Evidence for non-linear phonological structure in Indo-European: The case of fricative clusters

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Abstract

In this paper I argue for the necessity of reconstructing hierarchical phonological structure for onset clusters containing fricatives. The first part deals with /s/ in obstruent clusters. I show that it was subsegmental in Germanic and Latin, while in Greek and Indo-Iranian it was parsed into a semisyllable. In the second part the analysis is extended to laryngeals in onset clusters. Based mainly on Indo-Iranian evidence I argue that in PIE laryngeals were semisyllabic like *s*. PIE word-initial semisyllables were licensed only when they contained a fricative. The last part of the paper deals with *s*-mobile in clusters with plosives, which can be explained by the semisyllabic status of *s* in these configurations. I argue that semisyllabic *s* was highly marked and prone to lexically gradual change. The markedness of semisyllabic *s* is backed by observations from language acquisition, its diachronic instability by typological data.

1 Introduction

In this paper I argue for the importance of non-linear phonological structure for understanding PIE phonotactics. I show that a better grasp of prosodic phenomena sheds light on the segmental make-up of PIE phonemes.

First I give a short sketch of the perfect reduplication in ancient IE languages. Then I discuss the behaviour of onset clusters with initial /s/ or laryngeal followed by a plosive in reduplication. The observed anomalies are explained with recourse to subsegmental and supersegmental structure. In the final part of the paper I give a tentative explanation for at least one subgroup of *s*-mobile-phenomena based on a prosodic analysis.

2 Reduplication

Reduplication is important for the study of phonotactics, because the shape of the reduplicant is always determined by melodic specifications copied from segments of its base. The copy, however, is not necessarily faithful. In general, deviations from faithfulness lead to a very simple syllabic make-up, often a CV-template. Therefore, reduplication is seminal for investigating markedness in onset clusters.[1]

[1] In phonological theory this fact has recently been explained by assuming reduplicants without any phonological specification (cf. McCarthy & Prince (1994), (1995)). In Keydana

A case in point is the IE perfect reduplication. In (1) some core data are given:

(1) a. Old Latin *currō*, *cecurrī*
b. Greek τρέφω, τέτροφα
c. Vedic *kar*, *cakā́ra*
d. Vedic *prat*^{h}, *paprát*^{h}*a*

Two interesting patterns emerge. One concerns the vowel, which is an /e/ in PIE, regardless of the vowel of the base.[2] The other is the fact that only one of the onset consonants of the first syllable of the base is copied into the reduplicant.

In the languages under discussion, perfect reduplication was a fully active synchronic morphological operation, so that in Vedic and Greek every verbal root (except for the descendents of PIE *$\hat{u}e\hat{i}d$) with the capacity of forming a perfect stem was potentially subject to reduplication. The process was productive, as it was applied to all newly formed verbs.[3] While Latin had restricted reduplication to a small number of roots,[4] the process was still fully active, if not productive. This is evident from the fact that in the development from Old to Classical Latin, the reduplicant /e/ was systematically replaced by the vowel of the base.[5]

These observations lead to the following sketch of perfect reduplication as part of the grammar in the ancient IE languages and PIE.

The reduplicant as part of the lexicon was specified as a CV-template on the timing tier, and the V-slot was linked to a full featural specification on the melody tier:

(2) RED = 

In a first approximation the grammar may be sketched as in (3):

(3) grammar (preliminary version):
a. Attach RED to the left edge of the perfect stem (its base).
b. Copy the melodic specification of the base-initial consonant to the C-slot of RED.

3a. leads to morphological structures of the type *C*e*-*k*^{w}*or*-*e*.[6] The phonological grammar then copies the melodic specification of the base-initial *k^w into the C-slot of the reduplicant, resulting in *$k^w ek^w ore$.

(2006) I showed that at least for the ancient IE languages and PIE this claim can not be upheld. See below.

[2]See Keydana (2006) for details.

[3]Cf. Late Vedic *mlecc*^{h} with its perfect *mimlecc*^{h}*a*, which is probably of onomatopoetic origin (Gotō (1987:253), or Greek denominative δειπνέω with perfect δεδείπνηκα, already quoted by Schwyzer (1939:765) as evidence for the "Lebendigkeit der Reduplikation".

[4]For an overview see Meiser (2003:181).

[5]The exceptions, which in themselves also show a regular pattern, are discussed in Keydana (2006:79-80).

[6]For ease of printing the timing tier and the melody tier are conflated in this notation.

3 PIE */s/ in reduplication

3.1 Subsegmental structure

In data like (1b.) and (1d.), only the first segment of an onset cluster of the base is copied into the reduplicant. *S*-clusters, however, show a more complex behaviour. The present subsection deals with Gothic and Latin data, the following with Greek and Vedic material.

