

# Hard Choices: Sound Change in Northern Greek

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## **Abstract**

We propose a new account of the change from *-Vsis*, *-Vzis* to *-V<sub>i</sub>s* in Modern Lesbian, and of related changes in other Northern Greek dialects, arguing that they are special cases of the loss of unstressed high vowels. Our analysis depends on the new understanding of the nature of sound change that Nonlinear Phonology and Optimality Theory jointly make available.

Keywords: Lesbian, Northern Greek, sound change, metathesis, nonlinear phonology, Optimality theory.

# 1 The *i-shift*: a puzzle in Greek phonology

Like most other Northern Greek dialects, Modern Lesbian treats sequences consisting of an unstressed high vowel *i* between sibilants in a way that starkly diverges from standard Greek. For Standard Greek τῆς βρούσης, Modern Lesbian has *ts vriis*; for Standard Greek βρίζεις, Modern Lesbians again has *vriis*. This happens in every morphological combination where these phoneme sequences arise.

The reduction of /-Vsis-/ , /-Vzis-/ seems to be limited to dialects in which unstressed short *i* and *u* are lost across the board – the Northern Greek High Vowel Deletion. The reduction occurs in three varieties. *i* can simply be lost, or it can replace the postvocalic sibilant as nonsyllabic *i̯*, in which case the postvocalic sibilant’s voicing can be lost or retained. We will call them the Locris, Macedonian, and Modern Lesbian type, after the regions where they are best documented, with the understanding that each is more widely spread, and that in some localities two types co-occur in idiolectal or sociolectal variation.<sup>1</sup>

|     |                               |           |           |
|-----|-------------------------------|-----------|-----------|
| (1) |                               | /-Vsis-/  | /-Vzis-/  |
| a.  | Locris (Vitrinitsa, Salona)   | [-Vs:-]   | [-Vzs-]   |
| b.  | Macedonia (Kozani, Velvendos) | [-V̥is-]  | [-V̥iz-]  |
| c.  | Lesvos                        | [-V̥is̥-] | [-V̥is̥-] |

We’ll refer to these sound changes, and to the synchronic alternations that result from them, collectively as the Northern Greek *i-shift*. We put forward a new analysis of them that is grounded in a constraint-based version of non-linear phonology, and argue that it offers empirical support for a new understanding of sound change based on Optimality Theory. We argue that *i-shift* is neither a sound change in its own right, nor a separate independent synchronic process of the dialect, but part and parcel of the Northern Greek High Vowel Deletion (HVD), both in its diachronic origin and in its synchronic status in the phonological system. From the viewpoint of traditional historical phonology, as well as that of classical generative phonology, this makes no sense, since at least the Macedonian and Modern Lesbian types of *i-shift* are on the face of it different processes than HVD. The claim does make sense, though, if we assume an Optimality-theoretic perspective, which models sound change not as rule addition but as constraint promotion. That approach predicts that a sound change, though a single historical event, may have multiple manifestations because it can interact with the existing constraints of the language in different ways depending on the phonological context.

In the dialect of Locris (1a), /-Vsis-/ is pronounced [-Vss-], or /-Vs:-/,<sup>2</sup> and /-Vzis-/ is pronounced [-Vzs-] (at least the latter reportedly varying with the Modern Lesbian pronunciation [-V̥is̥-]).

|       |  |
|-------|--|
| (2)   | /-vzis-/ → [-Vzs-], /-Vsis-/ → [-Vss-] |
| 2.Sg. | αλλάζεις /alaz-is/ alázs ~ alai̯s      |
| 2.Sg. | χτίζεις /xtíz-is/ xtízs ~ xti̯is       |
| 1.Sg. | έζησα /é-zi-sa/ ézsa                   |

<sup>1</sup>Our principal source for Northern Greek dialects, and Modern Lesbian specifically, is Kretschmer (1905). We also rely on more recent works on specific dialects, as cited below.

<sup>2</sup>Kretschmer’s data (p. 82) has both long and geminated *s*, varying both within and across dialects. It is not clear to us how he differentiates them phonetically, but phonologically they are clearly /ss/, reduced from /sis/.

That the resulting consonant length (phonologically gemination) is contrastive is shown by minimal pairs such as κλώσσησα *klós:s:a* ‘I brooded’ versus κλώσσα *klósa* ‘brooding hen’ (Kretschmer p. 84).

Kretschmer reports the same voicing contrast for the speech of educated people in Janina, while uneducated people have the same forms as the Lesbos dialect has.

- (3) /vr̥isi-s/    vr̥iss (“educated”)    ~    vr̥i̇es (“uneducated”)  
       /e-zi-s-a/    ézsa                                ~    ėisa

In the islands of Samos and Skiros we also find contrastive lengthened [s:], phonologically /ss/. Compare 2Sg. *θα rutís*: from /θa rota-ís-is/ θα ρωτήσεις ‘you will ask’ with 3Sg. *θα rutís* from /θa rota-ís-i/ θα ρωτήσει ‘he/she will ask’.<sup>3</sup>

- (4) 1.Sg. φύσησα            /e-físa-is-a/    fí:s:a  
       μάσησα            /e-mása-is-a/    más:a  
       2.Sg. θα ρωτήσεις    /θa rota-ís-is/    θα rutís: (cf. 3Sg. θα rutís)  
       να ζβήσεις        /na zv̥isi-s/      na zvis:

The Locris type /-zis-/ → [-zs-] and /-sis-/ → [-ss] can be unproblematically understood as nothing more than the direct outcome of the loss of unstressed *i*. The difficulties begin with the other two systems, respectively encountered in Macedonian (1b) and in the Modern Lesbian dialect (1c).

