In Defense of Szemerényi's Law

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Abstract

This article offers discussion of many Indo-European categories (explicitly excluding the sigmatic aorist) that, in external reconstruction, exhibit lengthened grades. We argue that the great majority of these lengthened grades are attributable to processes of compensatory lengthening conditioned by the loss of certain consonants (fricatives) in certain positions in the syllable (the configuration CVC(C)F), as proposed *in nuce* by Szemerényi (1962). We explicitly refute the alternative proposals of Kortlandt (1975) (monosyllabic lengthening and lengthening before resonants in final syllables), followed by Beekes (1990), and counter recent skepticism towards versions of Szemerényi's Law voiced by Keydana (2013a). Finally, we discuss the relation of the Szemerényi's Law to other considerations about Proto-Indo-European prosody, and its impact upon certain other phonological developments in PIE.

1 Introduction

The oldest attested Indo-European daughter languages (especially Vedic Sanskrit, Avestan, Greek, Latin and other Italic languages) all exhibit a peculiar distribution of morphological marking in the nominative singular of animate nouns and adjectives:[1]

- vocalic stems (i.e., IE **o*-, **i*-, and **u*-stems) show an inflectional ending *[-s].[2]
- [-continuant, -sonorant] consonant stems show an inflectional ending *[-s].
- all other consonant stems (including stems in **-h_2*, which belong in this set, as recognized at least already in Pedersen 1926), which all contain a suffix -VC, typically show no inflectional ending **-s*, and instead have a long vowel of the suffix.[3]

A long-standing proposal to account for this seeming discrepancy has been to further reconstruct the nominatives singular of the form *[-V̄C] as somehow deriving from **-[VCs]. In the 20th century, this idea has come to be regularly attributed to O. Szemerényi, who first proposed such a reconstruction in Szemerényi 1956, and further discussed it Szemerényi 1962 and Szemerényi 1970: 109. Collinge (1985: 237-8) labels the

[1] In general, the Anatolian languages do not contribute to the picture of this distribution, because common gender nouns are exceptionlessly marked with an inflectional ending /-s/, and stress and vowel length are largely conflated in Proto-Anatolian (cf. Melchert 1994: 76; 89). A few traces, especially the inflection of *n*-stems in Old Hittite, indicate that the distribution still apparent in other languages must have been a feature of High IE. By the term 'High Indo-European' we intend PIE *stricto sensu*, the last period of common development of all daughter branches. In contrast, by the term 'Core Indo-European' we mean a period of common development shared by all Indo-European branches except Anatolian.

[2] Throughout, we will indicate surface forms in square brackets, [], and underlying forms in slashes, //. We use italics when speaking of a segment in general, and for attested forms.

[3] In the case of laryngeal-final stems, whether the vowel of the final syllable was long or short in the nom.sg. in PIE is virtually impossible to discern. See the discussion of "motion" feminines and */pont-oh$_2$-/ 'path' in Section 3 for possible motiviations of their respective formal characteristics.

proposal as SZEMERÉNYI'S LAW, and some handbooks of Indo-European Linguistics (e.g., Fortson 2010: 70, 116) explicitly name such a law as well. Nevertheless, Schindler (1973: 153-4), when assenting to this proposal, refers to it as "alt", and Szemerényi (1990: 121) recognizes that "diese Erklärung schon im 19. Jh. öfter entdeckt wurde...So haben Schleicher, Benfey, und Curtius das ai. *-ār* auf *-ars* zurückgeführt." Wackernagel (1896: 66 ff.) also operates with such a development.

We will argue in Sections 2 and 3 that straightforward morphological analysis of the Indo-European forms obtained through external reconstruction makes SZEMERÉNYI'S LAW (henceforth SzL) very attractive. This account, does not, however, provide an explanation for the reconstructible lengthened grade that appears in some obstruent stems, the best example of which is fem. *[u̯ōkʷs] 'voice' (Av. *vāxš*, Lat. *vōx*). Furthermore, the precise phonetic and phonological basis for the change **[-VCs] > *[-V̄C], has, to our knowledge, nowhere been explicitly developed, except in the subcases of **-Vr-s and **-Vs-s, in which assimilation to **-Vr-r, and the IE surface constraint against adjacent identical segments (see further Sections 5 and 6) are then invoked (cf. Szemerényi 1970: 109 or Szemerényi 1990: 121).[4] This proposal of assimilation would also leave suggestions of a similar development for the sequence **-VC-H > *-V̄C (already Szemerényi 1970: 155; 159; Nussbaum 1986: 129 ff.) unexplained. Most disturbingly, evidence for **-VC-F > *-V̄C in any position other than at the right edge of the word is altogether lacking. Hence, even if the distributional evidence speaks in favor of SzL (see Section 3), a more thorough phonetic and phonological analysis is not merely desirable but necessary.

Such a thorough analysis is precisely necessary because some scholars have rejected SzL, perhaps due to the impression that the law is not clearly motivated and constrained.[5] The principle alternative proposals to SzL appear in Kortlandt 1975: 84-6, which Beekes (1990) defends in greater detail. Beekes' article does not amount to a serious rebuttal of SzL: on the phonetic and phonological side, Beekes simply dismisses certain possible developments (e.g., **-er-s* > **-err* > **-ēr*,**-os-s* > **-ōs*, **-e̯i-i* > **-ē̯i*) as "improbable", without argumentation; on the morphological side, both Kortlandt and Beekes say "there is no indication whatever [sic] for the assumption of a sigmatic nominative in the case of *pitá́* and *sakhá́*" (Kortlandt 1975: 85) and "as to the nominatives, there is no necessity to assume an original *-s*" (Beekes 1990: 36), though each raises some interesting potential counterexamples that require attention (see Section 3.6). Kortlandt's alternative proposals for the data pertinent to SzL, "phonetic lengthening in monosyllables" and "phonetic lengthening before word-final resonant" (Kortlandt 1975: 85), building on suggestions in Wackernagel 1896: 66 ff., are demonstrably indefensible on both theoretical and empirical grounds. Arguments against these proposals are the topic of Section 4.

Before treating the principal examples and counterexamples concerning SzL in Section 3, we first feel the need introduce some of our theoretical premises; this is the object of Section 2. so that the reader can more readily grasp the analyses that we undertake throughout the paper. In Section 3, we find evidence not only for the traditional version of SzL as a sound change VRF]$_\omega$ > V̄R]$_\omega$(fricatives, when the second segment of a complex coda following a sonortant at a word boundary, are lost),[6] but for a broader sound change VC(C)F]$_\sigma$ > V̆̄C(C)]$_\sigma$.[7] Our core argumentation, however, appears in Sections 5-7:

- In accordance with evidence from Section 3, Section 5 demonstrates that a sound change VCF]$_\omega$ > VC]$_\omega$ is less readily motivated than a more general change, VC(C)F]$_\sigma$ > VC(C)]$_\sigma$ (fricatives, when the second segment of a complex coda at a syllable boundary, are lost). We suggest that this development, VC(C)F]$_\sigma$ > VC(C)]$_\sigma$, was a sound law that operated at an early phase of PIE. Moreover, following Solé 2010 and similar work in experimental phonetics, we will argue that SzL is comprehensible from the perspective of both articulatory production (stridency is generally weaker in codas than in onsets) and perception (the segments in complex codas, and especially fricatives, are less recoverable) and has numerous cross-linguistic parallels.

[4] Vaux (2002) also further explands this account.

[5] Beekes 1990: 37: "One gets the idea that in this way [viz., the notion of SzL that Beekes had] anything can be explained."

[6] The notation]$_\omega$ indicates a phonological word boundary.

[7] The notation]$_\sigma$ indicates a syllable boundary.

- Section 6 takes up the outstanding contrast between the outcome of $\text{VCF}]_\sigma > \breve{\text{V}}\text{C}]_\sigma$ in word-internal and word-final position: in word-final position, compensatory lengthening (CL) appears to take place (SzL in the traditional sense), while word-internally, we find no evidence of CL. We account for this difference through a new prosodic constraint for PIE: word-final consonants were EXTRAMETRICAL (i.e., not permitted to bear morae). We explain this constraint, adduce evidence for its presence in the phonological grammar of PIE, and illustrate its operation.

- Section 7 discusses the exact impact of either a narrower sound change $\text{VRF}_\sigma > \breve{\text{V}}\text{R}]_\sigma$ or a broader sound change $\text{VC(C)F}]_\sigma > \breve{\text{V}}\text{C(C)}]_\sigma$ upon morphological and phonological changes during the internal history of PIE. We also strive to motivate a phonological constraint $^\star\text{RF}]_\omega$ (fricatives are illicit after sonorants word-finally) as active in the grammar of PIE.

Section 8 finally summarizes our principal findings, and collects remaining unresolved issues.[8]

2 On the Architecture of Diachronic Phonology and Morphology

2.1 Constructing Grammars

The nature of investigation in Indo-European Linguistics often allows one to easily forget that Indo-European was an actual human language, with actual speakers; Indo-European is not merely a collection of forms assembled through the application of the comparative method. Rather, Indo-European, like any human language, was a GRAMMAR (plus a LEXICON), which could productively generate and parse novel words and utterances, according to the rules and constraints that the grammar possessed. The problem for the linguist, as de Saussure (1922: 25-32) and Chomsky (1957: 13-7, 1965: 18-27) identified, is how to uncover what the characteristics of a language are, given that the grammar is basically a mental entity, and thus accessible only indirectly. Chomsky (1967) brought to the fore the yet more difficult and pressing question of how a person acquires a grammar, given that the grammar must be able to produce grammatical utterances for which a learner has not received any direct evidence. Regardless of whether or not a grammar becomes truly "fixed" at some phase of acquisition, acquisition is rightly to be regarded as a major (though probably not the sole) locus for grammar change, since a grammar must always be constructed anew.[9]

While certainly not equivalent whatsoever in a real sense, the analysis of a synchronic linguistic system that linguists undertake is analoguous to the construction of a grammar that a learner undertakes on the basis of exposure to primary linguistic data. All of the linguist's formal tools obviously have no linguistic reality, but those tools do serve to make explicit the representative characteristics of a grammar. Hence, we will frequently speak of "constraints" (usually indicated in SMALL CAPS) to signal certain limitations on licit surface forms in a synchronic grammar. With respect to phonology, licit surface forms "derive" from the application of the phonological GRAMMAR to inputs provided by the LEXICON (and morphological and syntactic operations). Synchronically, the licit surface form is a SURFACE REPRESENTATION (SR, indicated throughout in square brackets []), which derives from an UNDERLYING REPRESENTATION (UR, indicated throughout with slashes //).[10]

[8]Sections 1-4, and 7, 8 are ultimately the product of joint discussion between the authors; Sections 3.5 and 5 largely reflect original work of Byrd; Section 6 largely reflects original work of Sandell. Byrd was responsible for drafting sections 3.5, 4, and 5; Sandell was responsible for drafting sections 2, 3.1-4, 3.6, 6, and 7.

[9]Accumulating empirical evidence suggests that grammars in fact, can change categorically, even during adulthood. For one especially compelling case of grammar change in adulthood, see Sankoff & Blondeau 2007. Hence, it is probably better to say not that grammars become immutable, but rather that they become more resistant to the influence of new linguistic data. That is, a grammar is a model constructed to account for data, and if a large amount of data supports a given hypothesis, then an equally large amount of data (probably more) should be needed to support a different hypothesis. Nevertheless, some tragic cases in which children received very little exposure to language prior to puberty, and subsequently were never able to obtain an adult-like grammatical competence, demonstrate that language (at least in general, if not a specific grammar) must be acquired at a relatively young age.

[10]The similarity between synchronic URs and and historically prior surface forms is often noted; synchronic rules or constraints likewise often look very similar to sound changes. The fact that synchrony frequently recapitulates diachrony is unsurprising, however,

We fear that the usage of terms like 'underlying representation' may sometimes create misapprehensions about the nature of such entities, so we wish to state directly that work on the discovery and analysis of internal linguistic objects in no way presupposes a sort of miraculous transfer of grammars from the mind of one speaker to another.[11] Rather, a new potential speaker must *induce* a grammar on the basis of the external linguistic data with which he is presented.[12] This process of induction precisely opens the door to genuine grammar change, because the learner may interpret distributions present in the data to construct a grammar that somehow differs from the grammar of the speakers who provided the primary linguistic data.[13] If grammars could be transferred directly, the only types of linguistic change that would be possible would be purely mechanical changes (i.e., due to articulatory considerations in the vocal tract); genuine phonological, syntactic, or semantic changes could never occur.[14]

Hence, there are two ways in which a surface form uttered by a later generation can come to differ from the surface form produced by speakers in some earlier generation: either the underlying representation of that form changes (morphological change) or the constraints on the production of that underlying form change (phonological change). For example, grant that the surface paradigm of the word for 'foot' in Core Indo-European was as in Figure 1.[15]

Figure 1: IE **pod-*

Case	Sg.	Pl.
nom.	[pṓs]	[pódes]
acc.	[pódm̥]	[pedn̥s]
gen.	[pedés]	[pedóh$_x$om]
dat.	[pedéi̯]	[pedb$^{\text{h}}$i̯ós]
loc.	[pedí]	[pesú]

Consider just the form of the nom.sg. *[pṓs], in comparison to Ved. [pā́t], Av. [pās]**, Attic-Ionic πούς [pōs], and Lat. [pēs]. First, why reconstruct *[pṓs] and not *[pōts]? Greek, Latin, and Iranian all disallow a sequence of a coronal stop followed by a coronal sibilant, and repair it by deletion of the stop.[16] The grammars of those three languages point to one constraint; Vedic, meanwhile, has a more general constraint against complex codas at a word edge, and always repairs underlying clusters by deleting segments from the right

because diachronic changes create distributions in the primary linguistic data, upon which learners may seize in constructing their grammars.

[11]For instance, Pronk (2013: 160-1 fn. 19), arguing against the analysis of Indo-European accentuation in Halle 1997 says that "the formulation of sound changes in terms of underlying features of synchronic systems…invites random shuffling of contrastive features. It enables the linguist to squeeze the data into a proposed reconstruction, rather than posit motivated changes to account for the data. The underlying problem seems to be that Halle's theory is based on *the assumption that an underlying feature can be transferred from one speaker to another without ever surfacing*" (emphasis ours). Halle's particular analysis may well be faulty or posit *ad hoc* and unmotivated changes, but those problems pertain to Halle's analysis, not to models of linguistic analysis that operate with synchronic underlying representations generally. Indeed, we find ourselves in difficulty to understand how even the contrast between phoneme and allophone is intelligible *without* the notion of underlying representations.

[12]Some work (e.g., Foulkes et al. 2005) on child-directed speech suggests that, phonologically at least, adults may speak in a fashion that facilitates the learner's acquisition of the same underlying representations that the adult has. For example, adults can, in careful speech, override some phonological processes (e.g., flapping of coronals or vowel reduction in American English), in order to provide information about the underlying forms that the adults have to a new learner.

[13]Probably some sort of universal considerations, whether specific to the faculty of language or general human cognitive considerations, restrict the possible types of grammars that can be constructed.

[14]On the notion of genuine phonological change as change in grammars (as opposed to simple sound change), see Kiparsky 1982a, Hale 2007: Part II, Ringe & Eska 2013: Ch. 6.

[15]Cf. fn. 1 on Core vs. High IE.

[16]Anatolian does not share in this constraint, so the High IE form may have been *[pṓts]. It is for this reason that Byrd (2010: 165) reconstructs **-ts* as a licit sequence for PIE.

edge until only one consonant remains (e.g., /adánts/ nom.sg.part.act. 'eating' → [adán]). Avestan [pās]** (cf. nom.sg. *napå* < *[napās] 'nephew') exhibits only the characteristic Indo-Iranian phonological change of the IE vowels, so its UR /pād-s/ surfaces as [pās]**. Vedic has introduced new phonological constraints on licit codas at the word edge, and thus its UR /pād-s/ surfaces as [pát].[17] Greek and Latin have undergone more extensive morphological changes: in Latin, the stem [ped-] has been introduced into the UR throughout the paradigm, thus /ped-s/ → [pēs]; in Attic-Ionic, the stem of the acc.sg./nom.pl. has been introduced throught the paradigm, so the UR is /pod-s/. However, deletion of coda dentals does not produce compensatory lengthening in Attic-Ionic (compare sigmatic aorists to roots in dentals, e.g., ἔπᾰσα 'I spread' ← /é-pat-s-a/), so one might expect ^{X}[pos]; instead, Attic-Ionic requires that every prosodic word be bimoraic (see Section 4.1 on word minimality requirements), and because word-final consonants are not mora-bearing in Attic-Ionic (see Section 6.2), the minimal word requirement can be satisfied only by lengthening the vowel, thus /pod-s/ → /pos/ → [pōs] (πούς). The Indo-European UR for the nom.sg. was */pōd-s/.

This case illustrates that merely operating with surface forms is inadequate for reconstruction of the correct Indo-European underlying and surface forms, and the Indo-European grammar. If we reconstruct **pṓds*, we are also correct, because */pṓd-s/ is the UR of the nom.sg. in the proto-language. Could the surface form be *[pṓts] instead? That reconstruction would assume that the constraint $^{\star}C_{[+coronal]}s$ is an independent innovation of Greek, Italic, and Iranian (and Balto-Slavic as well). Since the Sanskrit constraints on codas at the word edge is clearly different from the other branches, the parsimonous assumption is that Sanskrit is innovative, and all the other branches have maintained a constraint from Core IE. In the overall picture, Iranian is the most conservative in the developments related to this word: the only change is phonetic *[ō] > *[ā];[18] the phonology (the constraint $^{\star}C_{[+coronal]}s$) and the morphology (a different allomorph for the strong stem and weak stem) remain constant; Sanskrit is phonologically innovative ($^{\star}C_{[+coronal]}s$ is no longer active), and Greek and Latin are morphologically innovative (only one stem form throughout the paradigm).[19,20]

2.2 Morphophonemic Analysis/Internal Reconstruction

We recognize that the following section treats some procedures of linguistic analysis that will appear to be rather introductory for some readers, but because the essential motivation behind and evidence for Szemerényi's Law is the morphophonemic analysis[21] of the PIE animate nom.sg. and neuter "collective" and neuter plural, we believe that review of this method will benefit all readers. In reviewing this method, we thus also succeed in making explicit the procedure that Szemerényi and 19th-century scholars intuitively employed in their analyses of the animate nom.sg. in PIE. We further hope that the presentation of this method will help to dispel doubts as to the methodological soundness of the analyses on which SzL is based.

[17]Vedic exhibits a general tendency to preserve features of the root over features of a suffix, a tendency which is incipient already in Proto-Indo-Iranian, as Bartholomae's Law shows: the preservation of voicing and breathy voice (or similar glottal state) from a root-final segment through an obstruent belonging to the suffix (e.g., PIIr. */bud^{h}-tá-/ → *[budd^{h}á-]), rather than regressive assimilation of voicing and glottal state, indicates that the root consonant's features are more highly valued than the suffix consonant's features.

[18]This particular phonetic change, of course, plays into the larger phonological changes that affect the Proto-Indo-Iranian vowel system: at the least, the phonetic changes *[e] > *[ə], *[o] > *[ə] or *[ā] (by Brugmann's Law), *[ē] > [ā] and *[ō] > [ā] lead to the collapse of four phonemes (*/e, o, ē, ō/) into two (*/ə, ā/). On Indo-Iranian short <a> as /ə/ or /ʌ/ in Vedic at least, see Hoffmann 1976 and Lubotsky 2013.

[19]With Kiparsky (Forthcoming), Latin and Greek are morphologically innovative, because the morphophonological process of nominal ablaut is no longer active in those languages. In the case of this word, PIE had only one underlying stem form /pod-/, except in the nom.sg., and ablaut to [ped-] is triggered by inflectional endings with underlying accent.

[20]Note that the suggestion of Vaux (2002: 322), that the IE sequence *[ts] became *[t^{s}] already in Indo-European, and then [s] in all branches except Anatolian and Indic, is less likely. The merger of *[ts] into [t^{s}] is likely where the two segments were homosyllabic, but less so in a heterosyllabic [t.s] configuration; the heterosyllabic configuration, however, also exhibits deletion of the [t] in branches other than Indic and Anatolian. Therefore, the $^{\star}C_{[+coronal]}s$ better accounts for behavior throughout the system.

[21]The term 'morphophonemic analysis' in this context is somewhat infelicitous, because it may give the false impression that the objective is just to recover the phonemes of the language on the basis on morphological alternations, when in fact the objective is to reduce surface allomorphy to morphologically coherent underlying representations. 'Morphophonological analysis' would probably be a better term, but because 'morphophonemic' is well established, we will continue to employ it here.

Viewed from a synchronic perspective, the objective of morphophonemic analysis is to recover the underlying phonological representation (i.e., the phonological information associated with a morpheme in the lexicon) of a morpheme that exhibits multiple surface exponents, i.e., allomorphy. From a diachronic perspective, morphophonemic analysis recovers information about earlier phases of a language, based soley upon distributions and alternations present in the data of that single language. This diachronic perspective is internal reconstruction; hence, internal reconstruction is precisely the same method as synchronic morphophonemic analysis. Ringe & Eska (2013: 253) are helpfully explicit on this point: "Traditional historical linguistics recognizes a method of "internal" reconstruction, in which alternations within a single paradigm are exploited to reconstruct aspects of its prehistory. From a modern point of view this amounts to exploiting the phonological rules that generative phonology posits – and the exceptions to those rules." With respect to Indo-European or any reconstructed language, forms obtainable through external reconstruction render surface forms in that language; the application of morphophonemic analysis to those surface forms of the proto-language thus yields the underlying forms of the proto-language (or the forms of a pre-proto-language).[22]

We stated above that a language is essentially divisible into a lexicon and a grammar, which carries out syntactic, morphological, and phonological operations over inputs from the lexicon. Continuing research (e.g., in Construction Grammar; cf. Jackendoff 2002) shows that the storage in the lexicon is quite rich and varied. Meanwhile, psycholinguistic work on morphological processing indicates that a distinction exists between morphologically complex words that are likely stored and words that are productively generated through morphological operations.[23] Thus, while not every word, phrase, and utterance is always generated online by speakers, the possibility exists, and is indeed necessary for the production of new lexical items. In brief, the morphological grammar and lexicon of a language, which build up URs through morphological operations over the set of lexical items, then produce surface forms through phonological operations on those URs.[24]

In historical terms, since every lexical item must have been productively generated at some point in history, the method of morphophonemic analysis/internal reconstruction might, in fact, be more accurate from a historical than a synchronic point of view, because some forms may be synchronically lexicalized. At the same time, however, other phonological and morphological changes can, of course, obscure a distribution that may orginally have been wholly transparent. Keeping these various considerations in mind, we may state the following procedure for morphophonemic analysis.

(1) Procedure for Morphophonemic Analysis (after Hayes 2009: 162; cf. also Kenstowicz & Kisseberth 1979: ch. 3 and the procedure for internal reconstruction in Campbell 1999: 226):
   a. Examine the data, consulting the glosses, and make a provisional division of the forms into morphemes.
   b. Find each morpheme that alternates, and locate all of its allomorphs.
   c. Within each allomorph, locate the particular segment or segments that alternate.
   d. Considering the logical possibilities, set up the underlying representations so that all the allomorphs of each morpheme can be derived from a single underlying representation by general phonological rules (or constraints).

A relatively straightforward example from the morphological and phonological system of Present-Day American English will help to make this procedure concrete. Consider the realizations of the inflectional suffix, represented orthographically as *-ed* that marks past tense in Present-Day American English (PDE). This organization of the data already accomplishes steps 1-3 of the above procedure. A few representative examples in phonemic transcription will suffice:

[22]As we have seen above in the reconstruction of IE */pod-/ 'foot', sometimes one must compare not only surface forms in the daughter languages, but also phonological constraints that can be recovered through morphophonemic analysis in the individual daughter languages, in order to reconstruct appropriate surface forms of the proto-language.

[23]For a good survey of older literature, see Baayen 1989: ch. 2; for the role of frequency effects on morphological processing, see Hay & Baayen 2003.

[24]Though, with Kiparsky (1982b), morphology and phonology are likely interwoven.

(2) PDE Past Tense Forms

a. Set A: [spɪld] *spilled*, [lɪvd] *lived*, [beɪðd] *bathed*, [lɑɪd] *lied*

b. Set B: [mɪst] *missed*, [pɑpt] *popped*, [pɑɹkt] *parked*, [læft] *laughed*, [ɹʌʃt] *rushed*

c. Set C: [patəd] *patted*, [bɑɪdəd] *bided*

The sets given here present a clear complementary distribution in the forms of the morphme: [-t] after voiceless consonants, [-əd] after [+coronal] plosives, and [-d] elsewhere. That the underlying representation of this morpheme is /-d/ is the only possibility afforded us. The insertion of a schwa following coronal plosives, and the unlikelihood of progressive voicing assimilation from a preceding vowel as the means to account for cases like [lɑɪd] *lied* (which would predict that any English word ending in [-VC#] would have a final voiced consonant), makes /-d/ the only possibility; [-t] is explicable as voicing assimilation from a preceding voiceless consonant.

How does this procedure play out with respect to PIE, or any other reconstructed language? First, external reconstruction (the application of the Comparative Method) ought usually to render surface forms in the proto-language. From those surface forms, the data can be arranged precisely as the procedure given here specifies. In Section 3 immediately below, our presentation of data concerning the nom.sg. of animates follows this procedure: we group the data into two sets, one exhibiting the surface morpheme *[-s] and one without the surface morpheme *[-s]; we then are able to conclude that *[-s] alternates with ø; furthermore, the presence of a long vowel in the final syllable of a nom.sg. is in a nearly complementary distribution with the morpheme *[-s]; logically, to posit a UR */-VC-s/ in all cases follows, according to a rule (or constraint) that deletes the morpheme */-s/ after certain consonants, and induces lengthening of the vowel.

Let us proceed to the task at hand.

3 The Evidence for Szemerényi's Law

The objective of this section is to provide a systematic presentation of all datapoints that potentially bear on the interpretation of Szemerényi's Law. Our principal focus will lie with the nom.sg. of animate stem classes, where the data and relevant contrasts are most abundant, but the "collective"/neut.pl. in *-h_2 also plays an important role. Following the principles that we presented under Section 2, we argue that the underlying representations for the nom.sg. animate and neuter "collectives"/nom./acc.pl. in PIE contained */-s/ and */-h_2/. As we will ultimately discuss in Section 7, the ways in which those two morphemes were realized, and the phonological contexts in which they exhibited one allomorph or another, probably underwent changes during the internal history of PIE. Meanwhile, consideration of the lengthened grade that often appears in the nom.sg. of root noun admits of diverse accounts, one of which could involve SzL.Taken together, all of these examples lead to the two possible following formulations of SzL:

(3) Szemerényi's Law (Version 1 – Narrow).

PIE *VRF $\rightarrow$ $\left\{ \begin{array}{l} \bar{V}R \ /\_\_\# \end{array} \right.$

A fricative is deleted in a word-final coda sequence of the shape vowel + sonorant + fricative (*/s, h_1, h_2, h_3/), with compensatory lengthening.

(4) Szemerényi's Law (Version 2 – Broad).

PIE *VC(C)F $\rightarrow$ $\left\{ \begin{array}{l} \bar{V}C \ /\_\_\# \\ VCC \ /\_\_\# \end{array} \right.$

A fricative is deleted in a word-final coda sequence of the shape vowel + consonant (+consonant) + fricative (*/s, h_1, h_2, h_3/), with compensatory lengthening if lost word finally after a single consonant.

Finally, we also introduce some cases in which one finds alternation between forms with and without evidence for a laryngeal word-internally in Section 3.5. These examples support a phonologically more natural

formulation of SzL, in which fricatives in complex syllable codas generally, not just at the right edge of the word, were targeted for deletion. At the same time, reconstructable examples of surface *[RH$] sequences indicate that an across-the-board (post-lexical) constraint against fricatives following resonants in syllable codas probably was not active in the grammar of late PIE; we therefore provide a brief sketch of the necessary change in the phonological grammar.[25] In its broadest possible form then, we ultimately arrive at the following formulation of SzL:

(5) SZEMERÉNYI'S LAW (FINAL – BROAD).

$$\text{PIE *VCF} \rightarrow \begin{cases} \bar{\text{V}}\text{C} \;/\_\_\# \\ \text{VCC} \;/\_\_\# \\ \text{VC} \;/\_\_\$\text{C}_0 \end{cases}$$

A fricative is deleted in a coda sequence of the shape vowel + consonant (+ consonant) + fricative (*/s, h_1, h_2, h_3/), with compensatory lengthening if lost word finally after a single consonant.