Gothic and Latin exhibit the following patterns:

(4) a. Gothic *(ga)-stalda*, *staistald*, not †*saistald*
b. Latin *spondeō*, *spopondī*, not †*sospondī* or †*spospondī*

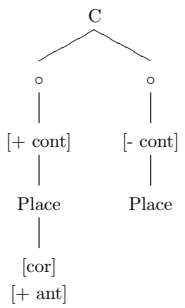
Both languages copy the entire cluster into the reduplicant. In Latin an additional complexity arises, as the cluster is simplified word-internally.[7]

Turning to the cluster in the reduplicant first, a rather straightforward – albeit simplistic – solution emerges: if the reduplicant offers only one slot for a non-peak segment, /st/ in onsets must count as one segment in Latin and Gothic.

This may come as a surprise when dealing with *st*-clusters, but it is a fairly accepted analysis for affricates, sequences of homorganic sounds with mutually exclusive melodic specifications. Their internal make-up prohibits their treatment as one phoneme, yet in languages such as German they are distributed like monosegmentals. With different tiers in the phonological structure, they are best viewed as one slot on the timing tier associated with two melodic specifications on the melody tier.

The analysis can be extended to *st*-clusters in Gothic and Latin as, in the words of Wiese (1996:262), these clusters simply show "a mirror shape [relative to affricates, G.K.]". Modifying a proposal by Weijer (1994), we postulate the following structure for clusters consisting of *s* and a plosive in Latin and Germanic:[8]

(5)



In the Germanic languages, subsegmental structure in *s*-clusters is evident from the earliest attestations up to the modern languages (Wiese (1996:43)).

[7] This phenomenon cannot be explained by dissimilation (cf. Meiser (1998:210)) as long as reduplication is still an active morphological process. See Keydana (2006:81) for details.

[8] The modification mentioned consists in the introduction of an additional timing tier (∘) below the segmental tier. Without this tier the fixed order of subsegmental specifications could not be accounted for, as *st* and *ts* are both licensed.

Latin subsegmental structure, however, is more recent. The lexicalized relic form *sistō* shows that *s* had segmental status in an earlier period.[9]

The assumption of subsegmental structure in Latin and Gothic *s*-clusters helps to clarify a variety of other, seemingly unrelated, facts.

In both Latin and Gothic, *s*-clusters violate the Sonority Sequencing Principle (SSP), because sibilants are inherently more sonorous than plosives. The SSP is a constraint on the well-formedness of syllables forcing the sonority within the syllable to rise through the onset, reach its peak at the nucleus, and fall throughout the coda.[10] *S*-clusters violating the SSP cannot be accounted for by reducing the principle to a mere tendency, as the exceptions to the SSP are highly regular. Nor can it be explained by assuming a single stratum for all obstruents on the sonority hierarchy. In Latin reduplicated perfects, the *s*-cluster is always reduced to the plosive word-internally, showing that plosives have a higher margin-affinity than sibilants.

Being grounded in phonetics, the essential sonority hierarchy is universal. Still, each individual language can stratify the hierarchy in its own way. Malayalam, for example, treats obstruents as one stratum, Arabic treats fricatives as more sonorous than plosives, and in Hindi fricatives are ranked lower in the hierarchy than plosives (Jany *et al.* (2007)). Therefore, one might argue that in Latin and Gothic all obstruents count as equally sonorous. Under this assumption *s* + plosive would form a plateau and thus not violate the SSP.

However, at least for Latin there is evidence from reduplication against this stratification. As forms like *spopondī* show, the monosegmental cluster is reduced to the plosive word-internally. This is a bipartite process. First, some markedness constraint forces the cluster in the input to surface as a non-branching segment word-internally. Second, some other constraint chooses between the two possible candidates for the output-segment, both /s/ and /p/ being available. Postponing the identification of the first constraint for the moment (see below), the most probable factor for selecting the melodic specification is margin-affinity: Languages always prefer maximally unsonorous onsets. Since the plosive is chosen, it must count as less sonorous than the sibilant.[11]

The data can, however, be dealt with by assuming subsegmental structure: The SSP is a condition on segments within and licensed by a syllable.[12] It is evaluated by computing the sonority of each segment and deriving a sonority grid from this computation. However, subsegmental structure is licensed and dominated by a segmental slot. The decline in sonority within *s*-clusters is therefore not in the domain of the SSP.

Subsegmental structure is also the reason why word-internal *s*-clusters are simplified, since highly marked phonological structure is often positionally constrained.[13] In Latin, monosegmental *s*-clusters are restricted to the onset of prosodic words. If we further assume that the right boundary of the redupli-

[9]Subsegmental structure is also short-lived. The Romance languages do not treat *s*-clusters as monosegmental. Cf. the Old French data below.

[10]The SSP goes back to Sievers (1901:204). For a modern account see Clements (1990).

[11]More arguments for the proposed Latin sonority scale can be found in Lehmann (2005).

[12]Licensing is an important concept in non-linear phonology, as phonological material and / or structure is only allowed for if it is properly embedded into a higher structural domain. Constraints on structure and / or material are always local: they apply only within the immediate domain of a given structure and / or given material.