Macedonian dialects, such as those of Kozani and Velvendos, as well as Modern Lesbian dialects, have a diphthong. But Macedonian, unlike Modern Lesbian, preserves the phonemic voicing contrast of the medial sibilant in the *word-final* sibilant, as in γνωρίζεις *gnuríjz* vs. πουλήσεις *plijs*. See the data in (5) (from Kretschmer 82):<sup>4</sup>

(5) *Macedonian (Kozani, Velvendos)*

/Vsis/ → [V̇is], /Vzis/ → [V̇iz]

- |    |         |            |                |   |
|----|---------|------------|----------------|---|
| a. | Gen.Sg. | της βρύσης | /tis vr̥isi-s/ | vri̇is (vs. οί βρούσες <i>i vr̥isis</i> ) |
| b. | 2.Sg.   | βάσεις     | /vaz-is/       | vai̇z                                     |
|    |         | πουλήσεις  | /pulis-is/     | pli̇is                                    |
|    |         | σκούζεις   | /skuz-is/      | sku̇iz                                    |
|    |         | γνωρίζεις  | /gnor-iz-is/   | gnuṙíjz                                  |
|    |         | τινάζεις   | /tin-az-is/    | tinájz                                    |
|    |         | αναμύζεις  | ana-mi-is      | anaṁíjz                                  |
| c. | 1.Sg.   | έχυσα      | /exi-s-a/      | ėisa                                     |
|    |         | κλώσισα    | /e-klos-is-a/  | klóisa                                    |
| d. | Names   | Λουίζις    | /luiz-is/      | luíjz                                     |
|    |         | Τσερχέζης  | /tserk-ez-is/  | tsirkéjz                                  |

<sup>3</sup>Kretschmer provides no examples of /-Vzis-/ from these dialects, so our limited data leaves open the possibility that /-Vsis-/ and /-Vzis-/ here merge as [-Vis:], by voicing assimilation applying to the output of HVD. From Samos Kretschmer (1905: 237) also records short *s* in Gen.Sg. *ts vr̥is*.

<sup>4</sup>Imbros shows a more complicated picture. It has /ðés-is/ → *ðes* ‘you bind’, presumably degeminated from a Locris-type *ðéss*, but also /arxiníz-is/ → *arxiníxs* ‘you start’ (Tzavaras 2016: 80, 96), which could come by voicing assimilation from an earlier *\*arxiníis*.

The Modern Lesbian data in (6a-e) are cited from Kretschmer (1905), Newton (1972: 84) and Gafos & Ralli (2001).<sup>5</sup> As in other dialects, the change is regular and productive; note especially *μασάζ* in (6e), a relatively recent loan that probably was not in the language when the sound change took place, yet undergoes it in combination with a clitic like any other word.

(6) /-Vsis-/ , /-Vzis-/ → [-V<sub>i</sub>s-]

|                          |                 |                  |                           |
|--------------------------|-----------------|------------------|---------------------------|
| a. Gen.Sg. -stem         | τῆς βρύσης      | /tis vrísi-s/    | <i>ts vriis, dz vriis</i> |
| b. 2.Sg. Nonpast         | βρίζεις         | /vríz-is/        | <i>vriis</i>              |
| Nonperfective            | παίζεις         | /péz-is/         | <i>peis</i>               |
|                          | θὰ λούσης       | /θa lús-is/      | <i>θa luiis</i>           |
|                          | ἀγοράζεις       | /aɣoráz-is/      | <i>aɣuráis</i>            |
| c. 1.Sg. Past Perfective | ἔροισα          | /e-ðrós-iz-s-a/  | <i>ðróisa</i>             |
|                          | ἔζησα           | /é-zi-s-a/       | <i>éisa</i>               |
|                          | μάσισα          | /mása-is-a/      | <i>máisa</i>              |
| d. 2.Sg. Nonpast Perf.   | θὰ ἀγοράσης     | /θa aɣoráz-s-is/ | <i>θa ɣuráis</i>          |
|                          | θὰ ἀκούσης      | /θa akú-s-is/    | <i>θa kuiis</i>           |
|                          | θὰ γεμώσης      | /θa ɣemó-s-is/   | <i>θa jimóis</i>          |
|                          | θὰ ρωτήσης      | /θa rotí-s-is/   | <i>θa rutiis</i>          |
| e. 2.Sg. Possessive      | μασάζ σου       | /masáz su/       | <i>masáis</i>             |
|                          | τὸ καρπούζι σου | /to karpúzi su/  | <i>tu karpúis</i>         |

After a brief review of previous work on the topic in section 2, we lay out our analysis and theoretical claims in three steps as follows. In section 3 we summarize the evidence for the continuing productivity of *i*-shift. In section 4 we outline the basic tenets of autosegmental and metrical phonology in so far as they are relevant to our thesis, illustrating them with examples from the modern Modern Lesbian dialect as well as the ancient Aeolic Greek dialect of Lesbos. We conclude with our analysis of *i*-shift in section 5.

## 2 Previous accounts of *i*-shift

Hadzidakis (1892) and Thumb (1895) viewed *i*-shift as a dissimilatory sound change by which intervocalic *-s-*, *-z* are lost if the next syllable contains *s*. This does not provide a satisfactory understanding of the specifics of *i*-shift, as Kretschmer (1905: 82) pointed out. It doesn't explain why the change takes place only when the intervening vowel is *i*. It fails to connect the change to the loss of unstressed *i* in Northern Greek dialects, still less to explain why it happens *only* in dialects which underwent that sound change. It doesn't account for the appearance of medial *-z* in final position in Macedonian dialects, as in (5). And finally, no convincing phonetic motivation for it has been put forward, nor can we find another instance of such a change in the literature.

Newton (1972) posited a sequence of five sound changes to account for the developments in the Macedonian and Epirus dialects (Velvendos and Zagori, see (5)). His analysis relates the change to another well-established feature of Northern Greek dialects that is broadly coextensive with it, namely the palatalization of sibilants before *i*. However, to implement his idea Newton had to postulate exceptional voicing assimilation in the progressive (left-to-right) direction for Macedonian (Velvendos), plus two other unmotivated sound changes – laxness assimilation, and consonantality dissimilation – in both types of dialects:

<sup>5</sup>Kretschmer's transcriptions show sometimes a diphthong *Vi*, and sometimes *Vj*, which according to him vary dialectally or idiolectally. Since the variation has no bearing on the analysis, we render both variants as *V<sub>i</sub>* here.