Often discussed in connection with SzL, but not attributed to SzL *per se*, are forms that may, in their underlying representations in PIE, have had a sequence of two identical segments. Possible cases include the nom.sg. of animate *s*-stems (e.g., *[$h_2$áu̯sōs] ← */$h_2$éu̯s-os-s/) and the loc.sg. of "proterokinetic" *i*-stems (e.g., *[-ēi̯] ← */-ei̯-i̯/). In Section 6, we will demonstrate that the long vowels in these forms are due to the same process of compensatory lengthening that is relevant to the proper SzL cases. Indeed, because the motivation for the absence of forms such as nom.sg. $^{\text{X}}$[$h_2$áu̯soss] or loc.sg. $^{\text{X}}$[$h_1$eg$^{\text{u̯h}}$néi̯i] is straightforward (a sequence of two identical segments was illicit in the surface form of PIE words), such cases are important to our ultimate understanding of SzL. However, because such forms do not necessarily bear on the possible loss of fricatives in complex syllable codas in PIE, we will not treat them great detail in this section.

3.1 Nominative Singular Animates

External reconstruction unmistakeably points to the existence of a nom.sg. inflectional suffix */-s/ in PIE, which surfaces as *[-s] (or perhaps *[-z]) in vowel stems (given in example set 6) and plosive-final root noun consonant stems (given in example set 7). In contrast, polysyllabic consonant stems that terminate in either [+sonorant] (resonant) or [+continuant] (fricative) consonants exhibit a nom.sg. surface form without a suffix *[-s]; only stems ending in a dental stop */-t/ or */-d/ give evidence of a suffix *[-s] on the surface. We exhaustively discuss these nominatives of these polysyllabic consonant stems, which regularly present a long vowel in the final syllable, under example set 8.

(6) Vowel Stems

a. **o*-stems: PIE *[-os]: Indo-Iranian */-a-s/,[26] Gk. -ος, Lat. *-us*, Hitt. *-aš* (e.g., Skt. *áśvas*, Avestan *aspō* 'horse', Gk. ἵππος, *equus* 'horse' < **h_1(é)k̂-u̯-o-s*;[27] Skt. *ŕkṣaḥ*, Gk. ἄρκτος, Hitt. *ḫar-tag-ga-aš* 'bear' < **h_2ŕtk̂-o-s*).[28] The reconstruction of the ending */-s/ for thematic nouns at any stage of Indo-European is wholly unproblematic and uncontroversial. Some scholars (e.g., Beekes 2011: 186) suggest that this ending was original and exclusive to *o*-stems. However, given that all **i*- and **u*-stems directly attest the morpheme */-s/ in (nearly) all daughter languages, animate *i*- and *u*-stems without **-s* cannot be internally reconstructed (by our definition in Section 2); from a purely morphological and phonological point of view, the claim that nom.sg. */-s/ originates in thematic stems does not rise above speculation.

[25] The symbol $ indicates a syllable boundary.

[26] We give the PIIr. ending as a UR, to abstract from complications of reconstructable PIIr. phonological processes.

[27] On the Greek, see now Bozzone 2013.

[28] Wodtko et al. 2008: s.v. **$h_1$ék̂u̯o-* and Wodtko et al. 2008: s.v. **h_2ŕtk̂o-*.

b. **i*-stems (hysterokinetic and proterokinetic *i*-stems): PIE *[-is]: Indo-Iranian */-i-s/, Gk. -ις, Lat. *-is*, Hitt. *-iš* (e.g., Skt. *ávis*, Av. *auuiš*, Gk. ὀΐς, Lat. *ovis*, Hitt. *ḫāu̯is** (UDU-*iš*) 'sheep' < **h*$_2$*óu̯-i-s*).[29] The PIE underlying representation */-i-s/ and surface form *[-is] are transparent.

c. **u*-stems (hysterokinetic and proterokinetic *u*-stems): PIE *[-us]: Indo-Iranian */-*us*/, Gk. -υς, Lat. *-us*, Hitt. *-uš* (e.g., Skt. *naús*, Gk. ναῦς < *[nó/éh$_2$us] 'ship'; Lat. *senātus* 'coucil of elders; Senate'; Hitt. *haššus** 'king' (LUGAL-*uš*, gen. *ḫaššuwas*)).[30]. Although exact word equations in daughter languages are less common, their inflection evidently points to */-u-s/ and [-us].

(7) Plosive stems: nom.sg. *[-Ps]. All stems in stops, other than */-t/ (and perhaps */-d/, see an example below) in PIE were root nouns, and their nominatives sg. consistently exhibit the marker *[-s].

a. Roots of the shape *C(C)VCC- surface in the daughter languages with zero grade or with a short vowel, never a long vowel:

i. Full-Grade: Gk. ζόρξ (Callimachus *In Dianam* 97 gen.sg. ζορκός; nom.sg. in Herodian and Hesychius) 'gazelle' < *[i̯órks] (cf. Corn. *yorch* 'roe'); Gk. πρόξ 'deer' < *πόρξ < *[pórḱs] (cf. Skt. *pṛśni-* 'spotted');[31] Gk. αἴξ 'goat' < *[h$_2$ái̯ks] (cf. Arm. *i*-stem *ayc* 'goat'); Lat. *arx* 'citadel' < *[h$_2$árks] (cf. Hitt. *ḫark-* 'have, hold')

ii. Zero-Grade: nom.sg. YAv. *viš* 'village, settlement' < *[u̯íḱs] (cf. Ved. *víṭ*, Gk. οἶκαδε 'towards the house' < [u̯ói̯ḱm̥de]); YAv. *kərəfš* 'body' < *[kŕ̥ps] (cf. Ved. *kŕ̥p-*, Lat. *corpus*); Gk. σάρξ 'skin' < *[tu̯ŕ̥ks]; Lat. *nix* 'snow' < *[sniks] */snig^{wh}-s/ (cf. Gk. acc.sg. νίφα). The consistent zero grade of such forms almost surely reflects the generalization of the weak stem throughout the paradigm in originally ablauting stems.

b. Roots of the shape *C(C)VC-, on the other hand, not infrequently appear with a long vowel in addition to the *[-s]. Avestan, Greek, and Latin furnish several good examples; Vedic often confirms a long vowel, but cannot directly show the presence of *[-s]:

i. *[u̯ōk^{w}s] 'voice' > Av. *vāxš*, Lat. *vōx*, Gk. -ωψ (e.g., μύωψ 'short-sighted'); Ved. *vā́k*

ii. *[pōs] 'foot' > Doric (Hesychius) πώς (if inherited as such, and not merely generated in Doric from /pod-s/); Ved. *pā́t*

iii. *[h$_2$ōps] 'water' > YAv. *āfš*

iv. *[klōps] 'thief' > Gk. κλώψ[32]

v. *[h$_3$rēḱs] 'king' > Ved. *rā́ṭ*

Stems in plosives thus decisively attest to a nom.sg. marker *[-s]. The co-occurence of lengthened grade and *[-s] in these forms will be further treated in Sections 4 and 7.

(8) Polysyllabic Consonant Stems: in stems terminating in [+sonorant] consonants and **s*-stems, the evidence for a long vowel in the nom.sg. is more or less unambiguous. **t*-stems (and perhaps **d*-stems) also point to a long vowel in the final syllable. Feminine **h*$_2$-stems are fundamentally ambiguous.

a. **e/oi̯*-stems (amphikinetic *i*-stems): PIE *[-ē/ōi̯]: Indo-Iranian */āi̯/, Gk. -ώ, Lat. *-ēs*, Hitt. *-ā́i̯š*, (e.g., Skt. **sákhā*, OAv. *huš.haxā*, YAv. *haxa* 'friend' < *[sék^{w}h$_2$ōi̯]; Gk. Πειθώ 'persuasion' < *[b^{h}éi̯d^{h}ōi̯]. Lat. *caedēs* 'slaughter' < *[kai̯dēi̯(s)] Hitt. *išḫamaiš* 'song' < *[sh$_2$ámōi̯]). Also OAv. *kauuā*, but contrast Ved. *kavíḥ*). Evidence for a derivational suffix **-oi̯* appears to be entirely limited to Indo-Iranian, Greek, and Anatolian, and is fairly sparse even in those branches. The suffix

[29]Wodtko et al. 2008: s.v. **h*$_2$*óu̯-i-*.

[30]Wodtko et al. 2008: s.v. **néh*$_2$*-u-*.

[31]Schindler (1972: 34) takes πρόξ 'deer' as metathesized from *πόρξ, which appears in Hsch. πόρκας· ἐλάφους, and likewise Att. ἄλοξ 'furrow' < *[h$_2$u̯olks]. Greek φλέψ 'vein' (= AVŚ 7.90.2 gen.sg. *bhrajás* '∼penis' ?) must continue an ablauting **b^{h}log^{w}-/b^{h}leg^{w}-*, in which case the weak stem has become the only stem in Greek, thus explaining the absence of expected *φλώψ.

[32]Lat. *cleps* '*fur*' is known only in a gloss (CGL V 349.51), though Ernout & Meillet (1985 [2001]: 127) seem to regard the form as old. Schindler (1972: 107) takes also σκώψ 'owl' and ῥώψ 'βοτάνη ἁπαλή' (Hesychius) as likely inherited forms, but considers most other Greek root nouns of the form -V̄T- (e.g. κλώς 'fate', πτώξ 'hare') as creations internal to Greek.

*-*e̯i̯* is best reflected in the Latin 3rd declension type with nom.sg. *-ēs* (e.g., *caedēs* 'slaughter', *aedēs* 'temple'). The reintroduction of the ending *[-s] in this Latin type can be explained on the grounds that the acc.sg. and nom.pl. would have aquired long vowels as well (acc.sg. *[-e̯i̯m̥] > *[-e̯i̯em] > Lat. *-ēm* > *-em*; nom.pl. *[-e̯i̯es] > Lat. *-ēs*), thus leading Latin speakers to posit an underlying /ē/ for the strong stem of this type. Since the long vowel in the nom.sg. would be non-derived, the ending /-s/ surfaces.[33] In Indo-Iranian, only PIIr. nom.sg. *[sákHā], gen.sg. *[sakHi̯ás] 'friend' is certain,[34] while the Greek nouns in nom.sg. -ώ gen.sg. -οῦς (e.g., Σαπφώ) make up just a few feminine nouns. Hittite *ai*-stems are more diffuse, but the ending *-š* must have been reintroduced in Anatolian, since not only common gender *ai*-stems, but also *au*-, *r*-, and *n*-stems exhibit the ending (see immediately below). Hence, the PIE surface form for such stems is *[-ōi̯], which may have an UR /-oi̯-s/.

b. *e/ou̯*-stems (amphikinetic *u*-stems; diphthong stems): PIE *[-ē/ōu̯]? PIE [-ē/ōu̯-s]? This class is problematic, in that external reconstruction suggests the reconstruction of *[-ē/ōu̯-s]; Weiss (2009: 249-50), for instance, sets up *-ōu̯-s*. This reconstruction, however, conflicts with any possible account of the lengthened grade: if *[ē/ō] were due to SzL, we should expect *[ē/ōu̯], not *[ōu̯-s]; similarly, if the *[ē/ō] is due to lengthening before a word-final resonant (see section 4.2 below), *[ē/ōu̯] would likewise be the expected result, or should have been blocked altogether, giving *[-e/ou̯s].[35] Therefore, because this complex of data is numerically small, difficult to describe in the daughter languages, and problematic for competing accounts, we do not accept reconstructions *[ē/ōu̯-s] as solid counter-evidence to SzL; most likely, the reconstruction is wrong (i.e., the co-occurrence of *[-s] and lengthened grade is due to isolated developments in daughter languages, thus creating an illusory match).

We treat forms with a possible suffix *-*ou̯* separately from root nouns ending in a diphthong (**di̯eu̯*- 'heaven') and *u*-stems to roots in a laryngeal (*/no/eh$_2$-u-/ 'ship'):

i. The suffix *-*ou̯*: Evidence for a genuine suffix *-*ou̯* in non-neuter nouns is even more spare than for the suffix *-*oi̯*: the suffix appears to be absent in Indic and Italic; Hitt. *ḫarnāuš* 'birthing stool' is the only animate example in that language; such a suffix (of IE origin) in Greek is limited to the nouns πατρώς 'father's relative', μητρώς 'mother's relative' and δμώς 'slave, servant', which are non-probative as to the IE nom.sg. form;[36] in Iranian, nominatives singular in *-āuš* are but three: OAv. *darəgō.bāzāuš* 'having long forearms' (Y. 38.5.h = Y. 67.8.i),[37] OAv. *hiθāuš* 'companion' (Y. 48.7.c; acc.sg. *hiθąm* Y. 34.10) , and OP *dahąyāuš* 'country' (contrast Ved. *dasyúḥ*, YAv. *daŋ́huš*). The testimony of *ḫarnāuš* is not entirely reliable, both from the philological point of view (the plene spelling *ḫar-na-a-ú* occurs only in KBo 5.1 i (MH/NS)) and the linguistic (inherited *[ōu̯] would be refitted with [-s] to give Hitt. *-āu̯š*). The Iranian forms are peculiar, at odds with Indic and sometimes with other Iranian material; they deserve a detailed treatment elsewhere. Nevertheless, we tentatively outline an explanation of OAv. *hiθāuš* and OP *dahąyāuš* here. If *darəgō.bāzāuš* indeed contains a suffix *-*ou̯* (i.e., */b$^{\text{h}}$eh$_2$ĝ$^{\text{h}}$-ou̯-/, in con-

[33]An identical analysis will be given for the reintroduction of [-s] in the nom.sg. of *u̯*-stems, *m*-stems, and */pont-oh$_2$-/ below.

[34]The inflection of PIIr. */sakHai̯-/ is entirely parallel in Vedic and Avestan. Ved. gen.sg. *kavéḥ* is surprising in a form with a light root syllable, but matches YAv. *kauuōiš*. However, the gen.sg. of the "closed" (proterokinetic) inflection is the only type gen.sg. known for *i*-stems in Avestan. Therefore, given the YAv. gen.pl. *kaoiiąm* vis-à-vis Ved. *kavīnā́m*, in conjunction with the Av. nom.sg. *kauuā*, an original amphikinetic inflection nom.sg. *[káu̯ā(i̯)], gen.sg. *[kau̯i̯ás], nom.pl. *[káu̯āi̯as] should be reconstructed for (early) PIIr. Ved. *kavíḥ* can then readily be the result reformation on the basis of the weak stem *[kau̯i̯-]. The introduction of the "proterokinetic" genitive sg. in both Vedic and Avestan is probably independent.

[35]Note that Vaux (2002) explicitly excludes **di̯éu̯s* and similar cases from his version of SzL, which he claims applied solely to coronal-final stems.

[36]As Schwyzer (1938 [1953]: 479) and Widmer (2008: 615) note, the Gk. nom.sg. -ως here probably reflects importation of the surface form of the acc.sg. into the nom.sg.: acc.sg. πατρών < *[pəh$_2$trōm] ← */ph$_2$-tr-ou̯-m/., etc.

[37]See Narten 1986: 241-5 and Hintze 2007: 251-3 on the interpretation of this form.

trast to the usual */b^{h}eh$_2$ĝ^{h}-u-/ > Ved. *bāhú-* 'arm'), then it might be susceptible to the same account.

The key to the Iranian forms may be in the acc.sg. *hiϑąm*, which suggests *[sitHoṷm] > *[sitHōm] by Stang's Law, thus *hiϑąm*.[38] At the same time, the nom.pl. *[-oṷ-es] became *[-āṷas] by Brugmann's Law (e.g., YAv. *daŋ́hāuuō*, OP *dahąyāva*), and the nom.sg. would show *[-ōṷ] > [-ā]. At this point, all of the strong case forms contain [ā] on the surface; there is no longer evidence for /aṷ/. Thus, the URs of the stems became /hiϑāu-/ and /dahyāu-/ in Av. and OP, respectively. With the long vowel in the UR, the nom.sg. was no longer derived in the same fashion as other [+sonorant] stems, where the URs still contained /-ăR-s#/. Granting that Indo-Iranian /-ăR-s#/ met the structural description for morphophonological process that caused it to surface as [ā], when the UR became /-āṷ-s/, the structural description for that morphophonological process was no longer met, thereby allowing the nom.sg. marking /-s/ to surface. OP /dahyāu-/, against Av. /dasyu-/ and Ved. /dasyu-/ suggests that the latter two languages may have replaced PIIr. */dasyaṷ-/ with the more common *u*-stem inflection.

ii. Root diphthong stems: The precise reconstruction of the nouns continued in the Vedic diphthong stems, noms.sg. *dyaúḥ* 'sky', *gaúḥ* 'cow', and *naúḥ* 'ship' presents a number of long-standing problems. For the first and last items listed here, the reconstruction of the underlying stems is relatively uncontroversial: */dị̯eṷ-/ and */no/eh$_2$-ṷ-/ (cf. Wodtko et al. 2008: 69 ff.; 515 ff.), but 'cow' is disputed, set up as either a root noun */g^{w}oṷ-/ or an *u*-stem */g^{w}e/oh$_3$-ṷ-/ (cf. Wodtko et al. 2008: 189 ff.). The details and problems of these reconstructions cannot detain us here, but we note in passing that *u*-stem noms.sg. *[nóh$_2$us] and *[g^{w}óh$_3$us] (if *[o] from */o/) would produce Ved. *naúḥ* and *gaúḥ*, to which *dyaúḥ* could be analogical (cf. again Wodtko et al. 2008: *loc. cit.*). Regardless, only Indo-Iranian would directly reflect a nom.sg. *[-ē/ōṷ-s] in these forms, but like the case of OAv. *hiϑāuš* and OP *dahąyāuš* above, the long vowel in the nom.sg. in combination with /-s/ might ultimately be due to analogical effects (i.e., learning of new URs) in Indo-Iranian prompted by Stang's and Brugmann's Laws. Note in particular that the paradigm of Ved. *dyaú-* behaves as though the root originally had **o* grade in the strong stem (despite *e* grade in Gk. Ζεύς) and was subject to Brugmann's Law (nom./acc.du *dyā́vā*, nom.pl. *dyā́vaḥ*), which decisively indicates that the entire strong stem of this word has been analogically reformed to contain an underlying /ā/.

c. **r*-stems (hysterokinetic *r*-stems): PIE *[-ēr]: Indo-Iranian *-*ā*, Gk. -ηρ, Lat. *-er*, Hitt. *-ērš* (e.g., Skt. *pitā́*, Av. *p(i)tắ*, Gk. πατήρ, OLat. *patēr* 'father' < *[pəh$_2$-tēr]; Hitt. *ḫašterza*[39] 'star' < *[h$_2$stēr]). The evidence of this inflectional class for PIE *[-ēr] is unambiguous and plentiful in Indo-Iranian, Greek, and Latin. The Anatolian material, as usual, is not probative.[40] Note also that root nouns of the form C(C)Vr- also exhibit a long vowel and lack **-s* in their nom.sg. (e.g., *[b^{h}ōr] 'thief' > Lat. *fūr*, Gk. φώρ), which suggests that the long vowel in the final syllable preceding [r] has a phonological motivation.

d. **l*-stems: Although Hittite attests a substantial number of *l*-stems (neuters especially), the number of animate *l*-stems reconstructable for PIE is very few in number. The two well-attested lexical items are the words for 'salt' and 'sun', the precise reconstructions for which are both disputed.

i. The principal question surrounding the reconstruction of the word for 'salt' is whether the apparent alternation between *[ā] and *[ă] found in the daughter languages are due to genuine */a/ vocalism (or at least an onset */sh$_2$-/) or the presence of an **h*$_2$. Morphologically speaking, the word may be either a root noun */sal-/ or */seh$_2$l-/ ~ */sh$_2$l-/ (the latter Petit 2004: 51-2), or

[38] Contrast, however, OP acc.sg. *dahąyāum*, though this form is likely made from the stem *dahąyāu-* present in the nom.sg. and nom.pl.

[39] Hoffner & Melchert (2008: 114), following Weitenberg (1995: 334-5), read the NS form *ḫa-aš-te-er-za* as /ḫastērz(a)/.

[40] Note that some Hittite nouns that show a nom.sg. in *-ar* (e.g., *šittar* 'sun disk') are due to a pre-Hittite change whereby **-Cros/m#* > Hitt. *-Car*; such forms were originally common gender *a*-stems in pre-Hittite. See Melchert 1993.

an stem with a derivational suffix *-l*, */seh$_2$-l-/∼ */sh$_2$-el-/ (Kortlandt 1985: 119, Kortlandt 1997: 26).

A long vowel *[ā] (or syllable rhyme *[ah$_2$]) is evident in Lat. nom.sg. *sāl* (gen.sg. *sălis*), OIr. *sál*, Latv. nom.sg. *sȁls* (falling tone), and Žem. Lith. *sólymas* 'salt marsh'.[41] A short vowel *[a] (or *[h$_2$a]) appears in Gk. ἅλς (gen.sg. ἁλός), Germanic (e.g., Goth. *salt*), and Proto-Slavic **sôlъ* (Russ. *sol'*, SCr. *sô*, gen.sg. *sȍli*).[42] In fact, the only potentially direct evidence for a laryngeal,[43] besides the *[ā] vocalism itself, is the "acute" intonation of *sólymas* < transponat **séh$_2$l-īmos*. However, this intonation is directly at odds with the Latv. *sȁls*, which, if from **seh$_2$ls*, should have yielded a form with "broken" intonation, ^{X}*sâls*. The accentological testimony of *sólymas* is not entirely reliable, however, if Būga (1922: 140) is correct in thinking that *sólymas* is "vielleicht entlehnt aus le. *sàlīj(u)ms*". The Slavic forms of the basic noun all also indicate "non-acute" intonation.

Kortlandt (see refs. immediately above) sets up a "hysterodynamic" paradigm nom.sg. **sé̆h$_2$ls*, acc.sg. *sh$_2$él-m*, gen.sg. *sh$_2$-l-ós*. In Kortlandt's view, Latv. *sȁls* directly continues the nom.sg. **sé̆h$_2$ls*, under the assumption that coda laryngeals do not ultimately cause "acute" intonation on original IE long vowels. Kortlandt's motivates the reconstruction of a long vowel in this nom.sg. through "monosyllabic lengthening", which could not, in fact, have applied to underlying */seh$_2$-l-s/, because such a form would already be bimoraic (see **4.1** below). Furthermore, the reconstruction of such "hysterodynamic" paradigms (or indeed, any paradigms with alternation of full grade between the root and the derivation suffix, such as the standard "proterokinetic" paradigm) lacks direct evidence in the daughter languages, and is ruled out by any model of PIE accentuation that is able to predict the synchronic position of the word ictus (see Kiparsky 2010b, Pronk 2013).[44] Petit (2010: 111) agrees that "auszugehen ist von einem ablautenden Stamm **seh$_2$-l-* (> bsl. **sāl-* > lit. *sól-*, lett. *sāl-*), vs. **sh$_2$-l-* (> bsl. **săl-* > sl. **sol-*). Perhaps most problematic of all is the syllabification of a nom.sg. */seh$_2$-l-s/, which should have been realized in PIE and PBSl. as *[sa.h$_2$l̥s], with a syllabic liquid. According to the chronology of Balto-Slavic sound changes given in Kortlandt 2008, the decomposition of syllabic resonants (Kortlandt's step 10) into VC sequences precedes the loss of laryngeals (Kortlandt's step 20, an independent development in Baltic and Slavic); therefore *[sa.h$_2$l̥s] ought to have become PBSl. *[sa.Hils], and subsequently Baltic *[sails] > Latv. ^{X}*saìls*. In sum, Kortlandt's solution for 'salt' cannot be accepted.

Larsson (1999) and Villanueva Svensson (2011) both (following an earlier idea of Rasmussen; cf. Rasmussen 2007) assume that Latv. *sȁls* is due to "métatonie douce" in monosyllabic words. We find the arguments of Petit (2002) and Pronk (2012: 235-9) against such a metatony persuasive. Since, however, *sólymas* cannot be older than Proto-Baltic (due to lack of cognate formations), it must be a derivative from the basic noun, the only attested accentuation for which is the Latvian form. The agreement between Latv. *sȁls* and PSlav. Proto-Slavic **sôlъ* entails the reconstruction of a Proto-Balto-Slavic **sāl-*/*săl-*, with "non-acute" intonation. *A priori*, then the "acute" of *sólymas* is more likely due to a "métatonie rude"; in particular, it may result from just such a metatony that one finds in trisyllabic nouns in Baltic (cf. Derksen 1996: 372). We find ourselves in agreement with Petit (2010: 111) who concludes "es scheint mir einfacher zu sein, eine sekundäre Intonationsentgelisung anzunehmen, auch wenni ich selbst zugebe, daß ihre

[41] Derksen (1996: 24, 144) and Kortlandt (2004: 15) mark *sólymas* as simply "Lith." but the word is in fact Žemaitian (specifically from Kvėdarna) according to Fraenkel (1965: 759) and Būga 1922: 140.

[42] Derksen 2008: 461

[43] Assuming that the only sources for Balto-Slavic "acute" accentuation are IE laryngeals in syllable codas and Winter's Law. For an overview of this problem, see Petit 2010: ch. 2.

[44] Discussion of Kloekhorst (2013)'s reconstruction of a "hysterodynamic" paradigm for Hitt. *keššar-* 'hand' goes beyond the scope of this paper.

Quelle dunkel bleibt." Without the intonation of *sólymas*, no sure evidence for a laryngeal in the word for 'salt' exists.

The most straightforward reconstruction, then, is a root noun */sal-/: nom.sg. *[sál], gen.sg. *[saló/és]. Latin essentially preserves this root noun directly (*sāl*, gen. *salis*). In Greek, any sort of morphophonemicized Szeményi's Law has ceased to apply to *l*-stems (see further Section **8**), so underlying /hals/ surfaces as [háls] (ἅλς).

ii. Because the word for 'sun' is extended with a number of secondary suffixes in many daughter languages (e.g., *-i̯o* in Greek, *-*o* in Germanic, *-ē* in Balto-Slavic), the exact protoform is difficult to recover. However, in the branches that maintain a more direct traces of an athematic *l*-stem, (Celtic, Italic, Indo-Iranian), we find fixed zero grade of the root *seh_2-, and *o*-grade or zero grade of the suffix. The Vedic oblique stem (gen.sg. *sū́raḥ*) exhibits laryngeal metathesis: */sh_2u̯l-es/ → *[súh$_2$los]; the same applies to OIr. *súil* 'eye' < *[suh$_2$li-]. Lat. masc. *sōl* and ON fem. *sól*, meanwhile, must have *[su̯ól], as its immediate surface preform, which derives from underlying */sh_2-u̯ol-s/, where the *h_2 does not surface due to the Saussure Effect (*/H/ → ø (oR)_(Ro)[45]), as per Weiss (2009: 241).[46]

Just as with *r*-stems, the presence of a surface long vowel in the nom.sg. of both a root noun (*[sál]) and a derived noun (*[su̯ōl]) indicates that the long vowel is phonologically, rather than morphologically, motivated. These two lexical items securely indicate the nom.sg. of Indo-European *l*-stems contained a long vowel and was asigmatic, again like *r*-stems.

e. **n*-stems: PIE *[-ōn]: Indo-Iranian *[-ā], Gk. -ων, Lat. *-ō*, Lith. *-uo*, OHitt. *-aš*, Toch. B *-o* (Skt. *aśmā*, Gk. ἄκμων, Liith. *akmuõ* 'stone' < *[$h_2$ek̂mōn]; Lat. *homō*, OLith. *žmuõ* 'man' < *[d^hĝ^{h}mōn];[47] Skt. *śvā́*, Av. *spa*, Gk. κύων, Lith. *šuõ* 'dog' < *[k̂u̯ōn];[48] Hitt. *ḫaraš*, Goth. *ara* 'eagle' < *[$h_3$erōn];[49] Toch. B *klyomo* adj. 'noble' < *[k̂leu̯mōn]. As with *r*-stems, the evidence for asigmatic *n*-stems with lengthened grade in the final syllable is unambiguous and plentiful, and exists in both root and derived nouns. The Anatolian evidence may be relevant here, if, as some scholars assume (e.g., Hoffner & Melchert 2008: 111, fn. 156), the absence of the nasal in in the Hittite shows the same loss of nasal following a long vowel as in Latin and Balto-Slavic, which may even be PIE.[50]

f. **m*-stems: PIE *[-ōm]: Indo-Iranian *[-ās], Gk. -ων, Hitt. *-am* (YAv. *ziiå̊* (PIIr. *[ǰ^{h}iās]) Gk. χιών 'winter' < *[ĝ^{h}éi̯ōm];[51] Hitt. *tēkan*, Gk. χθών, Skt. *kṣā́ḥ*, Av. *zå̊* (PIIr. *[dǰ^{h}ās]) 'earth' < *[d^hégĝ^{h}ōm].[52] The contrast in gender (neuter in Hittite, feminine in Greek and Indo-Iranian) in the word for 'earth' is due to reinterpretation of the original animate as neuter in Anatolian, due to the identity between the nominative and accusative, because the accusative was also *[d^hégōm] ← */d^heĝ^h-om-m/ (see further Section **6**). Crucially, the change in gender in Anatolian, which requires the incidental identity of the nom. and acc., demonstrates that the Hittite continues a form without a nom.sg. *-s*. The reintroduction of the nom.sg. *[-s] for these *m*-stems in Proto-Indo-Iranian could be motivated through the same process that introduced the **-s* in *ou̯*-stems discussed under example **7.b.**

[45]Perhaps understandable as Advanced Tongue Root disharmony; see Byrd 2013.