[13]Cf. the distribution of monosegmental *s*-clusters in Germanic.

cant is aligned to the right edge of the syllable,[14] word-internal *sp* would have to be parsed into an onset, but as that is blocked, it has to be reduced to a non-branching segment (i.e., a segment without subsegmental structure).[15]

Subsegmental structure also explains why verbs with *s*-clusters show reduplication at all, as reduplication is otherwise restricted to verbs with monosegmental onsets in Latin (Keydana (2006:81)).

Leaving reduplication for the moment, the assumption of subsegmental structure may also shed some light onto a problem of Latin syllabification. Latin has a strong tendency to reduce hypercharacterized syllables to simple bimoraic ones as long as the syllable is not identical to the prosodic word.[16] Most exceptions are due to contractions, but some cases escape this generalization. Not all of them can be dealt with under the approach advocated here,[17] but some fit more neatly into the general picture.

One such case is *lūstrum* (< **luH-stro*-, Serbat (1976:312), Vaan (2008:355)), seemingly with a trimoraic first syllable. However, assuming that the left margin of the suffix is aligned to the left margin of a prosodic word, the syllabic structure is *.lū.strum*, *st* being a monosegmental cluster. This analysis may be extended to *-sk-*-verbs like *dūrēscō*, if the morpheme boundary is prosodically aligned in a structure $[_{PrWd}$ *.dū.rē.*$][_{PrWd}$ *.scō.*$]$.[18]

Turning to Germanic, it has been observed that stops in *s*-clusters are exempt from Grimm's law (Iverson & Salmons (1995:386)). This exceptional behaviour can be accounted for if we assume that Grimm's Law operated on segments. Being subsegmental, plosives in *s*-clusters, then, were not in the domain of the law.

A last point illuminated by assuming subsegmental structure is the behaviour of *s*-clusters in Germanic alliterative verse. In Old High German, for example, the domain of alliterative verse is always the first segment of the word-initial syllable, be it a non-branching onset or the first part of a complex onset. The only seeming exception to this rule is constituted by *s*-clusters, which alliterate as wholes. If alliteration is defined in terms of segments, this behaviour is predicted by the analysis proposed here, since *s*-clusters are in fact segments.[19]

[14] On the alignment of morphological and prosodic structure see McCarthy & Prince (1993).

[15] In an OT grammar we can model this behaviour by introducing a cascade of constraints $*(\circ\circ/\mathrm{C}_{\mathrm{Ons}_\sigma}) \gg *(\circ\circ/\mathrm{C}_{\mathrm{Ons}_{\mathrm{PWd}}})$. The alignment is due to a constraint Align(Red(R),σ(R)). A grammar implementing these constraints blocks all candidates where an *s*-cluster is parsed into a word-internal syllable onset or where the *s* is parsed into the coda of the preceding syllable:

Red-*spondī*	$*(\circ\circ/\mathrm{C}_{\mathrm{Ons}_\sigma})$	Align(Red(R),σ(R))	Parse$^{\mathrm{Subseg}}$	$*(\circ\circ/\mathrm{C}_{\mathrm{Ons}_{\mathrm{PWd}}})$
☞ *.spo.pon.dī.*			*	*
.spo.spon.dī	*			*
.spos.pon.dī.		*		*

[16] See Allen (1973:51,141), Brennan (2006).

[17] The type *mōnstrum* with regular lengthening of the vowel followed by *nsT* has to be kept apart.

[18] That morphological words may consist of more than one phonological word in Latin is attested by compounds like *abrumpō* (= $[_{PrWd}$*ab*$][_{PrWd}$*rumpō*$]$), where the muta cum liquida rule does not apply. To my knowledge the prosodic status of Latin affixes has not been studied. However, evidence for affixes being mapped into phonological words of their own can e.g. be found in German, cf. *lieb.lich* as opposed to *ne.blig* (Wiese (1996:68)). Further evidence for Latin suffixes aligned to prosodic words can possibly be drawn from *ōstium* when taken as $[_{PrWd}$*ōs*$][_{PrWd}$*tium*$]$. Under this analysis the word conforms to the Latin constraint on syllable weight, as monosyllabic prosodic prosodic words are exempt.

[19] Andrew Byrd (email) drew my attention to a radical alternative proposed by Fleischhacker

3.2 Semisyllables

S-clusters in Greek and Vedic take the following shape:

(6) a. Greek στρατεύω, ἐστράτευκα
b. Vedic *stambʰ*, *tastámbʰa*, not †*sastámbʰa*

In both languages *s*-clusters are treated like other clusters, and only one segment is copied into the reduplicant. The clusters must therefore be sequences of distinct segments without subsegmental structure. Still, the data require some explanation. First, the segment that is copied differs: in Greek (or rather Pre-Greek) it is *s*, whereas in Vedic it is the plosive.

