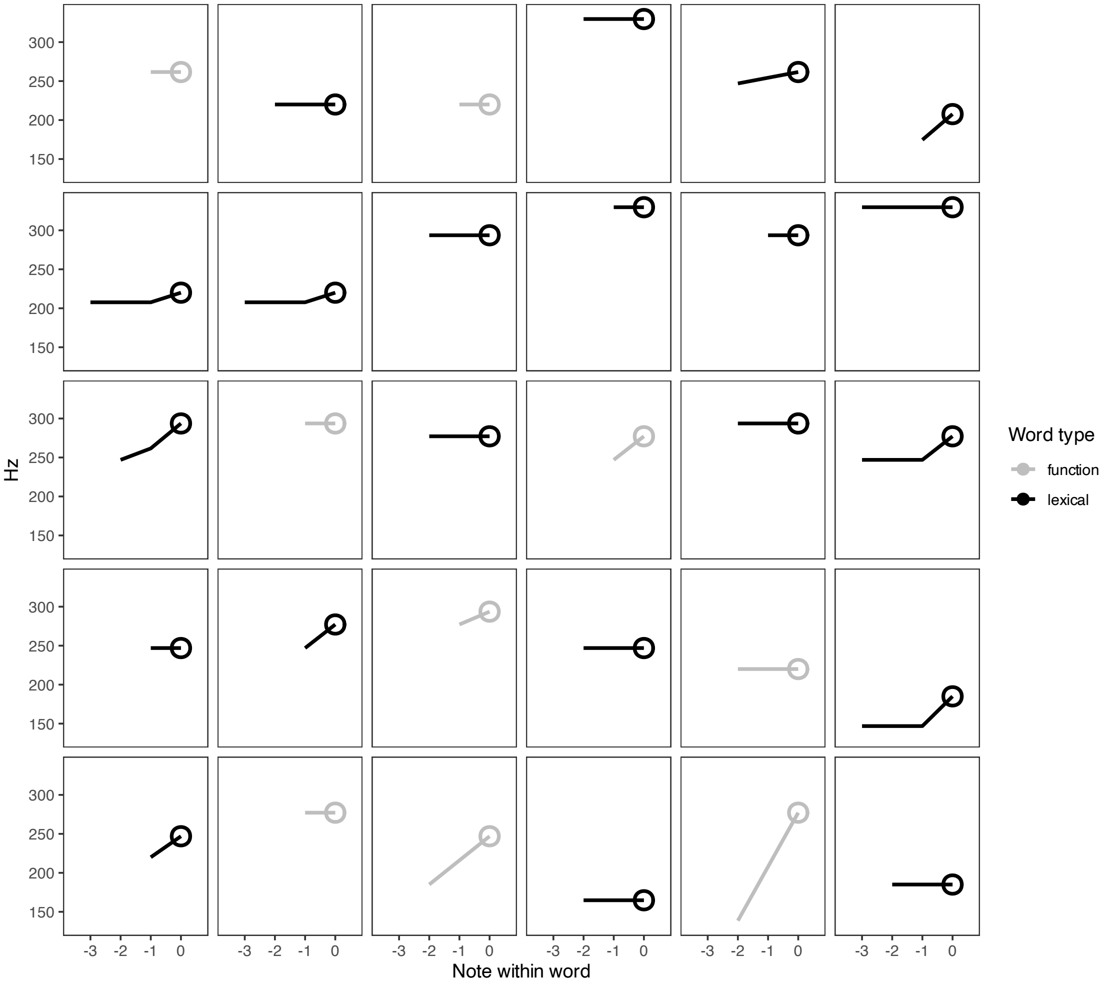
(c) mélpete dè Pū́thion khruseokhaítān

(d) hòn étikte Lātṑ mákaira parà [lím]nāi klutaî

(e) khersì glaukâs elaíās thigoûs' [ódzon èn agōníais] eritha[lê]

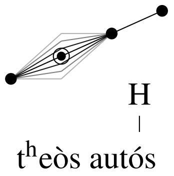
4 Grave words in the Delphic hymns: overview

1. Grave polysyllables are flat or rising (64% the former; $n = 30$)
2. % flat is essentially the same for lexical vs. function (a.k.a. orthotonic vs. proclitic) polysyllables (62% vs. 56%)
3. The two biggest rises (in the last row) are both sentence-initial, a context independently associated with rises, but I leave them in for completeness
4. Rising (besides being infrequent) is not necessarily indicative of a H^{L} target, given the possibility of phrasal trajectories

