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*Indo-European Linguistics in the 21st Century (3)*

# Optimizing the Laryngeal Theory: Testing the Models of Puhvel, Eichner and Melchert/Rix against Szemerényi's Monolaryngealism

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**ABSTRACT**: Since both the orthodox (MØLLER, BENVENISTE, PUHVEL) and the revisionist (KURYŁOWICZ, EICHNER, MELCHERT/RIX, KORTLANDT) models of the laryngeal theory (LT) have failed to solve the problem of the IE vowels (PYYSALO & JANHUNEN 2018a, 2018b), revisions in the theory are necessary. A comparison of the models of PUHVEL, EICHNER, and MELCHERT-RIX with regard to the criterion of economy shows that, although they are mutually contradictory, each of them has contributed at least one correct solution absent in the other models. By combining these correct solutions into a single model we can arrive at what may be termed the "Optimized Laryngeal Theory" (OLT), which, then, can be tested against monolaryngealism, as formulated by SZEMERÉNYI.

## 1 The reconstruction models to be analyzed

1.1 Hermann MØLLER's (1879, 1880, 1906, 1911) laryngeal theory originally assumed three laryngeals *$h_1$ *$h_2$ *$h_3$, a single vowel *e, and the Semitic root morphology CC·C for Proto-Indo-European (PIE). After Bedřich HROZNÝ's (1917) proof of the Indo-European character of Hittite MØLLER's Indo-Semitic hypothesis, subsequently known as the laryngeal theory (LT), was tested against the data. As a result of this the LT split in two in 1935, as the orthodox theory, defined by MØLLER's monovocalism hypothesis (PIE *e as the only root vowel), found a competitor in the revisionist theory, which postulated the vowel PIE *o in addition to PIE *e.[1] By the early 1950s yet another competitor — one with an inductive approach, starting directly from the data, rather than accepting MØLLER's theory — emerged when Ladislav ZGUSTA (1951) introduced monolaryngealism, which was subsequently developed by Oswald SZEMERÉNYI (1967, 1970).

1.2 During the classical phase Émile BENVENISTE (1935) had followed MØLLER's orthodox theory as such, but by 1960 it had become obvious that *$h_1$ *$h_2$ *$h_3$ and *e did not suffice to explain the new data now including Hittite, in which six, not three distinct correspondence sets were found (see §2.1). This state of affairs was first understood by Jaan PUHVEL (1960, 1965), who accordingly postulated six laryngeals for the correspondence sets required. Although PUHVEL's model (§2.2) no longer has significant support, it contains one correctly defined correspondence set absent from its two main revisionist competitors (see §3.6.6), which is why it is included in the present comparison of competing models.

1.3 The revisionist laryngeal theory made its first appearance in Jerzy KURYŁOWICZ's (1935) model. While otherwise adopting MØLLER's hypotheses KURYŁOWICZ diverged from his orthodoxy by assuming the vowel PIE *o in addition to PIE *e and adding *$h_4$ to cope with one of the correspondence sets not foreseen by MØLLER. However, Hittite indicated yet one additional correspondence set that KURYŁOWICZ was unable to reconstruct, and his model became superseded from the 1970s on by the

[1] For the terminology used in this paper and the background, see PYYSALO 2013, 2016 and PYYSALO & JANHUNEN 2018a, 2018b.

new revisionist models of Heiner EICHNER (§2.3) and H. Craig MELCHERT (§2.4), based on trilaryngealism and assuming additional vowels instead of — and in addition to — laryngeals.[2]

## 2 Description and definition of the models tested and analyzed

2.1 The comparison of the Old Anatolian laryngeal (Hitt. ḫ = Pal. ḫ = CLu. ḫ = HLu. ḫ) and the respective sets of IE vowels defines six PIE correspondences:

| | | | |
|---|---|---|---|
| Hitt. ḫe- : IE e- | Hitt. ḫa- : IE a- | Hitt. ḫa- : IE o- | (ḫ-series) |
| Hitt. e- : IE e- | Hitt. a- : IE a- | Hitt. a- : IE o- | (Ø-series) |

As the common primary goal of the competing models is to reconstruct these correspondence sets consistently with the data, the sets provide a basis upon which the testing, comparison and evaluation of the models and their performance can be based.

2.2 In PUHVEL's (1965) model the correspondence sets are reconstructed by means of three attested (*$H_1$ $H_2$ $H_3$) and three absent ('lost') laryngeals (*$h_1$ $h_2$ $h_3$) in Old Anatolian:

| | | | | | | |
|---|---|---|---|---|---|---|
| Old Anatolian: | ḫe- | ḫa- | ḫa- | e- | a- | a- |
| Indo-European: | e- | a- | o- | e- | a- | o- |
| PUHVEL: | *$H_1$e- | *$H_2$e- | *$H_3$e- | *$h_1$e- | *$h_2$e- | *$h_3$e- |

Characteristically PUHVEL's (orthodox) model has only a single proto-vowel *e. This led him to reconstruct a typologically questionable set of six laryngeals, which does not ultimately suffice to explain even the basic ablaut PIE *e/o, simply because PIE *o is not reconstructed.

2.3 EICHNER's revisionist model (see EICHNER 1973, 1978, 1980, 1988), instead of assuming six laryngeals and a single vowel PIE *e, posits three laryngeals and six vowel qualities PIE *e *a *o *ē *ā *ō to reconstruct the six sets as follows

| | | | | | | |
|---|---|---|---|---|---|---|
| Old Anatolian: | ḫe- | ḫa- | ḫa- | e- | a- | a- |
| Indo-European: | e- | a- | o- | e- | a- | o- |
| EICHNER: | *$h_2$ē- | *$h_2$e- | *$h_2$o- | *$h_1$e- | *$h_1$a- | *$h_3$e- |

Characteristically in EICHNER's model *$h_3$ is absent (or 'lost') in all positions, including word-initially, in Old Anatolian, i.e. Hitt. ḫ always corresponds to *$h_2$. EICHNER's model was initially supported by Norbert OETTINGER,[3] who retracted his view later on.[4]

2.4 A revisionist competitor to EICHNER's model appeared in the late 1980s, when H.

[2] In PYYSALO and JANHUNEN (2018b) we demonstrated that the distributional model of Frederik KORTLANDT (2003-04) and its theoretically possible reverse are inconsistent and therefore need not be included here.

[3] See OETTINGER (1979: 546[1]): "Nicht nur *h₁* (EICHNER, MSS 31, 1973, 54 ff.), sondern auch *h₃* hat im Anatolischen keinen konsonantischen Reflex hinterlassen."

[4] For OETTINGER's retraction, see OETTINGER (2004). Renewed support for EICHNER had, however, already been provided by ZEILFELDER (1997).