The second question concerns the sonority. *S*-clusters in Greek and Vedic are not subsegmental and should therefore violate the SSP. Since no other cluster violates this constraint, we would again be ill-advised to reduce it to a tendency. Rather, a principled explanation is called for. A possible explanation already discussed for Latin is that of a language specific sonority hierarchy. However, it must be wrong at least for Vedic, since the data show that plosives in onset position are preferred (see below). Vedic, therefore, has the same sonority hierarchy as Latin:[20]

(7) $*(a/\textsc{Mar}) \gg *(i/\textsc{Mar}) \gg *(r/\textsc{Mar}) \gg *(m/\textsc{Mar}) \gg *(s/\textsc{Mar}) \gg *(t/\textsc{Mar})$
In short: $*(a \triangleright t/\textsc{Mar})$

In the absence of evidence to the contrary, it seems reasonable to extend this hierarchy to Greek (and probably PIE).

Another possibility would be to assume some constraint or constraints ranked above sonority constraints and licensing *s*-clusters. This was proposed by Morelli (2003:364), who assumes two OCP-constraints interacting with a constraint penalizing tautosyllabic sequences of stop + obstruent in the onset. However, as this constraint is designed to cover exactly the phenomenon at hand and cannot be substantiated by extending its scope to other data or by phonetic grounding, this is an *ad hoc* solution.

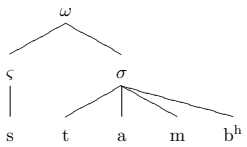
The best option is to propose some additional structure preventing the cluster from being accessible to the SSP. The subsegmental approach advocated for Latin and Gothic is of this type, but since reduplication patterns show the cluster was not subsegmental in Greek and Vedic, an alternative is called for. I therefore propose to promote part of the cluster into a structural domain outside the syllable. Following ideas going back to Sievers (1901:205-6), I will assume that initial *s* in clusters forms a semisyllable.

Semisyllables are non-moraic syllables (Cho & King (2003)). Lacking both nucleus and coda, they consist of an onset only. Under the semisyllabic approach, Vedic *stambʰ* has the following phonological structure:

(2002:5) for Latin reduplication. Fleischhacker claimes that in Latin the reduplicant is an infix. *Spopondī, then, is spo-po-nd-ī.* However, this approach cannot be upheld for two reasons: (1) Red is a prefix from PIE up to Italic. Fleischhacker therefore has to assume a change from prefixation to infixation in post-Italic Pre-Latin. Such a development comes as a surprise as (2) infixation is very rare in PIE (only the *n*-infix comes to mind) and totally absent in Latin.

[20] The hierarchy is given as a cascade of OT constraints, because it is part of the grammar. $*(a/\textsc{Mar})$ is a ban on non-high vowels (a) in the onset or coda (the margin) of the syllable, $*(t/\textsc{Mar})$ a ban on voiceless plosives (t) in the margin. The ranking ensures that whenever faithfulness to the lexical input allows for a choice, voiceless plosives in the syllable margin are preferred over fricatives, fricatives over nasals, nasals over liquids, and so on.

(8)



In this configuration, both the semisyllable and the moraic syllable satisfy the SSP.

Semisyllabicity of *s* in onset clusters may seem completely ad hoc; however, a comparison with semisyllables in other languages shows that, typologically, it is highly plausible. Semisyllables are typically aligned with the margin of morphemes. This is exactly the case with [$_{\varsigma}$ *s*], which only occurs on the left margin of root morphemes. Besides, semisyllables are often restricted as to possible melodic specifications. This, too, seems to hold true for Vedic and Greek: the only semisyllables identified so far contain the sibilant.[21]

As three of the four languages under discussion show semisyllabic structure in their earliest attestations,[22] it seems reasonable to assume semisyllabicity for PIE as well.

The second question mentioned above concerns the choice of the segment copied into the reduplicant. The Vedic behaviour is predicted if we take *$(a \triangleright t/\textsc{Mar})$ to be part of the reduplication grammar. This constraint will always favour the least sonorous consonant as a target for the copying mechanism. In Vedic this constraint outranks another one, called Distance,[23] which opts for copying the nearest possible consonant of the base.[24] In Greek, however, nearness is more important than margin-affinity. Both types are expected, as the interplay of *$(a \triangleright t/\textsc{Mar})$ and Distance leads to the following factorial typology:

(9) factorial typology for onsets of CV-reduplicants
   a. *$(a \triangleright t/\textsc{Mar}) \gg$ Dist: A Vedic-type grammar which selects the least sonorous consonant from the onset of the base.
   b. Dist $\gg$ *$(a \triangleright t/\textsc{Mar})$: A Greek-type grammar which selects the nearest consonant of the base.[25]

We are now in a position to update the grammar in the following way:

(10) informal grammar (final version)[26]
   a. Attach Red to the left edge of the perfect stem (its base).
   b. Copy the melodic specification of the consonant of the base to the C-slot of Red which optimally satisfies a nearness constraint and a constraint on margin-affinity.