[46]The idea that a *séh$_2$-u̯ōl* (note, however, that no language continues any such form directly) reflects an original "collective" ***séh$_2$-u̯ol-h$_2$* alongside a neut.sg. **séh$_2$u̯ḷ* (reflected in Ved. *súvar*, but with zero grade of the root) appears frequently (cf. Vijūnas 2009: 216, Kim 2001: 129: fn. 26). If so, then *[su̯ōl] could be added to the list of "collectives" with lengthened grade of the suffix in 3.3 below. The animate gender in the Latin and Old Norse forms suggests that surface *[su̯ōl] was reanalyzed was reflecting a UR */s(h_2u̯ol-s/.

[47]See Wodtko et al. 2008: s.v. **d^{h}égĝ^h-om-*.

[48]See Wodtko et al. 2008: s.v. **k̂(u)u̯ón-*.

[49]See Kloekhorst 2008: s.v. *ḫāran-*.

[50]A more coherent synchronic analysis of the Hittite *n*-stems, however, sets up a nom.sg. /-an-s/, which surfaces as [-as] due to a constraint against [ns] in a syllable coda; an electronic search of Old Hittite/Old Script texts yielded no sequences that could be construed as [ns$]. Kloekhorst (2008: 302) hints at this analysis.

[51]See Wodtko et al. 2008: s.v. **ĝ^{h}ei̯-om-*

[52]See Wodtko et al. 2008: s.v. **d^{h}égĝ^h-om-*.

above: the long vowel in the nom.sg. (**dʲʰáˀ*), acc.sg. (**dʲʰám*) by Stang's Law, and nom.pl. and nom./acc.du. (**dʲʰámas*; cf. Ved. *kṣámā*) results in attribution of the surface [ā] to the underlying form. The PIIr. nom.sg. then becomes */dʲʰām-s/, which surfaces as *[dʲʰás].[53]

g. **s*-stems: PIE *[-ōs] (amphikinetic *s*-stems), *-[ēs] (hysterokinetic adjectival *s*-stems): Indo-Iranian *[-ās], Gk. -ως, Lat. *-ōs* (*-ōr*) (Skt. *uṣáḥ*, OAv. *ušå*, Ion. Gk. ἠως, Lat. *aurōra* < *[$h_2$éuṣōs]; adj. Indo-Iranian *[-ās], Gk. -ης (e.g., masc.nom.sg. Ved. *nṛmánāḥ*, YAv. *nərəmanå* 'manly-minded', Gk. δυσμένης 'ill-willed', PN Ἀνδρομένης[54] < **-ménēs*). In the adjectival compounds, the long vowel is most sensibly attributed to */-es-s/. In the nominal forms, *[-ōs] is best attributed synchronically in PIE to */-os-s/, as a matter of coherence with other animate stems (cf. Meissner 2006), but may reflect an original collective **-os-h_2* (cf. Fritz 1998: 260-3, Stüber 2002).[55]

h. masc. **h_2*-stems: PIE *[ōh$_2$]? *[oh$_2$-s]? The evidence for the ablauting suffix **-oh$_2$* is limited to just one lexical item, attested directly as such only in Sanskrit and Avestan: */pont-oh$_2$-/ 'path'.[56] The nom.sg. of this word is clearly sigmatic and exhibits a long vowel in the suffix in Indo-Iranian (though whether that long vowel is due to compensatory lengthening from loss of the laryngeal, or is present regardless, is uncertain): Ved. *pánthāḥ*, Av. *paṇtå* < PIIr. */pant-ăH-s/. The co-occurrence of long vowel and nom.sg. *[-s] in Indo-Iranian is again explicable through the same analogical mechanism that permits their co-occurence in the **ou̯-* and **om*-stems in Indo-Iranian: the combination of Stang's Law in the acc.sg. and Brugmann's Law in the nom./acc.du. and nom.pl. results in a new UR containing the long vowel. A long vowel in the accusative singular in the paradigm of PIIr. */pant-āH-/ (< */pont-oh$_2$-/) could have been obtained either through Stang's Law or Brugmann's Law.

For the applicability of Stang's Law to **h_2*, compare the acc.sg. and acc.pl. of fem. **eh$_2$*-stems (for discussion, see Ringe 2006: 20-1; 73-4):[57]

1. acc.sg. Skt. *-ām*, Av. *-ąm*, Gk.-ην, Lat. *-am* (< *-ām*), Goth.*-a* < IE *[-ām] ← */-eh$_2$-m/.
2. acc.pl. Ved. *-ās*, Av. *-å̊*, Gk. -ης, Lat. *-ās*, Goth. *-os* < IE *[ā(n)s], ← */-eh$_2$-ns/.

The underlying and surface representations of the word for 'path', from PIE to attested Vedic and Avestan, may thus be reconstructed as in figure 2 (note the crucial morphological change in bold):[58]

i. fem. **h_2*-stems: *[ăh$_2$], *[ĭh$_2$]? *[āh$_2$], *[īh$_2$]? The precise reconstruction of the nom.sg. for the feminine nouns and adjectives in */-eh$_2$/, which provide parallel feminines to masculines/neuters in */-o/e/, is phonologically ambiguous: Ved. *-ā*, Av. *ă̄*, Gk. -η, Osc. **-ú**, *-o* all equally allow for *[ah$_2$] or *[āh$_2$] as a preform.[59,60] In case the surface form *[āh$_2$] is correct, an underlying form */-eh$_2$-s/ or earlier **[ah$_2$s] might account for the long vowel.[61] Indeed, Litscher (2013) has suggested the reconstruction *[ā$_2$]/*[īh$_2$] in order to account for the metrical behavior of the suffix in Vedic.

[53]Evidently a sequence [ms#] or [ām#] (except where overridden by Realize-Morpheme (see Section 7) as in the accusative singular) was not licit in a PIIr. surface form, thus selecting *[dʲʰás] as the optimal candidate.

[54]Thucydides *Hist.* 5.42.1.2.

[55]We, however, agree with Melchert (2014: 263) that the latter approach is "far from compelling."

[56]For discussion of the derivational history of this word, see now Steer 2013: 194-7.

[57]This apparent application of Stang's Law to **h_2* also strikes us as an unintuitive phonetic development, but it seems descriptively adequate.

[58]We reconstruct **o* in the root of **pont-oh$_2$-* because of the **o* grade in Lat. *pōns* 'bridge', Gk. πόντος 'sea', Arm. *hown* 'ford', OCS *pǫtъ* 'road', rather than adhering to a canonical amphikinetic ablaut pattern.

[59]The short *-ă* in the nom.sg. of the Lat. 1st declension remains mysterious; see Meiser 1998; Weiss (2009: 232) considers the development **ā# > ă* 'unlikely' (contrast *trīgintā* 'thirty').

[60]For discussion of why *[āh$_2$] might be a necessary preform to explain the Greek outcome, see section 8 below.

[61]The combination of laryngeal coloring and lengthening under this scenario does not conflict with Eichner's Law (Eichner 1973), because Eichner's Law prevents coloring only in *underlying* (i.e., lexically or morphologically specified) long vowels. The historical derivation **[-ah$_2$s] > *[āh$_2$] implies the lengthening of a laryngeal-colored vowel, not the coloring of a long vowel; similarly, a synchronic derivation */-eh$_2$-s/ → *[-āh$_2$] does not have an underlying long vowel.

Figure 2: IE **pónt-oh₂-*

Form	PIE		Earlier PIIr.	
	UR	Surface	UR	Surface
Nom.sg.	*/pont-oh$_2$-s/	*[póntōh$_2$]	*/pant-aH-s/	*[pántāH]
Acc.sg.	*/pont-oh$_2$-m/	*[póntōm][a]	*/pant-aH-m/	*[pántām][b]
Nom./Acc.du.	*/pont-oh$_1$-h$_1$e/	*[póntoh$_2$h$_1$e]	*/pant-āH-āH/	*[pántāHāH]
Nom.pl.	*/pont-oh$_2$-es/	*[póntoh$_2$es]	*/pant-āH-as/	*[pántāHas]
Form	Later PIIr.		Attested	
	UR	Surface	Vedic	Avestan
Nom.sg.	***/pant-āH-s/**	*[pántā(H)s]	*pánthāḥ*	*paṇtå̊*
Acc.sg.	*/pant-āH-am/	*[pántāHam]	*pánthām*	*paṇtām*
Nom./Acc.du.	*/pánt-āH-āH/	*[pántāHāH]	NA	NA
Nom.pl.	*/pant-āH-as/	*[pántāHas]	*pánthã̄ḥ*	*paṇtānō*

[a]Or *[póntoh$_2$m̥]
[b]Or *[pántāHam]

Perhaps the most crucial point concerning the seeming absence of the marking **-s* in "motion" feminines is the relative chronology of a possible SzL and the development of the feminine gender altogether. Assuming that some version of SzL *qua* sound law is correct, it must have operated in High IE, at latest, given the testimony of Anatolian *n*-stems. At the same time, we hold (as per Melchert 2014: 259) that the "development of the feminine gender is an innovation of Core Indo-European." "Motion" feminines as such therefore would not have been subject to SzL as a diachronic process. Nevertheless, if Melchert (2014: 263) is correct that the suffix **-(e)h$_2$* could serve in High IE (as still shown in Anatolian, e.g., the Lycian "professional" suffix *-(a)za-* < **-ti̯eh$_2$-*) "to derive grammatically animate substantives, at least some of which referred to (human) individuals" then the absence of **-s* marking on such pre-feminine nouns is just as problematic as on motion feminines themselves.[62]

The point of this discussion is simply to make clear that the apparent absence of sigmatic marking on motion feminines cannot play a substantial role in any discussion of SzL. On the one hand, the nom.sg. does not categorically exclude the possibility of an underlying or historical nominative /-s/ marker. On the other hand, the precise history and genesis of the motion feminines (and exactly whatever category underlies them) remains too uncertain (see many fine articles in Neri & Schuhmann 2014) for one to state decisively that such formations ought to have been analyzed by a learner as proper bearers of the animate sg. marker */-s/.

j. **t*-stems: High IE *[-ŏts] > Core IE *[-ōs].[63] On the category of nouns formed with a derivational suffix **-ot*, see now Vijūnas 2009: ch. 5. Hittite nom.sg. *garāz* 'intestine', is indicative of an *[ō] in the suffix, but the suffix is more likely to be **-od* than **-ot*, given the lack of geminate spelling of the dental (e.g., acc.sg. *ka-ra-a-ta-an* (OH/MS); compare also Gk. χορδή 'gut'); see the discussion in Vijūnas 2009: 185, Rieken 1999: 139, and Kloekhorst 2008: 445-6. The plene spelling in *ka-ra-a-a*[*z*] (OH/MS), however, may point to an original long vowel of this suffix, thus PAnat. *[garHáts] * < *[ĝ^{h}órHōdz].[64] Conversely, the large number of action nouns with the suffix *-att* (Hitt. *aniu̯att-* 'task, ritual', CLuv. *ariu̯att*(*i*)- 'mountain'), which likely do reflect a suffix */-ot/, do not exhibit plene

[62]The *-s* marking on the parallel Greek formations in -ᾱς and -τᾱς is not fatal; such formations inherited surface forms without *-s* (compare the cognate Latin type in *-ā̆*), but gained the *-s* in Greek.

[63]Compare the discussion on **pod-* 'foot' in Section 2 above.

[64] Lith. *žárnos* 'bowels' confirms *o*-grade of the root and a laryngeal; Greek χορδή 'gut' (without laryngeal reflex due to the Saussure Effect) appears to show the same suffix **-od*, reduced to zero grade due to the dominant derivational suffix */ā́/. Yet High IE */ĝ^{h}órH-ōd-s/ → [ĝ^{h}órHōts] should then have produced Hitt. ^{X}*ka-ar-ra-a-az*, with geminate *r*.

spelling in the suffix. Consequently, whether High IE stems built with the suffix */-ot/ showed a nom.sg. *[-ŏts] or *[-ōts] is not entirely certain.

The evidence of the few Core IE nouns derived with */-ot/, however, point clearly to a nom.sg. surface form *[-ōs]: Lat. *nepōs*, Av. *napå* (Ved. *nápāt*) < *[népōs]; Gk. εἰδώς, Goth. *weitwoþs*, OIr. *fíadu* 'witness' < *[u̯éi̯tu̯ōs]. The Germanic forms that point to PGerm. *[-ōþs] (cf. also Goth. *menoþs* 'moon' < */meh$_1$-n-ōt-s/) are important, in that they point to the maintainence of *[ō] when the constraint *C$_{[+cor, -son, -cont]}$s was not acquired in PGerm.: PGerm. learners did not attribute surface *[ō] in forms like *[mēnōs] to compensatory lengthening from loss of the underlying dental, but understood the *[ō] as underlying */ō/. Hence, from surface *[-ōs], PGerm. learners recovered */-ōþ-s/, and then allowed *[-ōþs] to surface. The further implication here is that IE *[-ōs] reflects */-ōt-s/, not */-ot-s/.

Hence, we may conclude that all polysyllabic animate consonant stems in PIE exhibited a long vowel of the final syllable and, with the exception of dental stems, lacked the surface marker *[-s].

3.2 Morphophonemic Analysis of the Indo-European Animate Nominative Singular

We have given a detailed presentation of such familiar material above in order to emphasize the self-evident distribution between the presence and absence of a morpheme *[-s] in the nom.sg. of animates in PIE. Setting aside the complications seen in the **o/eu̯*-stems, **m-stems*, and **h$_2$*-stems, for which we offered possible accounts above, one sees clearly that, in polysyllabic words, long vowels in final syllables occur in complementary distribution with *[-s]. This complementary distribution may be formulated as follows: fricatives may occur in a coda following a [-consonantal] (vowels) or a [-sonorant, -continuant] (plosives) segment, but do not occur following a [+sonorant, +consonantal] (liquids and nasals) or [+continuant, -sonorant, +consonantal] (liquids and fricatives) segment. Whether [+continuant, -sonorant, +consonantal] segments in fact play a role here is uncertain, because the evidence from laryngeal stems either is very sparse (limited essentially to */pont-oh$_2$-/) or difficult to interpret (feminines in *-*eh$_2$* or *-*ih$_2$*). Absolutely clear is that vowels and plosives cannot form a natural class, whereas liquids, nasals, and fricatives each do form a natural class, and liquids fall into larger natural classes with both nasals and fricatives. Straightforward morphophonemic analysis of the kind discussed in Section 2, when applied just to the data on the nom.sg. presented in the above section yields the following conclusions:

- the morphological marker of nom.sg. animates in PIE is */-s/, as its surface occurrence in vowel-final and plosive-final stems shows.
- in polysyllabic stems, the complementary distribution of the inflectional morpheme *[-s] and long vowels of the final syllable demands that the underlying sequence of phonemes and morphemes be */-VC-s/.
- since the final segments of the syllables in which the long vowels occur can be sorted into natural classes by phonological features, one can construct phonological constraints that account for the distribution of *[-s] and the long vowels: *C$_{[+sonorant]}$s (and perhaps *C$_{[+continuant]}$s).

A crucial point to recognize here is that a purely *synchronic* morphophonemic analysis of the PIE data, as obtained through external reconstruction, demands that one posit underlying representations of the form */-VC-s/ which gives surface *[V̄C] (obtained by external reconstruction), in the nom.sg. of animate [+sonorant] stems, at least. Even if the vowel length in sonorant stems were to have a diachronic source that were not to coincide with the synchronic underlying representation, this synchronic analysis of PIE would still hold good. But without data from a true sister language to PIE that could evince a different diachronic source for the long vowel in final syllables of sonorant stems, the morphophonological analysis that gives the underlying representation for the synchronic grammar (and is equivalent to internal reconstruction) may reasonably be assumed to hold true diachronically. The assumption of any other source for those long vowels in the nom.sg., without *further external evidence outside PIE*, would not be the most parsimonious analysis of the data.

Consequently, we may, at minimum, write the following morphophonological rule for PIE:

(9) Szemerényi's Law (Nom.Sg. Limited).

PIE */VR-s#/ → { V̄R /__#

An underlying */-s/, the marker of the animate nom.sg., is deleted word-finally following a [+sonorant] consonant, with concomitant lengthening on the preceding vowel.

We believe that the relatively tidy distribution of nom.sg. */-s/ and long vowels in final syllables is sufficient to establish a pre-PIE sound change and some (set of) phonological constraint(s) active in the grammar of PIE; the problem is merely how to motivate the sound change phonetically, and how to model the morphophonological alternations in PIE. However, other evidence, which points to a yet broader phonological development, is available, and some possible counterexamples require attention.

3.3 Further Evidence

In this subsection, we present in a more cursory fashion material that is indicative of a PIE process */VCC/ → *[V̄C].

1. The ending of the 3,pl. of the perfect. On this point, reproduction of the discussion in Kim 2001: 127-8 suffices; Kim says that not explainable by "any imaginable analogy" is

> "the alternation between the reconstructed 3pl.perf. endings *-*ēr* (Hitt. -*ēr*, Lat. -*ēre* < *-*ēr* + *i*) and *-*r̥s*, attested in Skt. 3pl. -*ur* (cf. *r*-stem gen./abl. sg. -*ur* < *-*r̥s*, originally proper to acrostatic inflection) and the isolated GAv. *čikōitərəš* 'they have understood' (or 'had understood'; Jasanoff 1997) next to usual -*arə̄*. Jasanoff (1988: 71 fn. 3) observes that if *-*ēr* continues earlier **-*ers*, we have a simple case of ablaut variants **-*ers* ∼ *-*r̥s* > *-*ēr* ∼ *-*r̥s*."

2. "Collective" or "Set" Plurals (largely after Nussbaum 2014). Already Szemerényi (1970: 155, 159) suggested, and Nussbaum (1986: 118 ff.) further argued, that the lengthened grade present in the in the suffix of forms such as Gk. ὕδωρ and Hitt. *u̯idār* was due to the same process that produced long vowels in the nom.sg., though in this case, through loss of the marker */-h_2/. We here reproduce a number of such cases:

(10) "Set" Plurals/Neuter Plurals with *V̄C#

a. *o̯i̯*-stem: Hitt. *ḫastāi* 'bone' < *[$h_2$óstōi̯].
b. *e̯i̯*-stem: Hitt. *utnē* 'land' < *[udnēi̯] (cf. Melchert 1994: 185).
c. **r*-stems: Gk. ὕδωρ, Umbr. *utur*, Hitt. *u̯idār* 'water' < *[u̯édōr]; GAv. *aiiārə̄* 'days' < *[$h_2$éi̯ōr]; Gk. σκώρ 'excrement' < *[sékōr].
d. **n*-stems: Goth. *namo*, GAv. *nāmą̄m* 'names' (cf. Ved. *nā́māni*) < *[$h_1$nóh_3mōn]; OHG *ancho* 'butter' < *[$h_3$óng^{w}ōn]; Gk. πῑ́ων, Ved. *pī́vān-* 'fat' (adj.) < *[píHu̯ōn].
e. **s*-stems: Av. *manå̊* 'minds' < *[ménōs]; GAv. *raocå̊* 'lights' < *[léu̯kōs].
f. **t*-stems: Goth. neut. *witoþ*, OHG neut./masc. *wizzōd* 'law' < *[u̯idōt].[65]

The existence of a "set" plural derivational morpheme *-(*e*)h_2 and a neuter plural inflectional morpheme *-h_2 is beyond doubt;[66] the neut.pl. inflectional morpheme Lat. -*a*, Gk. -α, Indo-Iranian *-*H* (Ved. *vásū*

[65] See Vijūnas 2009: 210 on the interpretation as an original collective. Vijunas (*loc. cit*: fn. 436) explains that the occasional masculine concord in OHG is secondary.

[66] On the grammaticalization of *-h_2 as an inflectional ending already in PIE, see Melchert 2011.

'goods', *yugá́* 'yokes'; YAv. *asti* 'bones' < *[$h_2$ást-h_2]) is sufficient proof. Essentially the same morphophonemic analysis as executed for the animate nom.sg. */-s/ falls out: */-h_2/ surfaces in vowel-final and plosive-final stems (e.g., the Ved. active participle shows neut.pl. *-ánti*), but does not surface in resonant-final or fricative-final stems, where instead a long vowel appears in the final syllable.

3. According to Jasanoff (1989), the OIr. neut. nom.sg. *bé* 'woman' < **bĕn* conceivably continues a **bēn* (by Osthoff's Law) < IE *[g^wé́n] ← */g^wen(-)h_2/. Skt. *jáni-* inflects as an *i*-stem, but this inflection could be based on a nom.sg. */g^wenh$_2$-s/ → [g^wenh$_2$əs] > nom.sg. *janīḥ*, where the seeming stem vowel is the reflex of the laryngeal. Similarly, the development *[g^wénh$_2$əs] > *[bénas] > *[bén] > OIr. *bé* is difficult to exlcude. If Jasanoff's interpretation is correct, it simply provides further evidence of the same sort as the neuter forms immediately above. Overall, the interpretative difficulties involved with the history of this word mean that it is best excluded from further consideration.

4. Kim (2001) also derives Toch. B. 2.sg. *śem* 'came' from IE **g^wé́m* < ***g^wém-s*. This outcome would match the long vowel found in the nom.sg. of *m*-stems. However, evidence of similar long vowels in the 2.sg. of root aorists or root imperfects is not readily forthcoming. One might imagine that a short vowel was not restored in this paradigm because the 1.sg. was also *[g^wé́m] in IE from */g^wem-m/.[67]

5. **[-Vrd] > [-V̄r#]. This development has one compelling example (nom./acc.sg. *[k̂erd] 'heart' > [kēr]: Gk. κῆρ, Ved. *hárd-i* with restoration of *-d*) and one possible example (3.sg.aor.inj. *[ker-d] 'he cut' > [kēr] >> GAv. *čōrət*); cf. Kim 2001: 128; 141.

6. **[-VRd#] > [-V̄R#]. This development would be a more general case of the above, for which Kim 2001 argues in order to account for Toch. B 3.sg. *śem* /śem-ə́/ 'he came' < **g^wēm* < ***g^wem-d* (perhaps rather *[g^wend]), with place assimilation of the nasal to the following stop), connecting also the vocalism seen in Lat. *vēnit*.

Whether the final two cases, which may exhibit loss of a word-final *[-d], properly belong with the evidence for loss of a word-final *[-s] or *[-h_2] is uncertain. If the final *[-d] in *[k̂erd] and *[g^wend] was indeed lost, then the vowel certainly would become long, due either to the PIE minimal word requirement (see Section 4.1), or to the same process that induces compensatory lengthening from loss of *[-s] and *[-h_2] in polysyllables (see Section 6). To connect this loss of *[-d] directly with the loss of the fricatives is impossible to motivate phonetically, without crafting a sound change that overgenerates. Hence, although the outcomes from loss of *[-d] resembles the outcome from loss of [-s] or *[-h_2] word-finally, loss of *[-d] probably has an separate phonetic motivation; to judge from the possible examples (*[k̂erd] and *[g^wend]), a dissimilation of [+coronal] consonants is conceivable.

3.4 Formulating Szemerényi's Law

The evidence that neuter plural/"collective" plural forms offer is crucial to a more complete understanding of SzL, because it indicates that not only PIE */s/ often failed to have a direct surface correspondent in complex codas at the word edge, but */h_2/ as well. This parallel behavior of */s/ and */h_2/, noted already by Szemerényi (1970: 155) and Nussbaum (1986: 129-30), happily falls out from the fact that both *[s] and *[h_2] are [+continuant, -sonorant] (fricative) segments. The rule given under (8), being a morphophonological rule limited to the nom.sg. */-s/, is not sufficiently powerful to capture the behavior of word-final */h_2/ as well; a strictly phonological rule/constraint is necessary. Given that no resonant-final stem attests a sigmatic nom.sg. or an inherited "collective" with a laryngeal direct reflex, the weakest version of such a phonological rule is stated here in example (11).

[67]Unhappily, the Toch. B. 1.sg. is probably *kámau*** /kəm-éw/, reflecting a short vowel in the root, though the form is unattested; cf. Winter 1999: 260-1 and Kim 2001: 122: fn. 8.

(11) Szemerényi's Law (Version 1 – Narrow).

PIE *VRF $\rightarrow$ { V̄R /__#

A fricative is deleted in a word-final coda sequence of the shape vowel + sonorant + fricative (*/s, h_1, h_2, h_3/), with compensatory lengthening on the preceding vowel.

Intriguing and puzzling, though, is the evidence from *_s_-stems, *_t_-stems, and other plosive-final root nouns, all of which also exhibit long vowels. Clearest are the two Avestan _s_-stem neuter plural forms, *manå̊* and *raocå̊*, both deriving from *[-ōs#], which show no other laryngeal reflex. Nussbaum 2014: 301: fn. 33 presumes that the long vowel in these forms is analogical to the neuter plural of resonant stems. Note, however, the OAv. neut.pl. *varəcāhī-cā* (Y. 32.14) 'glories', which must be Indo-Iranian at the oldest, since *varəcah-* (= Ved. *várcas-*) lacks any other etymological connections; *varəcāhī-cā* thus implies that productively built plurals of neuter _s_-stems employed the ending *-i* in Avestan. Consequently, the long vowel in *manå̊* and *raocå̊*, whether analogical or not, must be old. If Goth. *witoþ* and OHG *wizzōd* 'law' indeed reflect a collective **[u̯(e)idoth$_2$], they offer important evidence for loss of *[h_2] with compensatory lengthening following a plosive, though an analogical long vowel is difficult to exclude. The comparison of this long vowel to the long vowel in the nom.sg. of animate _t_-stems such as *[nepōs] 'nephew' and *[u̯eidu̯ōs] perf.part.act. to *_u̯eid-_ 'know', and the long vowel in root nouns such as *[u̯ōk^{w}s] 'voice' is suggestive: perhaps fricatives were lost word-finally after *all* consonants:

(12) Szemerényi's Law (Version 2 – Broad).

PIE *VC(C)F $\rightarrow$ { V̄C /__# / VCC /__#

A fricative is deleted in a word-final coda. sequence of the shape vowel + consonant + fricative (*/s, h_1, h_2, h_3/), with compensatory lengthening on the preceding vowel if lost word-finally after a single consonant.

The condition that compensatory lengthening does not occur in the configuration *VCCF > *VCC is based principally upon the absence of long vowels in the nom.sg. root nouns of the shape CVCC; the fact that *nt*-stems in Anatolian do not show signs of having contained a long suffix vowel suggests **[-e/onts] > *[-e/ont] would have occurred.[68]

This broad version of SzL has the advantage of directly accounting for many lengthened grade forms beyond the resonant stems to which SzL is traditionally restricted, through application of the same sound change that is necessary for the resonant stems. The obvious problem, however, becomes how to explain the restoration of the missing fricative morpheme solely to plosive-final stems; we discuss some possibilities, particularly as they relate to the root nouns, in Section 6.2. Whether the broad version or the narrow version of SzL is correct is undecidable on phonetic grounds; we show in Section 5 that loss of a fricative is, in either case, a plausible sound change.