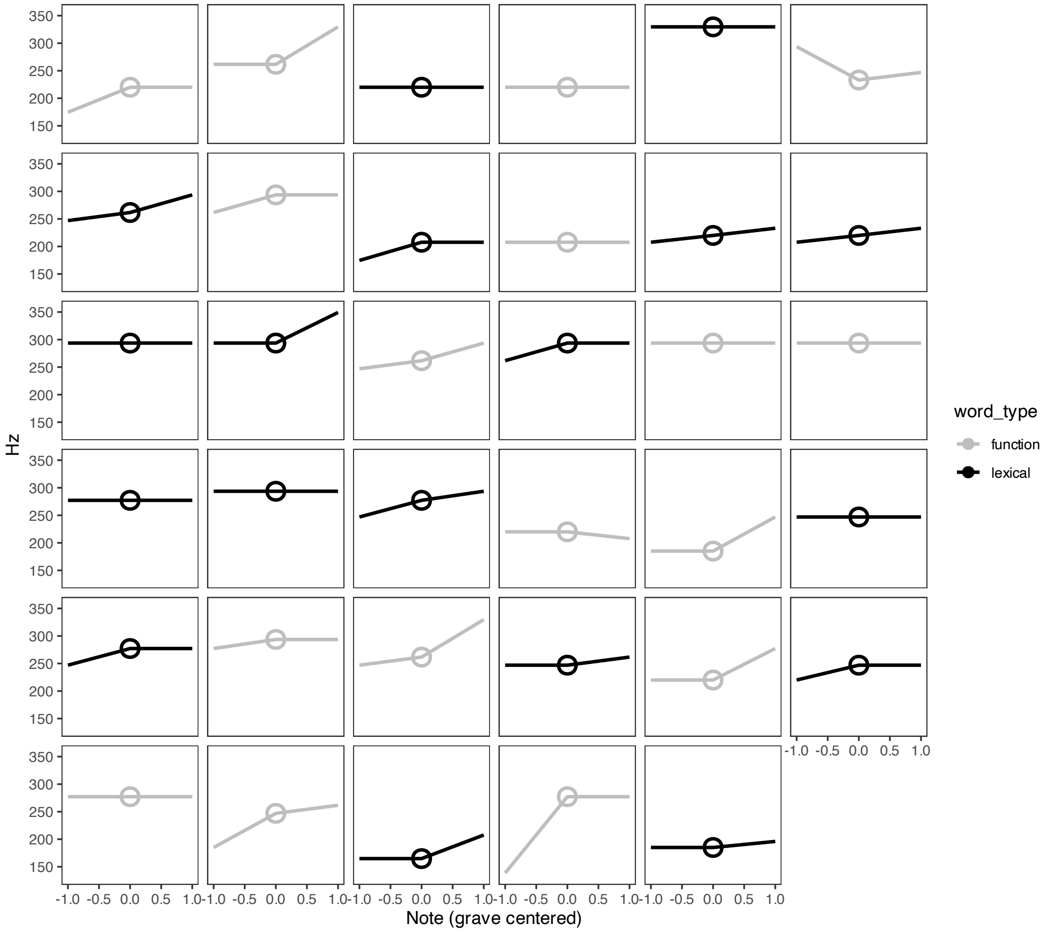


5 Grave vs. the interpolation line

1. Now taking all graved words (including monosyllables) and centering grave to show the local context ($n = 35$, half of which [18] are lexical words)
2. All three notes must be attested (so four words from the previous plot are dropped)[4]
3. Grave is on the interpolation line if $\sigma_2 = \frac{\sigma_1 + \sigma_3}{2}$
4. Even insofar as there is interpolation, however, we wouldn't expect it to be perfectly linear



5. The question is whether grave tends to be placed above the interpolation line



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[4] If grave is set to a melism ($n = 3$), the ending of the melism is taken to be the locus of grave. If one of the adjacent syllables is set to a melism, only the innermost note is used.

6. It does not; in fact, it is perfectly symmetric: 31% above, 31% below, 37% on

	Lexical	Function	Total
Above the line	5	6	11
On the line*	8	5	13
Below the line	5	6	11

*Rounding to the nearest Hz.