[21] In the following section I will extend the PIE semisyllable to fricatives in general. For another type of possible PIE semisyllables cf. Byrd, this volume.

[22] Cf. Latin *sistō* above.

[23] On the architecture of this constraint see Keydana (2006:66-7).

[24] This constraint is necessary on independent grounds, as it prevents consonants from other parts of the base from being copied into the reduplicant, even if they are better onset consonants according to the sonority hierarchy. The perfect of Vedic *MAD* e.g. is *mamā́da*, not †*damā́da*, although *d* is a better candidate for the onset than *m*.

[25] Avestan data show that the Vedic type is recent. Indo-Iranian was probably of the Greek type. See Keydana (2006:96-7).

[26] Vedic *tastámb^{h}a* is generated by an OT grammar along these lines as follows:

Semisyllabicity in onset clusters helps to clear up another long-standing mystery of IE phonotactics. As can be seen from root structures and Sievers phenomena, the maximal onset cluster in PIE consisted of two segments (Beekes (1981 [1982]:110), Keydana (2004:181-3)).[27] The only exception reconstructible with plausibility are tripartite *s*-clusters as in PIE **streiĝ*.[28] This fact confirms the hypothesis that /s/ was semisyllabic. With semisyllabic *s*, the onset of the moraic syllable is still made up of only two segments and thus in full accordance with the constraints on PIE onsets.

4 PIE *H in reduplication

(11) and (12) give an overview of clusters containing laryngeals in reduplication:

(11) H + sonorant

a. Vedic *ānáṁśa* (: *naś*) < **h*$_2$*e-h*$_2$*nóḱ*^{o} (on the second *n* cf. Kümmel (2000:287)). Cf. Old Irish *-án-aic*.

b. Greek ὀρώρυχα (: ὀρύττω) < **h*$_3$*re-h*$_3$*ru*^{o}, not †ὤρυχα < †*h*$_3$*e-h*$_3$*ru*^{o}.

(12) H + plosive

a. Vedic *jāgā́ra* (: *jar*) < **ge-h*$_1$*gor*^{o}, not †*h*$_1$*eh*$_1$*gor*^{o}. Greek has changed *ἐγήγορα to ἐγρήγορα under the influence of the aor. ἐγρε- (Rix *et al.* (2001:246)). Since there is no evidence for an initial laryngeal in the Vedic form (*i.e.*, **ge-h*$_1$*gor-* and **h*$_1$*ge-h*$_1$*gor-*, as suggested by Krisch (1996) and Kümmel (2000), would yield the same result), it seems appropriate to apply the grammar outlined above and reconstruct a simplex onset.

b. Greek ὄπωπα (: ὁράω) possibly < **h*$_3$*k*^{w}*e-h*$_3$*k*^{wo} (with zero grade).

RED-*stámb*^{h}*a*	*(*a* ▷ *t*/MAR)	*ς/$_{PwD_{int}}$	DIST	ALIGN(RED(R),σ(R))
.ta.s.tám.b^h*a.*		*	*	
.sa.s.tám.b^h*a.*	*	*		
.ta.stám.b^h*a.*	*			
☞ *.tas.tám.b*^{h}*a.*				*
.sas.tám.b^h*a.*	*			*

The ranking of *(*a* ▷ *t*/MAR) above DIST ensures that /t/ is copied into the C-slot of the reduplicant. *ς/$_{PwD_{int}}$ ensures that semisyllables are restricted to the edge of the prosodic word. In Vedic this constraint is ranked above ALIGN(RED(R),σ(R)). Evidence for this ranking comes from metrics, the initial syllable of a reduplicated verb with root-initial s-cluster always counting as long (see e.g. *tuṣṭuvuḥ* (RV 8.6.12 bis), *paspaśé* (RV 1.22.19), or *tast*^{h}*au* (RV 1.33.14 and passim)).

[27] It should be noted that this is a constraint on possible outputs of the phonological grammar. It does not hold for morphological inputs. Actually, PIE morphology generated tripartite clusters as in */*ph*$_2$*ter-*/ or */*kh*$_2$*p-i̯e-*/ etc. However, the attested ancient IE languages show that such morphological structures underwent repair by epenthesis (leading to **ph*$_2$*əter*^{o} or **kh*$_2$*əpi̯e*^{o}). Repair is also at work in zero grades of TeST-roots like **pesd*. Underlying **psd-éi̯e-* e.g. is realized as **p*$_{(e)}$*sd-éi̯e-*, as shown by slov. *pəzdím*. Alternatively, other IE dialects reduce the cluster, as in Greek βδέω (cf. Rix *et al.* (2001:477). Generally, CSC in morphological inputs is seldom attested, as TeST-roots are rare.