3.5 Szemerényi's Law in Word-Medial Position

The sum conclusion that one should take away from the distribution of */s/ and /*-h_2/ with long vowels in final syllables in PIE is that a surface sequence *[-RF#] would have been illegal in PIE. Byrd (2010: 88) views the illicitness of the sequence *[-RF#] as reflecting a broader constraint present within early PIE, *RF$. In this way, the loss of fricative segments after resonants would not be a special Auslautsgesetz, but rather one which targeted syllable codas. He cites three examples of medial fricative loss in the sequence *[-RF$]:[69]

[68]The long vowels in Greek -ων and Lat. *-ēns* may indicate a continuing application of some active constraint *RF# in the grammar of later PIE; Ved. *-an*, and OAv. *-ąs* must all reflect language-particular treatments of underlying /-ant-s/.

[69]Of course, to accept the idea that SzL occurred word-internally in early PIE, one must consider the laryngeals to have been fricatives in PIE. For this view, we refer the reader to Weiss 2009: 50-1, with references.

- Skt. oblique *jánman-* 'birth', Dor. Gk. γέννᾱ 'descent' < *[ĝenmn-] ← */ĝenh$_1$-mn-/. The laryngeal is still maintained in the Skt. strong stem *jánima* 'birth' < *[ĝenh$_1$mn̥]. We may also account for no laryngeal reflex in Skt. *jantú-* 'person' (< oblique */ĝenh$_1$-tu̯-/), and perhaps also Lat. *germen* 'seed' (***genimen*).[70]

- Lat. *verbum* 'word', Hesych. †ἔρθει · φθέγγεται 'speaks' < ***u̯erd^{h}h$_1$o-* ← */u̯erh$_1$-d^{h}h$_1$-o-/. For the laryngeal, cf. Gk. ῥῆμα 'word', TA *wram* 'thing'. As correctly recognized by Yamazaki (2009), Lith. *vařdas* 'name' is ambiguous, since laryngeal loss in */u̯orh$_1$-d^{h}h$_1$-o-/ may also be attributed to the Saussure-Hirt Effect (Nussbaum 1997).

- OIr. *fo·ceird* 'places' < *[kerd^{h}h$_1$o-] ← */kerh$_x$-d^{h}h$_1$-o-/ . A laryngeal is required for Ved. *kiráti* 'spreads, pours out' < ***k̥rh$_x$éti*.

Many readers will of course note that such instances of laryngeal loss in the sequence */RHCC/ are typically explained by LEX SCHMIDT-HACKSTEIN (LSH), also known as the CH.CC > C.CC rule,[71] which most famously occurs in the oblique stem of 'daughter': */d^{h}ugh$_2$trés/ → *[d^{h}uktrés].[72] However, as discussed at length in Byrd 2010, word-medial sequences of the shape */RHCC/ behaved quite differently from those of the shape */PHCC/ (where P stands for any obstruent) with respect to LSH. For while there are no reconstructable exceptions to LSH for the sequence */PHCC/, there are numerous well-understood counterexamples to LSH in the sequence */RHCC/: *[k̂érh$_2$srom] (Lat. *cerebrum* 'brain'), *[temh$_x$sráh$_2$] (Skt. *tamisrā*, Lat. *tenebrae* 'darkness'), *[ĝénh$_1$trih$_2$] (Lat. *genitrix*, Ved. *jánitrī-* 'bearer, mother'), *[ĝénh$_1$d^{h}lo-] (Gk. γένεθλον 'relative'), *[h$_2$árh$_3$trom] (Gk. ἄροτρον *árotron*, OIr. *arathar*, Arm. *arawr* 'plow'), *[(h$_x$)i̯énh$_2$trih$_2$-] (Lat. *ianitrīcēs* 'brothers' wives'), and *[térh$_2$trom] 'auger' > Gk. τέρατρον, OIr. *tarathar*). As argued in Byrd 2010, this disparity may be directly attributed to syllable structure - it was possible for PIE speakers to syllabify laryngeals in codas of the shape *-Rh$_x$]$_\sigma$, but not in codas of the shape *-Ph$_x$]$_\sigma$, as the latter violates the SONORITY SEQUENCING PRINCIPLE (SSP).[73] In short, the comprehensive loss of */h$_x$/ in the word-medial sequence */PHCC/ was driven by illicit syllable structure, while the seemingly sporadic loss in the word-medial sequence */RHCC/ must have arisen for some other reason. Following Byrd 2010, we contend that this loss was triggered by the medial application of SzL.

If the narrow version of SzL did occur word-internally, then one would expect there to have been instances of */s/ deletion in sequences of the shape */-RsCC-/ as well. While we have not been able to find any such examples, it is noteworthy that an examination of the forms listed in the IEW, LIV, and NIL reveals a number of roots of the shape */-Rs/, such as ***d^{h}ers-* 'take courage',[74] ***ĝeu̯s-* 'taste'[75] and **(s)kers-* 'cut',[76] though only a fraction attest derivatives containing the sequence ***-RsC-*C- that are reconstructable for PIE. Moreover, in almost each instance that a sequence *-RsCC-* is attested, it clearly does not derive directly from PIE; cf. Lith. *žiezdrà* 'gravel; grain', *žiẽz(g)dros* 'gravel' to the root ***ĝeu̯s-* 'gravel' (IEW 356); PSlav. ***męzdra* continued by RCS *męzdrica* 'egg shell' and Russ. *mjazdra* 'the flesh-side of the hide' to ***mēms-* 'meat' (IEW 725); and OPruss. *tiēnstwei* 'excite' from ***tens-* 'thin out' (IEW 1069). In fact, we may identify only one reconstructable sequence of the shape *[-RsCC-]: **(h$_1$)oi̯s-tro-/-trah$_2$*, continued by Gk. οἴστρος 'rage', Lith. *aistrà* 'vehement passion' and Lith. *aistrùs* 'passionate', formed to the root ***h$_1$eis-*, as seen in Lat. *īra* 'anger' (Plautus *Truculentus* 262, 264 *eiram*).[77] One could reasonably attribute the absence of word-medial *-RsCC- sequences to the markedness constraint prohibiting codas of the shape *RF]$_\sigma$ (or *CF]$_\sigma$) proposed above.

[70] See de 2008:Vaan 261 for discussion.

[71] Schmidt 1973, Hackstein 2002.

[72] There are a number of other strong examples, such as Ved. *mahnā* 'size, power (instr.sg.)' (< PIE */meĝh$_2$-mnéh$_1$/) and Lat. *suēscō* 'am accustomed' < (PIE */su̯e-d^{h}h$_1$-sḱe-/).

[73] "Between any member of a syllable and the syllable peak, only sounds of higher sonority rank are permitted." (Clements (1990); cf. Keydana (2004)). Byrd considers both sonority rises (*-ts]$_\sigma$) and sonority plateaus (*-ept]$_\sigma$) to be violations of the SSP.

[74] IEW 259; LIV 147; NIL 120-2. Ved. *dhṛṣṇóti* 'is courageous', Goth. *ga-dars* 'dares'.

[75] IEW 399-400; LIV 166-7. Ved. *juṣāná-* 'taking pleasure', Goth. *kausjan* 'taste; meet'.

[76] IEW 945; LIV 355-6. Hitt. *karaššzi* 'cuts, fails', TB *śarsa*, TA *śärs-* 'knew'.

[77] IEW 299ff.; Olsen 1988: 16.

In word-final position SzL triggers compensatory lengthening (CL): */u̯édorh$_2$/ > *[u̯édōr], */ph$_2$térs/ → ***pəh$_2$tér***. Therefore, if word-medial laryngeal deletion in sequences of the shape */RHCC/ had been driven by SzL, one would perhaps expect to find CL as well, since the deleted laryngeal would have carried a mora. This of course was not the case: *[ĝénh$_1$mn-] > Skt.*jánman-*, not ^{X}*já́nman-*.[78] Earlier, Byrd (2010: 88ff.) suggested that expected CL did not occur in medial position due to the strong tendency in PIE to avoid superheavy syllables (syllables consisting of more than two morae), a tendency that may explain the prevalence of Osthoff's Law in the daughter languages and the application of Sievers' Law and certain instances of Schwebeablaut in PIE. Modelling this change within Optimality Theory, he contends that there was a reranking of two constraints in late PIE, with speakers moving from a grammar of coda fricative deletion (*[ĝenh$_1$.mn-] > *[ĝen.mn-] > *janman-*) to one of fricative retention (*[ĝénh$_1$.trih$_2$-] > *jánitrī-*). He uses the following four constraints in his analysis:

(13) Constraints for ⋆RF$ Analysis:

a. ⋆RF$: The output may not have the sequence sonorant + fricative immediately preceding a syllable boundary. Assign one ∗ for each violation.

b. Max-F: Each fricative in the input has a correspondent in the output. Assign one ∗ for each instance of deletion.

c. ⋆Superheavy: No medial syllable may consist of three or more morae. Assign one ∗ for each violation.

d. Max-μ: Every mora in the input has a correspondent in the output. Assign one ∗ for each instance of deletion.

According to Byrd (ibid.), the reranking of two constraints in the PIE grammar resulted in the conflicting set of data attested in the IE languages, which he assumes to have occurred in late PIE. The grammar in which SzL occurred prioritized the avoidance of resonant + fricative over the preservation of fricative segments (⋆RF$ ≫ Max-F), with CL being blocked in word-medial position (i.e., ^{X}[ĝēn]$_\sigma$[trih$_2$]$_\sigma$) on account of the constraint ranking ⋆Superheavy ≫ Max-μ.

(14) Variant One: /ĝenh$_1$trih$_2$/ → [ĝen]$_\sigma$[trih$_2$]$_\sigma$

/ĝenh$_1$trih$_2$/		⋆RF$	Max-F	⋆Superheavy	Max-μ
a.	[ĝenh$_1$]$_\sigma$[trih$_2$]$_\sigma$	∗!		∗	
b. ☞	[ĝen]$_\sigma$[trih$_2$]$_\sigma$		∗		∗
c.	[ĝēn]$_\sigma$[trih$_2$]$_\sigma$		∗	∗!	

In the grammar in which SzL does not occur the constraint ranking was Max-F ≫ ⋆RF$.

(15) Variant Two: /ĝenh$_1$trih$_2$/ → [ĝenh$_1$]$_\sigma$[trih$_2$]$_\sigma$

/ĝenh$_1$trih$_2$/		Max-F	⋆RF$	⋆Superheavy	Max-μ
a. ☞	[ĝenh$_1$]$_\sigma$[trih$_2$]$_\sigma$		∗	∗	
b.	[ĝen]$_\sigma$[trih$_2$]$_\sigma$	∗!			∗
c.	[ĝēn]$_\sigma$[trih$_2$]$_\sigma$	∗!		∗	

While Byrd's analysis successfully accounts for instances of medial laryngeal loss with no CL in */RHCC/ sequences, it runs into a serious roadblock. Byrd is forced to assume that the constraint ⋆Superheavy applies only to medial syllables, thereby restricting compensatory lengthening to final syllables: */u̯édorh$_2$/ > *[u̯édōr]. Otherwise, if ⋆Superheavy had applied to all syllables, we would expect */u̯édorh$_2$/ > [^{X}u̯édor].

[78] The forms Dor. Gk. γέννᾱ 'descent', Lat. *verbum* 'word', Hesych. †ἔρϑει 'speaks', and OIr. *fo·ceird* 'places' may have contained a long vowel in the initial syllable, but it is impossible to know due to Osthoff's Law.

(16) /u̯édorh$_2$/ → [u̯é]$_\sigma$[dōr]$_\sigma$

/u̯édorh$_2$/		*RH$	MAX-F	*SUPERHEAVY	MAX-μ
a.	[u̯é]$_\sigma$[dorh$_2$]$_\sigma$	*!		*	
b. ☞	[u̯é]$_\sigma$[dōr]$_\sigma$		*		
c.	[u̯é]$_\sigma$[dor]$_\sigma$		*		*!

However, the restriction of the constraint *SUPERHEAVY to medial syllables is unmotivated and ad hoc, and therefore this aspect of Byrd's analysis must be abandoned. In truth, as we will argue in section 6, the problem lies not with the constraint *SUPERHEAVY (which certainly applied to all syllables throughout the word); rather, the problem lies in Byrd's expectation that CL should have even occurred in the medial sequence */VRH/ upon loss of a laryngeal.

Leaving the problem of CL aside for the time being, we will follow Byrd (ibid.) in collapsing together the word-medial and word-final instances of fricative deletion in the sequence */-VC(C)F/, thereby viewing SzL as a phonological process in early PIE that targeted not only the right edge of words, but also the right edge of syllables.

(17) SZEMERÉNYI'S LAW (FINAL – BROAD).

$$\text{PIE *VC(C)F} \rightarrow \begin{cases} \bar{V}C\ /\_\_\# \\ VCC\ /\_\_\# \\ VC\ /\_\_\$C_0 \end{cases}$$

A fricative is deleted in a coda sequence of the shape vowel + consonant (+ consonant) + fricative (*/s, h$_1$, h$_2$, h$_3$/), with compensatory lengthening on the preceding vowel if lost word-finally after a single consonant.

3.6 Possible Counterexamples

Thus far, we have considered almost exclusively material that seems to speak in favor the operation of a sound change as formulated under 17 above. To our knowledge, our formulation of SzL *qua* sound change does not undergenerate; it successfully generates all the data for which the sound change is intended to account. However, one can point to a number of standard reconstructions where that sound change apparently overgenerates, that is, forms in which SzL ought to have applied, but apparently does not. Under the narrow formation of SzL (i.e., purely **RF]$_\sigma$ > *R), the instances in which SzL applied are limited to forms where a coda sequence RF in fact appears at a syllable boundary. As we noted in the immediately preceding subsection, numerous reconstructable instances of surface *RF]$_\sigma$ exist; we would claim that SzL did originally apply in such forms. Consequently, explaining the occurrence of such forms in IE is a problem of chronology, specifically, a problem of what phonological constraints were learned at what phases of PIE. We will defer discussion of this chronology to section 7. More immediately pressing are cases in which SzL appears not to apply in VRF]$_\sigma$ word-finally.

Besides the animate nom.sg. and "collective"/neut.pl., which provide the bulk of the evidence in favor of SzL, other inflectional endings that potentially create VRF]$_\sigma$ sequences at the word edge include the animate acc.pl. (in vowel stems), the gen.sg. (in "proterokinetic" resonant stems), and the inst.sg. (in "proterokinetic" resonant stems). The acc.pl. of vowel stems in particular directly requires an immediate preform *[-V̆ns#] in many daughter languages, e.g., Gk. -ους, Lat. *-ōs*, and Goth. *-ans* in *o*-stems. While the reconstruction of a gen.sg. *[-VRs#] and an inst.sg. *[-VRh$_1$#] in "proterokinetic" resonant stems (especially *i*- and *u*-stems) follows directly from commonplace assumptions about Indo-European accent and ablaut (cf. Schindler 1975), the direct evidence for such reconstructions is rather less widespread than for the acc.pl. *[-Vns#].

3.6.1 The Animate Acc.pl. of Vowel Stems

Kim (2013b) has recently treated the seemingly problematic relation between the animate acc.pl. and SzL in some detail; although Kim specifically examines only the acc.pl. of *o*-stems, his conclusions for that class may well apply to *i*- and *u*-stems as well.[79] Kim argues that SzL in fact did apply to the sequence **[-ons], thus producing *[ōn], at which point "since *o*-stem desinences already at this stage were no longer automatically analyzable as thematic vowel *-o- + case/number ending, there is no difficulty in supposing that (pre-)PIE opted for the second option [viz. replaced final *-m (or *-n) with *-ms]: thus **-oms > **-ōm (**-ōn) → *-ōns" (*op. cit.*). Therefore, Kim suggests that perhaps a pre-form *[-ōms] is to be reconstructed, and is in fact preserved as such in the following languages:

(18) *o*-stem acc.pl. *[-ōns]
   a. Vedic acc.pl. *-ān* (with sandhi variants *-āṃ*, *-āṃś* and *-āṃs*).
   b. Av. *mąθrå* (< *[manθrāh], with dissimilatory nasal loss < *[manθrānh]).
   c. Lith. *-ùs*, *-úos-*, Latv. *-us*, *-uõs-* < Proto-East Baltic (PEBalt.) *-ṓ(n)s.[80]
   d. PCelt. *[-ōns] > *[-ūns] > *[-ūh] > e.g., OIr. acc.pl. *firu* to *fir* 'man' (see also Griffith 2006).
   e. perhaps Hitt. *ku-u-uš* /kṓs/ 'these', *a-pu-u-uš* /abṓs/ 'those', < *[k̂ōms] and *[obṓms], respectively, assuming the maintenance of PIE **ṓ* before nasal in a final syllable.

Furthermore, Kim rightly notes that, at whatever phase in the prehistory of a given daughter language a constraint *RF]$_\sigma$ (or positionally restricted *RF#) ceased to apply, underlying */-V-ns#/ could have licitly surfaced as *[-Vns#] – *[V̄n#] was "analogically replaced by" *[-Vns#].[81] In addition, the operation of Osthoff's Law in many daughter languages would eliminate the distinction between *[-ōms#] and *[-ŏms]; thus Gk. -ους, Lat. *-ōs*, and Goth. *-ans* could continue either preform. All things considered, at least the Indo-Iranian evidence for IE *[-ōns] seems difficult to explain otherwise , and the overall compatibility of other daughter languages with that reconstruction speaks in favor of the idea that an acc.pl. **[-ōn/m], generated by SzL, existed at some point in the history of PIE.

The acc.pl. of *i*- and *u*-stems, from the testimony of Vedic and Baltic, at least, may support a scenario similar to that which Kim traces for the *o*-stems: **[-īn] and **[-ūn] created by SzL became *[-īns] and *[-ūns], respectively. Vedic certainly attests to the (masc.) acc.pl. *-īn* and *-ūn*, while Lith. *-ìs* and *-ùs* may continue PEBalt. *[-ī́(n)s] and *[-ū́(n)s], respectively.[82] Note, though, that Ved. *-īn* and *-ūn* may be an innovation (so Wackernagel & Debrunner 1930: 159-60, 208-9) to distinguish the inflection of masculine *i*- and *u*-stems from feminines (which usually show *-īs*, *-ūs*). On the other hand, consider that the gen.sg. of the "closed" and "open" inflections of *i*- and *u*-stems (i.e., gen.sg. *-eṣ*, *-oṣ* vs. *-ayas*. *-avas*). which must be inherited, also comes to distinguish masc. and fem. *i*- and *u*-stems in the history of Sanskrit.

3.6.2 Gen.sg. and Inst.sg. in "Proterokinetic" Inflection

Within the "proterokinetic" inflection as reconstructed according to the views of Erlangen School, the genitive and instrumental singular cases should have exhibited forms *[-VCs#] and *[-VCh$_1$#]. In the case of "proterokinetic" *i*-, *u*-, and *men*-stems, for instance, the gen.sg. would have been *[-ei̯s] (e.g., Ved. *agnéṣ* 'fire'), *[-eu̯s]

[79]Kim in fact seems to believe that SzL did not apply to **[-ins] and **[-uns] (he writes "*i*-stem *-i-ms, *u*-stem *-u-ms"), but under the formulation of SzL that Kim gives ("pre-PIE word-final *-VRs > *-V̄R"), that **[-ins] and **[-uns] became *[īn] and *[ūn] is inescapable.

[80]Kim assumes that inherited IE long vowels, except in absolute auslaut, give "acute" accentuation in Balto-Slavic. An alternative explanation for these Baltic forms is that, in the the acc.pl. of *eh$_2$*-stems, PEBalt. *[-aHns], the ending was reanalyzed as */-Hns/, and this ending was introduced to the acc.pl. of *o*-stems, thus producing an ending *[-oHns], whence *[-ṓ(n)s] (cf. Kortlandt 2006: 367). This explanation necessarily does not accept the application of Stang's Law in the acc.pl. of *eh$_2$*-stems.

[81]This possibility means that the forms of the nom.sg. anim. and neut.pl. with long vowels in consonant stems, would have been morphologized, but that an acc.pl. *[V̄n/m] in vowel stems never became morphologized.

[82]Note the same difficulties and alternative explanations for the long vowel and "acute" accentuation in Baltic as mentioned for the *o*-stems.

(e.g., Ved. *śatróṣ* 'enemy'), *[-mens] (e.g., OAv. *cašməṇg* 'vision'); such forms pose the same problem as an acc.pl. *[-Vns] for SzL and any phonological constraints in PIE that might recapitulate the sound change. However, whether the reconstruction of "proterokinetic" paradigms, with a strong stem R(é)-S(z)-E(z) / weak stem R(z)-S(é)-E(z) is at all correct is currently a topic of debate. At minimum, the clean division between accent and ablaut between strong and weak cases of the "proterokinetic" type is in no way reconstructable for PIE; see Kümmel 2013 on the Indo-Iranian material in particular. The accent alternation that the "proterokinetic" paradigm sets up is also not directly attested, and Kiparsky (2010b), Keydana (2013b), Kim (2013a) and Pronk (2013) all observe that such an alternation of the accent is typologically to be excluded and/or difficult to capture with any synchronic accentual grammar.

Nevertheless, at least Indo-Iranian gives clear testimony to virtual forms gen.sg. *[-ei̯s], *[-eu̯s], etc. Apart from the syntagms *[démspoti-] 'master of the house' (Av. *dəŋgpaiti-*, Ved. *dán páti-*, Gk. δέσποτες) and *[nékʷtsmēh$_2$u̯r̥] 'evening time' (Hitt. *nekuz meḫur*) the genitive ending *[-s] finds little direct support elsewhere. Difficult to dismiss is the seeming word equation found in the *u*-stem gen.sg. of 'son': Ved. *sūnóḥ*, Goth. *sunaus*, Lith. *sūnaũs*, which imply an Indo-European gen.sg. *[suHnóu̯s]. First, one must take into consideration the distribution of suffix full-grade and suffix zero-grade seen in Indo-Iranian "proterokinetic" *i*- and *u*-stems: zero grade appears before ending beginning with a consonant, nom.sg. *-*s*, acc.sg. *-*m*, inst.pl. *-*b^{h}is*, loc.pl. *-*su*. Furthermore, as Kümmel (2011) has established, *i*- and *u*-stems showing full grade of the suffix at all originally were exclusive to roots with a uniformly heavy syllable, i.e., roots of the shape CVCC- or CV̄C-. The Indo-Iranian evidence thus indicates that "proterokinetic" ablaut has a phonological conditioning. Only the gen.sg. is strange, in exhibiting a suffix full-grade before an apparently consonantal ending, *[-s]. Keydana (2013b: 52-3) suggests that a gen.sg. of the form *[-éu̯s] or *[-ei̯s] is motivated by a paradigmatic uniformity constraint, which forced the forms of the singular to be consistently bisyllabic, and forms of the plural to be consistently trisyllabic. Hence, underlying gen.sg. */suH-nóu̯-e/os/ surfaces as *[suHnéu̯s], with deletion of the ending's vowel. If the enforcement of such paradigmatic uniformity were to postdate the cessation of the constraint *RF]$_\sigma$, then no conflict with SzL arises. We see no decisive evidence on this point.

As for a "proterokinetic" inst.sg. *[-VCh$_1$], there is probably no good evidence whatsoever. Hale (2010) has suggested that "proterokinetic" *s*-stem instrumentals are preserved in Ved. *śavas* 'with power' (RV VIII.3.6a) and *vácas* (*návyasā vácah* RV II.31.5c, VI.48.11b, VIII.39.2a and *divímatā vácaḥ* RV I.26.2c).[83] The interpretaion of *śavas* is ambiguous; at VIII.3.6a, a reading as an acc.sg., rather than an inst.sg., is altogether possible, and the interpretation as a nom./acc.sg. is formally preferable in any case. As for *návyasā vácah* and *divímatā vácaḥ*, were expected inst.sg. *vácasā* to occur in these phrases, which appear only line-finally (as opposed to line internal *návyasā vácasā*), an illicit choriambic metrical structure would result. Useful to compare is the construction *návyam arkaíḥ* or *návyam gīrbhiḥ* (RV I.190.1b, VIII.161b., resp.) 'anew with songs', thus consisting of adv. + inst. Perhaps, then, *návyasā vácah* reflects a structure inst. + adv. (with a neut.nom./acc.sg. in adverbial function), as a poetic repair to the illegal line-final ^{X}*návyasā vácasā*. An altogether different possibility (Brent Vine, p.c.) is that *návyasā vácah*, which occurs only in 11 syllable lines, is a conversion from an unattested *návyasā vácasā* in a twelve syllable line, as one sees in the usage of the Ved. 2.pl. ending *-t*(*h*)*a*(*na*) and other forms (cf. Lubotsky 2004).

In short, as long as the status of "proterokinetic" paradigms remains a matter of contention, one cannot adduce the possible paradigmatic forms thereof as serious counterevidence to SzL.

4 Alternative Proposal: the Wackernagel-Kortlandt Hypothesis

Kortlandt (1975: 84-6), building upon suggestions in Wackernagel 1896: 66 ff., and whom Beekes (1990) in turn follows, has proposed that the vocalic nucleus of any monosyllabic word form was subject to lengthening, thereby producing long vowels. Kortlandt's account in particular intends to explain the lengthened grade that often appears in the nom.sg. of root nouns (e.g., *[u̯ók^{ʷ}s]), and the persons singular of the sigmatic aorist

[83]The following discussion is based on working notes of Jesse Lundquist, who very obligingly shared his work and allowed for its inclusion here; all credit on this point is owed to him, while responsibility for error or misrepresentation belongs with the authors.

indicative.[84] The assumption of monosyllabic lengthening (MSL) alone, however, will not account for all reconstructable cases of lengthened grade, as one finds lengthening in disyllabic stems such as *[pəh$_2$tḗr] 'father' as well. It is for this reason that both Kortlandt and Beekes (once again following Wackernagel) must assume an additional phonological rule: the lengthening of pre-resonant vowels in word-final position (*/ph$_2$tér/ → *[pəh$_2$tḗr]). We will address this latter proposal in section 4.2 below.

One distinct advantage that the Wackernagel-Kortlandt hypothesis (WKH) has over SzL is its ability to explain lengthened grade in nouns such as *[u̯ṓk$^{\text{w}}$s] 'voice', which have no apparent loss of postconsonantal *[-s]. However, the WKH in no way handles all cases of lengthened grade in the nom.sg. of obstruent stems. For while the lengthened grade within certain monosyllabic root nouns may be neatly explained, the nuclei of others remain mysteriously short, such as the widespread and well-understood form *[nó/ék$^{\text{w}}$ts] 'evening, night', for which all attested languages indicate a short vowel (Goth. *nahts*, Lat. *nox*, Gk. νύξ, Ved. *nák*, Hitt. gen.sg. *nekuz*, OIr. *innocht*, etc.). According to Beekes (1990: 39-40), "the solution must probably be found in the ablaut", despite the fact that */pód-s/ [pṓ(t)s] 'foot' illustrates the same type of paradigmatic ablaut (*o/e*) as the vexing noun in question. Moreover, The WKH is unable to account for those rare, but genuine instances of lengthening in disyllabic *t*-stems such as */nep-ot-/ and */u̯eid-u̯ot-/, as well as lengthening in the feminine *h_2-stems.

4.1 Lengthened Grade in Monosyllabic Word Forms

Although SzL, as formulated above, is not entirely free of complications, we should evaluate its likelihood and explanatory adequacy in comparison to the competing theory that attempts to account for a similar set of data. Therefore let us now turn our attention to the phonetic and phonological plausibility of the WKH. First, is it reasonable for one to assume that MSL occurred in all monosyllables in PIE? The phonological literature is quite clear on this matter. In those languages where MSL must be considered to be a synchronic phonological process (Itô 1988: 123), it is utilized to make light monosyllables heavy, in order to satisfy a minimal word requirement that demands that a lexical item consist of at least two morae.[85]

(19) Minimal Word Requirement (MWR).
Any word bearing stress must consist of at least two morae.