7. Grave is never a local maximum (as might be expected for $\mathrm{H^L}$), and once a local minimum

8. Lexical and function words are equally symmetric (though the latter show more variance)

9. Mean offset is -0.05 semitones (-0.03 for lexical, -0.07 for function), below the interpolation line, but not a significant departure from it[5]

10. Gunkel and Ryan (2022) use essentially the same test (except excluding melisms)

    - The same year, Dieu in his *Traité d'accentuation grecque* (2022: 51) independently came to the same conclusion (without presenting data):

      > "D'un point de vue phonologique, le grave qui résulte de la barytonèse des oxytons pourrait parfaitement noter une atonie totale. D'un point de vue phonétique, en revanche, cela ne semble guère probable, si l'on conçoit la réalité articulatoire de l'accent grec comme un accent de contour: il se peut très bien que cet accent grave initie ou prolonge un mouvement ascendant vers l'aigu du mot suivant"[6]

11. Moreover, grave looks nothing like a (mini-)acute

    (a) Vis-à-vis the interpolation line, acutes ($n = 113$) are 95% above, 1% below, 4% on (whereas grave is just as likely to be above as below)

    (b) Mean 2.0 semitones above (vs. -0.05 for grave)

    (c) Acute is usually (55%) a local maximum (whereas grave never is)

12. Gunkel and Ryan (2022) present two other tests, both supporting grave $\approx \emptyset$

    (a) The relative pitch of G# does not differ significantly from that of U#

    (b) Graved words pattern like the unaccented initial members of compounds

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[5] $t = -0.20$, $p = 0.85$. Per Devine and Stephens (1994), the offset in semitones is $\frac{12}{\log_{10}(2)} \cdot \log_{10}(\frac{\sigma_2\mathrm{Hz}}{(\sigma_1\mathrm{Hz}+\sigma_3\mathrm{Hz})/2})$.

[6] Ruijgh (2001: 306f) expresses a similar sentiment.

6 Devine and Stephens' (1994) tests

1. Devine and Stephens (1994: 181–4, 445–9) run several tests on the Delphic hymns, ultimately supporting both H1 and H2:[7]

   H1. Grave is lower than acute: $G < A$

   H2. Grave is a high target, distinct from unaccented: $G > U$

2. The six tests annotated for which hypothesis (H1 or H2) each is claimed to diagnose:

Test	Finding	Claimed to diagnose
1a	rise to $A >$ rise to G	H1
1b	rise to $G > 0$	H2
2	$G < A$ or C (but not G) in the next word	H1
3	longer word $\rightarrow$ greater rise to G	H2
4a	G#U rises less than U#U	H2
4b	G#U tends to rise (not significant)	—

3. Relevantly, (unshaded) tests 1b, 3, and 4a are claimed to demonstrate that "the grave accent is a lowered High tone, not an unaccented syllable"

4. I'll argue that all three tests are non-diagnostic of H2; additionally, the third is non-significant when run on the whole corpus

6.1 Test 1b: rise to $G > 0$

(a) The mean rise to G within the word is significantly greater than zero

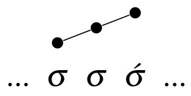
(b) As we saw (p. 5), however,

   i. Most (64%) graved polysyllables are flat

   ii. When rises do occur, they can be part of larger, phrasal rises

(c) Since this test fails to account for the possibility of interpolation, it's non-diagnostic

(d) To wit, nobody proposes a pitch target on σ_2 of $(...)\sigma\sigma\acute{\sigma}(...)$, even though σ_1 to σ_2 tends significantly to rise[8]



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[7] This section reflects collaboration with Dieter Gunkel. G = grave, A = acute, C = circumflex, and U = graphically unaccented.

[8] Mean rise of 10 Hz from the pre-pretonic to pretonic vocoid mora (Wilcoxon $V = 342$, $p < 0.0001$).

6.2 Test 3: longer word → greater rise to G

(a) This reinforces a general tendency to rise to the first full accent[9]

(b) For comparison, within acute/circumflex words, the amount of rising between the initial and the pretonic correlates with the number of vocoid moras in the span ($r = 0.22$), even though none of those moras is accented

6.3 Test 4a: G#U rises less than U#U

(a) If G is a high target, G#U should have an aggregately *lower* slope than U#U, e.g.

(b) If G represents deletion, G#U and U#U should have similar slopes, e.g.