[28] On other fricative clusters and especially the tripartite cluster in **h*$_2$*stér-* see below. Strunk (1985:227) arrives at the rather dubious reconstruction **pster* by comparing Greek ἔπταρε, πτάρνυμαι with lat. *sternuō*. **psténo-* is also highly doubtful. See Klingenschmitt (1974:276-7) and especially Hamp (1960:274), who argues for an original onset in **spt-*.

These data show a distribution of onsets reminiscent of *s*-clusters. Pre-Greek laryngeal clusters are always copied as wholes, the laryngeal must therefore be subsegmental throughout. Vedic shows a more complex distribution: if the initial laryngeal is followed by a sonorant, the laryngeal is copied into the C-slot of the reduplicant. This is predicted if *H* is less sonorous than a sonorant. If the laryngeal is followed by a plosive, however, the plosive is selected. This pattern exactly matches that for *s*-clusters.[29] Since laryngeals are on the same stratum in the sonority hierarchy as /s/, the PIE hierarchy can be reconstructed as follows:

(13) $*(a/\textsc{Mar}) \gg *(i/\textsc{Mar}) \gg *(r/\textsc{Mar}) \gg *(m/\textsc{Mar}) \gg *(s/\textsc{Mar})$, $*(H/\textsc{Mar}) \gg *(t/\textsc{Mar})$

Reduplication data therefore confirm the view held, for example, by Rasmussen (1983), Kobayashi (2004:22-3) and Kümmel (2007:327-336), i.e. that the laryngeals – all three of them – were fricatives. Their behaviour and that of their continuants in Pre-Greek and Indo-Aryan proves that they remained fricatives throughout their existence.[30]

As fricatives, laryngeals are expected to form onset clusters with sonorants, but they should not be parsed into tautosyllabic onset clusters with plosives. However, some PIE roots begin with a sequence of laryngeal plus plosive, a convincing example being $*h_1 ger$ (Keydana (2004:fn.49)), a possible candidate $*h_2 te\underset{\frown}{u}\hat{g}$- (Rix *et al.* (2001:286)). This pattern can be explained by extending semisyllables to laryngeals. Thus, we can conclude that PIE allowed for non-moraic semisyllables in the onset of prosodic words if and only if they contained a fricative which could not be parsed into a moraic syllable.

4.1 Maximizing semisyllables

The PIE word-initial semisyllables reconstructed so far consist of a simple non-branching onset containing a fricative.

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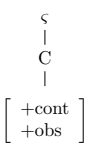

This structure is similar to simple onsets of moraic syllables. However, since the PIE onset was maximally two-segmental, it could be expected that two-segmental semisyllables were also well-formed. A possible candidate for a two-segmental semisyllable is PIE $*/h_2 st\acute{e}r-/$ with two fricatives preceding a plosive. The word is most probably a morphologically complex hysterodynamic stem with a zero-grade root (Schindler (1969:155,fn.71), Rieken (1999:282-3)).[31] The

[29] As all three laryngeals are attested in root-initial clusters and in Attic reduplication (cf. $*h_2 ne\hat{k}$-, $*h_3 re\underset{\frown}{u}k$-, $*h_1 ger$-), it seems feasible to view them as one natural class with identical phonotactic behaviour.

[30] Against Lamberterie (2004:238)) they never changed sonority in Pre-Greek, and against Lubotsky (1981:138), Beekes (1994:451) they did not merge in a glottal stop in Indo-Iranian.

[31] See Wodtko *et al.* (2008:349-50) for an overview of the various stem-formations discussed in the literature, especially their discussion of Watkins (1974) and Puhvel (1991).

initial cluster may have been parsed into a complex semisyllable followed by a moraic syllable with a non-branching onset: $*[_{PrWd}[_{\varsigma} h_2 s][_{\sigma} t\acute{e}r]]$ (n.sg.).

But the evidence for such a structure is scanty at best, and the cluster is not actually attested in any IE language. Of the languages confirming the initial laryngeal, Greek has ἀστήρ, which probably goes back to disyllabic *.h_2əs.$t\acute{e}r$. Hitt. *ḫašterza* is ambiguous. Attested only once (see Puhvel (1991:238-9)), it is written <*ḫa-aš-ter-za*>,[32] which may be interpreted as *.hsterts.* or *.has.terts.* with a moraic first syllable. The second analysis is advocated by Melchert (1994:111) among others: he states that "a synchronic triple cluster /Hst-/ [...] is possible, but unlikely" and assumes epenthesis (cf. Kimball (1999:393)).