(7) *Newton 1972*

|                              | Velvendos  |         | Zagori     |         |
|------------------------------|------------|---------|------------|---------|
| Underlying                   | /aɣorázis/ | /xásis/ | /aɣorázis/ | /xásis/ |
| Palatalization               | aɣoráʒis   | xáʒis   | aɣoráʒis   | xáʒis   |
| Loss of <i>i,u</i>           | aɣoráʒs    | xáʒs    | aɣoráʒs    | xáʒs    |
| Voicing Assimilation         | aɣoráʒz    | —       | aɣoráʒs    | —       |
| Laxness dissimilation        | aɣorájz    | xáçs    | aɣoráçs    | xáçs    |
| Consonantality dissimilation | aɣorájz    | xájz    | aɣorájz    | xájz    |

Modern Greek dialects (as well as ancient Greek) normally resolve dissimilar voicing in obstruent sequences by *regressive* (right-to-left) voicing assimilation, e.g. φοβηθησαν *fufθúkan* in Mandamados (Kretschmer p. 177-8). Indeed, the Macedonian dialect of Velvendos, for which Newton postulated exceptional *progressive* voicing assimilation in (7), actually hews to regressive voicing assimilation even more consistently than other dialects, see (8a).

(8) Velvendos (Kretschmer 177, Newton 1972: 200 ff.)

- a. έφυγε > ένʒi ‘he left’ (in other Northern dialects more commonly έφʒi, with progressive voicing assimilation, Newton 1972: 87, 105, 202)
- b. λαδικό > laθkó (not \*laðgó)
- c. δικός μου > θkósim (not \*ðgósim).

Drachman & Malikouti-Drachman (1976) reworked Newton’s analysis, again positing Progressive voicing assimilation for Velvendos but replacing Laxness assimilation and Consonantality dissimilation by two other rules. Rather than deriving [j] via [j, ç] from [ʒ, ʒ], they propose that [j] is simply extruded from [ʒ, ʒ]. Their historical scenario for the same two dialects is reproduced in (9):

(9) *Drachman & Malikouti-Drachman 1976*

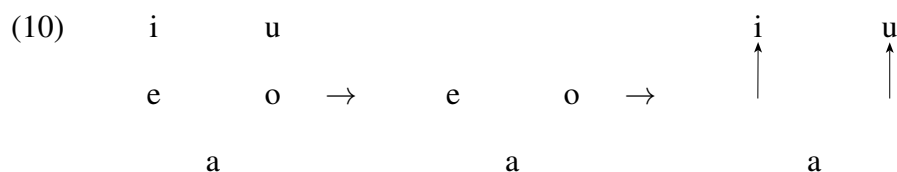
|                      | Velvendos  |         | Zagori     |         |
|----------------------|------------|---------|------------|---------|
| Underlying           | /aɣorázis/ | /xásis/ | /aɣorázis/ | /xásis/ |
| Palatalization       | aɣoráʒis   | xáʒis   | aɣoráʒis   | xáʒis   |
| Loss of <i>i,u</i>   | aɣoráʒs    | xáʒs    | aɣoráʒs    | xáʒs    |
| Voicing Assimilation | aɣoráʒz    | —       | aɣoráʒs    | —       |
| <i>j</i> -Extrusion  | aɣorájzz   | xájss   | aɣorájss   | xájss   |
| Degemination         | aɣorájz    | xájz    | aɣorájz    | xájz    |

The Drachmans suggested that the reverse direction of voicing in Macedonian dialects might be functionally motivated by the preservation of the voicing feature that distinguishes between perfective and imperfective aspect. This seems reasonable for the verbs in (5), but not for the nouns, which do not distinguish aspect, such as (5e) Λουίʒις > Λουίʒ, Τσερχέʒης > Τσιρχέιʒ. Our analysis in section (5) will account for both the nouns and the verbs.

Another questionable feature of Newton’s and Drachman & Malikouti-Drachman’s derivations is the intermediate palatalized stage *-ašis*, *-ažis* that they posit between original non-palatalized *-asis*, *-azis* and the non-palatalized end result *-ais*. Their analysis requires this intermediate step, but otherwise there is no reason to believe that palatalization is implicated in *i*-shift at all. Some dialects, such as that of Ajassos, do not even palatalize *s,z* to *š,ž* (Kretschmer 1905: 151), yet have *i*-shift in their phonology. This would then be a so-called Duke of York derivation, in which an auxiliary step is introduced only to then be undone again. Our analysis will not depend on palatalization.

### 3 On the synchronic phonology of the Northern dialects

Northern Greek underwent a chain shift consisting of the loss of unstressed high vowels and the raising of mid vowels in their place.



We claim that *i*-shift is a concomitant of high vowel deletion, indeed an integral part of it. Since *i*-shift is productive, we are committed to establishing that High Vowel Deletion is productive too. High Vowel Deletion is part of a chain shift whereby unstressed */i/*, */u/* are lost and */e/*, */o/* are raised into their place. In this section we argue that this entire chain shift is synchronically live, so that the underlying vowel system has a lexical contrast between */i/*, */u/* and */e/*, */o/*, and that the synchronic phonology of the dialects therefore has an analog to the historical chain shift.

Although we do not follow Newton and the Drachmans in implicating palatalization directly in *i*-shift, their interaction in that subset of dialects where they are synchronically operative contributes to the evidence for our analysis. Stress-conditioned *e~i* and *o~u* alternations in the Modern Lesbian dialects appear in many morphological categories. The examples in (11) are from Kretschmer and Thumb.

|      |                |                 |                   |  |
|------|----------------|-----------------|-------------------|--|
| (11) | /e-ɣraf-s-ame/ | <i>ɣrápsami</i> | /e-ɣraf-s-ame to/ | <i>ɣrápsamé du</i> (= ἐγράφαμέ το)             |
|      | /ðeka/         | <i>ðéka</i>     | /ðo-ðeka/         | <i>ðódika</i>                                  |
|      | /petra/        | <i>pétra</i>    | /petra-ón/        | <i>pitrún</i> (Gen.Pl.)                        |
|      | /ðul-év-o/     | <i>ðlévu</i>    | /ðúl-ev-s-a/      | <i>ðúlipsa</i> (= δουλεύω, δούλεψα)            |
|      | /fon-áz-i/     | <i>funáz</i>    | /fón-az-s-e/      | <i>fónaksi</i> (= φωνάζει, φωνάξε)             |
|      | /men-o/        | <i>ménu</i>     | /é-men-a/         | <i>émina</i>                                   |
|      | /apó-min-a/    | <i>apómna</i>   | /apo-mín-a-me/    | <i>apumínami</i>                               |
|      | /ruxo/         | <i>rúxu</i>     | /ruxo-ón/         | <i>rxón</i> (= ρούχο, ρουχών)                  |
|      | /paputsi/      | <i>papúts</i>   | /palopáputso/     | <i>palupáptsu</i> (= παπούτσι, παλαιοπάπουτσο) |
|      | /vreθika/      | <i>vréθka</i>   | /vreθíkami/       | <i>vriθíkami</i> (= βρέθηκα, βρεθήκαμε)        |