There are numerous cases of MSL across the Indo-European world. For example, in Old Irish, vowels found in open monosyllables are lengthened if the word bears stress; contrast the pairs *sé* ∼ *sessed* 'sixth', *mé* 'I' ∼ *messe*, *gé* 'pray (3.sg.subj.)' ∼ *gessam* (1.pl.subj.), and *trú* 'doomed person (nom.sg.)' ∼ *troch* (gen.sg.). However, in unstressed monosyllables the vowel is never lengthened, as we see in the unstressed clitic *de* 'from him, it' (not $^{\text{X}}$*dé*). Whether the lengthened vowel in the monosyllable was historically or synchronically derived is irrelevant; *synchronically* there are no stressed monosyllables in Old Irish that consist of a single mora. Since coda consonants are moraic in Old Irish, closed monosyllabic words do not undergo MSL: /troch/ ↛ $^{\text{X}}$[trúch].

However, in certain languages one finds instances of MSL in closed syllables as well. In many of these cases the coda consonant(s) in question are considered to be extrametrical, rendering said consonant(s) invisible to certain phonological rules (see below).[86] Thus, if a word of the shape /#CV#/ lengthens to [#CV̄#] and /#CVX#/ also lengthens to [#CV̄X#] by MSL, we may assume that X is extrametrical. For example, in Ponapean, a Micronesian language spoken primarily on the island of Pohnpei and the Caroline Islands, one finds vowel

[84]The sigmatic aorist must be wholly a separate problem, which we will leave aside for future discussion. As our treatment here will demonstrate, that a process of monosyllabic lengthening could generate long vowels forms such as 3.sg.aor.act.ind. *[u̯ḗḱst] 'led, carried' is not possible, and therefore inadequate as an explanation of the ablaut of sigmatic aorists.

[85]See McCarthy & Prince 1986 [1996]: 6-7 for discussion, with references. Typically it is thought that the MWR falls naturally from the prosodic constraint Foot-Binarity (Ft-Bin), which requires that all feet minimally consist of two morae (in quantity-sensitive trochaic or iambic languages) or two syllables (in non-quantity sensitive trochaic languages); however, see Garrett 1999 for a different view.

[86]Byrd (2010) considers such segments to be extrasyllabic, which are word-edge consonants that are syllabified at the level of the prosodic word. Note that by definition all extrasyllabic consonants are extrametrical.

lengthening in certain monosyllabic nouns ending in a consonant (Rehg & Sohl 1981: 117; McCarthy *apud* Itô 1988: 123 ff.).

(20) Ponapean Monosyllabic Noun Lengthening.

a. /pik/ → [pii⟨k⟩] 'sand' (vs. inflected *pik-en* 'sand of')

b. /pet/ → [pee⟨t⟩] 'bed' (< Eng. *bed*)

c. /keep/ → [kee⟨p⟩] 'yam', not **[keee⟨p⟩]

d. /kent/ → [ken⟨t⟩] 'urine', not **[keen⟨t⟩]

In Ponapean, a monosyllabic noun of the shape CVC behaves as if it is light, or consisting of only one mora, while a noun of the shape CVVC and CVCC behaves as if it is heavy. McCarthy argues that by assuming the final consonant of nouns to be extrametrical, the forms presented in (20) may be parsed as $[pi⟨k⟩]_\sigma$, $[pe⟨t⟩]_\sigma$, $[kee⟨p⟩]_\sigma$, $[ken⟨t⟩]_\sigma$. In the last two forms $[kee⟨p⟩]_\sigma$ and $[ken⟨t⟩]_\sigma$ are bimoraic and therefore syllabically heavy, whereas $[pi⟨k⟩]_\sigma$ and $[pe⟨t⟩]_\sigma$ are monomoraic and therefore light. It is for this reason that MSL occurs in monosyllabic nouns of the shape CVC — the phonology treats the final consonant as if it does not exist (cf. Section 6.1 below). To cite an example a little closer to home, a number of recent scholars (see Seiler 2009) have suggested that the lengthening found in monosyllabic words in NHG such as *Glas* [gla:s] 'glass', *Tal* [ta:l] 'valley', and *Weg* [ve:k] 'way', did not arise by analogy (as is the usual explanation)[87] but rather through a process of MSL within Middle High German in forms where the final consonant was extrametrical. Therefore $[gla⟨s⟩]_\sigma$, $[ta<l>]_\sigma$, $[ve⟨k⟩]_\sigma$ → [gla:s, ta:l, ve:k]. Note that (just as in Ponapean) words of the shape CVCC exhibited no lengthening in MHG: $[kin⟨d⟩]_\sigma$ 'child' > $[kint]_\sigma$, not $^{X}[ki:nt]_\sigma$ (Seiler 2009:258).

It also appears that in PIE the vocalic nucleus of a light monosyllabic word (i.e., a non-clitic) was lengthened in words of the shape CV and CVC in order to satisfy the MWR. This idea goes back at least as early as Hirt (1921-37: II/227), in order to account for long and short variants of some very common Indo-European words. Sihler (1995: 38) proposes that this lengthening occurred only when PIE monosyllables were stressed, as in Old Irish. If a minimal word requirement had been present in the proto-language, a restriction of vowel lengthening to stressed light monosyllables is to be expected, since lexical items require accentuation, while grammatical items (such as clitics) do not.[88] The most solid examples of MSL are presented in (21) below, primarily taken from Kapović (2006:147ff.).[89]

(21) Possible examples of lengthened monosyllables in PIE.

a. In open syllables.

i. ***b^{h}e*** 'emphasizing particle' (East Lith. *bè*), ***b^{h}o*** (Goth. *ba*, OCS *bo*) vs. ***b^{h}ē*** (perhaps Av. *bā*), ***b^{h}ō*** (Pol. *ba*) [90]

ii. ***de*** 'directional particle' (Lat. *quan-de*, *in-de*), ***do*** (OCS *do*) vs. ***dē*** (OIr. *dí*, Gk. δή, Lat. *dē*), ***dō*** (Lat. *dōnec*, OIr. *do, du*, PGmc. **tō*)[91]

iii. ***ku*** 'interrogative particle' (Skt. *kútaḥ*, Av. *kuϑa*) vs. ***kū*** (Skt. *kú́*, Av. *kū*)[92]

iv. ***me*** 'me (acc.)' (Gk. ἐμέ, με, OIr. *mé*, Goth. *mi-k*) vs. ***mē*** (Skt. *mā*, Av. *mā*, Lat. *mē-d*, Gaulish *mi*, Welsh *mi*)[93]

v. ***ne*** 'not' (Skt. *ná*, OCS *ne*, Lat. *ne-que*, Goth. *ni-h*) vs. ***nē*** (Lat. *nē*, OIr. *ní*, OCS *ně-*)[94]

[87]See Seiler, ibid. for discussion, with references. Gordon et al. (2010) also consider NHG to have extrametrical final consonants.

[88]Cf. Blevins & Wedel 2009: 158.

[89]Much of this discussion has already been presented in Byrd 2010: 96-100 with many corrections and updates.

[90]IEW 113.

[91]IEW 181 ff.; de Vaan 2008:162.

[92]IEW 647 ff.

[93]IEW 702.

[94]IEW 756-8.

vi. ***nu*** 'now' (Skt. *nú*, Gk. *nu*, Lat. *nu-nc*, OIr. *nu*, *no*, Latv. *nu*) vs. ***nū*** (Skt. *nū́*, Av. *nū*, Gk. νῦν, OCS *ny-ně*, Lith. *nū-naĩ*)[95]

vii. ***tu*** 'you' (Gk. *sú*, Latv. *tu*, OE *þu*, OIr. *tu-ssu*, Hitt. *tu-k*) vs. ***tū*** (Lat. *tū*, Hom.Gk. τῡ́νη, Av. *tū*, OCS *ty*, OE *þū*)[96]

viii. ***t(u̯)e*** 'you (acc.)' (Gk. *sé*, *té*) vs. ***t(u̯)ē*** (Skt. *tvā́*, Av. *θβā*, Lat. *tē-d*)[97]

ix. ***u̯e*** 'disjunctive particle' (Lat. *-ve*, Skt. *i-vá*) vs. ***u̯ē*** (Skt. *vā*, Av. *vā*, Gk. ᾗ-(ϝ)ε, ᾖ)[98]

b. In syllables with one coda consonant.

i. Endingless loc.sg. ***dōm*** > YAv. *dąm* 'in the house', implicit in Welsh *daw* 'son-in-law' < PCelt. **dām-o-*.[99]

ii. ***nos*** 'we' (Skt. *nas*, Hitt. *-naš*, YAv. *nō*, GAv. *nā*, Alb. *na*, Gk. νόσ-φιν 'apart (from)') vs. ***nōs*** (Lat. *nōs*, OCS *na*)[100]

iii. Endingless loc.sg. ***pēd***, implied by loc.pl. **pēd-su* > OIr. *ís* 'beneath', Alb. *për-posh*.[101]

iv. ***ub*** (Lat. *sub*) vs. ***ūb*** (OHG *ūf*, OCS *vy-sokъ*)[102]

v. ***úd*** 'on high' (Skt. *úd*) vs. ***ūd*** (Gmc. **ūt* > Goth. *ut* [ūt], Eng. *out*, Germ. *aus*)[103]

vi. ***u̯os*** 'you (pl.)' (Skt. *vas*, YAv. vō, GAv. *vā*) vs. ***u̯ōs*** (Lat. *vōs*, OCS *va*)[104]

If monosyllabic lengthening did exist as a synchronic phonological process within PIE, then it clearly must have occurred in words of the shape /#CV#/, thereby accounting for the long variants of **b^{h}e*/**b^{h}o* 'emphasizing particle', **de*/**do* 'to', **ku* 'interrogative stem', **me* 'me', **ne* 'not', **nu* 'now', **tu* 'thou', **t(u̯)e* 'thee', and **u̯e* 'or'. But there are six possible examples of monosyllabic lengthening in words ending in a single final consonant given in (21b) above. Had the coda consonant been weight-bearing, lengthening in words of the shape CVC simply should not have occurred. One could conceivably view four of these cases as einzelsprachlich (as per Byrd 2010:99-100), as the majority of long variants occurs in only three Indo-European (sub-)branches: Italic, Slavic, and Germanic, though we do not find such explanations altogether convincing. If, however, one accepts that all segments were extrametrical in absolute word-final position in PIE, then /CV́C/ words would be subject to the minimal word requirement and surface as $[\text{CV̄}\langle\text{C}\rangle]_\phi$. As in Ponapean and MHG, words of the shape */CVCC$_0$/ exhibited no lengthening: cf. $*[\text{h}_1\text{sén}\langle\text{t}\rangle]_\phi$ 'they were', $*[\text{nók}^\text{w}\text{t}\langle\text{s}\rangle]_\phi$ 'evening'.[105]

We therefore accept the idea that monosyllables were indeed lengthened in PIE, but not in an across-the-board fashion as the Wackernagel-Kortlandt Hypothesis would claim. MSL targeted *only* words of the shape */CV́/ and */CV́C/ in PIE. In this way one could account for MSL in resonant-final monosyllables such as *[ḱṵ́ón]

[95]IEW 770.

[96]IEW 1097.

[97]IEW 1097.

[98]IEW 75.

[99]Cf. Widmer 2008: 618.

[100]IEW 758. According to Kapović (2006: 151: fn. 442), lengthening should never have occurred in either **nōs* 'us' or **u̯ōs* 'you (pl.)', since, having been a clitic, it was always unaccented. However, in both cases the clitic forms have been reanalyzed as full-fledged (accentable) pronouns.

[101]Cf. Fortson 2010: 57.

[102]IEW 1106-7; Derksen 2008: 535.

[103]IEW 1103-4.

[104]IEW 514.

[105]If MSL is to be reconstructed as an active phonological process within the synchronic grammar of PIE, we must accept the inconsistent attestation of lengthened grade in the daughter languages. In fact, with the possible exception of Latin, the languages themselves are inconsistent, as in some instances the short form is continued while in others the lengthened form (cf. OCS *do* vs. *ně-*, Skt. *nú* vs. *vā*, Goth. *mi-k* vs. **tō*, etc.). Such inconsistency will perhaps explain why certain forms (such **k$^\text{w}$ód* and **ád*) are never continued as lengthened – for whatever reason, the stressed (and thus lengthened) form was never inherited. As for the absence of lengthening in the demonstrative pronoun **só*, etc. (Kümmel 2013), one could conceivably assume that it functioned as a clitic in the proto-language (despite its lexical accent), and therefore would not have been subject to MSL, though further research is required to back up such an assertion. However, should one choose to view counterexamples such as **só* as evidence that MSL did not occur within PIE *in any fashion*, the burden of proof lies with him to account for the lengthened forms cited above in a satisfactory manner.

'dog', but not in obstruent-final stems such as *[u̯ók^{w}s]. For if *[u̯ók^{w}s] was underlyingly */u̯ók^{w}-s/ and derived its lengthened grade by MSL, then it would defy any described behavior of minimal word phenomena, as it could only have been parsed as [u̯ók^{w}⟨s⟩]$_{\phi}$.[106] Thus, if the origin of the long vowel in this form was truly by sound law and not analogy, then it must be explained by some process other than MSL. As we will demonstrate below, should one choose to follow our broad version of SzL, then she may generate long vowels in monosyllabic words of the following three types: words of the shape /CV/, words of the shape /CVC/, and words of the shape /CVCF/, in which SzL applied, creating [CV̄C]. In most instances where the stem ended in a stop, the word-final F was restored, resulting in a word of the shape /CV̄C-F/.

4.2 Lengthening before Resonants Word-Finally

The second component of the Wackernagel-Kortlandt Hypothesis proposes that PIE vowels were lengthened before a resonant in word-final position: */ph$_2$tér/ → *[pəh$_2$tḗr]. Phonetically, this proposal is quite plausible and is supported by numerous cross-linguistic examples. For instance, in the Neo-Štovakian dialect of Serbo-Croatian, vowels are synchronically lengthened before a sonorant at two types of morpheme junctures, one that indicates inflectional constituency (/konac + a/ → [kōnca] 'thread' (gen.pl.); contrast *vosak, voska* 'wax') and another that indicates certain types of derivational constituency (/pijan + stvo/ → [pijānstvo] 'drunkenness'; contrast /brat + stvo/ → [bratstvo] 'brotherhood').[107] Pre-sonorant vowel lengthening must have occurred in Serbo-Croatian's linguistic past as well, for in the Posavian and North Čakavian dialects vowels were lengthened in open syllables only before sonorants in words of the shape **CVCʊ/ɪ*: **darʊ* > *da:r* 'gift' but **pragʊ* > *prag* 'threshold' (Kavitskaya 2002: 124). Thus, the notion that vowels were phonetically longer before sonorants than obstruents in early PIE is indeed a likely one, especially at a stage of the language where a contrast in vowel length did not exist.

However, while phonetically plausible, it is difficult to imagine a scenario in which pre-sonorant lengthening could have been phonologized. How did the phonetic change of */ph$_2$tér/ to *[pəh$_2$tḗr] lead to its reanalysis as */ph$_2$tḗr/? Such conditions for reanalysis in the Posavian and North Čakavian dialects have been convincingly identified by Kavitskaya (2002: 126 ff.), who shows that pre-sonorant vowels are significantly longer in open syllables than in closed ones. Once the apocope of final jers took place, speakers no longer understood the phonetic motivation for vowel lengthening, resulting in the phonemicization of vowel length. But such conditions for phonemicization are conspicuously absent in PIE. What would cause the speakers to attribute the phonetic length of the vowel to the vowel itself, rather than the following sonorant? Thus, even though phonetically the vowel in Standard American English *bear* is longer than in the word *bet*, both words phonologically contain the same vowel, and will continue to do so until some change occurs (such as the deletion of coda /r/ in non-rhotic dialects).

A further problem for the WKH is its arbitrary restriction of pre-sonorant lengthening to word-final position. Why is such lengthening not found word-internally? As a general rule, we believe that is unwise to use morphological and phonological boundaries in such an arbitrary fashion without explaining why they should produce different outcomes from their lower-level parallels; indeed, no such arbitrary divisions will be utilized in the current analysis, for we will demonstrate that SzL *qua* sound law occurred in all syllable codas, not just in auslaut position. But perhaps most seriously, as Beekes (1990: 45 ff.) himself admits, the number of secure instances where pre-sonorant word-final lengthening does not occur is quite substantial: accusatives of the shape **-Vm*(*s*), locatives in **-er*, the vocatives of **r*-, **n*-, and **u*-stems , the pronominal nom.pl. in **-oi̯*, the locative in **-oi̯*, etc. To account for these exceptions, Beekes is required to make quite a few ad hoc assertions about phonetic plausibility (e.g., "Phonetically it is unproblematic that *m* blocked the lengthening") and assumptions regarding a deep pre-proto-state of PIE that many scholars will perhaps find questionable (e.g., his views on the origin of **o* grade). In comparison, the classes of counterexamples that SzL faces (discussed un-

[106] On possible analyses of the lengthened grade in such root nouns, see Section 7.

[107] See Zec 2002 for further examples.

der 3.6 above) seem relatively limited. For these reasons – and for the reasons stated above in section 4.1 – we contend that both subparts of the Wackernagel-Kortlandt Hypothesis should be abandoned.

5 The Phonetics of Szemerényi's Law

In a forthcoming paper Keydana (2013a) claims that the widely-accepted phonological rule in question is "far less compelling than traditional sound laws". For Keydana, were the sequence */VRF#/ to simplify its final consonant cluster with compensatory lengthening, the only conceivable change would have been to *[V̄F] not *[V̄R]. In fact, according to Keydana (ibid.), only the liquid /r/ was weakened and lost in the original complex coda */Vrs/, which triggered compensatory lengthening on the preceding vowel (***pəh*$_2$*térs* > **pəh*$_2$*tés*). At this point, stem-final */r/ was reintroduced by speakers for reasons of paradigmatic uniformity (**pəh*$_2$*tés* → **pəh*$_2$*tér*), with further analogical spread of the lengthened grade to other nominative singular forms in the proto-language. We, of course, freely acknowledge that the change of */VRF#/ to *[V̄F] is a common cross-linguistic occurrence; cf. PGmc. **branxta* > OE *brohte* 'brought', PGmc. **fimf* '5' (Grm. *fünf*) > OE *fīf*, and Eng. *five* [faɪv] > Southern American English [fa:v]. And though we agree with many of Keydana's criticisms of SzL as it has been traditionally explained (see below), we will demonstrate in this section that the change of */VRF#/ to *[V̄R] (and more broadly */VCF#/ to *[V̄C]) is indeed a compelling sound law, as SzL is rooted in a straightforward and natural phonetic explanation.

5.1 Earlier Phonetic Views of SzL

Maintaining his earlier views presented to the Oxford Philological Society in 1957, Szemerényi first published a brief sketch of SzL in 1962, with no mention of those scholars who had proposed essentially identical views. He writes: "[T]he typical mark of the Indo-European nominative in the animate class (masc. and fem.) is a final *-s*; cf. Latin *equus, ignis, manus*. We must therefore assume that the same was true of the nasal, liquid, and *s*-stems, too, where the lengthened grade nominative is found. In other words the nominative of, e.g. **māter-*, was *māters*. If instead of this form we find **mātēr*, the explanation is simply that **māters* was assimilated to **māterr*, and subsequently the quantity was transferred to the vowel. In the same way, **gh*(*e*)*mon-s* > **gh*(*e*)*monn* > **gh*(*e*)*mōn*; **ausos-s* > **ausōs*; and, in the dental stems, **pod-s* > **poss* > **pōs* (sometimes restored to **pōd-s*, with *-s* and vṛddhi!)." Szemerényi thus viewed the phonological rule in question as a word-final process of consonant gemination (**gh*(*e*)*mon-s* > **gh*(*e*)*monn*), with subsequent degemination **gh*(*e*)*monn* > **gh*(*e*)*mōn*, the latter which leads to a transferrance of syllabic weight to the preceding nucleus. He suggests that stem-final dental stops are restored in certain languages (such as Hittite), though provides no explanation as to why such stems were different from the others (e.g. **mātēr*) or why lengthening occurs in labial and dorsal stems (such as **u̯ó́k*^{w}*s*) as well.

Following Szemerényi's initial suggestion of cluster gemination with subsequent degemination, Vaux (2002) further proposes SzL to have been the simplification of a coronal + coronal sequence in the syllable coda,[108] motivated by OCP constraints on the Place tier.[109] Vaux further compares Stang's Law, which he views as the simplification of a labial + labial sequence (*/Vu̯m-m/ → *[-V̄m#]), setting aside instances of */eh$_2$-m/ →*[-ām#]. For Vaux (2002:327), such constraints "disallow adjacent identical place feature specifications in IE roots, codas, and syllable junctures, and a constraint against geminates", citing the well-known absence of roots of the shape */C$_\alpha$VC$_\alpha$/ (*/ses/ 'sleep' being the lone counterexample),[110] the lack of *-mo- suffixation to labial roots, and the complete avoidance of heteromorphemic geminates.[111] In order to explain SzL as an instance of place dissimilation, Vaux must restrict the process in question to the non-plosive coronal consonants */r, l, n, i̯, s/ + */s/. Sequences of the shape coronal stop + */s/ (such as */pod-s/ 'foot') were exempt

[108]Nevertheless, he only considers word-final codas in his analysis; see section 8 below.

[109]The Obligatory Contour Principle (OCP) may be defined as follows: "At the melodic level, adjacent identical elements are prohibited" (McCarthy & Prince (1986 [1996])).

[110]Watkins 1992: 31.

[111]See Byrd 2010: 15-22, with references.

from SzL due to the violation of the Sonority Sequencing Principle.[112] In such cases word-final */s/ was realized as extrasyllabic (also known as a syllable appendix), an environment which Vaux proposes to have been exempt from the OCP-Place constraint; see Vaux 2002:322ff. for discussion, with references.[113] He also accounts for loss of */s/ with CL in forms such as **dʰéĝʰōm* 'earth', by reasonably assuming the change **-ms* > **-ns*, presumably with later restoration of the */m/ based on other forms in the paradigm (i.e., ***dʰéĝʰōn*).

We applaud Vaux's attempt to provide a grounded phonetic and phonological basis for SzL, yet we see a number of problems in his account. For while he is certainly correct that there was an OCP constraint in PIE that banned heteromorphemic geminates (which possibly also accounts for the absence of */C_1VC_1/-roots), it is highly unlikely that "identical Place specifications were not allowed to surface within single coda positions", as we may reconstruct a number of syllable codas composed of two coronal segments: cf. *[(e)g^{wh}end] 'he slew' (Ved. *áhan*(*n*)), *[k^{w}érd] '(s)he cut' (Hitt. *kwerta*),[*h$_1$ést] '(s)he was' (Luv. *āsta*), etc.[114] Vaux's account is also unsatisfactory in that he must ignore the application of SzL in word-final */-VCh$_2$/ sequences (such as *[u̯édōr] 'waters'), as loss of the pharyngeal fricative */h$_2$/ in this sequence could in no way be explained by OCP-Place. Moreover, Vaux considers OCP-Place to have operated both tautosyllabically (cf. */h$_2$éu̯s-os-s/ → *[h$_2$áu̯sōs]) and heterosyllabically (*/h$_1$és-si/ → *[h$_1$ési]), though it is clear that OCP-Place could not have applied to two adjacent coronals separated by a syllable boundary. The evidence is too great to list fully, though we trust that two universally-accepted reconstructions will suffice: PIE */V-nti/ '(3.pl. primary)' (> Skt. *sánti*, etc.) and PIE **ters-V-* 'be dry' (> Gk. τέρσομαι 'become dry', Skt. *tarṣá* 'thirst', etc.) But the most serious problem with Vaux's (and Szemerényi's) account lies in the assumption that a marked sequence such as *-C$_{[+coronal]}$s]$_\sigma$ would ever have resolved into a geminate sequence in the first place. Presumably speakers would not have replaced one disfavored sequence with another (arguably even more) disfavored sequence. One might invoke different time layers in PIE and suggest that in pre-PIE heteromorphemic geminates were licit, but there is absolutely no evidence that speaks in favor of this claim.

5.2 The Relevance of the Syllable for SzL

While Vaux's hypothesis ultimately misses the mark, we do believe that he was on the right track to restrict SzL to coda position, in which segments are more prone to lenition and loss. As early as Ohala and Kawasaki (1984), scholars have documented a number of differences in the behavior of segments in a syllable onset versus coda. For example, languages usually permit a greater variety and number of segments in the syllable onset than in the coda. This was certainly true of PIE, for which we may reconstruct approximately four times the number of onsets vs. codas (Byrd 2010: 163-5)[115] and in which obstruents were in many instances neutralized in coda position. Related is the widely-observed phenomenon that segments are better preserved diachronically in onsets than codas, for which the fate of **h$_2$* in Anatolian is a prime example (contrast *[h$_2$anti] > **ḫanti*(*-šši*) 'in his face' with *[h$_1$ésuh$_2$] > *āššū* 'goods'). There also appears to be an innate bias towards the onset in the phenomenon of Onset Maximization, in which speakers prefer to syllabify intervocalic /VCV/ as [V.CV].[116] Each of these observations naturally leads one to conclude that codas are more marked than onsets.

The reasons for this bias are partly articulatory and partly perceptual. As Ohala & Kawasaki (1984: 117) discuss, the transition from onset consonant (especially obstruent) to vowel creates an "abrupt change in transglottal pressure drop and in the pressure drop across the point of constriction at consonant release than at onset. This produces sudden changes in voice amplitude and in the case of voiced obstruents, fundamental

[112] See section 3.5 above.

[113] The framework of Byrd, forthcoming also treats such segments as extrasyllabic. Such a view is reinforced by the absence of reconstructable obstruent + obstruent medial coda clusters for PIE.

[114] On the other hand, */d/ deletion in [kḗr] 'heart' (← */kérd/) might support such assertions for an earlier stage of PIE. See discussion under 3.3 above.

[115] There are 111 different word-initial onset clusters reconstructable for PIE, compared to a mere 30 in word-final position. Should one also take extrasyllabicity into consideration, the latter number number drops significantly.

[116] According to Ohala and Kawasaki (ibid.), "The 'onset first principle' may derive from an attempt by the speaker to create maximally clear temporal anchors which will make his synchronization of the segmental and suprasegmental streams obvious to the listener... [H]e knows tacitly that there is greater pay-off in salience by making pre-vocalic segments precise than post-vocalic."

frequency." All of this results in a very noisy transition from onset to nucleus, thereby making an onset consonant more salient (i.e., more perceptible) than a coda one. CV sequences (onset + nucleus) are also more perceptible than VC (nucleus + coda) sequences due to the nature of coarticulation (assimilation), which is more thoroughgoing within a syllable rhyme, producing a nucleus that is more colored by (and therefore more similar to) a coda consonant than the preceding onset (Ohala and Kawasaki, ibid.). Since onsets are more perceptually different from the vowel nucleus than are codas, they are more salient, leading to a speaker's ability to perceive differences in onset consonants more easily than for codas. It is for this reason that that listeners rely on CV cues rather than VC cues to determine the place of articulation of a consonant and that coda consonant cues are often misinterpreted as features of the vowel, leading to the creation of new phonological rules (such as vowel nasalization) and even new phonemes (such as phonemic nasalized vowels in French).

5.3 Szemerényi's Law as the Lenition of Coda Fricatives

As in all languages, coda segments in PIE would have exhibited greater coarticulation with the preceding nucleus, would have been more difficult to perceive, and therefore would have been more prone to lenition and loss. In fact, as Solé (2010) discusses in great detail, it is even more common for fricatives (vs. other segments) to be weakened or deleted in coda position. It thus makes good sense to follow Vaux in restricting SzL to the syllable coda, a process that we propose to have first begun as fricative lenition which then led to loss. The lenition of fricatives takes many guises : gliding (Ital. *noi* 'we' < Lat. *nōs*), rhotacism (Eng. *ear* < PIE *[$h_2$au̯s-]), debuccalization (Southern Span. *doh* 'two' ← *dos*), gemination (Aeol.Gk. ἔμμι < **esmi*), or some combination thereof (Gascon [es], [eh] / __voiceless stop, [ei] / __voiced C, [ez] / __V < Lat. *est* 'is'). Lenited voiced coda fricatives usually become glides (or in the case of alveolars, rhotics), while lenited voiceless coda fricatives typically lose all place features (debuccalization), resulting in glottal [h]. These lenited segments may then be lost; cf. French *nous, vous* 'we, you (pl.)' from Lat. *nōs, vōs*, respectively.[117]

According to Solé (ibid.), when articulating fricatives speakers must follow "strict positional, aerodynamic and time constraints to generate friction" in order for these segments to be properly perceived.[118] But given the tendency for lower oral pressure build-up, diminished frication, and lower velocity of air in the articulation of coda fricatives, it becomes increasingly more difficult for the speaker to meet these strict constraints, and consequently the more likely the fricatives in question will be misperceived as approximants or /h/. An observant reader will likely note that it is not the case that all coda fricatives were deleted in PIE, but rather post-consonantal (or post-resonant) coda fricatives. Such a restriction does not weaken our proposal that fricatives were lost in coda position due to diminished salience, for consonants are even less salient in post-consonantal (vs. post-vocalic) position. As Byrd (1996) demonstrates, coda consonant clusters exhibit a high level of coarticulation compared to onset sequences and thus are more difficult to perceive. For a direct comparandum of the narrow SzL *qua* sound change, cf. Icelandic, where forms such as *erfði* 'inherited', *hvolfdi* 'capsized' are realized as [erði], [k^hvɔltɪ], respectively (Côté 2004), both exhibiting fricative deletion in the complex coda VRF]$_\sigma$.