The reading without epenthesis was first proposed by Schindler (1969:144,fn.5), and has recently been taken up by Kloekhorst (2008:326). Extending assumptions developed in Kloekhorst (2004), (2006), the author claims that word-initial clusters in Hittite were never dissolved by epenthesis. Kloekhorst (email) takes <*ḫa-li-iḫ-la-*> (*/HliHla(i)-/*), a reduplicated verb with a *hl*-cluster in the onset of the base (cf. Puhvel (1991:32)), as main evidence for this claim. However, a lack of epenthesis in *hl*-clusters does not imply that other *h*-clusters were treated in the same fashion. *hl-* is in accordance with the SSC and well-formed, unlike *hs* or *h* + plosive, which, from a typological perspective are not very likely.[33]

Although a clear decision for or against an initial Hittite cluster *hst-* is impossible, it seems less probable than epenthesis. Therefore, I assume that lexical $*/h_2 st\acute{e}r/$ was syllabified as $*[_{PrWd}[_{\sigma} h_2$əs$][_{\sigma} t\acute{e}r]]$ in PIE.

In the absence of evidence to the contrary, I conclude that PIE semisyllables consist of exactly one fricative. Plateaux (*i.e.*, sequences of equally sonorous segments) are not licensed. This restriction holds for onsets of moraic syllables as well,[34] with the sole exception of plateaux with an initial coronal plosive.[35]

5 *s*-mobile

In this section the semisyllabic approach is extended to *s*-mobile. As is well known, roots such as **(s)pe$\hat{k}$* and **(s)teg* come in two avataras, viz. with or without initial *s* as in Vedic *páśyati* vs. *áspaṣṭa*, G.-Avestan *spasiiā*, and Greek τέγος vs. στέγος.

Currently two hypotheses are discussed in the literature (Southern (1999), Rasmussen (2005)). The first takes *s-* to be a preverb. However, this analysis is confronted with serious problems, because, first of all, there is no clear evidence

[32]The writing is affirmed by the place name $^{\text{URU}}$*ḫašter(a)-*, which is attested six times (Watkins (1974:12), Kloekhorst (2008:326)).

[33]Besides *hst-* Kloekhorst (2008) proposes for example *ss-* in *ssanti*. Word-initial geminates are attested in at least two Austronesian languages, viz. Leti (Hume *et al.* (1997)) and Trukese (Davis (1999)). Still, they are very rare and should not, without necessity, be postulated for Hittite.

[34]Fricative plateaux in underlying representations are mostly of the type *sH*. In Hittite they surface as *ish-*, which seems to indicate a prothetic vowel. There is evidence for *Hs* as well: $*h_1 su$ is highly plausible, as is $*h_3 sle\underline{i}d^h$ in Greek ὄλισθε 'slipped', ved. *mā́ srid^{h}at* 'shall not fail' Rix *et al.* (2001:307) (but cf. Mayrhofer (2005:31)). Less convincing is $*h_2 se\hat{u}s$, Vedic *śuṣyati*, Greek (gloss) αὕω, cf. Mayrhofer (2005:28).

[35]See Keydana (2004:fn.48) for an overview. Plateaux are attested in Greek and Tocharian. The analysis of Schindler (1977) shows that they were always treated as real clusters with no evidence for epenthesis.

that PIE had preverbs. Rather, since free adverbs are the dominant pattern in the oldest attested texts, prefixation seems to have been a late development.[36]

Besides, a methodological problem arises: as forms with or without the initial *s-* never show any semantic difference, it is impossible to determine the denotation of the alleged preverb. This means that the lexical entry proposed for PIE consists of the signifier only.

Finally, the distribution is problematic. Typically *s*-mobile occurs as part of an onset cluster. The few cases with simple *s*-onsets discussed in the literature (Rasmussen (2005:66-7)) are inconclusive at best. While this distribution may be attributed to chance, it still casts doubts on the preverbal status of *s-*.

An alternative explanation going back to Schindler (Mayrhofer (1986:120)) is that of reanalysis in a sandhi-context. According to Schindler the double *s* in sequences like *$\hat{u}$*iHros spe$\hat{k}$ieti* was simplified and then reanalyzed as *$\hat{u}$*iHros pe$\hat{k}$ieti*. The process is claimed to be similar to that leading to Engl. *nickname* from **ick-name* in contexts with preceding indefinite *a*. Notwithstanding its elegance, this solution faces serious difficulties. The domain of the reanalysis in the English example is a prosodic word, the article being proclitic. The domain of reanalysis in PIE is less easily established, however, the intonational phrase or the utterance being possible candidates. But coherence in these prosodic domains is less rigid than in the prosodic word (Nespor & Vogel (2007:217,245). Besides, although *^{o}*s-s*^{o} was simplified word-internally, there is no evidence that this process extended to higher prosodic units as well.

Another problem which affects some of the most obvious examples of *s*-mobile is of a syntactic nature. Roots like **(s)teg* or **(s)pe$\hat{k}$* are transitive. PIE being an SOV language, transitive verbs were typically preceded by an object. This does not amount to saying that configurations with words ending in *s* preceding *(s)teg* or **(s)pe$\hat{k}$* did not occur,[37] of course, but it is doubtful whether they were frequent enough to trigger reanalysis.

An alternative explanation for at least some of the data with *s*-mobile is based on semisyllabicity. In cases like **(s)teg* and **(s)pe$\hat{k}$*, the *s* as part of the word-initial cluster had to be parsed into a semisyllable. Being non-moraic, semisyllables are highly deficient phonological structures and therefore marked. As a consequence, they tend to be simplified.