Craig MELCHERT (1987) and Sara KIMBALL (1987) proposed an alternative, later followed almost as such by RIX et al. (2001). This model, here labeled MELCHERT/RIX, defines the six correspondence sets as follows:

| | | | | | | |
|---|---|---|---|---|---|---|
| Old Anatolian: | ḫe- | ḫa- | ḫa- | e- | a- | a- |
| Indo-European: | e- | a- | o- | e- | a- | o- |
| MELCHERT/RIX: | *$h_2$ē- | *$h_2$e- | *$h_3$e- | *$h_1$e- | *$h_1$a- | *$h_1$o- |

While sharing the laryngeals and vowels of EICHNER, the MELCHERT/RIX model assumes that initial *$h_3$- is preserved, not lost, in Anatolian.[5]

2.5 By eliminating the teething problems of ZGUSTA's (1951) early excursion, Oswald SZEMERÉNYI (1967, 1970, 1996) presented a first synthesis of monolaryngealism as a coherent system. Unlike the laryngealist models, taking MØLLER's theory (or its later revision) as their starting point, SZEMERÉNYI postulated PIE, and in particular the laryngeal(s), inductively, that is on the basis of their attestation in the Anatolian data.[6] Accordingly, the root hypothesis CC·C and laryngeals *$h_1$ *$h_3$ were not assumed, and a single laryngeal PIE *h was reconstructed on the basis of Hitt. ḫ in the six sets:

| | | | | | | |
|---|---|---|---|---|---|---|
| Old Anatolian: | ḫe- | ḫa- | ḫa- | e- | a- | a- |
| Indo-European: | e- | a- | o- | e- | a- | o- |
| SZEMERÉNYI: | *he | *ha | *ho | *e | *a | *o- |

SZEMERÉNYI's single 'laryngeal', phonetically a glottal fricative PIE *h,[7] roughly matches *$h_2$ except for not having a colouring effect on adjacent PIE *e.

2.6 The reconstructions of PUHVEL, EICHNER, MELCHERT/RIX, and SZEMERÉNYI, as well as their mutual relations, can be summarized as follows:

| Hitt. : IE | PUHVEL | EICHNER | MELCHERT/RIX | SZEMERÉNYI |
|---|---|---|---|---|
| ḫe- : e- | *$H_1$e- | *$h_2$ē- | *$h_2$ē- | *he- |
| ḫa- : a- | *$H_2$e- | *$h_2$e- | *$h_2$e- | *ha- |
| ḫa- : o- | *$H_3$e- | *$h_2$o- | *$h_3$e- | *ho- |
| e- : e- | *$h_1$e- | *$h_1$e- | *$h_1$e- | *e- |
| a- : a- | *$h_2$e- | *$h_1$a- | *$h_1$a- | *a- |
| a- : o- | *$h_3$e- | *$h_3$e- | *$h_1$o- | *o- |

## 3 Applying the criterion of economy to the sound laws of the models

3.1 Since the models of PUHVEL, EICHNER, and MELCHERT/RIX postulate laryngeals not attested in the data, 'the material does not contain a scientific standard to decide

[5] In the revisionist models PUHVEL's 'lost' *$h_3$- is continued by EICHNER'S *$h_3$- and PUHVEL's preserved *$H_3$- by MELCHERT/RIX'S *$h_3$-.

[6] For the postulation of the laryngeal(s) in monolaryngealism, see SZEMERÉNYI's rule (1970: 131) for Old Anatolian: "Ein heth. *es*- 'sein' (...) beweist also ein idg. **es*- (...) ohne Laryngal, ein heth. *henkan* 'Schicksal, Pest' ein idg. *Henk*- mit Laryngal."

[7] See SZEMERÉNYI (1996: 140): 'We know, moreover, that, as R. Jakobson formulated it, 'languages which have the pairs voiced–voiceless, aspirated–unaspirated also have the phoneme /h/'. It seems to follow from this that the laryngeal which we have just accepted was none other than *h*, the normal glottal spirant. With its *h* the IE system was similar to that of Latin.'

between the alternatives (…).'[8] However, the six correspondence sets are constant and the reconstructions of all models are fixed (§2.6), due to which it is possible to present an objective assessment of the models by means of Occam's razor.

3.2 The criterion of economy, more specifically Occam's razor for sound changes, was formulated by Lyle CAMPBELL (2004[2]: 133) as follows:

> What is meant by the criterion of economy is that when multiple alternatives are available, the one which requires the fewest independent changes is most likely to be right.

3.3 This version of Occam's razor (Occam LC) is particularly well suited to this complex situation, because several related sound laws are actually shorthand for multiple ones, and when they are expanded to their full form, 'the one which requires the fewest independent changes', i.e., the one 'most likely to be right', can be defined for each of the six correspondence sets. For the sake of illustration, the alternative most likely to be right of *$h_3$e- (EICHNER & PUHVEL) : *$h_1$o- (MELCHERT/RIX) in the set Hitt. a- : IE o- is resolved by Occam LC in favour of *$h_1$o- (MELCHERT/RIX), because the latter requires one sound change less: EICHNER's (and PUHVEL's) reconstruction, when expanded into its full form, requires three changes *$h_3$e- → *$h_3$o- → *o- → Hitt. a- while in contrast MELCHERT/RIX only requires two: *$h_1$o- → *o → Hitt. a-. In other words, Occam LC chooses *$h_1$o-, which is marked in square brackets and shown to be chosen by using the symbol '→'

| | PUHVEL | EICHNER | MELCHERT/RIX | | |
|---|---|---|---|---|---|
| Hitt. a- : IE o- | *$h_3$e- | *$h_3$e- | [*$h_1$o-] | → | *$h_1$o- |

3.4 The analysis of the models using Occam LC, will be executed as follows:[9]

3.4.1 In §3.5 we will apply Occam LC to the reconstructions of the models of PUHVEL, EICHNER and MELCHERT/RIX and define the most economic reconstruction for each correspondence set.

3.4.2 In §3.6 the reconstructions chosen by Occam LC will be used to define the optimized laryngeal theory (OLT), i.e., the maximally economic version of the laryngeal theory, which, then, will consist exclusively of reconstructions chosen by Occam LC. After this, the OLT will be briefly evaluated as a system and compared with its predecessors.

3.4.3 In §3.7 we will use Occam LC in an identical manner, but this time for comparing the OLT with SZEMERÉNYI's monolaryngealist model, again defining the more economic alternative, which is then briefly evaluated as a system and compared

[8] See PYYSALO & JANHUNEN 2018a: 7 also for the broader context and discussion.