Earlier we identified two possible versions of SzL: a narrower one that specifies that fricatives were targeted only within the sequence VR__]$_\sigma$ (*[pəh$_2$tḗr] 'father') and a broader one that includes all post-consonantal fricatives in coda position (*[népō(t)s] 'grandson, nephew'). We may now identify the likeliest phonetic paths for each of these analyses. The narrower version should be explained by loss of fricative via approximantization of a voiced fricative (see (22a) below); the broader version through a combination of (22a) and the loss of a

[117]The majority of examples have been taken from Solé 2010: 290, to which we refer the reader for additional examples, discussion, and references.

[118]According to Solé (ibid.), fricatives may be characterized by the following four acoustic and articulatory properties. Fricatives: (1) are characterized by a high frequency noise, produced by turbulent airflow. This turbulence is the result of narrow articulatory constriction; (2) have very precise "articulatory positioning and shape to form an oral constriction within a certain critical range", more so than any other segments; (3) are characterized by a difference in pressure "across the constriction for high-velocity airflow, which requires a sufficient rate of flow through the glottis"; (4) maintain constriction size and transglottal flow over a certain period of time.

voiceless fricative via debuccalization (see (22b) below).[119] For at least the first scenario, one must assume that all post-sonorant fricatives were voiced in PIE in word-final position; therefore */s, h_1, h_2, h_3/ → *[z, ɦ, ʕ, ʕʷ]. While it is widely believed that stops were also neutralized to voiced unaspirated after sonorants in word-final position[120] (PIE */-t/ → *[-d] > Hitt. *pa-i-ta-aš* [páyd-as] 'went he', Old Lat. *feced* '(s)he made'; */up/ (cf. **upó*) → *[ūb] > PGmc. **ūp* > OHG *ūf*),[121] the same does not hold true for */s/ – the typical reconstruction is *[tómh$_1$os], not *[tómh$_1$oz]. However, it is clear that in Proto-Germanic all instances of post-vocalic */s/ were realized as *[z] in word-final position, a phenomenon typically attributed to Verner's Law in final stressed syllables, with later generalization of *[-z] in the endings of polysyllabic nominals in Proto-Germanic (Ringe 2006: 104). But there is no need to assume such analogical / systemic generalizations, as the voiced allophone *[z] could easily have arisen in PIE as a result of word-final voicing. In short, we propose that word-final neutralization targeted *all* obstruents in PIE, as neutralization processes are wont to do.[122] As for the broad version, voiceless */s/ and */h$_2$/ were debuccalized (i.e., merged with **h*$_1$) after a voiceless obstruent in a syllable coda,[123] which led to later loss. The merits of each version of SzL will be weighed in section 7 below.

(22) The Phonetics of SZEMERÉNYI'S LAW

a. Deletion via Approximantization of Voiced Fricative:
*/ph$_2$tér-s/ → *[pəh$_2$térz] > *[pəh$_2$térɪ] > *[pəh$_2$tḗr]

b. Deletion via Debuccalization of Voiceless Fricative:
*/népot-s/ → *[népots] > ***népoth*** > *[népōt][124]

6 The Phonology of Szemerényi's Law: Compensatory Lengthening

Thus far, we have presented argumentation to the effect that SzL *qua* sound change is supported by a morphophonemic analysis of the Indo-European surface forms (Section 3), demonstrated that the alternative explanations for the long vowels based on "monosyllabic lengthening" and "lengthening before final resonants" are untenable (Section 4), and provided a phonetic motivation for the diachronic loss of fricative segments such as **s* and **h$_2$* word finally as the tendency for fricatives to weaken in syllable codas generally (Section 5). However, the mere loss of those fricatives, whether via intermediate approximantization or debuccalization, does not directly account for the most salient ultimate effect: the apparent compensatory lengthening in the syllable to which that segment belonged. Szemerényi (1962) himself believed that the intermediate phase involved was full assimilation of the consonant, e.g. ***-rs* > **-rr* > **-r*; on this point, we concur with earlier criticisms of SzL that such a geminate would be unlikely, because there is no evidence in Indo-European or any pre-stage thereof for the presence of licit *surface* (heteromorphemic) geminate consonants. In a real sense, while the ultimate compensatory lengthening that occurs is intelligible under Szemerényi's original formulation, assuming that the segment of the geminate adjacent to the vowel is ultimately lost, such compensatory lengthening is not immediately to be expected under the phonetic account given in Section 5.

The principal object of this section, then, is to explain how a development of the type **[pəh$_2$térz] > *[pəh$_2$tḗr] can be possible. To understand this development, we must first discuss the nature of compensatory lengthening, both as a diachronic change and synchronic process active in the grammar of a language. The behavior of underlying heteromorphemic geminates and general phonological considerations (based on

[119]One could also conceive the broader version of SzL as involving solely the debuccalization of *all* post-consonantal coda fricatives, with voiceless fricatives becoming the voiceless glottal fricative *[h], voiced fricatives the voiced glottal fricative *[ɦ].

[120]Melchert 1994: 85, Ringe 2006: 20, etc.

[121]This is unquestionably a strange rule to reconstruct for PIE, but the reader should note that this type of neutralization also occurs synchronically in the Northeast Caucasian language Lezgian (Yu 2004).

[122]Cf. German, Polish, Catalan, and many others. See Iverson & Salmons 2011 for discussion of final devoicing, with references.

[123]Post-obstruent word-final fricatives were likely devoiced in PIE: *[pṓts] 'foot', not ^{X}[pṓdz]. Therefore */s, h$_1$, h$_2$, h$_3$/ → *[s, h, ħ, ħ^{w}] / C$_{[\text{-voi}]}$_#.

[124]With later replacement of ***népōt*** by ***népōts*** in High IE, and subsequent word-final cluster simplification to ***népōs*** in Core IE.

Goldsmith 1979) initially implies that compensatory lengthening from loss of the second segment in the configuration $VC_1C_2]_\sigma$ is unexpected. However, under the assumption that word-final consonants in PIE were EXTRAMETRICAL (i.e., banned from bearing prosodic weight) the change $VC_1C_2 > \bar{V}C_1$ becomes not only possible, but expected. Final segment extrametricality fills in a crucial part of the prosodic phonology of PIE, and accounts for the contrast in behavior between $VCF]_\sigma$ sequences word-finally and word-internally (as described in Section 7). Final segment extrametricality is suggested not only by SzL, but also by the lengthening of vowels in PIE words of the shape CVC and Kuiper's Law. We thus find that SzL presents no genuine phonological quandary.

6.1 The Nature and Typology of Compensatory Lengthening

In order to answer the question of whether the change **[pəh$_2$térz] > *[pəh$_2$tḗr] is possible, and can be classed under cases of compensatory lengthening (CL) generally, we first require a definition and formal model of compensatory lengthening, in order to know with precision both what can and cannot occur. As a basic definition, the statement of Kavitskaya (2002: 3) works nicely, though remains somewhat vague: "The term *compensatory lengthening* refers to a set of phonological phenomena wherein the disappearance of one element of a representation is accompanied by a lengthening of another element." The crucial question that this definition begs is: *why* does the loss of some element induce the lengthening of another element? Timberlake (1983) argued that compensatory lengthening involves the direct reattribution of PHONETIC length from one segment to another; Kavitskaya (2002: esp. ch. 4), somewhat differently, interprets many cases of CL (in particular CVCV > CV̄C CL) as the phonologization of originally phonetic differences in length.[125]

Although a phonetic motivation for CL, like any phonological process, is desirable, the diverse typology of CL effects (see Gess 2011, Topintzi 2012, or Yun Forthcoming), with lengthening of both preceding and following segments, of both consonants and vowels, and some apparently non-local applications, should indicate that no single phonetic source that feeds CL is available. The most successful general characterization of CL thus far is then a purely phonological model: Hayes (1989) broadly frames compensatory lengthening as the transfer of a MORA (a unit of prosodic weight) from one segment to another, when the segment to which the mora was originally adjoined can no longer host it. The core insight is to view compensatory lengthening as conservation of a phonological unit, the mora.[126,127] The most typologically common type of CL, in which a coda consonant is lost with concomitant lengthening of the preceding vowel, may be represented with the following prosodic structure:[128]

[125]For instance, one case of diachronic CL in Friulian is conditioned by the type of consonant intervening between the two vowels (Kavitskaya 2002: 108-17; see further Hualde 1990).

(1) CVCV CL in Friulian (NB: word-final consonants in Friulian are subject to devoicing)
   a. **kazu* > *kās* 'case' vs. **kasu* > *kăs* 'bodice'
   b. **mudu* > *mūt* 'mode' vs. **mutu* > *mŭt* 'mute'

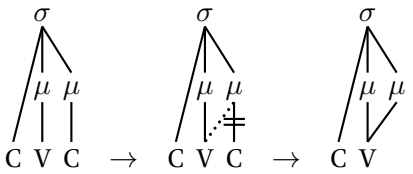
Pace Kavitskaya, however, probably not all instances of CVCV CL are diachronic and irrecoverable: Topintzi (2012) describes a synchronic case in Modern Greek, and Gess (2011) cites a case from Yapese (Jensen 1977.)

[126]The notion of a timing unit as a means of describing CL is hardly an innovation, however. Hock (1986: 432) notes that "at least some traditional historical linguists have offered a phonetic explanation of CL in terms of the concept 'mora'"; even already Whitney (1889 [1960]: § 246) speaks of "compensatory lengthening, or absorption by a vowel of the time of a lost following consonant..."

[127]Hayes' original model, which assumed that onset consonants could never bear morae, and that weight was assigned to coda consonants "by position" is no longer tenable; on moraic onsets generally, see Topintzi 2010. The interplay between a "weight-by-position" rule to create prosodic weight and the loss of segments to induce CL also renders Hayes' model subject to opacity effects, which a poses a serious problem for any non-serial approach to phonology (such as Optimality Theory). For some possible solutions to this opacity problem, see Samko 2011 (Harmonic Serialism) or Kiparsky 2010a (Stratal OT). Exactly how opacity in CL is to be accounted for does not have particular bearing on our analysis here. Perhaps more seriously troubling for the moraic approach to CL are apparent instances of VCV > V̄V CL (e.g., Afrikaans /vəx-ə/ 'wedges' → [vəːə]; cf. Beltzung 2008: 128 ff.), in which an ostensibly non-moraic onset appears to trigger CL. CL is not necessarily the correct analysis for such cases, however.

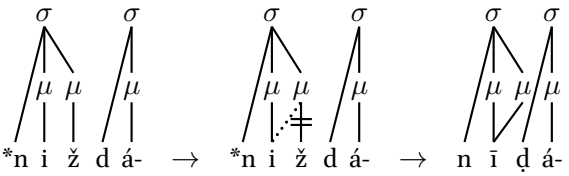
[128]In this and succeeding representations of prosodic constituency, we do not take a strong position on the status of onset segments, which, when adjoined directly to the syllable node, appear to violate the STRICT LAYERING CONDITION of Selkirk 1984. In this paper, a representation in which a branching mora node dominates the syllable nucleus (its head) and an onset would be equally acceptable.

(23) CVC → CV̄ CL



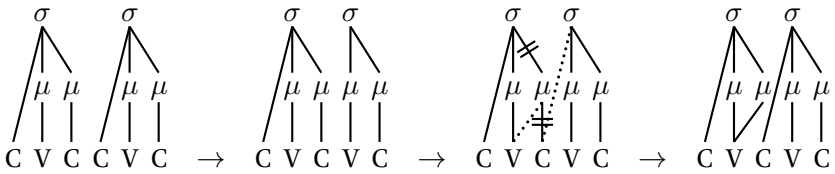
Here, a syllable originally (diachronically or underlyingly) is composed of a single onset and a single coda consonant surrounding the nucleus; both the nucleus and the coda are weight-bearing (i.e., this syllable is "closed" or "heavy"). the coda consonant of syllable is lost, and the mora formerly borne by that consonant transfers to the syllable nucleus. This type of CL is commonplace and trivial in languages with moraic coda consonants. Take, as an example IE *[nizdó-] > Ved. *nīḍá-*, Lat. *nīdus*, in which the same coda consonant is (independently) lost in both languages, with lengthening of the preceding vowel. The change from Proto-Indic to attested Vedic is illustrated below:

(24) PIIr. *[niždá-] > Ved. *nīḍá-*



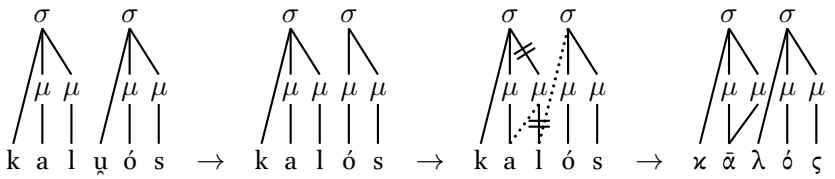
For present purposes, the only other type of CL that is relevant is the variety that Hayes (1989: 265) refers to as "double flop" CL.[129] Here, the loss of an onset consonant in a following syllable leads a former coda consonant to fill that onset slot, but, in the event that onsets are not permitted to bear morae, the mora that was previously adjoined to that coda consonant instead adjoins to the syllable nucleus. The diagram below shows this type of CL schematically:

(25) "Double Flop" ($CVC_1.C_2VC \rightarrow C\bar{V}.C_1VC$) CL



By far the most famous case of "double flop" CL in the phonological literature (discussed as such at least already in Steriade 1982) is the so-called "dritte Ersatzdehnung" that differentiates Attic and Ionic Greek upon loss of *μ. Ionic exhibits compensatory lengthening (thus Proto-Attic-Ionic *[kalu̯ós] 'good' > Ionic κᾱλός, *[enu̯eka] > ἕνεκα 'because (of)'), whereas Attic does not (thus Proto-Attic-Ionic *[kalu̯ós] > Attic κἄλός, *[enu̯eka] > εἵνεκα). The following diagram illustrates "double flop" CL at work in Ionic Greek:

(26) "Double Flop" CL in Ionic Greek



Topintzi (2012) rightly characterizes "double flop" CL as a mere subcase of the very common CVC → CV̄ CL. The crucial similarity is that, in both types, the mora that was borne by a coda consonant re-adjoins to the

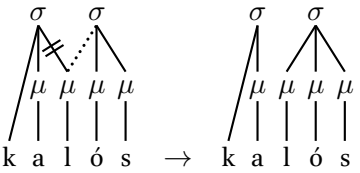
[129]The term "double flop" refers to the "flop" of a single segment out of one syllable, where is was a coda, and into another syllable, where it provides an onset.

nucleus in which that consonant served as a coda; the difference is that, in CVC → CV̄ CL, the coda consonant is lost altogether, whereas in "double flop" CL the syllabic constituency of that coda consonant changes, due to the loss of another segment. Despite this fundamental similarity, "double flop" CL appears to be typologically much less common than CVC → CV̄ CL: Gess (2011) mentions only this Greek case, though Yun (Forthcoming) has collected a fair number of other likely cases, from Coptic, Akkadian, Fula, Kasem, and Old English.

To dwell briefly on the difference in behavior between Attic and Ionic with respect to "double flop" CL is worthwhile, because an understanding of why this CL should occur in Ionic but not Attic has consequences for the analysis of CL in PIE. Steriade (1982: 117 ff.) proposes that a difference in syllabification in fact underlies the contrasting behaviors of Attic and Ionic: in Proto-Attic, clusters of C + [u̯] were parsed into an onset (thus *[ho.du̯ós] 'way; threshold' > Att. ὁδός, without CL), but in Proto-Ionic were parsed heterosyllabically (thus *[hod.u̯ós] > Ion. οὐδός, with CL). To reconstruct a difference is syllabification, however, is implausible for other examples, such as Att. κᾰλός vs. Ion. κᾱλός or Att. κόρος 'boy' vs. Ion. κοῦρος, because a Proto-Attic form *[ka.lu̯ós] or *[kó.ru̯os] would have contained an onset ([lu̯] or [ru̯]) that was almost surely illegal at any stage of the language, from PIE to attested Attic; this statement is possible because there is no evidence for onset clusters *[lu̯V] or *[ru̯V] at the left edge of the word, where often languages permit onset sequences that would not be licit word-medially. Hence, a pre-form *[kal.u̯ós] or *[kór.u̯os] must underlie both the Attic and Ionic forms. Descriptively, the mora that [r] or [l] in these forms originally hosted appears to be preserved or contained in the first syllable in Ionic (see the diagram above), but is simply erased from the representation in Attic.

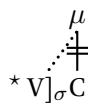
One possibility is that, in both Attic and Ionic, the mora borne by the *[r] or *[l] in *[kór.u̯os] and *[kal.u̯os] remains linked to that segment when resyllabification due to loss of *[u̯] occurs; the representation at this intermediate phase looks as follows:

(27) Resyllabification Following *[u̯]-Loss



Here, the *[l] has shifted from coda to onset position, but the mora that this *[l] originally projected is still adjoined to the *[l]. This situation cannot hold, because it is highly unlikely that onset consonants were permitted to bear morae in Attic, Ionic, or indeed any old IE language. Conceivably, the new syllable boundary *[ka.lós] acts as a sort of "barrier" to the transfer of the mora from the *[l] that can no longer host it in Attic, but not in Ionic; this "barrier" can be formalized in terms of the following violable constraint:

(28) Condition on Mora-Attachment (COMA)



A mora may not adjoin to a given target segment if a syllable boundary intervenes between the segment that projects the mora and the target segment.

Evidently, in Ionic, the constraint Max-μ (every mora in the input must have a correspondent in the output) outranks the above COMA, while the reverse ranking holds in Attic.[130] To judge from the typological rarity of "double flop" CL, the Attic ranking is more common cross-linguistically. Given the typological rarity of "double flop" CL, and absence of evidence for cases in other old IE languages, and Proto-Greek in particular,

[130]Insofar as this formulation refers to syllable boundaries, some level of intermediate structure in the derivation, as could arise in a Stratal OT analysis, would be necessary

indicates that the constraint ranking COMA ≫ Max-μ is to be reconstructed for PIE; the Ionic reversal of this ranking is an innovation. As particular evidence for this claim, note that, to our knowledge, the configuration PIE *[VC.HV] regularly becomes [V̆.CV], except in Anatolian, where instead the laryngeal often assimilates to the preceding consonant; cf. Skt. gen.sg. *mahás* 'great' < *[meĝ.h$_2$ás], Hitt. *mekki-* 'big' < *[meĝ.h$_2$i-].

Before proceeding to the analysis of compensatory lengthening phenomena in PIE, we must emphasize one further fact about CL: its application, in the Autosegmental framework that we employ here, must be local in the sense that a mora cannot "leap over" an intervening mora in order to attach to a segment. This restriction on the locality of application in CL follows directly from part of the Well-Formedness Condition, as developed by Goldsmith (1979: 48):

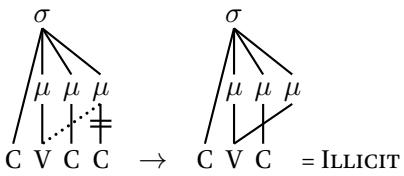
(29) Well-Formedness Condition (Revised for the Prosodic Hierarchy)

a. All segments are associated with at least one prosodic unit;
all prosodic units are associated with at least one segment.

b. Association lines do not cross.

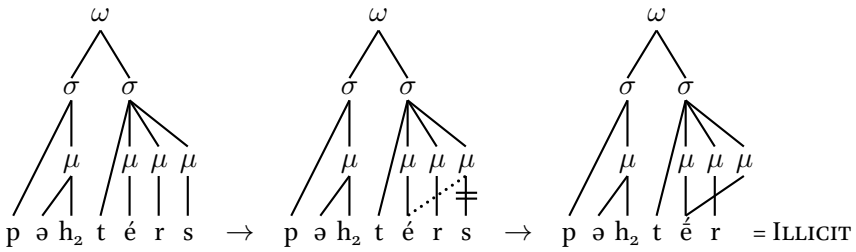
The immediate consequence of the Well-Formedness Condition (WFC) is that CL could never result from the loss of a non-adjecent segment, as long as a segment already linked to a mora (i.e., at the same level of the Prosodic Hierarchy) intervenes:

(30) CL Rendered Illicit by the WFC



For the purposes of understanding Szemerényi's Law, the WFC means that the rules formulated under Section 3.4 cannot be literally true as given there. Compensatory Lengthening simply could not result from the transfer of a non-adjecent mora.[131]

(31) How CL in SzL Cannot Work

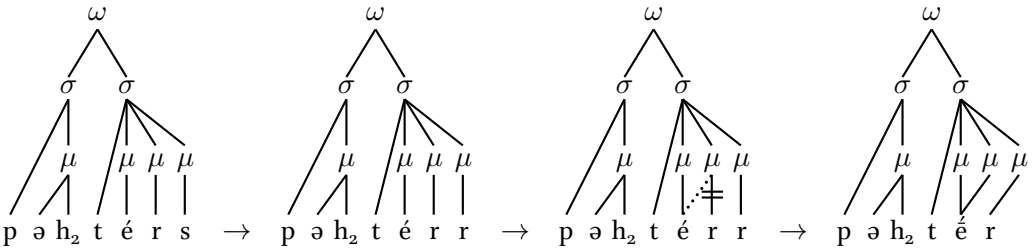


A descriptive account of SzL that involves the loss of a (presumably weight-bearing) segment, with concomitant CL on a non-adjecent vowel, thus appears to encounter an insuperable theoretical difficulty.[132] This problem reveals the intuitive appeal of Szeményi's own particular version of the law, with an intermediate stage of gemination: ***ph$_2$térs* > ***ph$_2$térr* > **ph$_2$tḗr*. Under this conception, CL could follow from simplification of the geminate, with transfer of an adjacent mora to the vowel:

[131]Consistent with the spirit of Optimality Theory, one might wish to regard the WFC as a violable constraint, rather than a universal restriction on language. In that case, a ranking Max-μ ≫ WFC could allow for the CL seen in SzL. However, we have not encountered any other analyses of prosodic phenomena that would require a violable WFC; we therefore prefer to maintain the WFC as a universal restriction.

[132]Also noted by Keydana (2013a).

(32) CL in SzL as Geminate Simplification



But, as we stated above, that PIE ever licensed geminate segments in a surface representations, least of all at the word edge, is without any supporting evidence. Likewise, that the derivation of PIE forms like *[pəh$_2$tḗr] from underlying */ph$_2$-ter-s/ passes through an intermediate level containing geminate consonants is also theoretically infelicitious. Szemerényi's solution to the problem of CL is therefore unlikely, and probably to be rejected.

In working toward a comprehensive understanding of the CL involved in the derivation */ph$_2$-ter-s/ → *[pəh$_2$tḗr], to examine cases that must contain underlying, heteromorphemic geminates is helpful. Since the simplification of underlying geminates was an active phonological process in PIE (cf. Mayrhofer 1986 [2012]: 120-1), the treatment of such sequences may provide some indication of how PIE behaved when consonants that were present in the UR could not surface.[133] Consider first the following examples of identical segments at the right edge of the word:

(33) PIE Underlying Word-Final Geminates

a. nom.sg. of animate *s*-stems: Ved. *uṣā́ḥ*, Av. *ušå̊*, Lat. *aurōra* < *[h$_2$áu̯sōs] ← */h$_2$eu̯s-os-s/ 'dawn'.

b. acc.sg. of *m*-stems: Hitt. *tēkan* < *[d$^{\text{h}}$éĝ$^{\text{h}}$ōm] ← */d$^{\text{h}}$eĝ$^{\text{h}}$-om-m/ 'earth'; Arm. *tun* < *[dǒm] ← */dom-m/ 'house'.[134]

c. loc.sg. of "proterokinetic" *i*-stems: Ved. *agnā́* < *[h$_1$og$^{\text{wh}}$né̯i̯] ← */h$_1$og$^{\text{wh}}$-né̯i̯-i̯/

Certainly, the simplification of the underlying sequences of identical consonants, with CL, is readily explained if one assumes that the consonant adjacent to the vowel is lost, rather than the consonant at the edge of the word. Consider now the output of word-internal sequences of heteromorphemic geminates:

(34) PIE Underlying Word-Medial Geminates

a. 2.sg.pres.act.ind. of **h$_1$es-* 'be': Ved. *ási*, OAv. *ahī*, Gk. ἐῖ, Lith. *esi* < *[h$_1$ési] < */h$_1$és-si/ (contrast Hitt. *ēšši*).

b. gen.sg./acc.pl. of *s*-stems: Ved. *uṣás* 'dawn' (RV < */h$_2$us-s-és/, */h$_2$us-s-ńs/).

c. loc.pl. *s*-stems: Ved. *áṃhasu* 'distress' < */h$_2$émĝ$^{\text{h}}$-os-sú/ (contrast productively built locs.pl. *śrávassu* (to *śrávas-* 'fame') and *vákṣassu* (to *vákṣas-* 'chest, breast')).

d. OIr. *néim* 'poison' < *[némn̥] ← */ném-mn/.

e. Gk. στόμα 'mouth' < *[stómn̥] ← */stómh$_1$-mn/ (NB that the **h$_1$* does not surface due to the Saussure Effect).

Immediately the question arises: why do we observe compensatory lengthening in 26 (word-final cases) but not in 27 (word-medial cases)? Descriptively, the distribution appears to be that CL occurs when the sequence of identical segments occurs word finally, but not when the sequence occurs word-medially:

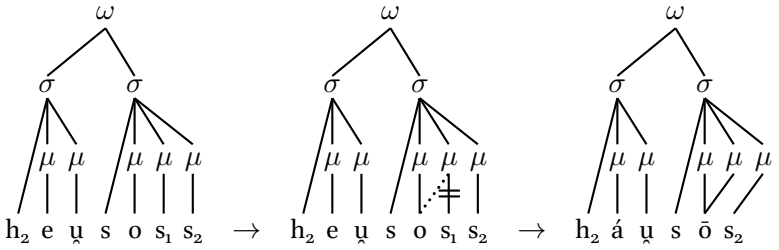
[133]The PIE ban on surface geminates is easily formalized with a constraint $^{\star}C_{\alpha}C_{\alpha}$: a sequence of two identical consonants is illicit. Such a constraint falls out readily from the Obligatory Contour Principle (McCarthy & Prince 1986 [1996]); see also Byrd 2010 for further discussion.

[134]For an account of by-forms of the root involved in IE words for 'build' and 'house' that seem to provide evidence for a root **demh$_2$-*, see Nikolaev 2010.