The *i*-shift change (/Vsis-/ , /Vzis-/ → -Vĩs-) takes effect before both steps of the Northern Greek Chain Shift: before the loss of /i/ (counterbleeding), and before the raising of /e/ (counterfeeding). In some dialects the same is true of palatalization. In particular, Southwestern varieties of Modern Lesbian palatalize *s* to *š* before deleted /i/, and conversely do *not* palatalize it before *i* that comes from /e/ by raising. In these dialects, both parts of the chain shift add to the opacity of *i*-shift and of palatalization (Newton 1972: 84).

- (12) a. i. ἀγοράζεις /aɣoraz-is/ → *aɣoráis*  
 ii. ἀγόραζες /aɣoraz-es/ → *aɣórazis*  
 ἀγόρασες /aɣoraz-s-es/ → *aɣórasis*
- b. i. τῆς βρύσης /tis vrís-is/ → *ts vriš*  
 ii. οἱ βρύσες /i vrís-es/ → *i vrišis*

Kretschmer gives the following examples to illustrate the dialectal contrast in palatalization between Northeastern and Southwestern Lesvos.

(13) *s*-Palatalization

/vrísi/ → *vríš*, but /vrís-es/ → *vrísis*

|    | Mantamados (NE) |                  | Antissa-Eresos (SW) |                     |
|----|-----------------|------------------|---------------------|---------------------|
|    | Sg.             | Pl.              | Sg.                 | Pl.                 |
| N. | <i>i vrís</i>   | <i>i vrísis</i>  | <i>i vríš</i>       | <i>i vrísis</i>     |
| G. | <i>ts vriš</i>  | <i>tu vrisún</i> | <i>tsi vríš</i>     | <i>tu vrisó(nu)</i> |
| A. | <i>d vrís</i>   | <i>ts vrísis</i> | <i>ǵ vríš</i>       | <i>s vrísis</i>     |

Newton also notes that palatalization is variable in opaque contexts in the Southwestern varieties of Modern Lesbian. While *s* generally palatalizes before deleted *-i-*, as in (14a,b,c), non-palatalized pronunciations such as (14d) are also on record:<sup>6</sup>

- (14) a. ἄξιος *ákšus* ‘worthy’ (Sg.)  
 b. ἄξιοι *ákš* ‘worthy’ (Pl.)  
 c. ἐκκλησία *aklisá, aklišá* ‘church’  
 d. μὲν βρασιά *mia vrasá* ‘portion to cook’

It is likely that this variation is due to analogical elimination of opaque cases of palatalization. If so, it confirms the live status of palatalization in the synchronic phonology.

<sup>6</sup>Kretschmer also cites innovative pronunciations such as *aklisjá, vrisjá, krósja* as having been introduced from Standard Greek.

Palatalization of consonants other than *s* is less salient, but the same generalization applies: *n* and *l* are palatalized before /i/ even where the triggering /i/ is lost, and are *not* palatalized before /e/ even when it is raised to *i*.

- (15) ἔλυσα /é-li-s-a/ ἔλσα ‘I loosened’  
 ἐλούσα /é-lu-s-a/ ἐλσα ‘I washed (hair)’

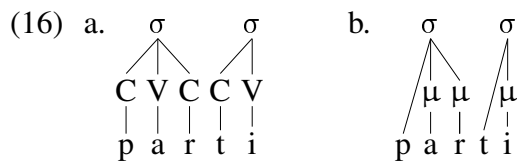
See Newton (1972:210 ff.) for other phonological processes that consistently apply before HVD. Newton also observes that no processes take effect *obligatorily* before HVD, although many do so optionally (*ibid*200).

The most direct evidence for the productivity of *i*-shift is that it applies to new words, even to entirely new *kinds* of words and cases with epenthetic *i*. In the derivation /masáz-su/ → masázis → masázis → *masá̃is* (see (6e)) -*i*-epenthesis feeds *i*-shift. When the sound change took place, there were probably no words like /μασάζ/ in Modern Lesbian. But when they were introduced, they became subject to the already existing synchronic process and have since then continued to undergo it.

We conclude from these data that palatalization is a live process in the dialects, and that palatalization is opaque in at least some of them, in that its context is the vocalism that obtains *before* the Northern Greek Chain Shift. Together, this provides independent evidence for underlying /i, u/, and for the synchronic productivity of vowel raising and deletion and the resulting phonological alternations. The chain shift of vowel height, and its interaction with palatalization, form a robust opaque subsystem in the dialects.

#### 4 Theoretical background

Our analysis draws on autosegmental phonology, according to which phonological representations are not simply sequences of binary feature matrices, but multidimensional structures of layered tiers. In particular, the constituent structure of a syllable is separate from its phonetic content, whose elements can stand in a many-to-many relation to each other. Their synchronization can be graphically rendered by association lines. Syllable structure can be represented in several ways. The simplest way is a “flat” structure where each syllable is a node with its segments as constituents. A richer representation assigns an internal structure to the syllable, in which the onset is a separate constituent, and syllable weight is represented by moras. To illustrate, a disyllabic word *party* can be represented as in (16a) or as in (16b).



Both representation are consistent with our analysis. For expository purposes we adopt (16a) here.

This understanding of syllable structure is helpful in the study of phonetic processes such as assimilation, fusion, compensatory lengthening, and metathesis (Goldsmith 1990). They can all be understood as realignments between segmental content and syllable structure. Assimilation, for example, extends the reach of a phonological segment or feature to an adjacent constituent of a syllable or of a neighboring syllable. Compensatory lengthening results from loss of segmental material from a mora-bearing syllable slot and its replacement by new featural content from an adjacent segment.