This proposal is backed by empirical evidence from L1-acquisition and typology, as *s*-clusters are always late in L1-acquisition (Barlow & Dinnsen (1998)). Children prefer unmarked structures and typically reduce clusters of this kind to monosegmental onsets to accomodate them to their restricted articulatory capabilities. Such simplifications are usually short-lived, as children are under pressure from the speech community, especially if the error is highly salient. But once in a while, simplifications made in lexical acquisition survive.[38] This scenario not only explains why the *s* became mobile at all, it also explains why the loss did not spread in the manner of a regular sound change: the simplification

[36]See Hettrich (1991), Pinault (1995), and Tjerkstra (1999). The univerbations attested with *pe-* and *u-* are Anatolian developments, see Kloekhorst (2008:617-8) for a recent assessment.

[37]PIE had plural objects with *s*, of course, and there is every reason to believe that dislocations breaking up the SOV order were possible (cf. Keydana (to appear)).

[38]See Hayes & Steriade (2004) and Bermúdez-Otero (2006) on this type of change. A well-documented example is analogy. In phonology, this type of change leads to lexical diffusion as described for example by Labov (1994:421-39).

takes place in lexicon acquisition, and is hence lexically gradual.

Typology further strengthens this proposal. In many languages, we can observe a tendency to reduce the markedness of initial *s*-clusters by applying repair strategies. The strategy proposed here is deletion. Alternatives attested in languages throughout the world are prothesis or epenthesis of a vowel.

Data from Anatolian show deletion and – possibly – prothesis: in Hittite, underlying clusters of *s* + plosive are regularly written as <*is-C^o*>. This may be due to the inappropriate writing system, but the fact that *s* + sonorant is typically written <*sV-R^o*> (Melchert (1994:111)) points to a significant difference, which may be interpreted as prothesis.[39] More importantly in our context, Luvian shows deletion of *s* (Melchert (1994:271)), cf. Luvian *par(r)iy-* 'smear' as opposed to Hittite *ispar(r)-* 'strew'.[40]

Similar evidence comes from the Indo-Aryan languages. Already in Vedic we find word based alternations like *stár-* with nom.pl. *tā́raḥ*. In Middle Indian, we get Pāli *tārā* and the Ardhamāgadhī-continuants of Vedic *strī́-*, *itt^{h}ī* with prothesis and *t^{h}ī* with deletion.

Old French is another language showing both types of repair. Regularly, initial *s*-clusters were recast by prothesis like in *escrivre*, but in loan words deletion is attested, cf. *tricoter*, which goes back to Low German *strîken*.

The third type of repair, epenthesis, is attested in Iranian. Cf. Iranian **spāda* (Avestan *spāda*), which is continued by Manichean Parthian *'sp'd* / *ispaδ* with prothesis and Middle Persian *spāh* > Persian *sipāh* with epenthesis.

These data from a variety of IE languages show that both assumptions made for *s*-mobile above are confirmed by typology: *s*-clusters tend to be repaired, and the repair is often word-based.

6 Summary

The preceding investigation into *s*-clusters and laryngeal clusters in reduplication led to the following results: Laryngeals and the sibilant form a natural class, as both were fricatives. Onset clusters with initial fricative followed by a plosive had either subsegmental structure (*s*-clusters in Germanic and Latin, laryngeal-clusters in Greek), or the fricative was parsed into a semisyllable (*s*-clusters in Greek, fricative clusters in Vedic).

PIE had semisyllables, and they were licensed (at least) in the onset of phonological words. There is no evidence for semisyllables word-internally. However, it cannot be excluded that they were licensed at morpheme-boundaries due to alignment-constraints. Semisyllables were restricted to one C-slot filled by a fricative. Evidence for clusters is dubious at best. The investigation further showed that PIE onsets maximally contained 2 segments.

[39] The whole issue is far from being settled. At least *ša/eppikkušta-* 'pin' is evidence for a *sp*-onset (Melchert (1994:111)). The *išpand-/šipand-*-variation is another problem (Puhvel (1984:436), Melchert (1994:31), Kloekhorst (2008:404-6)) – the proposal of Forssman (1994:103), taken up in Rix *et al.* (2001:577), is rather improbable because of the amount of *ad hoc* hypotheses involved). As Melchert (1994:31) points out, we either have to assume prothesis (with two unexplained exceptions) or a rather bizarre spelling alternation.

[40] A possible counterexample to the Luvian loss is <*sá-pa-tara/i-isa*> 'religious functionary', if to be read as /*spandaris*/ and taken as a derivative from the unattested cognate of Hittite *išpand-*, see Hajnal (1995:134), Tischler (2006:1058).

Finally, I argued that the instability of semisyllabic structure was at least one origin of the *s*-mobile phenomena.

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