[9] The number of sound laws is naturally not the only criterion for defining the maximally economic model. Often, though not always, a more economic phoneme inventory compensates for a larger set of rules. Thus, for instance, the inventory *t, *h, *$t^h$ is less economic than one with only *t, *h and a rule *t+h –› $t^h$, because despite having one rule more the latter requires only two proto-phonemes PIE *t *h, i.e., fundamental building blocks. Of course, the choice between monophonemic and biphonemic solutions always requires careful consideration of language-specific phonotactic properties. The ultimate goal is to find a balance between a minimal phoneme inventory and a minimal set of phonological rules. For this reason, for instance, PIE reconstructions with only one vowel phoneme are not only universally unlikely, but also uneconomic because of the number of rules required.

to those models already analyzed.

3.5 The first round of application of Occam LC to the models of PUHVEL, EICHNER, and MELCHERT/RIX models yields the following results:

3.5.1 In the set Hitt. a- : IE o-, as e.g. in Hitt. adeš- 'Axt, Beil' (HEG A: 94) : OEng. adesa·n- (m.) 'addice, adze, ascia' (ASaxD. 7), reconstructed as *h$_3$e- (PUHVEL & EICHNER) versus *h$_1$o- (MELCHERT/RIX), the latter is chosen because it requires one sound change less (*h$_3$e- → *h$_3$o- → *o- vs. *h$_1$o- → *o-):

| | PUHVEL | EICHNER | MELCHERT/RIX | | |
|---|---|---|---|---|---|
| Hitt. a- : IE o- | *h$_3$e- | *h$_3$e- | [*h$_1$o-] | → | *h$_1$o- |

3.5.2 In the set Hitt. a- : IE a-, reconstructed as *h$_2$e- (PUHVEL) versus *h$_1$a- (EICHNER and MELCHERT/RIX), the latter is chosen as it requires one sound change less (*h$_2$e- → *h$_2$a- → *a- vs. *h$_1$a- → *a-):[10]

| | PUHVEL | EICHNER | MELCHERT/RIX | | |
|---|---|---|---|---|---|
| Hitt. a- : IE a- | *h$_2$e- | [*h$_1$a-] | [*h$_1$a-] | → | *h$_1$a- |

3.5.3 In the set Hitt. e- : IE e-, as e.g. in Hitt. eš- 'to be' (HEG A: 76, e-eš-zi [3sg]) : Lat es- 'to be' (WH 2: 628-9, est [3sg]) all three models agree: PUHVEL, EICHNER, and MELCHERT/RIX reconstruct *h$_1$e-, which is therefore chosen:

| | PUHVEL | EICHNER | MELCHERT/RIX | | |
|---|---|---|---|---|---|
| Hitt. e- : IE e- | [*h$_1$e-] | [*h$_1$e-] | [*h$_1$e-] | → | *h$_1$e- |

3.5.4 In the set Hitt. ḫa- : IE o-, as e.g. in Hitt. ḫaštai- (n.) 'Knochen, Gebeine, Widerstandskraft' (HEG H: 202-3) : Gr. ὀστέο- (n.) 'Knochen, Kern einer Frucht' (GEW 2: 436-7, ὀστέον [sgNA]), reconstructed as *h$_2$o- (EICHNER) versus *H$_3$e-/h$_3$e- (PUHVEL and MELCHERT/RIX), the former is chosen because it requires one sound change less, namely the 'colouring rule':[11]

| | PUHVEL | EICHNER | MELCHERT/RIX | | |
|---|---|---|---|---|---|
| Hitt. ḫa- : IE o- | *H$_3$e- | [*h$_2$o-] | *h$_3$e- | → | *h$_2$o- |

3.5.5 In the set Hitt. ḫa- : IE a-, as e.g. in Hitt. ḫant- (c.) 'Stirn, Stirnseite, Gesicht, Vorderseite, Front' (HEG H: 149-153, ḫa-an-za) : Gr. ἀντί (prep.G) 'angesichts, gegenüber, anstatt' (GEW 1: 113-4), all three models agree:[12] PUHVEL, EICHNER, and

[10] While the other five sets are unproblematic, the correspondence Hitt. a- : IE a- remains disputed. The alleged examples are few and can be explained with better etymologies (see e.g. PYYSALO 2013: 87-89). As the existence of this set is not relevant to the study, it is, however, treated as if existing, although no examples (for which see KURYŁOWICZ 1935: 75f., TISCHLER 1980: 504, and EICHNER 1988: 132-33) are offered here.

[11] Note that *h$_2$o- is often actually confirmed by the data with a parallel PIE *e-grade. This is reflected in doublets such as Gr. ὀστακό- : Gr. ἀστακό- (m.) 'Meerkrebs' (GEW 1: 169) and Gr. ὄστρακο- (n.) 'knöcherne Schale' (GEW 2: 437) : Gr. ἀστράγαλο- (m.) 'Knöchel' (GEW 1: 173).

[12] LT *h$_2$ is usually interpreted as the velar fricative IPA [x] on the basis of the graphemic value of Hitt. ḫ, but this is not unproblematic: The cuneiform script has only one 'laryngeal', conventionally romanized as Sumerian ḫ. This value was chosen on the basis of Akkadian ḫ in its Semitic context, but this does not confirm the value Akk. /ḫ/ for Hitt. ḫ any more than interpreting Hitt. š as [š] on the basis

MELCHERT/RIX all reconstruct *h₂e-/*H₂e-, which is therefore accepted as such:

| | PUHVEL | EICHNER | MELCHERT/RIX | | |
|---|---|---|---|---|---|
| Hitt. ḫa- : IE a- | [*H₂e-] | [*h₂e-] | [*h₂e-] | → | *H₂e-/h₂e- |

3.5.6 In the set Hitt. ḫe- : IE e-, as e.g. in Hitt. $^{NA4}$ḫegur- (n.) 'Felsgipfel, Felsheiligtum, Fels' (HEG H: 235-6, $^{NA4}$ḫé-gur, HED 3: 287, HIL. 395, AHPh. 144) : RV. ágra- (n.) 'Spitze, äußerstes Ende, Gipfel, Anfang' (WbRV. 10, EWA 1: 45, KEWA 1: 18), reconstructed as *H₁e- (PUHVEL) versus *h₂ē- (EICHNER and MELCHERT/RIX), the former is chosen, because a conditioned change is more complex than a change not requiring a condition:

| | PUHVEL | EICHNER | MELCHERT/RIX | | |
|---|---|---|---|---|---|
| Hitt. ḫe- : IE e- | [*H₁e-] | *h₂ē- | *h₂ē- | → | (*H₁e-) |

For this set PUHVEL postulated a 'colourless' laryngeal preserved in Old Anatolian. EICHNER (1973: 53, 71f.), in turn, opted for conjecturing that the colouring effect of *h₂ was absent (neutralized) in the environments *h₂ē and *ēh₂ (Lex EICHNER). This conjecture is, however, methodologically flawed due to the absence of any criterion that would allow it to be either verified or falsified (see PYYSALO 2013: 91f.), in that the Old Anatolian orthography (and phonology) is ambiguous (or disputed at best) with regard to quantity, i.e., Hitt. e can represent both PIE *e and PIE *ē. Therefore none of EICHNER's examples can be confirmed to contain *ē in the first place.[13] In addition, EICHNER fails to explain the absence of 'a-colouring' in connection with the non-Anatolian data verifying a short PIE *e instead of *ē, which suggests that the entire conjecture is incorrect.[14]