For an illustration of the approach, we turn to ancient Greek, where the data are well-known, and offer illuminating analogies to the phenomena of modern Northern Greek dialects that we are concerned with.

Let us start with compensatory lengthening in ancient Greek.<sup>7</sup> When *-s-* in coda position was lost, its mora survived as a lengthening of a neighboring segment — the preceding vowel in the majority of dialects, the following consonant in Lesbian and Thessalian:

|      |                  |             |           |
|------|------------------|-------------|-----------|
| (17) | Aeolic (Lesbian) | Attic-Ionic |           |
|      | <i>*esmi</i>     | ἐίμι        | ‘I am’    |
|      | <i>*selasnā</i>  | σελήνη      | ‘moon’    |
|      | <i>*naswos</i>   | νηός        | ‘temple’  |
|      | <i>*-osyo</i>    | -ῶο > -ου   | ‘Gen.Sg.’ |

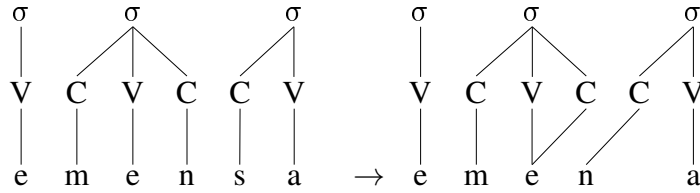
Compensatory lengthening typically happens to preserve the shape of a syllable when a weight-bearing coda consonant is lost. But it can also happen when a weight-bearing consonant is forced to vacate its coda position and is reassigned to an onset position. The generalization is that the syllable weight pattern remains intact. Such cases show that compensatory lengthening is not simply a matter of assimilation. For example, when *s* forms a medial cluster with a sonorant in the reverse order, exactly the same thing happens:

|      |                  |             |            |
|------|------------------|-------------|------------|
| (18) | Aeolic (Lesbian) | Attic-Ionic |            |
|      | <i>*e-nem-sa</i> | ἐνεμα       | ‘I shared’ |
|      | <i>*e-men-sa</i> | ἐμενα       | ‘I stayed’ |
|      | <i>*awsōs</i>    | ἠώς         | ‘Dawn’     |

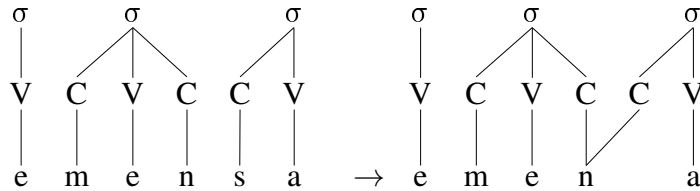
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<sup>7</sup>The data discussed in this section are well-known; see Lejeune (1972) or any historical grammar of ancient Greek. The analysis is based on Kiparsky (1967a, 1967b).

(19) a. Aeolic



b. Attic-Ionic



These compensatory lengthening processes of Greek are part of a larger complex of changes that eliminate *s* in many other environments. An *s-* that is inherited from Indo-European appears as *h-* word-initially before a vowel:

- (20) \**septm* ἑπτὰ ‘seven’  
 \**sems* εἷς ‘one’

Syllable-initially before sonorants, where *h* is prohibited, *s* is lost:

- (21) \**smor-ya* μοῖρα ‘fate’  
 \**snusós* νύος ‘daughter-in-law’, ‘bride’  
 \**pes-os* πέος ‘penis’  
 \**nes-o-mai* νέομαι ‘I return’

Optimality theory and nonlinear phonology not only perspicuously model well-understood processes such as deletion, assimilation, and compensatory lengthening, but provide entirely new explanations for processes such as metathesis, which cannot be reconciled with the traditional picture of gradient sound change, and are for that reason set aside as a problematic category of “minor sound changes”. What is more, in many cases it unifies multiple changes as a single historical event.

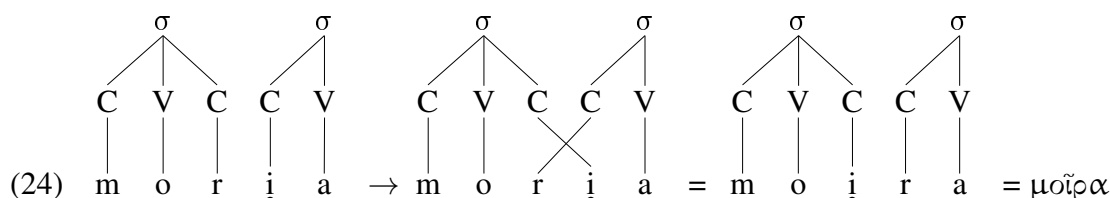
This unification is illustrated even more clearly by the treatment of *y* in ancient Greek. It is partly parallel to that of *s*, but more varied because *y* could survive in a larger number of contexts than *s*. The principal innovation is that *y* became prohibited in onsets. Word-initially *y-* [j̥-] was either debuccalized to *h-* (22a), or, in some words, underwent fortition to *dz-* or *zd-* (22b); intervocally it was lost, probably via *h* (22c).

- (22) a. \**yugóm* > *dzugón* ζυγόν ‘yoke’, \**yésō* > ζέω ‘seethe’  
 b. \**yēkʷr* > *hēpar* ἥπαρ ‘liver’, \**yōrā* > *hōrā* ὥρα ‘hour’  
 c. \**treyes* > \**trehes* > τρεῖς ‘three’, \**dwésos* > *dwéhos* > δέος ‘fear’

In medial consonants clusters, *-y-* can be moved from an onset position where it cannot be pronounced by changing places with an adjacent coda sonorant, to be licensed postvocally as the second member of a diphthong.