(c) DS counted U#U only from *Athenaeus*; here, I use the whole corpus

(d) DS' treatment of melisms is not specified; here, I run two versions of the test

  i. Exclude melisms, i.e., drop any bigram in which either syllable is a melism
  ii. Include melisms by taking the nearest note

(e) Neither is significant

Melisms	*n* G#U	mean G#U	*n* U#U	mean U#U	Wilcoxon *p*
Excluded	19	0.42	69	0.87	0.25
Included	23	0.39	81	0.95	0.10

(f) Moreover, even if it *were* significant, the test suffers from a confound

- U#U follows an acute or circumflex within its word; G#U does not
- Pitch drops sharply after an acute or circumflex
- Thus, even if U < G, it could be due to the drop into U rather than G being high

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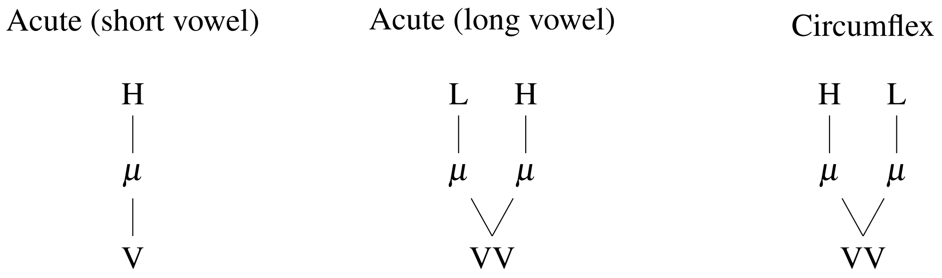
[9] Additionally, the test employs a fairly arbitrary trichotomy—(1) function words of 2–3 moras vs. (2) lexical words of 3 moras vs. (3) lexical words of 4+ moras—and is not quite significant ($p = 0.054$).

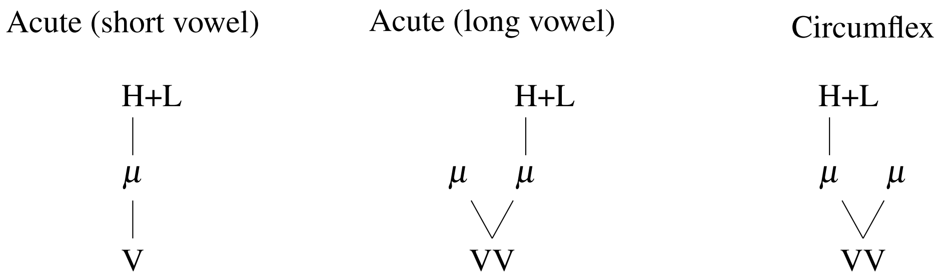
7 Analysis of graving

1. A traditional analysis of full accents: acute long = rising; TBU = vocoid mora (μ_V)



2. Alternative: acute long = high (e.g. Steriade 2014, Sandell 2023, Sandell and Gunkel 2024); TBU = syllable (at least for Sandell 2023)

3. Here, I tentatively assume a variant of the traditional analysis: all full accents are basically the same, namely, H+L, where L links to the following mora, if any



4. On this approach, acute and circumflex aren't different *types* of accent, but different *alignments* of the same accent[10]
   (a) Both exhibit a gentle rise or plateau before μ_V and a sharp drop after μ_V (hence H+L)
   (b) In the Delphic hymns, the drop is about twice as steep as the rise[11]
   (c) Ignoring alignment, the shape of the acute is similar to that of the circumflex[12]

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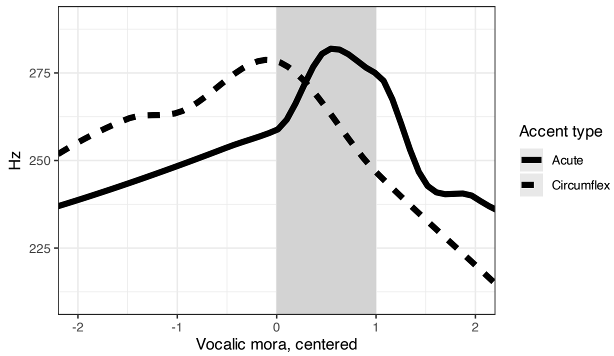
[10] Cf. the diachronic development of circumflex from acute (e.g. Jasanoff 2004, Gunkel 2023: 232–5).