3.6 The preliminary outcomes of Occam LC, arranged in a single table, stand as follows:

| Hitt. : IE | PUHVEL | EICHNER | MELCHERT/RIX | | |
|---|---|---|---|---|---|
| a- : o- | *h₃e- | *h₃e- | [*h₁o-] | → | *h₁o- |
| a- : a- | *h₂e- | [*h₁a-] | [*h₁a-] | → | *h₁a- |
| e- : e- | [*h₁e-] | [*h₁e-] | [*h₁e-] | → | *h₁e- |
| ḫa- : o- | *H₃e- | [*h₂o-] | *h₃e- | → | *h₂o- |
| ḫa- : a- | [*H₂e-] | [*h₂e-] | [*h₂e-] | → | *H₂e-/h₂e- |
| ḫe- : e- | [*H₁e-] | *h₂ē- | *h₂ē- | → | *H₁e- |

A comparison of the models immediately shows the following:

3.6.1. PUHVEL's model only agrees with the OLT in three reconstructions. Of these *H₁e- : Hitt. ḫe- : IE e- is uniquely chosen for the OLT, since it contains a non-

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of Akk. š. Altogether, it is important not to confuse letters, phonemes and sounds when we 'read' languages for which no actual phonetic information is available.

[13] See EICHNER (1973: 72): "Trotz der — wie nicht anders zu erwarten — geringen Zahl von sicheren Beispielen (mēhur, šēhur, hēkur, $^{É}$hištā-, $^{LÚ}$hippara-) dürfte die Folgerung, das uridg. ē neben H₂ (ēH₂ H₂ē) seine Qualität bis ins Hethitische halten konnte, unausweichlich sein. Vorbilder, aus denen das lange ē dieser Wörter analogisch bezogen sein könnte, fehlen völlig."

[14] For an example of a short PIE *e in connection with Hitt. ḫ, see Hitt. ḫašteli- (c.) 'Held' (HIL. 379, ḫa-aš-te-li-ia-an) with a corresponding adjective in Hitt. ḫaštelia̯nt- (a.) 'brave' (HIL. 379, ḫa-aš-te-li-an-za), which semantically matches Gr. ἐσθλό- (a.) 'tüchtig, brav, edel' (GEW 1: 574, ἐσθλός).

colouring laryngeal *$H_1$ preserved in Old Anatolian. This item is otherwise absent in the laryngeal theory, but its properties are identical to SZEMERÉNYI's non-colouring PIE *h.[15] The other two chosen solutions are identical with the two other models, and the three remaining sets are not chosen by Occam LC. This leaves PUHVEL's model the weakest of the three.

3.6.2. EICHNER's model, like the one of MELCHERT/RIX, has four reconstructions chosen by the Occam LC, but it is slightly superior to the latter, because it correctly postulates three sets based on the confirmed laryngeal *$h_2$ = Hitt. ḫ, against only two in MELCHERT/RIX. Both EICHNER and MELCHERT/RIX resort to *$h_3$, but in different contexts. Since, however, EICHNER explains the critical set Hitt. ḫa- : IE o- correctly from *$h_2$o-, his model emerges as the winner in the internal competition of the extant models of the laryngeal theory.

3.6.3 The second position is taken by the model of MELCHERT/RIX, which narrowly loses to that of EICHNER, because it postulates *$h_3$ against EICHNER's correct *$h_2$ for the epistemologically confirmed laryngeal in the set Hitt. ḫa- : IE o-.

3.6.4 In order to neutralize the notational differences between the three models in table §3.6 and to present the OLT with a unified set of reconstruction phonemes, we may make the following observations:

(a) *$h_1$ appears before all vowels *e a o (in *$h_1$e- *$h_1$a- *$h_1$o-).

(b) *$h_2$ appears only before the vowels *e and *o (in *$h_2$e- *$h_2$o-), but there is a gap before a-, i.e. †$h_2$a- is absent. At the same time, *e is preceded by a preserved laryngeal twice, in *$h_2$e (EICHNER, MELCHERT-RIX = PUHVEL *$H_2$) and *$H_2$e (Puhvel). This double asymmetry is caused by an underlying error in the LT that can be corrected as follows:

(c) When PIE *a is substituted for PIE *e in the set *$h_2$e- (Hitt. ḫa- : IE a-), thus replacing it with *$h_2$a-, the colouring rule for *$h_2$e- becomes redundant.

(d) As *$h_2$ has no colouring effect, it is identical with PUHVEL's *$H_1$ (Hitt. ḫe- : IE e-), i.e., the value *$h_2$ can be used to replace *$H_1$. This removes the redundant assumption of a colouring effect of *$h_2$ and the multiplied reflex in PUHVEL's distinction between *$H_1$ ≠ $H_2$ ≠ $H_3$, all properly speaking denoting a single, non-colouring *$h_2$.

3.6.5 The implementation of these adjustments defines the OLT, now having a completely symmetrical shape and unified symbolism:

| | | | | | | |
|---|---|---|---|---|---|---|
| Hitt./IE | ḫe-/e- | ḫa-/a- | ḫa-/o- | e-/e- | a-/a- | a-/o- |
| OLT | *$h_2$e- | *$h_2$a- | *$h_2$o- | *$h_1$e- | *$h_1$a- | *$h_1$o- |

Regarding the OLT vowel and laryngeal inventory as a system, we may further note the following:

[15] PUHVEL's *$H_1$ alongside *$H_2$ goes back to PEDERSEN's (1938: 179–181) early suggestion concerning the existence of two different laryngeals, both preserved as Hitt. ḫ, a non-colouring *H (e.g. Hitt. ue-eḫ-zi 'sich wenden' [3sg] : Umbr. ue- (vb.) 'wenden' (WbOU. 835-6, uetu [3sg])) and an a-colouring *$H_a$ (e.g. Hitt. ḫanti 'frons' : Lat. ante).

3.6.6 The only laryngeals in the OLT are *$h_1$ and*$h_2$ (both non-colouring), but there is no reason to postulate a separate *$h_3$. In terms of assumed laryngeals the OLT is thus $^1/_3$ more economic than the models assuming three laryngeals.

3.6.7 The laryngeal OLT *$h_2$ is always reflected as Hitt. ḫ = RV. ’ : IE Ø as in SZEMERÉNYI’s monolaryngealism and EICHNER’s model.[16]

3.6.8 Lacking the colouring rules for *$h_2$ and *$h_3$ the OLT is in terms of the number of sound laws more economic than all other extant models of the LT.