- (23) a. *\*smorja* > *moĩra* μοĩρα ‘lot’, ‘fate’  
 b. *\*k<sup>h</sup>imarja* > *\*k<sup>h</sup>imaira* χίμαира ‘chimera’  
 c. *\*g<sup>w</sup>njeti* > *\*banjeti* > *bainei* βáινει ‘goes’

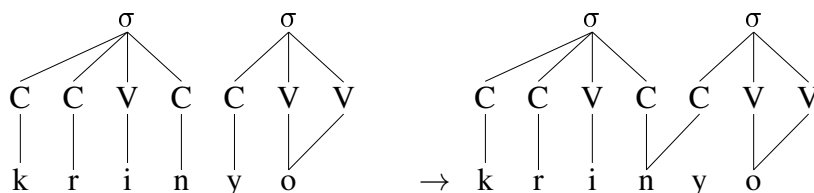
This metathesis ‘salvages’ both segmental content and syllable structure, at the price of violating the Linearity constraint, which demands maintaining the respective order of a syllable’s terminal slots and the feature bundles associated with them.<sup>8</sup>



But this metathesis only takes place when it produces the diphthongs /oi/ and /ai/, as in (23) μοĩρα, χίμαира, βáινει. /oi/ and /ai/ are the diphthongs with the most sonorous nuclei. Cross-linguistically they are the most common diphthongs with /y/ – in some languages they are the *only* diphthongs with /y/, as in standard German.<sup>9</sup> Instead of creating the more marked diphthongs /iy/, /ey/, /uy/ by metathesis, y is lost by the same two compensatory lengthening processes that we saw in (17)-(19). The Aeolic dialects (Lesbian and Thessalian) geminate the sonorant, Attic-Ionic lengthens the vowel.

- (25) • Aeolic: ὀλοφύρρω ‘I ululate’, οἰκτίρρω ‘I pity’, κρίνω ‘I judge’  
 • Attic and Ionic: ὀλοφύρω, οἰκτίρω, κρίνω (long  $\bar{i}$  shown by meter, among other indications)  
 • All dialects: *\*ban-y-ō* > βáίνω ‘I go’

- (26) a. Aeolic



- b. Attic-Ionic

<sup>8</sup>Some accounts of the sound change posit that the coda consonant first merges with the following y into a palatalized geminate, which then splits up into its original components again, this time in the reverse order, e.g. *\*ban-ye- → baññe- baiñe-*. A problem with this two-step analysis is that -wy- too metathesizes to -yw- in the same way, e.g. *\*dawγō > \*daiwō > δάω* ‘kindle’ (the unassimilated metathesized form appears as Διδάω in an inscription from Corinth). The palatalized w posited in this scenario is unlikely, and practically a contradiction in terms.

<sup>9</sup>Though *ui* occurs in interjections like *pfui*.



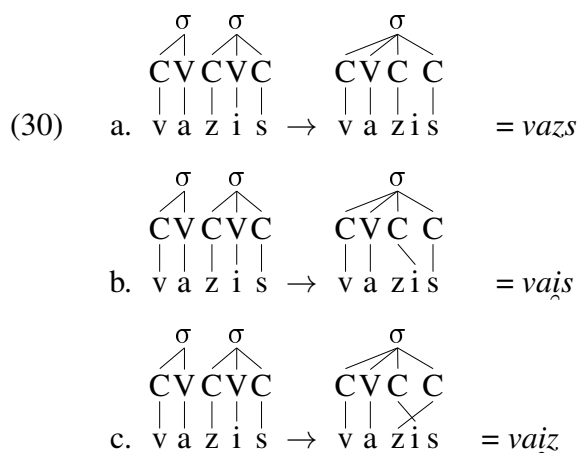
(28) \*V  
 |  
 [+High]

(28) prohibits syllables with the nucleus *i* or *u*. The prohibition is satisfied with the minimum possible disturbance to the language’s phonological system, as defined by its lower-ranked constraints: where possible, (28) is satisfied without incurring a MAX-V violation, by not deleting the high vowel but moving it from a syllable nucleus position to a non-head (C) slot where it is licensed as the second part of a diphthong (metathesis of *vazis* to *vaiz*, *vais*). Otherwise it is deleted if possible. Stressed *i* cannot be deleted or resyllabified because a higher-ranked constraint MAX- $\acute{V}$  requires stressed vowels to be retained. Moreover, where syllable structure constraints allow neither resyllabification nor deletion, even unstressed *i* is retained as a last resort; e.g. *đimitrijaris* → *đimtrijars* (not *\*đmtrjars*, *\*đmitrjars*, *\*đmtrijars*) ‘October’ (Kretschmer p. 93).

We rely on the following standard assumptions about the well-formedness of syllable structure and its maintenance.

- (29) a. A syllable must have a head.  
 b. When the head is deleted, the syllable structure it dominates is erased and the stranded phonemes are reassociated with the remaining prosodic structure if possible.  
 c. The reassociation is optimal in accord with the phonological constraint system of the language.  
 d. Stranded phonemes that cannot be reassociated are deleted.

The varieties of *i*-shift across the Northern Greek dialect continuum are the result of alternative reassignments of the phonemes of disyllabic sequences to the monosyllables that arise from them by HVD. Each variety of *i*-shift is optimal under a different constraint ranking. All of the constraint rankings are compatible with the pre-existing phonological constraint system of the respective dialects. However, they are not necessarily uniquely determined by it. This is another case where the promotion of a constraint leads to dialect differentiation.



All attested forms preserve the CVCC syllable structure of the original input form. Unattested longer forms such as *\*vaizs* violate the syllable canon, and shorter forms such as *\*vai*, *\*vas*, *\*vaz* deform the structure more than necessary to satisfy the new constraint without offering any compensating advantage. They are therefore not optimal no matter how the phonological constraints are prioritized.

Our analysis relies on previously proposed and validated constraints (reformulated here where necessary in the explicit format of correspondence theory, which formalizes constraints in terms of the relation between input and output structures). Most of the constraints come in families that differ in degrees of stringency; our tableaux state them in the most general version that the data allows, with the reservation that deeper study might require more restricted versions. We begin with the constraints which hold equally for all the dialects, and then analyze the variation in terms of the ranking of a small number of remaining constraints.