(35) PIE Treatment of Underlying Geminates
   a. /-VC$_\alpha$C$_\alpha$#/ → [-V̄C#]
   b. /-VC$_\alpha$C$_\alpha$V-/ → [-VCV-]

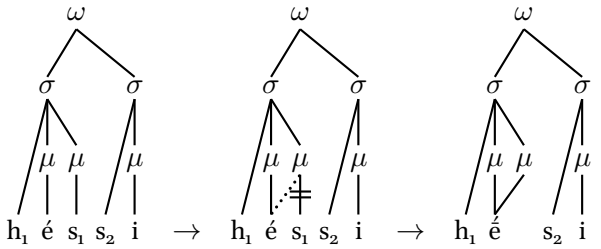
This distribution of CL from geminate simplification in PIE creates poses a conundrum. The different behavior in word-medial vs. word-final position is not attributable to the nature of the segments themselves, since */ss/ examples exist for both positions in the word. If the geminate simplification is driven purely by phonology (i.e., ALIGNMENT constraints[135] decide whether the rightmost or leftmost segment in an underlying geminate does not surface), then one would expect the same rightmost/leftmost member of the geminate to be deleted in both cases. Assume, for the moment, that CL in the word-final cases proves that, in a sequence /C$_{\alpha1}$C$_{\alpha2}$/, the surface form is [C$_{\alpha2}$], that is, the leftmost member of the geminate is deleted. This assumption then generates the correct result for */h$_2$e̯us-os-s/:

(36) /-VC$_{\alpha1}$C$_{\alpha2}$#/ → [V̄C$_2$]



However, to assume that the leftmost member of an underlying geminate does not surface makes incorrect predictions for word-medial geminate sequences; we should expect to find 2.sg.pres. X[h$_1$ési], with CL, for instance.

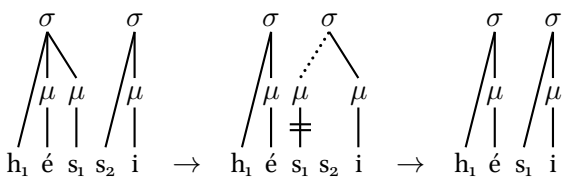
(37) /-VC$_{\alpha1}$C$_{\alpha2}$V/ → [V̄C$_2$V]



Even if the selection of the segment to be deleted is in part morphologically sensitive (e.g., MAX-STEM outranks MAX-AFFIX), no difference in behavior would be predicted, because in all cases, the underlying geminates appear at a stem-suffix boundary.

To make the converse assumption, that the rightmost of two identical segments is deleted does not clearly provide a solution either. Given the evidence the likelihood that the CONDITION ON MORA-ATTACHMENT discussed above is reconstructable for the grammar of PIE, "double flop" compensatory lengthening can be avoided in the derivation of *[h$_1$ési] from */h$_1$és-si/.

(38) /-VC$_{\alpha1}$C$_{\alpha2}$V-/ → [VC$_{\alpha1}$V]



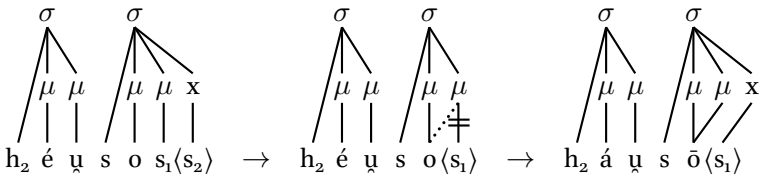
[135]Cf. Kager 1999: ch. 3 on this constraint family.

The same assumption, however, would appear to incorrectly generate ^{X}[h$_2$áu̯sos] from underlying */h$_2$eu̯s-os-s/. Nevertheless, the absence of CL in *[h$_1$ési] ← */h$_1$és-si/ strongly suggests that, indeed, the rightmost of the two segments is deleted. How, then, are nom.sg. *[h$_2$áu̯sōs] or acc.sg. *[d^{h}égĝ^{h}ōm] possible surface forms, without incurring violation of the WELL-FORMEDNESS CONDITION (as illustrated in 30 and 31)?

6.2 Final Consonant Extrametricality in PIE

The problem that the conflicting behavior seen in word-medial and word-final geminate sequences poses is obviated under the assumption that word-final consonants in PIE were EXTRAMETRICAL. For the practical purposes of the analysis presented here, that the final consonant of a word is extrametrical means that it does not bear prosodic weight. In effect, the final syllable of the word, if it contains only one coda consonant, counts as as light (monomoraic) rather than heavy (bimoraic or greater). As an immediate example, the nom.sg. of the animate *s*-stems is now comprehensible: when the underlying geminate is resolved through deletion of the rightmost segment, a segment that was mora-bearing moves into a position in which it can no longer remain linked to that mora, and consequently, the mora is preserved by relinking to the preceding vowel.[136,137]

(39) */h$_2$eu̯s-os-s/ → *[h$_2$áu̯sōs]



We will demonstrate in this section that the analysis of final segments in PIE as extrametrical allows for a coherent phonological interpretation not only of Szemerényi's Law, but several other phonological phenomena in PIE as well, and plausibly remains as an inherited part of the phonological grammar in Attic-Ionic Greek and Old Latin.

In general, constraints (or rules) that designate certain prosodic entities as extrametricality effectively render that entity "unparseable" or "invisible" to higher level prosodic groupings.[138] Extrametricality of final segments and final syllables is typologically very common, and widely reported; see Gordon et al. 2010 for many examples, as well as an attempt at a phonetic explanation for the prevalence of extrametricality phenomena.

Still a topic of debate, however, is the exact prosodic status of extrametrical constituents generally, and extrametrical consonants in particular. One fairly common interpretation (implicitly adopted in Gordon et al. 2010, explicitly in Cho 2007) is that extrametrical consonants are similar to extrasyllabic consonants: they are parsed into a weightless "semisyllable", or they simply constitute an "appendix" that directly adjoins to the prosodic word. This interpretation renders final consonant extrametricality with the constraint NONFINALITY (Prince & Smolensky 1993: 52) that penalizes prosodic heads at the edges of prosodic constituents; in particular, a consonantal appendix would regularly prevent the rightmost foot in a word from standing at the edge of the prosodic word. Hyde (2003) reinterprets NONFINALITY as penalizing the addition of gridmarks (indicators of prosodic prominence) over elements at the edges of prosodic constituents, in order to permit exhaustive parsing (i.e., no violations of STRICT LAYERING occur). Thus, under Hyde's view, final consonants are always still linked to a mora, but may be penalized for receiving a gridmark, which accounts for their prosodic invisibility.

[136]Elements enclosed in ⟨⟩ are extrametrical. The absence of a mora in the moraic tier on extrametrical consonants is indicated with an 'x'.

[137]As a synchronic derivation, it would be more accurate to say that first the stem $h_2e_\mu u̯_\mu\mu.so_\mu s_\mu$- is constructed (with the syllabification and weight assignment as shown), and then at the word level/post-lexical phonology, the weight-bearing *s* of the suffix *-os* ultimately falls in an extrametrical position, whereupon the mora that it had been assigned earlier in the derivation relinks to the *o*. On weight-assignment and syllabification as persistent through the morphological derivation of PIE words, necessary in particular to account for the syllabification of nasal presents, see Byrd Forthcoming: ch. 6.

[138]See generally Hayes 1995: 57 and Hyde 2011 on extrametricality.

We believe that our analysis of SzL here contributes substantially to this discussion. Specifically, the possibility of CL as a consequence of final consonant extrametricality would explicitly contradict Hyde's interpretation of Non-Finality, because, if final consonants were always parsed into a mora, then extrametricality could not be a possible trigger of CL. Prince & Smolensky's version of NonFinality potentially fits with the CL seen in SzL, but the conflation of extrametrical and extrasyllabic consonants that NonFinality would require is troubling. Extrasyllabicity typically results from SSP or OCP violations, and entails prosodic weightlessness precisely because the extrasyllabic segment is a mere "appendix".[139] Final consonant extrametricality, on the other hand, is conditioned by the segment's position in the prosodic word, and nothing else. We prefer, at present, to interpret extrametricality generally as simply the failure to parse a constituent into the next immediately higher level of the prosodic hierarchy. This interpretation avoids gratuitious violations of Strict Layering, and facilitates the analysis of CL in SzL, since extrametrical segments will always belong to a syllable.

An analysis of the Latin stress system furnishes perhaps one of the clearest instances of the need for extrametricality in the study of word-level prosody generally. Here, we are speaking of syllable extrametricality, rather than segment extrametricality. Descriptively, the word ictus in Latin falls on the penultimate syllable if the penult is heavy, but otherwise on the antepenultimate syllable. Like many accentual (as opposed to tonal) languages, Latin computes the relative prominance of syllables in word by grouping syllables into metrical units below the level of the prosodic word, usually referred to as feet.[140] Latin parses syllables into moraic trochees, parsing from right to left in the word; a foot thus consists of either one heavy syllable or two light syllables, in which the leftmost mora of each foot is prominent. That is to say, Latin has quantity-sensitive and left-headed feet. The primary word ictus is assigned to the rightmost foot of the word. However, the rightmost foot corresponds to the penult or antepenult only under a view of final syllables as extrametrical.[141] Forms of the adj. *sapiēns* 'wise' illustrate the relevant contrasts:[142]

(40) Latin Ictus Assignment
  a. Antepenult: nom.sg. (sá.pi.)⟨ēns⟩
  b. Penult: nom.pl (sa.pi.)(én.)⟨tēs⟩
  c. Antepenult, with unparsed penult (no degenerate feet permitted): cmpv.nom.sg. (sa.pi.)(én.)ti.⟨or⟩
  d. **False**: cmpv.nom.sg. ^{X}(sa.pi.)(en.)(tí.or)

Similarly, although the word ictus in Attic-Ionic Greek is often lexically/morphologically determined,[143] the language does assign a default accent phonologically, just in case there is no lexical/morphological accent assignment; this phonologically assigned word ictus is the so-called "recessive" accent. According to the analysis of Golston (1990) (cf. Sauzet 1989, Probert 2010: 2-5, Gunkel 2010: 25-7), Attic-Ionic, like Latin, builds moraic trochees, and assigns the principal word ictus to the rightmost foot in the word; however, because Attic-Ionic has a pitch, rather than stress, accent, the default accent consists in the assigment of a low tone (marked with an * below), which then causes the immediately preceding vocalic mora to obtain a high tone. However, this analysis is possible only if final consonants are extrametrical. Extrametricality of final consonants in Attic-Ionic renders final CVC syllables light, which consequently leaves them unparseable when a heavy syllable occurs immediately to their left (as in nom.sg. ἄνθρωπος 'man').[144]

(41) Attic-Ionic Default Ictus Assignment

[139]For an analysis of word-internal extrasyllabic segments as being weight-bearing in some Arabic dialects, see Kiparsky 2002.

[140]The term "foot" and the terms for the varieties of feet attested cross-linguistically are borrowed from the study of Greek and Latin metrics. For an introduction to the notion of the foot, see Hammond 2011; for many case studies that illustrate the role of footing in accentual languages, see Hayes 1995.

[141]This basic analysis of the Classical Latin stress system appears throughout the literature; one may again consult Hayes 1995. See also Mester 1994 for a detailed treatment of the moraic trochee's role in various phonological phenomena in Latin.

[142]Elements enclosed in () represent a foot.

[143]For the theory, see Kiparsky 2010b and Kiparsky Forthcoming; for detailed case studies, see Probert 2006.

[144]The high tone in Doric, where attested, often descriptively appears to be one syllable further to the right than in Attic-Ionic; compare Att.-Ion. 1.sg.aor.act.ind. ἔλαβον 'I took' vs. Dor. ἐλάβον. If we assume that the default ictus assignment in Doric was precisely

a. nom.sg. (πο.λυ)(άν.)(*θρακ)⟨ς⟩ 'having much coal'
b. nom.sg. (ἄν.)(*θρω.)πο⟨ς⟩ 'man'
c. acc.pl. (ἀν.)(θρώ.)(*που)⟨ς⟩
d. 1.sg.impf.mid.ind. ἐ.(δυ.νά.)(*μη)⟨ν⟩ 'I was able'
e. 1.pl.impf.mid.ind. ἐ.(δυ.νά.)(*με.θα) 'we were able'
f. **False**: nom.sg. ^{X}(ἀν.)(θρώ.)(*πος)

Besides accentual phenomena, at least two further facts about the phonology of Attic-Ionic demand that final consonants be extrametrical: the application of a Minimal Word Requirement (MWR, in the sense discussed in Section 4) to words of the underlying shape /CVC/, and the non-application of Osthoff's Law in final syllables. As to the MWR, already in Section 2 we mentioned that the vocalism of nom.sg. πούς 'foot', with spurious diphthong [oː] is explicable only as the application of a MWR to a /pos/ ← /pod-s/. Other examples include neut. nom./acc.sg. πῦρ /pŭr/ 'fire' (contrast gen. πῠ́ρός) and nom.sg. χούς 'an amount' (contrast dat.sg. χοΐ).[145] Concerning the non-application of Osthoff's Law, consider the nom.sg. of *r*- and *n*-stems such as μήτηρ 'mother' or χθών 'earth'. Osthoff's Law does not apply in these cases because the final segment is not weight-bearing, and therefore, cannot induce shortening of the long vowel.

The non-application of Osthoff's Law in final syllables in Attic-Ionic may find a direct parallel in Old Latin, where scansion indicates that inherited long vowels remain long, at least before liquids: *frātēr* 'brother' (Plautus *Aulularia* 140), *exercitōr* 'trainer' (Plaut. *Trinummus* 226), *Bacchanāl* 'shrine of Bacchus' (Plaut. *Aulularia* 411).[146] If Old Latin still applied extrametricality to final consonants, then the preservation of long vowels in this context is unsurprising. Further Italic evidence for early resistence to Osthoff's Law comes from South Picene, where, according to Weiss (2009: 125) "the genitive plural in South Picene seems not to have been affected by the South Picene raising rule of short *-om* to what is written **-úm**." The Latin testimony is not entirely straightforward, however, because long vowels in monosyllables closed by resonants remain long throughout the history of Latin (e.g., *fūr* 'thief', *sāl* 'salt', *sōl* 'sun'); the right analysis cannot simply be a change in the prosodic system of Latin from the presence of an extrametricality constraint (Old Latin) to its absence (Classical Latin).[147]

Besides the evidence for final consonant extrametricality in Attic-Ionic and Old Latin, which could together point to a common inheritance from PIE in this feature of prosody, evidence from PIE itself suggests that word-final consonants were not weight-bearing. The most compelling evidence is the application of lengthening, due to a MWR, in monosyllabic words of the shape /CVC/; we have given examples of this feature above in Section 4.1. Particularly strong, in our view, are forms built to endingless locatives, such as Welsh *daw* 'son-in-law' (< */dōm-o-/), which Widmer (2008: 618) interprets as a thematic derivative to a hypostasized loc.sg. */dōm/. The application of a MWR to monosyllables with a coda consonant, in languages in which all coda consonants normally are weight-bearing, often constitutes sufficient evidence of final consonant extrametricality. For instance, McCarthy & Lombardi (1991) conclude that final consonants in Choctaw are extrametrical solely on this basis.

PIE also furnishes evidence for a process in which a consonant directly adjacent to a vowel is lost, without compensatory lengthening: Kuiper's Law (Kuiper 1955; cf. Mayrhofer 1986 [2012]: 149). Specifically, vocatives to *$*eh_2$*-stems in often scan as short in the *Ṛgveda*, and sometimes attest a short vowel -ă̆ in Greek (e.g., νύμφᾰ̆

the same as in Attic-Ionic, but resulted in the assignment of a high tone, rather than low tone, to the rightmost foot, this difference falls out easily: /elabon/ is parsed as ἐ(*λαβο⟨ν⟩) in both dialects, but a different phonetic realization results.

[145]Cf. Golston 1991: 73 ff..

[146]Cf. Weiss 2009: 128.

[147]Perhaps the fact of final syllable extrametricality in Latin arises out of a reanalysis of unparsed final syllables with short vowels, given that final consonants were extrametrical. For example, nom.sg. *amı́cus* 'friend', in a system with final consonant, but not final syllable extrametricality, would be parsed as a.(mı́).cu⟨s⟩. Precisely because words with a heavy penultimate syllable and ultimate syllable of the shape CV̆(C) would always have been parsed like *amı́cus*, the final syllable would have been ambiguous between an unparsed syllable with final consonant extrametricality and a final extrametrical syllable.

'o nymph') and *-o* (< **-ă*) in OCS (e.g., *ženo* 'o woman').[148] If the **h*$_2$ indeed was regularly weight-bearing in the configuration *[-ah$_2$#], that its loss under certain conditions, in PIE, would not induce compensatory lengthening is surprising, unless that word-final **h*$_2$ could not be weight-bearing regardless. Evidence that synchronic processes of consonant deletion do not cause CL only when a consonant is extrametrical comes from Choctaw. In Choctaw, underlying nasals that are parsed into a syllable coda are lost, with lengthening and nasalization of the preceding vowel (McCarthy & Lombardi 1991: 40, Nicklas 1974: 14):[149]

(42) Choctaw Nasal Lengthening
- a. /łabaNka/ 'to snore' → [łabã:ka]
- b. /bijóNkko/ 'strawberry' → [bijő:kko]
- c. /oNsi/ 'eagle' → [õ:si]
- d. /halloNs/ 'leech' → [hallõ:s]

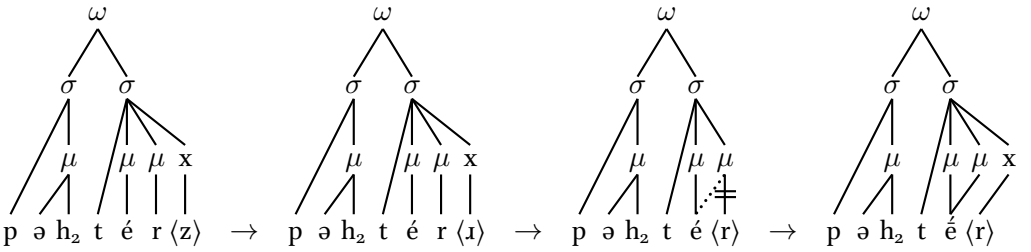
However, when an underlying nasal occurs word-finally, where consonants are extrametrical in the language, it nasalizes the preceding vowel, *but does not cause CL* (Nicklas 1974: 14-5, 21, 127-9, McCarthy & Lombardi 1991: 41).

(43) Absence of Nasal Lengthening Word-Finally in Choctaw
- a. /ma+n/ 'that' → [mã]
- b. /yaNma+n/ 'that' → [yammã]
- c. /a:chin/ Future → [a:chĩ]
- d. /an/ 'my' → [ã]

The behavior that Kuiper's Law captures is entirely compatible with Litscher (2013)'s interpretation of **h*$_2$-stems: voc.sg. *[V̆h$_2$], where loss of **h*$_2$ *in pausa* > [V̆], vs. nom.sg. *[V̄h$_2$], where loss of **h*$_2$ > [V̄] everywhere. Recall that we suggested above that nom.sg. *[V̄h$_2$] may also be due to SzL.[150]

The sum total of the evidence presented in this section makes the conclusion that word-final consonants in PIE were treated as extrametrical virtually inescapable. At the least, we see no other coherent interpretation for Kuiper's Law and the lengthening of PIE monosyllables of the shape */CVC/, while the clear treatment of final consonant as extrametrical in Attic-Ionic, and the possibility of extrametrical consonants in Italic as well, would support the reconstruction of final consonant extrametricality in PIE on a comparative basis. Following the phonetic developments described at the close of Section 5, we can trace the following diachronic path to compensatory lengthening:

(44) Lenition of Coda Fricatives, with CL upon Loss
- a. Deletion via Approximantization of Voiced Fricative: */ph$_2$tér-s/ → *[pəh$_2$térz] > *[pəh$_2$térɹ] > *[pəh$_2$téŕ]

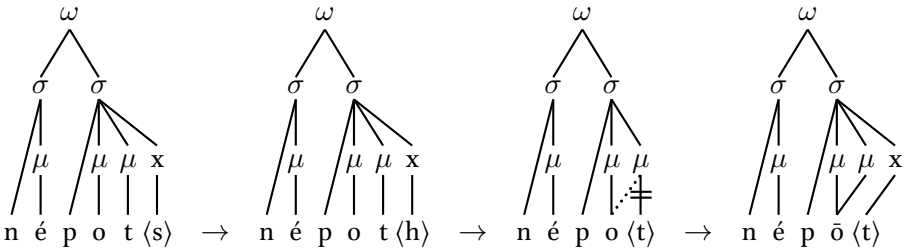


[148]For reasons why Greek may in fact be non-probative on this point, see Section 8.

[149]Acute indicates high tone in Choctaw forms.

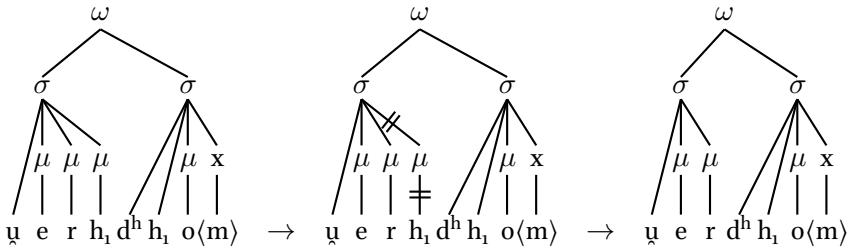
[150]Litscher (*op. cit.*) sees the nominatives *[-āh$_2$] and *[-īh$_2$] as analogical to the long vowel of the nom.sg. of resonant stems, but if forms such as **[-ah$_2$s] ever existed (cf. the discussion under Section 3), then the long vowel could be obtained directly via SzL.

b. Deletion via Debuccalization of Voiceless Fricative: */népot-s/ → *[népots] > *[népoth] > *[népōt] (later >> *[nepōs])



We now have the complete picture for the diachronic origin of long vowels in final syllables in Indo-European. Word final consonants were always extrametrical, so once fricatives in complex codas underwent various lenitions and ultimate loss, consonants that were weight-bearing came to stand in word-final position, where consonants were not allowed to bear weight, and consequently, the weight of that segment was reattributed to the immediately preceding vowel. This course of development avoids running either afoul of the WELL-FORMEDNESS CONDITION (crossing association lines in the reassignment of prosodic weight) or constructing intermediate diachronic stages that would have been illicit (surface geminates). The WFC further accounts for the absence of CL in the examples of word-internal SzL, *[gén.mnV-] (Ved. *jánman-*, Doric γένν̄α), *[u̯ér.dʰh₁om] (Lat. *verbum*), and *[kér.dʰh₁o-] (OIr. *fo·ceird*) treated under 3.5 above: because the remaining coda consonant does not move into a position where it would be forced to give up its mora (as in word final position), the mora that was originally associated with the lost fricative simply undergoes Stray Erasure.

(45) Absence of CL in Word-Internal SzL



As a closing note to this section, we would like to observe that the analysis that we propose of the CL involved SzL is not an altogether isolated case. In colloquial Tehrani Farsi, as reported by Darzi (1991) (cf. also discussion in Kavitskaya 2002: 82-7), the underlying sequences /-VCh#/ and /-VCʔ#/ both are realized as [-V:C]: underlying glottals following another consonant are lost, with CL on the preceding vowel. For example:

(46) CL from Loss of Word-Final Glottals in Tehrani Farsi

a. /robʔ/ 'quarter' → [ro:b]

b. /ʃæmʔ/ 'candle' → [sæ:m]

c. /sobh/ 'morning' → [so:b]

d. /solh/ 'peace' → [so:l]

Samko (2011: 33) explicitly suggests that the CL in these forms could be explained through extrametricality of the final consonant, but he is unable to find evidence to support the idea that final consonants indeed are extrametrical in Tehrani Farsi. This case is therefore likely not entirely parallel to SzL. The point here, though, is simply that we are not alone in seizing upon extrametricality as a potential explanatory device for some attested instances of compensatory lengthening.

7 Learning *RF]$_{\omega}$ and the Lengthened Grade in Nom.sg. of Root Nouns

Now that we have provided a plausible diachronic pathway to SzL on both phonetic and phonological grounds, we would like to return to the question that we left open in Section 3: how broad was the scope of SzL? Apart from Szemerényi himself, who invoked assimilation and degemination to derive the long vowel in *[pō(t)s] 'foot', via *[poss], most scholars (e.g., Nussbaum 1986, Nussbaum 2014, Kim 2001, Kim 2013b, Fortson 2010) formulate SzL essentially as we have in our "narrow" version of the sound change under example 11 above: the loss of fricatives applied only in syllable codas where the fricative followed a resonant. Under this narrow formulation, the long vowels in "collective"/neut.pl. forms such as Av. *manå* 'minds' (< *[ménōs]), Av. *raocå* 'lights' (< *[léu̯kōs]), Goth. *witoþ* 'law' (< *[u̯idōt]), and nom.sg. forms such as Av. *napå*, Lat. *nepōs* (< *[népō(t)s]), do not have a direct explanation. Some scholars (e.g., Nussbaum 2014: 276: fn. 12) view the long vowel to be analogical to the resonant stems that obtained a long vowel via SzL. Such an analogy is difficult to disprove, but a formalization of the analogy reveals some potential problems. For instance, if, at some point, nom.sg. *[népŏts] existed alongside *[-V̄R] in resonant stems, then the analogy ought to have proceded as follows:

(47) acc.sg. *[-V̆Rm̥], nom.pl. [-V̆Res], etc. : nom.sg. *[-V̄R] :: acc.sg. *[népotm̥], nom.pl. [népotes], etc. : X, where X is solved as *[népōt].

Since, however, the Core IE surface form was *[népōs] (← */nep-ōt-s/),[151] the question then becomes how and why the marker */-s/ was allowed to surface again in this plosive stem, but not in the resonant stems. Similarly, if the fricative markers were permitted to surface on stems containing analogically generated long vowels, then the lack of the suffix *-i* on the Avestan neut.pl. forms is surprising (cf. OAv. *varəcā.hī-cā* 'glories' Y 32.14); we might expect to find ^{X}*manāhī* and ^{X}*raocāhī*. On the other hand, the "broad" version of SzL would directly generate all of these forms, as well as long vowels in root nouns such as *[pṓ(t)s] and *[u̯ṓk^{w}s], as part of the original sound change.

If root nouns are excluded, the total number of examples that point to VC$_{[\text{-sonorant}]}$F]$_{\sigma}$ > V̄C$_{[\text{-sonorant}]}$ is small enough that the "broad" version of the sound change need not be compelling. Therefore, we ought first to consider whether any other acceptable account exists for the lengthened grade of nom.sg. of plosive-stem root nouns. As we have discussed in Section 4.1 above, the version of monosyllabic lengthening that Kortlandt, building on Wackernagel, employs is to be rejected, because a surface form like *[klóps] 'thief' would be bimoraic in PIE, and thus meet a minimal word requirement. One might nevertheless attempt to compel the application of a MWR on such forms in three other imaginable fashions:

1. assume the long vowel in these root nouns is extremely archaic. If a pre-PIE, prior to the grammaticalization of case endings, possessed both final consonant extrametricality and a MWR, then a UR /klóp/ would surface as [klṓp]. This scenario is totally unprovable and uselessly speculative.

2. assume the obstruents were not moraic in PIE. PIE, in this respect, would have been similar to Lithuanian, in which only [+sonorant] segments are able to bear prosodic weight, so a syllable closed by a [-sonorant] consonant would count as light. In this scenario, a UR /klóp-s/ could be subject to a MWR, because the coda /p/ and coda /s/ would not be weight-bearing, thereby allowing [klṓps] to surface. The comparative prosody of IE languages, however, strongly indicates that coda obstruents were weight-bearing in PIE; Greek, Indo-Iranian, Italic, and Germanic all unambiguously agree on this point. In particular, the analysis of Siever's Law at the Indo-European level as the avoidance of superheavy syllables necessarily treats coda obstruents as moraic (cf. Byrd 2010: ch.5). Note furthermore that the 2.sg. and 3.sg. of root imperfects/aorists, e.g., *[h$_1$ést] 'was' or *[h$_1$épt] 'seized', with short vowels, also indicate that /s/ and /p/ in such forms are able to bear weight. Consequently, there is little basis to believe that a MWR should have applied to a form containing at least two coda consonants.

[151] Likely pronounced as [népōz] in late PIE; see section 5.3 above.

3. assume that, because a coda sequence of stop + fricative violates the SONORITY SEQUENCING PRINCIPLE, the fricative would be extrasyllabic (and extrametrical as well, by definition), and that final-consonant extrametricality targets the final consonant of the final genuine syllable in a word. The prosodic structure built for */klop-s/ would then be $[[\text{klṓ}\langle\text{p}\rangle]_\sigma\text{s}]_\omega$. In effect, both /p/ and /s/, although not strictly banned from bearing weight, would each not bear a mora in this configuration, thereby triggering the MWR. The facts of PIE prosody do not strictly rule out this possibility, but theoretically, this option is highly suspect. Hayes (1995: 57-8) argues that the relevant domain for the application of extrametricality is the prosodic word, and (*op. cit.*: 107) explicitly excludes a configuration of the type $[[\text{klṓ}\langle\text{p}\rangle]_\sigma\text{s}]_\omega$: "extrametricality does not chain; i.e., a constituent followed by an extrametrical consituent is not counted as peripheral." To argue for the application of a MWR here due to chained extrametricality would thus entail a substantial revision to the theory of extrametricality. Without other very strong evidence elsewhere of a need for chained extrametricality, this option is also to be excluded.