3.6.9 The laryngeal OLT *$h_1$ is always reflected as Hitt. Ø = IE Ø as in all other laryngeal models after MØLLER. Simultaneously the OLT shares the critical weakness of its predecessors, since the correspondence Hitt. Ø = IE Ø actually implies PIE Ø, not *$h_1$-[17]: the postulate $^{\dagger}h_1$ is only based on an aprioristic internal assumption, i.e. the root hypothesis CC·C, since it does not actually exist in the data.[18]

3.6.10 Occam LC can, of course, be applied to all models of the LT, including those of KURYŁOWICZ (1935), BENVENISTE (1935), and KORTLANDT (2003-04). The results will in all cases be identical to those obtained above, i.e., the OLT is more likely to be right than any of these other models.[19]

3.7 We shall now proceed to the second round of applying Occam LC in order to evaluate the relation between the OLT and SZEMERÉNYI’S (SZ) monolaryngealism. This will allow us to choose the optimal reconstruction of Proto-Indo-European.

3.7.1 In the set Hitt. ḫe- : IE e- (Hitt. ḫegur- : RV. ágra-), reconstructed as OLT *$h_2$e- (PUHVEL *$H_1$e-) versus *he- (SZEMERÉNYI), the latter is chosen as it does not require the neutralization rule OLT *$h_2$e- → *He- → Hitt. ḫe-:

Hitt. ḫe- : IE e- OLT *$h_2$e [SZ *he-] → PIE *he-

3.7.2 In the set Hitt. ḫa- = IE a-, as e.g. in Hitt. ḫant- (c.) ‘Stirn, Stirnseite, Gesicht, Vorderseite, Front’ (HEG H: 149-153, ḫa-an-za [sgN]) : Gr. ἀντί (prep.G) ‘angesichts, gegenüber, anstatt’ (GEW 1: 113-4), reconstructed as OLT *$h_2$a- (PUHVEL, EICHNER,

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[16] Here RV. ’ stands for a hiatus required by the Vedic metre as noted by Hermann GRASSMANN in WbRV., predating the discovery of the laryngeals. GRASSMANN’s hiatus almost always coincides with Hitt. ḫ = *$h_2$ = PIE *h (but never with *$h_1$ or *$h_3$). In these words PIE *h is thus independently confirmed by (at least) two branches despite its loss as a segmental phoneme outside of Old Anatolian.

[17] KLOEKHORST (2006: 80-81 & fn14), referring to DURHAM’s observation that “in the Akkadian text written in Bogazköy the sign I could be read as ’$i_x$, Ú as ’$u_x$, and A as ’$a_x$”, suggests a similar reading for Old Anatolian, writing: “a-sa-an-zi ‘they are’ is to be read as ’a-sa-an-zi = /ʔ$_{ø}$santsi/, just as e.g. sa-sa-an-zi ‘they sleep’ is generally interpreted as /s$_{ø}$santsi/ (e.g. Melchert 1994a: 66).” For heavy criticism of the proposal, see MELCHERT (2010), RIEKEN (2010), and WEEDEN (2011).

[18] In (HED 3: v) PUHVEL admits that the “Laryngeals [not attested in Old Anatolian – our insertion] do not have the same confirmed epistemological standing in established Indo-European grammar as do the traditionally posited phonemes.” This is the case simply because the laryngeals allegedly ‘lost’ in Old Anatolian (i.e., not matching Hitt. ḫ) were originally postulated on the basis of MØLLER’s conjecture of IE languages sharing the Semitic root structure CC·C, a conjecture which, in turn, was based on the unsubstantiated assumption concerning a genetic relationship between IE and Semitic (see SZEMERÉNYI 1967: 92–93).

[19] Thus, for instance, in the set Hitt. a- : IE a-, reconstructed as KURYŁOWICZ (1935) *$h_4$e- : PUHVEL *$h_2$e- : EICHNER & MELCHERT/RIX *$h_1$a-, the last one is opted for as it does not require the application of a colouring rule (not to mention the cost of having an additional laryngeal in the set).

and MELCHERT/RIX) versus SZ *ha-, the latter is chosen as it requires one (neutralization) rule less:

Hitt. ḫa- : IE a- OLT *h$_2$a- [SZ *ha-] → PIE *ha-

3.7.3 In the set Hitt. ḫa- = IE o-, as e.g. in Hitt. ḫaštai- (n.) 'Knochen, Gebeine, Widerstandskraft' (HEG H: 202-3) : Gr. ὀστέο- (n.) 'Knochen, Kern einer Frucht' (GEW 2: 436-7, ὀστέον [NA]), reconstructed as OLT *h$_2$o- (EICHNER) versus SZ *ho-, the latter is chosen as it requires no neutralization *h$_2$o- → *Ho-:

Hitt. ḫa- : IE o- OLT *h$_2$o- [SZ *ho-] → PIE *ho-

3.7.4 In the set Hitt. e- : IE e-, as e.g. in Hitt. eš- 'to be' (HEG A: 76, e-eš-zi [3sg]) : Lat es- 'to be' (WH 2: 628-9, est [3sg]), reconstructed as OLT *h$_1$e- (PUHVEL, EICHNER, and MELCHERT/RIX) versus SZ *e-, the latter is chosen as it requires one rule less, namely the loss of the laryngeal (*h$_1$e- → e- vs. *e-):

Hitt. e- : IE e- OLT *h$_1$e- SZ [*e-] → PIE *e-

3.7.5 In the set Hitt. a- : IE a-, reconstructed as OLT *h$_1$a- (EICHNER and MELCHERT/RIX) versus SZ *a-, the latter is chosen as it requires one rule less, namely, again, the loss of the laryngeal (*h$_1$a- → a- vs. *a-):

Hitt. a- : IE a- OLT *h$_1$a- SZ [*a-] → PIE *a-

3.7.6 In the set Hitt. a- : IE o-, as e.g. in Hitt. ani- (vb.) 'wirken, schaffen' (HEG A: 30f., HIL. 216-8, a-ni-e-mi) : Dor. ὀνίνᾱ- (vb.) 'deliver, benefit, support' (GEW 2: 395), reconstructed as OLT *h$_1$o- (MELCHERT/RIX) versus SZ *o-, the latter is chosen as it, once again, does not require the loss of the laryngeal *h$_1$ (*h$_1$o- → *o- vs. *o-)

Hitt. a- : IE o- OLT *h$_1$o- [SZ *o-] → PIE *o-

3.7.7 As can be seen, Occam LC chooses the values of SZEMERÉNYI's reconstruction in each set:

| Hitt. : IE | ḫe-/e- | ḫa-/a- | ḫa-/o- | e-/e- | a-/a- | a-/o- | |
|---|---|---|---|---|---|---|---|
| SZEMERÉNYI | *he- | *ha- | *ho- | *e- | *a- | *o- | (= Occam LC) |

Regarding the features of SZEMERÉNYI's model as compared with the OLT, we may observe the following:

(a) There is only one laryngeal SZ *h = Hitt. ḫ, making the model 50% more economic than the OLT, which has two laryngeals *h$_1$ ≠ *h$_2$.