[11] The difference is not an epiphenomenon of the uneven placement of accent in the word: Even when the accent is flanked by equal numbers of μ_V on both sides, the slopes tend to differ.

[12] Acute is sharper, but that might be due to its different distribution within words vis-à-vis circumflex.



5. The drop (L in H+L) is known as the **contonation** (e.g. Allen 1968: 114–6)

6. With Allen (1968) and others,[13] I take graving to be due to the inability to realize the contonation across words (here via CrispEdge, after Ito and Mester 1999)

    - *Contour-μ: at most one tone may be linked to a mora
    - CrispEdge: a tone must not be realized outside of its licensing PWd_{max}
    - NoFlop(H): the accent (specifically, its head, H) must not shift
    - Ident(T): the accent must be fully realized, as falling (in essence, it is the *drop*, not the *height*, that cues the accent)
    - Max(T): the accent must be realized (in some form)

H L ∨ μμ μμ...	*Contour-μ	CrispEdge	NoFlop(H)	Ident(T)	Max(T)
a. ☞ μμ μμ...					*
b. H L ∨ μμ μμ...	*!				
c. H L | | μμ μμ...		*!			
d. HL | | μμ μμ...			*!		
e. H | μμ μμ...				*!	

7. "Sour grapes": the accent would rather be deleted than incompletely realized

    - As L goes, so goes H

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[13] Cf., similarly, Devine and Stephens (1994: 449): grave "is not a full accent; it lacks the fall to Low tone [...] a word bearing the grave accent combines with a following fully accented word [...] to form a single accentual trajectory."

8. So far, no analysis of ι-final oxytones, in which acute is realized as H, sans contonation[14]

9. My suggestion: the ι-final PWd$_{max}$ is the head of ι (essentially, bears nuclear stress); as such, its accent must be realized (even if partially)

   - Max(T)$_{head}$: the accent must be realized in the head PWd$_{max}$
   - Cross-linguistically, the final PWd of ι is normally its head, even in verb-final languages (e.g. Hayes and Lahiri 1991: 55 on Bengali, Kahnemuyipour 2003: 337 on Persian)

H L ∨ $\mu\mu$]$_\iota$	Max(T)$_{head}$	*Contour-μ	CrispEdge	NoFlop(H)	Ident(T)	Max(T)
a. ☞ H | $\mu\mu$]$_\iota$					*	
b. H L ∨ $\mu\mu$]$_\iota$		*!				
c. $\mu\mu$]$_\iota$	*!					*

10. Two faithfulness constraints here could be replaced by markedness constraints without altering the spirit of the analysis

    (a) Instead of Ident(T), HaveContonation (*vel sim.*)
    (b) Instead of Max(T)$_{head}$, Headedness$_\iota$ “the head PWd$_{max}$ of ι must have an accent”

7.1 What about final lengthening?

1. Duration plays no role in my analysis
2. Counter-proposal: graving of PWd$_{max}$ happens everywhere except phrase-finally because of the extra duration of the phrase ultima
3. It’s not plausible that, say, ι-internal [àːn] (which graves, even minor phrase-finally) is shorter than ι-final [í] (which does not grave)
4. Moreover, very short vowels like [í] have no trouble hosting H word-internally

7.2 What about default/boundary tones?

1. Boundary tones play no role in my analysis
2. An idea: graved “oxytones” are inherently toneless, but only acquire H ι-finally via a boundary tone (cf. Trubetzkoy 1939: 215, Blumenfeld 2004: 3f)
3. First, the accent is underlying in at least some oxytones
4. Second, I know of no other evidence for a general H% (cf. ι-final proparoxytones)

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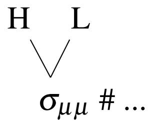
[14] In the Delphic hymns, three such tokens are found, two ending with a sharp rise and one flat.