Thus, for nom.sg. forms such as *[u̯ók$^{\text{w}}$s] 'voice' (Av. *vāxš*, Lat. *vōx*, Gk. -ωψ, Ved. *vā́k*), *[h$_2$ṓps] 'water' (YAv. *āfš*), or *[h$_3$rḗ̆ks] 'king' (Ved. *rā́ṭ*, Lat. *rēx*, OIr. *rí*), four real options exist, but each comes at a certain cost:

1. the origin of the long vowel lies deep in the irrecoverable prehistory of PIE. To accept this explanation means to accept the existence of some (few) phonological long vowels in that did not arise in the recoverable history of PIE, although SzL and a reduplicative origin of "Narten" formations (on which see now Melchert Forthcoming: fn. 10, building on de Vaan 2004 and Kortlandt 1999) would suggest that perhaps all PIE long vowels may have an "origin".

2. the long vowels that the languages transmit make for specious matches, and require einzelsprachlich explanations. The evidence for long vowels in nom.sg. forms that exhibit *o*-grade could easily be explained away as analogical in Indo-Iranian, where the long vowels would arise in the acc.sg. and nom.pl. via Brugmann's Law (e.g., *[u̯ok$^{\text{w}}$m̥] > PIIr. [u̯āčam]). The long vowels elsewhere lack an evident account, however, and the alternation between nom.sg. -ωψ and the acc.sg. ŏπα in Greek is especially suggestive of an alternation between long *[ō] in the nom.sg. and short *[ŏ] in the acc.sg. and nom.pl.

3. the long vowels in root nouns of the shape CVC$_{[\text{-sonorant}]}$- are analogical to the long vowels in root nouns of the shape CVR- (e.g., *[b$^{\text{h}}$ṓr] 'thief'), which surely underwent SzL. This explanation effectively applies the analogical explanation for long vowels in **t*-stems and **s*-stems given in example 47 above to root nouns as well. If SzL never applied to **[u̯ók$^{\text{w}}$s], then by a surface analogy to *[b$^{\text{h}}$ṓr], etc., **[u̯ók$^{\text{w}}$s] would become **[u̯ṓg$^{\text{w}}$], not the desired *[u̯ṓk$^{\text{w}}$s]. In effect, the output of such an analogy would be the same as the output of Broad SzL, and therefore would need to contend with same problem of why the morpheme */-s/ is ultimately able to surface in plosive-final stems.

4. the long vowel originates in the sound change given under example 17 above: $\text{VCF}]_\omega > \bar{\text{V}}\text{C}]_\omega$. This sound change, of course, would generate nom.sg. forms without the surface *[-s] marking, which would require that the marking be restored in some fashion.

In combination with the evidence given by the neuter forms Av. *manå*, *raocå*, and Goth. *witoþ*, we believe that the fourth option, and expanded version of Szemerényi's Law, is at least worthy of serious consideration.

For convenience, we repeat here the full "broad" version of SzL given at the end of Section 3.5:

(48) SZEMERÉNYI'S LAW (FINAL – BROAD).

$$\text{PIE *VC(C)F} \rightarrow \begin{cases} \bar{\text{V}}\text{C} \;/\_\_\# \\ \text{VCC} \;/\_\_\# \\ \text{VC} \;/\_\_\$\text{C}_0 \end{cases}$$

A fricative is deleted in a coda sequence of the shape vowel + consonant (+ consonant) + fricative (*/s,

h_1, h_2, h_3/), with compensatory lengthening on the preceding vowel if lost word-finally after a single consonant.

The nom.sg. forms of root nouns to roots of the shape CVC- would fall under the first conditioned outcome of this sound change. Thus, for instance **[u̯ók^{w}s] 'voice', **[póts] 'foot', and **[b^{h}órs] 'thief' would generate **[u̯ók^w], **[pót], and *[b^{h}ór] respectively. In the case of those CVC roots in which the second consonant is [+sonorant], their nom.sg. continues to behave just as other [+sonorant] stems. The further development of the plosive stems, however, may be crucially connected with the second conditioned outcome: **VCCF]$_\omega$ > **VCC]$_\omega$. This change would have affected at least three classes of nouns: root nouns of the shape CVCC- (e.g., **[$h_2$ái̯ks] 'goat'), acrostatic *t*-stems (e.g., **[nók^{w}ts] 'night') and the participle in *-*nt* (nom.sg. **[-e/onts]). Using the same examples, we find that this sound change would generate **[$h_2$ái̯k], **[nók^{w}t], and **[-e/ont], respectively.[152] The immediate implication of this broad sound change is that nom.sg. forms to stems ending in two consonants are without any surface morphological morphological marking whatsoever, as opposed to stems ending in a single consonant, which obtain an Ersatz marking (the long vowel).

The second condition (**VCCF]$_\omega$ > **VCC]$_\omega$) under Broad SzL is potentially problematic. Given that the correct PIE form for the nom.sg. of 'night', for instance, is *[nók^{w}ts], then either this second condition leads to overgeneration, or another factor must be at play to permit a surface configuration *[VCCs#]. Kurisu (2001: 39) has helpfully formalized a constraint Realize-Morpheme that can clarify when lack of overt marking for a given morphosyntactic category will be allowed or not:

(49) Realize-Morpheme (RM)
"Let α be a morphological form, β be a morphosyntactic category, and F(α) be the phonological form from which F(α+β) is derived to express a morphosyntactic category β. Then RM is satisfied with respect to β iff F(α+β) ≠ F(α) phonologically."

Let us take the nom.sg. */nók^w-t-s/ as an example. Here, F(α) is the stem */nok^w-t-/, and F(α+β) is the inflected stem */nók^w-t-s/, which could conceivably surface as *[nók^{w}t] or *[nók^{w}ts]. Since RM is satisfied for the morphosyntactic category Nom.sg. iff the surface form resulting from */nók^w-t-s/ is not formally equivalent to the stem */nok^w-t-/, then only the output *[nók^{w}ts] would in fact satisfy RM. Since the sound change **VC(C)F]$_\sigma$ > **VC(C)]$_\sigma$ would have created a language in which fricatives never occurred as the non-initial member of a complex syllable coda, learners exposed to the primary linguistic data of this language could have acquired a constraint *CF]$_\sigma$: fricatives are disallowed as the second member of a syllable coda. With respect to both vowel stems and stems with only one final consonant, both *CF]$_\sigma$ and Realize-Morpheme may be satisfied:

(50) Forms Satisfying Both *CF]$_\sigma$ and Realize-Morpheme

a. */$h_2$óu̯-i̯-s/ 'sheep' → *[h_2ó.u̯is]

Input: /$h_2$óu̯-i̯-s/		*CF]$_\sigma$	RM
a. ☞	h_2ó.u̯is		
b.	h_2ó.u̯i		*!
c.	$h_2$óu̯i̯s	*!	

b. /méh$_2$-ter-s/ 'mother' → *[máh$_2$tēr]

[152]Note that no CL occurs in these cases because, in the configuration VCC⟨C⟩ > VC⟨C⟩, the consonant immediately following the vowel always remains weight bearing; recall that CL does not occur word-interally for the exact same reason.

Input: /méh$_2$-ter-s/		*CF]$_\sigma$	RM
a. ☞	máh$_2$.tēr		
b.	máh$_2$.ter		*!
c.	máh$_2$.ters	*!	

c. /u̯ók^w-s/ 'voice' → [u̯ók^w]^{153}

Input: /u̯ók^w-s/		*CF]$_\sigma$	RM
a. ☞	u̯ók^w		
b.	u̯óg^w		*!
c.	u̯ók^{w}s	*!	

Conversely, those forms with two consonants at the end of the stem must violate either *CF]$_\sigma$ or Realize-Morpheme:

(51) Forms Satisfying Either *CF]$_\sigma$ or Realize-Morpheme

a. /h$_2$éi̯g-s/ 'goat' → ?

Input: /h$_2$éi̯g-s/		*CF]$_\sigma$	RM
a.	h$_2$ái̯ks	*!	
b.	h$_2$ái̯g		*!

b. /nók^w-t-s/ 'night' → ?

Input: /nók^w-t-s/		*CF]$_\sigma$	RM
a.	nók^{w}ts	*!	
b.	nók^{w}t		*!

c. /-o/ent-s/ → ?

Input: /-o/ent-s/		*CF]$_\sigma$	RM
a.	-o/ents	*!	
b.	-o/ent		*!
c.	-o/ens	*!	

Without a ranking of Realize-Morpheme with respect to *CF]$_\sigma$, the output for such forms is uncertain. In order to arrive at the forms that external reconstruction delivers to us, we should assume that Realize-Morpheme outranks *CF]$_\sigma$, at this phase:

[153] Recall from section 5.3 that word-final obstruents were voiced in PIE.

(52) REALIZE-MORPHEME $\gg$ $^{\star}\text{CF}]_{\sigma}$

Input: /nók^{w}-t-s/		RM	$^{\star}\text{CF}]_{\sigma}$
a.	☞ nók^{w}ts	*!	
b.	nók^{w}t		*!

Thus, beginning from a stage of (pre-)PIE prior to the application of Broad SzL, two developments have ensued:

1. Broad SzL *qua* sound law operates: **[máh$_2$ters] > *[mah$_2$tēr]; **[u̯ók^{w}s] > **[u̯óg^{w}]; **[nók^{w}ts] > **[nók^{w}t]; **[u̯érh$_1$d^{h}om] > *[u̯érd^{h}om]; **[dugh$_2$.trés] > *[dug.trés]. This typology of this primary linguistic data permits the acquisition of a constraint $^{\star}\text{CF}]_{\sigma}$.

2. The ranking REALIZE-MORPHEME $\gg$ $^{\star}\text{CF}]_{\sigma}$, however, allows URs of the type */nók^{w}-t-s/ to surface faithfully as *[nók^{w}ts].

For a subsequent generation of speakers, the data is now fundamentally altered. With the distribution *[máh$_2$tēr], **[u̯óg^{w}], *[nók^{w}ts], *[u̯érd^{h}h$_1$om], *[dug.trés], the data no longer unambiguously point towards a constraint $^{\star}\text{CF}]_{\sigma}$, since a form *[nók^{w}ts] clearly does not satisfy such a constraint. Moreover, the deletion of fricatives when parsed into syllable codas in word-internal position (*/dugh$_2$trés/ $\rightarrow$ *[duk.trés]), rather than being attributed to a constraint $^{\star}\text{CF}]_{\sigma}$, can be attributed to a more phonetically and phonologically natural constraint, the SONORITY SEQUENCING PRINCIPLE (SSP; cf. Section 3.5 above).[154] Hence, *[duk.trés] follows from the ranking of SSP-CODA (no SSP violations in codas)[155] over MAX-C, while *[nók^{w}ts] falls out from the ranking of RM over SSP-CODA. Meanwhile, the data do consistently point toward the absence of fricatives in codas following a [+sonorant] consonant, so forms such *[máh$_2$tēr] and *[u̯érd^{h}h$_1$om] are explicable through a more restricted contraint $^{\star}\text{RF}]_{\sigma}$.[156]

(53) REALIZE-MORPHEME $\gg$ SSP-CODA, $^{\star}\text{RF}]_{\sigma}$ $\gg$ MAX-C

a. */nók^{w}-t-s/ $\rightarrow$ [nók^{w}ts]

Input: /nók^{w}-t-s/		RM	SSP-CODA	$^{\star}\text{RF}]_{\sigma}$	MAX-C
a.	☞ nók^{w}ts		*		
b.	nók^{w}t	*!			*

b. */dugh$_2$-tr-és/ $\rightarrow$ [duk.trés]

[154]This distinction in the learnability of constraints like $^{\star}\text{CF}]_{\sigma}$ verus constraints like the SSP is crucial. Constraints like $^{\star}\text{CF}]_{\sigma}$ certainly are learnable, but based principally upon distributions in the learning data; note that, although the diachronic pathways to the absence of fricatives in syllable codas are phonetically natural (cf. Section 5), the constraint $^{\star}\text{CF}]_{\sigma}$ is relatively arbitrary, from a synchronic point of view. The SSP, on the other hand, reflects the well-established cross-linguistic preference for rising sonority onsets and falling sonority codas. Recently, Hayes & White (2013) have demonstrated that humans do have a preference for the acquisition of relatively natural over relatively arbitrary constraints.

[155]Also conceivable as the conjunction of SSP plus NO-CODA, in Harmonic Grammar terms (Smolensky & Legrendre 2006).

[156]Rather than $^{\star}\text{RF}]_{\sigma}$, the correct constraint might in fact be $^{\star}\text{C[+continuant]F}]_{\sigma}$, but this difference depends largely upon whether the nom.sg. *h$_2$*-stems are to be analyzed as underlying */-Vh$_2$-s/, which, as we have already emphasized, remains uncertain.

Input: /dugh$_2$-tr-és/	RM	SSP-Coda	*RF]$_\sigma$	Max-C
a. ☞ dug.trés				*
b. dugh$_2$.trés		*!		

c. */méh$_2$-ter-s/ → [máh$_2$tēr]

Input: /méh$_2$-ter-s/	RM	SSP-Coda	*RF]$_\sigma$	Max-C
a. ☞ máh$_2$tēr				*
b. máh$_2$ters			*!	

d. */u̯érh$_1$-d^{h}h$_1$-o-m/ → *[u̯érd^{h}h$_1$om]

Input: /u̯érh$_1$-d^{h}h$_1$-o-m/	RM	SSP-Coda	*RF]$_\sigma$	Max-C
a. ☞ u̯ér.d^{h}h$_1$om				*
b. u̯érh$_1$.d^{h}h$_1$om			*!	

Forms of the type *[u̯óg^w] do not fit neatly into this grammar, because they were explicable only under the old constraint ranking, Realize-Morpheme ≫ *CF]$_\sigma$, where such a form could satisfy both constraints simultaneously. In the face of forms of the type *[nók^{w}ts], learners could readily infer that the marker */-s/ belonged to plosive final stems, and was allowed to surface. Given the overall constraint ranking presented immediately above, but a datapoint *[u̯óg^w], the long vowel is simply mysterious – the learner is unable to combine a set of constraints that account for *[nók^{w}ts] with the correct analysis that the nom.sg. animate is marked with a morpheme */-s/ in order to derive the surface form *[u̯ōg^w] with which he is presented. Because the learner is unable to account for this long vowel with the set of constraints to which the rest of the grammar points, the long vowel is *reattributed to the underlying representation* for the nominative singular.[157] The marker */-s/ thus becomes necessary to satisfy Realize-Morpheme:

(54) */u̯ók^w-s/ → *[u̯ók^{w}s][158]

Input: /u̯ók^w-s/	RM	SSP-Coda	*RF]$_\sigma$	Max-C
a. ☞ u̯ók^{w}s		(*)		
b. u̯óg^w	*!			*

[157]Note, also, that effectively the same process occurs again in other forms in the daughter languages. For example, Latv. *sàls* 'salt' must be a consequence of learners failing to acquire constraints that could derive *[sāl] from */sal-s/, and so attributing the long vowel to the UR.

[158]Since the word-final *[s] is likely, in fact, to be considered extrasyllabic, the form might not violate SSP-Coda at all.

In terms of surface form and violation pattern, *[nók^{w}ts] and *[u̯ók^{w}s] or *[népō(t)s] now fit together. The result is that nom.sg. forms like *[u̯ók^{w}s] or *[népō(t)s] now appear to be doubly marked, exhibiting both a long vowel and the suffix */-s/. Such morphosyntactic multiple exponence is wholly unproblematic both empirically (e.g., PIIr. nom.pl. *-āsas* (Ved. *-āsaḥ*, Av. *-å̊ŋhŏ*) << IE *-*ōs*) and theoretically (cf. Kurisu 2001: ch. 5). Practically speaking, one could simply say that, once forms like **[nók^{w}t] became *[nók^{w}ts] in order to have a surface morphological marker, other plosive-final stems with long vowels again obtained the */-s/ marker as well, on the model of the former type. This "analogy" should, however, be motivated in terms of morphological and phonological learning, which is why we have presented such detailed argumentation here.

At this stage, the phonological grammar of PIE would be essentially equivalent to the VARIANT 1 grammar discussed under Section 3.5 and in Byrd 2010: SSP violations are permissible at the word edge, while fricatives are generally blocked in syllable codas following [+sonorant] consonants (*RF]$_{\sigma}$). That grammar is also what one would expect to emerge in the case that one wishes to accept the "narrow" version of SzL, **VRF]$_{\sigma}$ > V̆R]$_{\sigma}$. Under the "narrow" version of SzL, the preceding discussion of long vowels in obstruent stems is moot.

However, the existence of forms like *[h$_2$árh$_3$.trom] 'plow' (Gk. ἄροτρον, Arm. *arawr*, OIr. *arathar*), in which we find evidence for a laryngeal in a syllable coda following a resonant, prove that, at least in some later stage of Core IE, the constraint *RF]$_{\sigma}$ can no longer be active (the VARIANT 2 grammar in 3.5).[159] At most, a yet more positionally restrictive constraint, *RF]$_{\omega}$, which would militate against resonant + fricative solely at the word boundary, might have been acquired, since the salient morphophonemic alternations in the nom.sg. and neut.pl. would have required it. Conversely, speakers might not have encountered salient alternations between forms with and without fricatives word-internally (given that quadripartite consonant clusters in PIE were relatively rare, in any case), and so did not need to posit the broader constraint *RF]$_{\sigma}$.

Exactly how long *RF]$_{\omega}$ remained active in the grammar of PIE is difficult to say. By and large, the nom.sg. of resonant stems seems to be morphologized in the daughter languages, and likewise the neut.pl. of resonant stems in all languages following the loss of laryngeals. As long as it did remain active, however, it may have produced interesting interactions with another sound change in Core PIE: *[ōN#] > [*ō#] (e.g., *[d^{h}égĝ^{h}ōm] nom.sg. 'earth' > *[d^{h}égĝ^{h}ō]).[160] The latter development is especially interesting, because the outputs of SzL/*RF]$_{\omega}$ feed this sound change. This feeding relationship means that two constraints *RF]$_{\omega}$ and *ōN]$_{\omega}$ cannot be active in the same (layer of a) grammar, without generating unexpected results. Consider the nom.sg. of **on*-stems, if derived from a UR */-on-s/:

(55) Interaction of *RF]$_{\omega}$ and *ōN]$_{\omega}$

Input: /-on-s/			RM	*RF]$_{\omega}$	*ōN]$_{\omega}$	MAX-C
a.		-ons		*!		
b.		-ōn			*!	*
c.	✕	-ōs				*
d.	☞	-ō				**!

Since *[-ōs] here would be a perfectly well-formed output (cf. nom.sg. *[h$_2$áu̯sōs] 'dawn'), no constraint can forbid it; *[-ōs], however, is not the desired form for the nom.sg. of an **on*-stem. In order to generate

[159] Perhaps significant is the fact that, among Byrd (2010: 47-8; 87-88)'s eight examples of *[RH.CC], no Tocharian cognate appears, while Tocharian does offer a substantial number of examples for */PHCC/ → *[P.CC]. Under the common view that Tocharian was the second branch to diverge from PIE, the lower re-ranking of *RF]$_{\sigma}$ might date to the period after the Tocharian divergence; at least, we know of no counterexamples to such an assumption.

[160] With respect to Greek, the "restoration" of word-final nasals (cf. χθών 'earth') is not a morphological change ("analogy") at all, but rather the loss of the constraint *ōN]$_{\omega}$ in the grammar of Greek.

expected *[-ō], the constraint *ōN]$_{\omega}$ must operate on an UR */-ōn/, which entails that the asigmatic nom.sg. already be morphologized. In this sense, the sound change *ōN]$_{\omega}$ > *ō provides a *terminus ante quem* for the morphologization of SzL outputs. The question of exactly why SzL-related outputs became morphologized or lexicalized is still an open question. If PIE were to have accumulated a number of surface exceptions to *RF]$_{\omega}$, then the attribution of long vowels in resonant stems to URs would follow directly; such exceptions are not forthcoming, however, which is precisely why the morphophonemic analysis that led to the formulation of SzL in the first place is appears so straightforward. We will leave a thorough account of this issue to future research. For convenience, we provide a summary table of the developments that we have outlined in this section.

Figure 3: PIE Phonological Changes Treated: From Broad SzL to Core PIE

Phase	**Change**	**Effects**
Early PIE (1)	Broad SzL operates	No fricatives in syllable codas; compensatory lengthening
Early PIE (2)	Constraint *CF]$_{\sigma}$ acquired	Recapitulates Broad SzL
PIE (3)	Ranking RM ≫ *CF]$_{\sigma}$	*[nók$^{\text{W}}$ts]-type words surface faithully, creating conflict with the *[u̯óg$^{\text{W}}$]-type
PIE (4)	Emergence of *[u̯ók$^{\text{W}}$s]; replacement of *CF]$_{\sigma}$ with SSP-Coda and *RF]$_{\sigma}$	SzL recapitulates only in R-final stems
Late PIE (5)	*RF]$_{\sigma}$ further restricted to *RF]$_{\omega}$	*[h$_2$árh$_3$.trom]-type emerges
Late PIE (6)	Morphologization of *RF]$_{\omega}$ outputs	SzL lacks a direct phonological correlate
Core PIE (7)	*[ōN#] > [*ō#] operates	N-final stems lack *[-s] and *[-N]

8 Conclusions and Future Directions

In the course of the paper, we have systematically argued for the following conclusions:

1. In Section 3, we made explicit that Szemerényi's Law, at its core, rests on a largely unproblematic morphophonemic analysis. This analysis pertains to externally reconstructable animate nom.sg. and "collective"/neut.pl. forms. We find no compelling reason to deny the existence of nominative singular marking */-s/ and "collective"/neuter plural */-h$_2$/ that this morphophonemic analysis (i.e., internal reconstruction) furnishes. We account for the instances in which a long vowel appears to co-occur with sigmatic nominative marking, which are all but exclusively Indo-Iranian (e.g., Ved. *dyaúḥ* 'sky', Av. *hiϑāuš* 'companion', Ved. *páthāḥ* 'path'), as analogical innovations of Proto-Indo-Iranian.

2. Given this evidence, we believe that, at minimum, a (pre-)PIE sound change **VRF]$_{\omega}$ > *V̄R]$_{\omega}$ must be reconstructed (the narrow version of SzL). Based on further evidence of long vowels in final syllables in non-sonorant stems (*[ménōs] 'minds', *[léu̯kōs] 'lights', *[népō(t)s] 'nephew'), and absence of expected laryngeal reflexes word-medially in the configuration */RHCC/ (*[g̑enmnV-] 'birth, descent', *[u̯érd$^{\text{h}}$h$_1$om] 'word', *[kerdh$_1$o-] 'place'), a broader sound change **VC(C)F]$_{\sigma}$ > V̆C(C)]$_{\sigma}$ (with CL only at the right edge of the word) may be reconstructed as well.

3. In Section 4, we demonstrated that the accounts which Kortlandt (1975: 84-6) adopts as the origin of the IE lengthened grade, monosyllabic lengthening and lengthening before resonants word finally, are untenable. PIE likely did possess a Minimal Word Requirement of two moras. Compelling evidence exists for lengthening in PIE words of the shape /CV/ and /CVC/, but not /CVCC$_0$/. Although vowels before [+sonorant] coda consonants likely were phonetically longer in PIE (as in many languages), no motivation for the phonologization of that lengthening is available, and the process is victim to a slew of counterexamples, moreover.

4. In Section 5, we proposed a plausible phonetic motivation for both the narrow and broad version of SzL as formulated in Section 3. Szemerényi's Law likely originated as a sound change (post-lexical

phonological process) that lenited fricatives (PIE */s/ and */H/) to ø in syllable codas. This lenition could have obtained either through the approximanization of voiced fricatives (e.g., [z] > [ɪ] > [ø]) or the debuccalization of voiceless fricatives (e.g., [s] > [h] > [ø]). The lenition of fricatives in syllable codas finds ample cross-linguistic parallels, and is readily justified in the phonetic literature on the grounds of both production (fricatives are more difficult to articulate in syllable codas) and perception (fricatives are more difficult to perceive in syllable codas); see in particular Solé 2010 and Côté 2004.

5. In Section 6, we showed that the compensatory lengthening (CL) that results from the loss of coda fricatives word-finally in the change **VCF]$_{\omega}$ > V̄C]$_{\omega}$ is comprehensible under the assumption that word-final consonants were EXTRAMETRICAL (i.e., they were not permitted to bear prosodic weight). The cases of lengthening in PIE words of the shape */CVC/ and Kuiper's Law provide direct confirmation of final consonant extrametricality; this same prosodic feature may be directly inherited in Attic-Ionic Greek and (Old) Latin. Word-final consonant extrametricality also directly explains the discrepancy in behavior between loss of consonants word-finally, which causes CL, and word-medially (evident in cases like *[u̯érd^{h}h$_1$om] 'word' and simplification of underlying identical segments), which does not cause CL.

6. In Section 7, we offered a tentative account of how the broad version of SzL (**VC(C)F]$_{\sigma}$ > VC(C)]$_{\sigma}$) could account for the lengthened grade in the nom.sg. of root nouns. Specifically, forms such as **[u̯ók^{w}s] 'voice' became *[u̯ó́g^{w}] by sound change, and subsequently, at a point when the sound change was recapitulated through a more restricted markedness constrait *RF]$_{\sigma}$, the long vowel was reattributed to the UR, and nom.sg. */u̯ó́k^{w}-s/ was able to surface as *[u̯ó́k^{w}s].

In sum, we hold that a combination of morphophonemic analysis, diachronic and experimental phonetics, and theoretical phonology, make a (pre-)PIE development **VRF]$_{\sigma}$ > *V̆R]$_{\sigma}$ difficult to deny. The broader version of this change, **VC(C)F]$_{\sigma}$ > *VC(C)]$_{\sigma}$ strikes us as plausible, but the smaller body of evidence and the possibility of alternative solutions make it less compelling.

In the main, we see three further avenues of research that are not yet fully exploited:

1. To what extent are SzL and changes of the type **VRd > *V̄R (e.g., *[k̂erd] > *[kēr] 'heart'; see Section 3.4 and Kim 2001) connected? Our intuition is that such developments are phonetically unrelated to our version of SzL, but the compensatory lengthening falls out from the same mechanism as described under Section 6.

2. What diachronic trajectory, precisely, does SzL follow, from (pre-)PIE sound change, to synchronic phonological constraint in PIE grammar, to morphologization? How does SzL interact with other (Core) PIE sound changes? We have alluded to some of these issues at the close of Section 7.

3. What impact does final consonant extrametricality hold for processes of CL diachronically between PIE and its daughter languages? Namely, is CL to be expected when an extrametrical consonant is lost? This question depends in part on the as yet unresolved question of whether CL generally is principally a phonetic or phonological process. Should one view CL as basically phonological in nature (i.e., the transfer of prosodic weight), then one might not expect CL from loss of a word-final consonant, just in case extrametricality remains a constant feature of the grammars between PIE and a given daughter language (as we suggest holds for PIE to Attic-Ionic Greek) . Thus, PIE *[V̆H#] might give Attic-Ionic V̆#, not V̄#. If so, then reconsideration of the reconstruction for certain inflection endings might be necessary (e.g., 1.sg.pres. *[ōh$_2$] instead of *[oh$_2$], nom.sg. of fem. *h_2-stems *[āh$_2$] instead of *[ah$_2$]).[161]

[161]For at least the 1.sg. thematic -ω and thematic. nom./acc.du. -ω, Jasanoff (2003: 59-63): has already proposed a PIE apocope process to account for *-h_2 ∼ *-h_2e and *-h_1 ∼ *-h_1e: **-*oHe*# > *-*oH*#. Relevant for the purpose at hand is the existence of another type of CL, CV.CV > CV̄C : the vowel of a following syllable is lost, with compensatory lengthening of the vowel of the preceding syllable (see generally Kavitskaya 2002: 108-17; cf. Section 4.2 above). Perhaps **[-oHe#] > *[-ōH] occurred.

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