(b) Lacking *h$_1$, SZ requires one rule less than the OLT, viz. the one specifying the loss of this laryngeal (*h$_1$ → Ø), a situation that makes SZEMERÉNYI's model more economic also in this respect.[20]

[20] For the alleged 'laryngeal loss' rules *h$_1$e- → Hitt. ʔe and *h$_1$o- → Hitt. ʔa, see KLOEKHORST (2006: 95).

## 4 Evaluation of the laryngeal theory against monolaryngealism

4.1 As has been shown above, a major problem of the laryngeal theory is that it has been developed and promoted in a number of competing and mutually contradictory forms, including both the orthodox and the revisionist models. Since it is impossible that all these models could be correct at one and the same time, we have tried to formulate an optimal version of the theory — the optimal laryngeal theory (OLT) — which, unlike the orthodox models, has a sufficient number of distinctive vowel qualities, but which is free from the ambiguity problems of the revisionist models. It is obvious that the OLT supersedes all of its predecessors in terms of economy, in that it has only two laryngeals, *$h_1$ and *$h_2$, and no colouring rules. It therefore emerges as the simplest theory in existence after SZEMERÉNYI's monolaryngealism. This makes the OLT not only a natural step forward, but also the only exit from the cul-de-sac of the earlier models, whose developers and supporters have not been able to arrive at an agreement concerning the set of laryngeals.

4.2 A further comparison of the OLT and SZEMERÉNYI's monolaryngealism gives the following result:

4.2.1 The postulate *$h_1$ — like *$h_3$ — turns out to be unnecessary, since *$h_1$ equals zero, i.e. vocalic anlaut. This means that the root hypothesis CC·C, only used to justify the postulation of *$h_1$ *$h_3$, becomes redundant as well.[21]

4.2.2 The removal of $^{\dagger}h_1$ leaves only a single, non-colouring laryngeal OLT *$h_2$, from which the subscript can be removed in the absence of oppositions to other laryngeals, i.e. OLT *$h_2$ = PIE *h. This single remaining laryngeal is identical with the actually attested and, therefore, empirically confirmed Hitt. ḫ. The OLT is thus reduced into SZEMERÉNYI's monolaryngealism, in effect responding to Johann TISCHLER's call to reduce the number of laryngeals.[22]

4.3 The reduction of the laryngeal system leaves SZEMERÉNYI's monolaryngealism the only remaining starting point for a definitive solution of the PIE laryngeal/vowel problem.[23]

4.3.1 However, although the LT has given too much explanatory power to laryngeals, the reduction of the laryngeal system to one does also not solve all issues. Therefore, EICHNER's (1988: 128) criticism of SZEMERÉNYI, noting that monolaryngealism is hardly more than a replica of the Neogrammarian theory to which PIE *h has been

[21] On the benefits of the removal of the root hypothesis CC·C, which requires the postulation of laryngeals not attested in the data, compare TISCHLER (1980: 500): "Nun verstößt zwar der Ansatz von Lauten, die überall geschwunden sind und nirgends Spuren hinterlassen haben, nicht gegen die Gesetze der Logik, er ist aber insofern unwissenschaftlich im Sinne der Empirie, als er weder verifizierbar noch falsifizierbar ist."

[22] TISCHLER (1980: 498): "Angesichts all dieser Schwierigkeiten ist man versucht, eine Lösung nicht in Richtung einer Vermehrung, sondern vielmehr in einer Reduzierung der Zahl der Laryngale zu suchen, wie dies auch tatsächlich schon mehrfach, so von ZGUSTA (1951) und SZEMERÉNYI (1967) vorgeschlagen worden ist."

[23] Compare EICHNER's (1988: 123) now outdated remark on the existence of only two viable options for the solution of the PIE laryngeal/vowel problem: trilaryngealism and monolaryngealism.

forced without consideration of its role in the "system", bears a seed of truth.[24] In the absence of a colouring rule SZEMERÉNYI's theory is unable to explain the core result of the laryngeal theory: the correlation between de SAUSSURE's and MØLLER's *A and Hitt. ḫ, now abundantly confirmed by the data.

4.3.2 A new solution to this problem — the glottal fricative theory (GFT) — was recently presented by Jouna PYYSALO (2013) and will be discussed in the sequel to the present paper.

## 5 General remarks concerning laryngeals

5.1. It is an empirical fact that laryngeals, be it glottal stops or laryngeal continuants (fricatives, spirants, approximants), are sounds that tend to occupy a marginal position in the phonological system of languages. Synchronically, this means that they are 'weak' segments, bearing minimal marking, and often representing the neutralized reflex of other, more marked, segments.[25] Phonetically, the category of laryngeals is diffuse and may also comprise segments realized as velars, postvelars, uvulars, or pharyngeals, often with positionally conditioned variation.

5.2 Diachronically, laryngeals are typically the last traces of segments that are on their way towards disappearing. Since they are minimally marked, their disappearance also involves a minimal loss of information.

5.2.1 Empirical evidence from many different languages and language families confirms that glottal stops and laryngeal spirants are among the least stable members of sound systems, which is why a laryngeal in one idiom often corresponds to zero in another related idiom. Correspondences of the type [h] (glottal spirant) or [ʔ] (glottal stop) vs. Ø (zero) are often encountered even on a very shallow level between closely related languages and dialects. This suggests that laryngeals are chronologically short-lived segments, and we should not expect them to be preserved in any language over long spans of time.[26]

5.2.2 There is also a phenomenon that we may call the 'laryngeal cycle', in that lost laryngeals are often replaced by new laryngeals at a later stage in the life of a language. Laryngeals may therefore be divided into 'secondary', implying that they are transparent reflexes of other segments, and 'primary', implying that their origin cannot be detected by the methods of diachronic linguistics. Secondary laryngeals typically represent debuccalized reflexes of various types of oral segments, including

[24] In EICHNER's (1988: 128) words: "Er [= der Monolaryngalismus] bildet im Grunde die Fortsetzung der Brugmannschen Auffassungen vermehrt um die Einsicht, daß man nach der Entdeckung der anatolischen Evidenz nicht mehr ganz ohne Laryngal auskommt. […] Der Laryngal wird zum übrigen addiert und nicht in das System integriert."