The goal of OT is to derive complex effects from the interaction of simple ranked violable constraints. Following that practice, we decompose deletion of unstressed high vowels into a Faithfulness constraint (31a) that bars deletion of stressed vowels (Orgun & Sprouse 1999, Coetzee & Pater 2006), and a Markedness constraint (31b) that prohibits high vowels (Golston 1996, Beckman 1997, Rubach 2006, Anttila 2006), ranked as indicated.<sup>10</sup> Moreover, these dialects also categorically disallow complex codas such as those in the hypothetical outputs *\*vai̯zs* and *\*vai̯zz*. In the absence of a general study of the permissible codas of the dialects with HVD, we just formulate the constraint as (31c) *\*VCC<sub>i</sub>C<sub>i</sub>*, where C<sub>i</sub>C<sub>i</sub> are homorganic (have the same place of articulation), which is probably overly narrow. Also, the segments in the rhyme of the syllable must be placed in descending order of sonority (the Sonority Sequencing Generalization, Bat-El 1996). For example, *\*vasi̯*, where *i̯* occupies a C slot, is not a well-formed syllable because *i̯* is more sonorous than *s*.<sup>11</sup>

(31) *Dominant Constraints*

- a. MAX- $\acute{V}$ : every input stressed vowel has an output correspondent
- b.  $*V$   
|  
[+High]  
No High vowels
- c.  $*-VCC_1C_1$
- d. SONORITY SEQUENCING Elements of an onset must rise in sonority, elements of a coda must fall in sonority.

To streamline the exposition, we omit these undominated constraints, and the candidates that violate them, from the tableaux. The ranking of the additional constraints in (32) differentiate the Northern dialects.

<sup>10</sup>We could further decompose High Vowel Deletion into the Markedness constraint that prohibits vowels, which is dominated by the Faithfulness constraint that causes more sonorous (Nonhigh) vowels to be retained. Let us mention in addition that prevocalic vowels are not deleted, even if they are unstressed. For example, High Vowel Deletion does not apply to either one of the stem vowels in Λουίζις /luiz-is/, pronounced Λουίζ *lui̯z*, not syncopated to *\*Λι̯ζ* *\*li̯z*.

<sup>11</sup>Final obstruent+nasal clusters are however permitted in some subdialects of Modern Lesbian: βάζουν, φύγουν, πέφτουν > *vázn*, *fīyn*, *péfn* in Eastern Lesvos, but *vázin*, *fījin*, *péftin* with epenthesis in the North and in the West (Kretschmer p. 106).

- (32) a. MAX-V: every input vowel has an output correspondent (McCarthy 2000).  
 b. MAX-SEG(Stem): A segment in a stem has a correspondent in its derivative (Zhang 2000, Gafos 2003), cf. MAX-ROOT (McCarthy & Prince 1995).  
 c. LINEARITY: If  $\alpha$  precedes  $\beta$  in the input, the correspondent of  $\alpha$  precedes the correspondent of  $\beta$  in the output (no metathesis) (McCarthy & Prince 1995).  
 d. IDENT-VOICE: The output correspondent of an [ $\alpha$ Voiced] input segment is [ $\alpha$ Voiced].

The tableaux (33)-(35) show how the different ways of satisfying the dominant constraints in (31) arise from variation in the ranking of the lower constraints in (32).

The delinking of *i* from its V slot removes a syllable head, and thereby a whole syllable. For example, it turns a disyllabic CVCVC word like *vazis* into a monosyllabic CVCC word. Adding a C slot to it to turn it to CVCCC would accommodate all the segments in a long monosyllable such as *vaẓis*, *vaịzs*, or *vaịzs*, but such syllables are not permitted in Greek – a restriction formalized by the undominated status of constraints (31c) and (31c). So the five segments must compete for the four available syllable slots. We can visualize the phonology as a two-stage competition. The principal competition is between *z* and *i* for the postvocalic C slot. Depending on how it is resolved, the remaining consonants compete for the final C slot. This competition translates directly into a formal system of ranked violable constraints.

The competition between *z* and *i* for the postvocalic C slot corresponds to the ranking of MAX-V, which requires that vowels of the phonological input representation be pronounced, that is, linked to a slot in some syllable of the output representation. If MAX-V ranks high, *i* must survive. By (31b) *i* cannot be linked to a V slot (that is what High Vowel Deletion means), and by (31d) *i* cannot be linked to the syllable-final C slot. But it can be linked to the immediately postvocalic C slot as a glide (semivowel) *ị* (also notated as *y*, and as IPA [j]), in other words resyllabified as the second part of a diphthong. The final C slot must then be affiliated with either the *s* or the *z* of *vazis*, respectively resulting in the outputs *vaịs* and *vaịz*. Each of these has advantages and disadvantages. The form *vaịs* has the advantage of containing the remaining consonants in the proper order. The form *vaịz*, on the other hand, prioritizes the stem consonant. Resistance of stem consonants to deletion has been typologically validated, see the references in (32b). The two advantages are reflected as Faithfulness constraints in the OT repertoire. The preservation of the phonological order of segments in the output is imposed by (32c) LINEARITY. Retention of material in a stem in preference to material in an affix is imposed by (32b) MAX-SEG(Stem). The choice between *vaịs* and *vaịz*, then, depends on whether LINEARITY or MAX-SEG(STEM) is prioritized, as formalized by their ranking, see (33) and (34).

(33)

|                   | MAX-V | LINEARITY | MAX-SEG(Stem) |
|-------------------|-------|-----------|---------------|
| Input: /vaz-is/   |       |           |               |
| c. ⇒ <i>vaịs</i> |       |           | *             |
| d. <i>vaịz</i>   |       | *         |               |
| a. <i>vazs</i>    | *     |           |               |
| b. <i>vass</i>    | *     |           |               |
| e. <i>vazz</i>    | *     |           |               |

(34)

|                             | MAX-V | MAX-SEG(Stem) | LINEARITY |
|-----------------------------|-------|---------------|-----------|
| Input: /vaz-is/             |       |               |           |
| c. $v\hat{a}is$             |       | *             |           |
| d. $\Rightarrow v\hat{a}iz$ |       |               | *         |
| a. $vazs$                   | *     |               |           |
| b. $vass$                   | *     |               |           |
| e. $vazz$                   | *     |               |           |

The remaining form, from Locris, is derived by ranking MAX-V *below* MAX-SEG(STEM) and LIN. *vazs* is the most faithful output that satisfies these constraints, and to our knowledge the only one that is cited in the literature.