7.3 What about the OCP?

1. The OCP (Obligatory Contour Principle) plays no role in my analysis
2. Counter-proposal: graving is a repair for OCP-violating H#H, given that the intervening contonation cannot be realized (cf. Meillet 1905–6 on Vedic, critiqued by Dieu 2022: 53f)
3. The musical evidence makes clear that grave tends to interpolate with—not dissimilate from—the following syllable (which, moreover, need not be H)

7.4 What about non-finality?

1. NonFinality plays no role in my analysis
2. Counter-proposal: NonFinality(H), not Ident(T), motivates graving
3. We still need to account for the non-graving of ι-final position (which is final *par excellence*), so Max$(T)_{head}$ (or some replacement) is still needed
   (a) Sandell (2023: 560) employs $*H]_{\omega}\ {}_{\omega}[$
   (b) Less stipulative would be Max$(T)_{head} \gg *H]_{\omega}$
4. Given that circumflex (HL) does not grave, the problem is not H on the final *syllable*, but H on the final *mora*: NonFinality-μ(H)
5. Sandell (2023) has σ as the TBU, so he uses an edge-based (as opposed to TBU-based) version of NonFinality, namely, $*H]_{\omega}$. Some concerns with $*H]_{\omega}$:
   (a) Empirically, graving is not motivated by the avoidance of high endings; graved syllables are frequently as high as nearby Hs (see p. 5)
   (b) Mechanically, realizations of grave as HL and L still need to be excluded (cf. Sandell 2023: 562–9)
      i. On the one hand, if the input/basic form of the tone is H, Dep(L) accomplishes this; but then the contonation onto an enclitic string is unmotivated[15]
      ii. On the other hand, if the input/basic form of the tone is HL, it's unclear how to preclude the faithful candidate, namely,[16]



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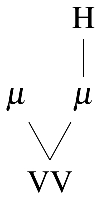
[15] The mean drop onto an enclitic (3.1 semitones) is greater than that within an orthotonic word (2.5 semitones). This remains the case for enclitic strings of two or more syllables (2.8 semitones).

[16] Sandell (2023: 569) allows that graving might involve replacing H* by L*. However, the musical evidence does not support a low target in graved words.

8 More on the TBU

(a) Acute VV as ØH
(setting aside the contonation)



(b) Acute VV as H

1. The analysis of graving here assumes structure (a) above
    - TBU is the vocoid mora (μ_V)
    - Acute VV is (potentially rising) ØH
2. Others (e.g. Steriade 2014, Sandell 2023, Sandell and Gunkel 2024) take acute VV to be simple H, as in structure (b) above
3. The graving of long vowels favors (a) in my view (§7.4)
    - The accent can be HL (with the desired contonation)
    - NoFlop(H) prevents neutralization with circumflex
4. One argument for (b) concerns musical mapping
    (a) Long acute is set flat (i.e. to a single note) 81% of the time in the Delphic hymns (vs. 38% for circumflex; Sandell 2023: 510–2, Sandell and Gunkel 2024: 100)
    (b) The few ($n = 4$) cases in which long acute is set to a melism are equally likely to rise or fall (*id.*: 111)
    (c) This speaks against acute as LH, but not necessarily against acute as ØH
    (d) We expect ØH to rise less often than HL falls
5. Second, it's typologically unusual to permit the contour tones LH and HL on VV, but not the level tone H (*id.*: 134–52)
    - Such a system is attested, but uncommon
    - Relevant comparanda are languages with long vowels and culminative H
    - Cf. Somali, e.g. *béer* [bêːr] "liver" (HL) vs. *beér* [běːr] "garden" (LH), *[béːr] (H); although LH is optionally flattened (Orwin 1994: 164f)[17]

(3.17) The phonetic realization of **béer** and **beér**

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[17] The second part of LH "is realized at a pitch higher than the first part, resulting in a slightly rising realization [...] however, the difference in pitch is not as great and the long vowel may sometimes be realized at a steady pitch."

6. Third, (a) shows pre-accentuation before an enclitic. The lack of pre-accentuation in (b) can be explained by the OCP (Steriade 2014: 14)
    (a) *oîkós esti* “is a house” HL + H satifies the OCP
    (b) *daímōn estí* “is a god” **daímṓn esti* because H + H would violate the OCP[18]
    (c) This explanation fails if acute is LH (i.e. if **daímṓn esti* is LH + LH)
    (d) With *ō* = ØH, however, either
        i. Ø remains unlinked, and the OCP is violated (by HØH)
        ii. The (preceding) contonation is realized on *ō*, yielding LH, which violates *Rise
7. I’ve focused on the grave, but the choice of TBU affects the whole accentual system (for a comprehensive treatment, see recently Sandell 2023)

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[18] But the facts are complicated; cf. e.g. *állós tis* “anyone else.”

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