[25] This situation is illustrated in detail by the case study of JANHUNEN (1986), in which it is shown that the glottal stop in several Samoyedic languages represents the positionally neutralized reflex of a number of different morphophonemes (in Nenets d s n ng, in Enets also r/l m). The glottal stop may be seen as a minimally marked consonant segment that lacks the distinctive marking present in the morphophonemes that it represents.

[26] In the Samoyedic case, as mentioned above (note 25), we can also see that the glottal stop is easily lost either syntagmatically (as in Nenets before consonants) or paradigmatically (as in modern Enets, where the remaining speakers often ignore the glottal stop as a segment, even if they maintain the segmental alternations connected with the glottal stop).

obstruents such as *[k] *[p] or fricatives such as *[s] *[ʃ]. A language may synchronically have several layers of laryngeals, but more typically, the primary laryngeals are lost before secondary laryngeals arise.[27] Languages with more than one distinctive segment in the laryngeal range are universally rare, and, in any case, complex laryngeal systems are liable to be simplified.

5.3 The general synchronic and diachronic properties of laryngeals have obvious consequences for the reconstruction of laryngeals for Proto-Indo-European, but also for other early protolanguages, like Proto-Uralic.

5.3.1 In view of the general synchronic and diachronic properties of laryngeals it is understandable that PIE *h was a typical primary laryngeal that was inherently liable to be lost, as happened in all branches of IE outside of Old Anatolian.[28] There are also many kinds of secondary laryngeals in the different IE branches and languages, and many of these have also been lost, only to be replaced by tertiary laryngeals. An example is Greek, which during the course of its history has lost both the primary PIE laryngeal *h and the secondary laryngeal [h] (spiritus asper) from *s, but which synchronically has created a third laryngeal in the form of a velar fricative [x] from the velar aspirated stop (*)k$^{h}$.

5.3.2 While the synchronic position of PIE *h is well within the limits of universal typological variation, it is much less likely that there could have been other laryngeals in the protolanguage. Moreover, since only *h is confirmed by the comparative method, there is no methodological basis to postulate any other segments of the laryngeal range for PIE. The situation is similar for many protolanguages. For Proto-Uralic, for instance, we can reconstruct a laryngeal, but only one, variously symbolized by the letters *x or *ɣ, and implying a segment that may phonetically have been a velar or postvelar spirant or glide. Although this segment could possibly be postulated also on the basis of systemic considerations, an essential circumstance confirming its reconstruction is the fact that it has been preserved as a segment in one branch of Uralic, Saamic, where it was merged with *k. Without this segmental evidence we would be on a shaky ground in trying to reconstruct a segment that has

[27] An illustrative example of a laryngeal cycle is offered by the Mongolic languages. Several Mongolic languages have a secondary laryngeal of the type [x] ~ [h], which represents the spirantized reflex of an original velar stop *k. A few Mongolic languages, notably Buryat, have also a tertiary laryngeal of the type [h], which represents the debuccalized reflex of the dental sibilant *s. In some idioms, as in Bargut, the two secondary and tertiary laryngeals have merged into a single phoneme with the phonetic representation varying between [x] and [h]. However, a few marginal Mongolic languages, like Dagur, preserve also a primary laryngeal, which represents an 'original' velar to postvelar spirant, reconstructed as Proto-Mongolic *x. External comparisons (with Turkic and Tungusic) allow the primary laryngeal to be derived from an earlier strong labial stop *p, positionally also from a weak velar stop *g, which means that it is also not 'primary' in the ultimately sense. There are, indeed, indications that Pre-Proto-Mongolic may once have had an even more 'primary' laryngeal, whose origin, then, remains obscure. A rather similar, though somewhat less complicated situation is observed in many Central Eurasian languages, including Turkic and Tungusic, as well as Hungarian. For a discussion, see JANHUNEN (1997).

[28] The possibility that PIE *h may also be preserved as a hiatus in Vedic Sanskrit (see note 16 above) suggests that the loss of this segment may have taken place separately, and perhaps at different times, in the different branches of IE. This is in accordance with the general picture of laryngeals, as it is inherently more likely that laryngeals are lost, rather than preserved, and the likelihood that they are lost increases as a direct function of time.

left no traces in most Uralic languages.[29]

5.3.3 It happens that the Uralic laryngeal *x has also been used in support of the hypothetical PIE *$h_3$, as proposed by Jorma KOIVULEHTO (1991), who identified several Proto-Uralic items as Indo-European 'loanwords' with the laryngeal 'preserved' on the Uralic side. In a similar attempt, Václav BLAŽEK (2012) has tried to justify the LT by listing 'cognates' for IE lexical items in Afro-Asiatic. Since both of these proposals are based on controversial and not generally accepted etymological comparisons, we will not go into further details here.

5.4 Although there is, consequently, neither internal nor external evidence in support of the laryngeal *$h_3$, there is one possible argument that may be brought in favour of the reconstruction of the laryngeal OLT *$h_1$.

5.4.1 As was shown above (see §4.2.1), OLT *$h_1$ systematically equals zero (Ø), that is, vocalic anlaut. Vocalic anlaut (#V) is a well-known problem in phonological typology, in that it contradicts the universally favoured syllable type, which begins with a consonant and ends in a vowel (CV). It is, therefore, at least theoretically, possible to view the absence of a word-initial consonant as a 'zero segment' (# = Ø), which, then, may be identified as a kind of 'laryngeal'. How this 'laryngeal' is pronounced varies from language to language, with some languages having a 'hard anlaut', phonetically equal to a glottal stop, while others have a 'soft anlaut', phonetically hardly observable as a segment. For some languages, there are systemic reasons to analyze vocalic anlaut as a segmental laryngeal consonant, while for others it is more difficult to find evidence in favour of its segmental status.[30] It is also well known that vocalic anlaut is equaled to a consonant in many writing systems, including not only the Semitic scripts (aleph), but also, for instance, Greek (spiritus lenis). There is, consequently, a basis to argue that the PIE roots that begin with a vowel actually contain an initial 'zero segment', which may or may not be identified as a 'laryngeal'. If we opt for the 'laryngeal' interpretation, all roots will have an initial consonant (CV-), as also in the OLT.

5.4.2 It should, however, be stressed that the analysis of initial zero as a segment has no consequences to what has been mentioned above against the different models of the laryngeal theory, including the OLT. Since comparative Indo-European linguistics conventionally operates with the assumption of vocalic anlaut in the modern languages, it is logical to apply this approach also to the protolanguage, which means that initial zero should be treated at face value. In any case, there is no a priori reason to postulate an initial 'zero segment' for the protolanguage only in order to give its morpheme structure an artificially Semitic 'look', in favour of which no independent evidence can be presented.

[29] On the Proto-Uralic laryngeal see JANHUNEN (2007), where the favoured notation is *x. In the consonant system, *x seems to have occupied the position of either a velar glide (*w *y *x) or a weak velar obstruent (*d *j *x). The phonotactics of this segment and its possible connection with the long vowels in Finnic and the vowel sequences in Samoyedic are still under discussion.