(35)

|                       | MAX-SEG(Stem) | LINEARITY | MAX-V | IDENT-VOICE |
|-----------------------|---------------|-----------|-------|-------------|
| Input: /vaz-is/       |               |           |       |             |
| a. $\Rightarrow vazs$ |               |           | *     |             |
| c. $v\hat{a}is$       | *             |           |       |             |
| d. $v\hat{a}iz$       |               | *         |       |             |
| e. $vass$             |               |           | *     | *           |
| f. $vazz$             |               |           | *     | *           |

Although forms with regressive voicing assimilation of the Locris type *vazs* to *\*vass* or even with progressive voicing assimilation to *\*vazz* are not attested, they would also be consistent with our constraints. The former would be phonotactically well-formed in at least those Northern dialects where *-Vss* is the regular output of *\*-/sis/*. The latter would be unique, for no Greek dialect appears to have word-final voiced geminates. So it is not impossible that assimilated counterparts of *vazs* for *vázis* exist in some Northern Greece dialect. The derivation of these hypothetical forms would require enforcing voicing assimilation by constraints that dominate IDENT-VOICE.

In conclusion, let us stress once more that our analysis depends on the new understanding of the nature of sound change that Optimality Theory makes available. In traditional historical linguistics, sound changes were thought of as context-sensitive replacement processes, much like generative phonology's synchronic phonological rules of the form  $A \rightarrow B / C\_D$ , and generative approaches to historical linguistics simply modeled sound change as the addition of a rule to the grammar, normally as the last rule, though sometimes before one or more existing rules. Such a framework does not reveal any intrinsic relationship between the three types of *i*-shift, and struggles to even formulate two of them without recourse to unwarranted stipulations.

Optimality Theoretic phonology has no rules, and its empirical success in the synchronic domain invites a rethinking of historical phonology as well. The idea is that sound change is the promotion of a phonological constraint. This is not merely a notational or terminological shift. Because the effect of a constraint can depend on the context due to its interaction with other constraints, it leads to an entirely different view of what a sound change is. In this new conception sound changes are still theorized as single events that take place at a particular time in a particular speech community, but they are events of a different kind, in that they interact with the phonological system of the language to yield multiple manifestations, as we have illustrated here with ancient and modern Greek sound changes. The unification of apparent diversity achieved by this new look in historical linguistics is telling evidence in favor of the theoretical principles on which it is based.

## Excursus

About 3000 years ago a similar metathesis of high vowels may have taken place in early Greek. Comparative grammar reconstructs the 2. and 3. person singular endings of Indo-European as *\*-si*, *\*-ti* in the present and *\*-s*, *\*-t* in the past. The past endings *-s*, *-t* are derivable from the reconstructed *\*-s*, *\*-t* by the regular loss of word-final obstruent stops. But their present counterparts in Greek *-is*, *-i* (φέρεις, φέρει) are not so straightforwardly derivable from their presumed IE sources, and some scholars have actually sought a different origin for them. Recently the idea has gained ground that they are derived from the IE base forms *\*-si*, *\*-ti* by metathesis, specifically by metathesis of nonhigh unaccented word-final *-i* with dental (coronal) consonants, and the regular deletion of word-final *-t* (Kiparsky 1967, Rix 1976, Cowgill 2006[1985], Willi 2012, Hill & Fries 2020).

|                |                   |                   |                    |                    |                            |
|----------------|-------------------|-------------------|--------------------|--------------------|----------------------------|
| (36)           | <i>Present</i>    |                   | <i>Past</i>        |                    |                            |
|                | 2.Sg.             | 3.Sg.             | 2.Sg.              | 3.Sg.              |                            |
| Indo-European: | <i>*bher-e-si</i> | <i>*bher-e-ti</i> | <i>*e-bher-e-s</i> | <i>*e-bher-e-t</i> |                            |
| PreGreek       | <i>pher-e-is</i>  | <i>pher-e-it</i>  | <i>e-pher-e-s</i>  | <i>e-pher-e-t</i>  | by metathesis              |
| Greek          | <i>pher-e-is</i>  | <i>pher-e-i</i>   | <i>e-pher-e-s</i>  | <i>e-pher-e</i>    | by loss of final <i>-t</i> |

This metathesis also explains imperatives like *dídoi* from *\*dídothi* (Cowgill 1985). It correctly extends to function words and clitics, since these count as unaccented. For example, *kai* ‘also’, ‘and’, from *\*kati* ‘with’ (Hittite *kati*), related to *kasi-gnētos* (Thessalian *kati-gneitos*) ‘sibling’ (‘co-born’), Doric and Northwest Greek *poi* < *\*poti* (cf. Iranian *pati*), Homeric *eni* ~ *ein*, *eini* ‘in’, 2.Sg. *phēis*, from *\*phē-si* ‘you say’ (a clitic verb, hence unaccented and subject to the metathesis). Hackstein (2002), Ellsworth (2011), and Willi (2012) provide additional etymological support for the metathesis.

Independent evidence for *i*-metathesis is that it explains why 3.Sg. *-ei* and locative *-oi* count as long (two-mora) diphthongs for purposes of accentuation. The simple generalization is that original final diphthongs are short, whereas new final diphthongs count are long.

High vowels did not participate in the metathesis (e.g. *πέρυσσι* < *per-wet-i* ‘last year’), nor did syllabic nasals (*εἴκοσι* < *\*dui-dkmt-i* ‘twenty’). As outlined above, the reason is that *īi*, *uī*, *m̄ī* were not permitted diphthongs at the stage when the metathesis applies. Like the restriction on the metathesis of *y* (recall *\*g<sup>w</sup>mjeti* > *\*banjeti* > *βάνει* *baínei* ‘goes’) the restriction to nonhigh vowels limits the change to forming diphthongs that are unmarked, in the sense of having relatively sonorous nuclei.

Typological support comes from an almost identical change in Finnish. In Eastern Finland, dentals were palatalized before *-i*. In a subset of these dialects, dentals after unaccented short nonhigh vowels underwent metathesis with word-final *-i*. The Basque data in (37b) suggest a similar development.

- (37) a. Eastern Finnish: *poika-ni* > *poika-n'i* > *poikain* ‘my son’  
 b. Basque: \**seni* > *sein* ‘boy’, \**usani* > *usain* ‘smell’, \**lehoni* > *lehoin* ‘lion’

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