[30] Modern standard Finnish, as discussed by JANHUNEN (2014), is an example of a language where vocalic anlaut can be analyzed as a laryngeal segment /x/. In the case of Finnish, the evidence comes from both morphophonology and phonotactics, as the same segment is also attested medially (as a hiatus), as well as finally (idiolectally as a glottal constriction).

## Abbreviations

| | |
|---|---|
| A | accusative |
| a. | adjective |
| AHPh. | MELCHERT 1994 |
| ASaxD. | BOSWORTH & TOLLER 1882–98 |
| C | consonant |
| CLu. | Cuneiform Luwian |
| Dor. | Doric |
| EWA | MAYRHOFER 1986–2000 |
| G | genitive |
| GEW | FRISK 1960–72 |
| GFT | glottal fricative theory |
| Gr. | Greek |
| HED | PUHVEL 1984ff. |
| HEG | TISCHLER 1977–2016 |
| HIL. | KLOEKHORST 2007 |
| Hitt. | Hittite |
| HLu. | Hieroglyphic Luwian |
| IE | Indo-European |
| KEWA | MAYRHOFER 1956–80 |
| Lat. | Latin |
| LC | Lyle CAMPBELL |
| LT | laryngeal theory |
| m. | masculine |
| N | nominative |
| n. | neuter |
| Neogr. | Neogrammarian |
| OEng. | Old English |
| OLT | optimal laryngeal theory |
| Pal. | Palaic |
| PIE | Proto-Indo-European |
| prep. | preposition |
| RV. | Rig-Veda |
| sg | singular |
| SZ | SZEMERÉNYI's model |
| V | vowel |
| WbOU. | UNTERMANN 2000 |
| WbRV. | GRASSMANN 1996[6] |
| WH | WALDE & HOFFMANN 1938 |

## References


BENVENISTE, Émile. 1935. Origines de la formation des noms en indo-européen I. Paris: Adrien-Maisonneuve.

BLAŽEK, Václav. 2012. Indo-European laryngeals in the light of Afroasiatic. In: Benedict NIELSEN WHITEHEAD & Thomas OLANDER & Jens ELMEGÅRD RASMUSSEN & Birgit Anette OLSEN (eds.), The sound of Indo-European: Phonetics, phonemics, and morphophonemics. Copenhagen: Museum Tusculanum Press & University of Copenhagen, 1–26.

BOSWORTH, Joseph & T. Northcote TOLLER. 1882–98. An Anglo-Saxon dictionary. Oxford, Clarendon Press.

CAMPBELL, Lyle. 2004[2]. Historical Linguistics: An Introduction. Edinburgh: Edinburgh University Press.

EICHNER, Heiner. 1973. Die Etymologie von heth. mehur. MSS 31: 53–107.

—— 1978. Die urindogermanische Wurzel *$H_2$reu- 'hell machen'. Die Sprache 24: 144–162.

—— 1980. Phonetik und Lautgesetze des Hethitischen — ein Weg zu ihrer Entschlüssung. In: Manfred MAYRHOFER & Martin PETERS & Oskar E. PFEIFFER (eds), Lautgeschichte und Etymologie. (Akten der VI. Fachtagung der Indogermanischen Gesellschaft.) Wiesbaden: Reichert, 120–165.

—— 1988. Anatolisch und Trilaryngalismus. In: Alfred BAMMESBERGER (ed): Die Laryngaltheorie und die Rekonstruktion des indogermanischen Laut- und Formensystems. Heidelberg: Winter, 123–51.
FRISK, Hjalmar. 1960–72[2]. Griechisches etymologisches Wörterbuch I-III. Heidelberg: Winter.
GRASSMANN, Hermann. 1996[6]. Wörterbuch zum Rig-Veda. 6. überarbeitete und ergänzte Auflage von Maria KOZIANKA. Wiesbaden: Harrassowitz.
JANHUNEN, Juha. 1986. Glottal Stop in Nenets. (Mémoires de la Société Finno-Ougrienne 196.) Helsinki: Suomalais-Ugrilainen Seura.
—— 1999. Laryngeals and pseudolaryngeals in Mongolic: Problems of phonological interpretation. Central Asiatic Journal 43/1: 115–131.
—— 2007. The primary laryngeal in Uralic and beyond. Mémoires de la Société Finno-Ougrienne 253: 203–227. Helsinki: Suomalais-Ugrilainen Seura.
—— 2014. On the "zero consonant" phoneme in modern standard Finnish – towards a coherent paradigmatic interpretation. Mémoires de la Société Finno-Ougrienne 270: 129–140. Helsinki: Suomalais-Ugrilainen Seura.
KIMBALL, Sara E. 1987. *$H_3$ in Anatolian. In: George CARDONA & Norman H. ZIDE (eds.), Festschrift for Henry HOENIGSWALD on the Occasion of his Seventieth Birthday. Tübingen: Narr, 185–190.
KLOEKHORST, Alwin. 2006. Initial Laryngeals in Anatolian. Historische Sprachforschung 119: 78–108.
—— 2007. The Hittite Inherited Lexicon. Dissertation, University of Leiden. https://openaccess.leidenuniv.nl/handle/1887/11996
KOIVULEHTO, Jorma. 1991. Uralische Evidenz für die Laryngaltheorie. (Veröffentlichungen der Kommission für Linguistik und Kommunikationsforschung 24.) Wien: Verlag der Österreichischen Akademie der Wissenschaften.
KORTLANDT, Fredrik H. H. 2003–04. Initial laryngeals in Anatolian, Orpheus 13–14: 9–12 (Memorial Volume to Georgi RIKOV).
KURYŁOWICZ, Jerzy. 1935. Études indoeuropéennes I. (Polska Akademja Umiejętności. Prace Komisji Językowej 21.) Kraków: Polska Akademja Umiejętności.
MAYRHOFER, Manfred. 1956–1980. Kurzgefaßtes etymologisches Wörterbuch des Altindischen I–IV. Heidelberg: Winter.
—— 1986–2000. Etymologisches Wörterbuch des Altindoarischen. Heidelberg: Winter.
MELCHERT, H. Craig. 1987. Reflexes of *$h_3$ in Anatolian. Die Sprache 33: 19–28.
—— 1994. Anatolian Historical Phonology. (Leiden Studies in Indo-European 3.) Amsterdam-Atlanta GA: Rodopi.
—— 2010. Spelling of Initial /a-/ in Hieroglyphic Luwian. In Itamar SINGER (ed.), Ipamati kistamati pari tumatimis: Luwian and Hittite Studies presented to J. David HAWKINS on the Occasion of His 70th Birthday. Tel Aviv University: Institute of Archaeology, 147–58.
MØLLER, Hermann. 1879. Rewiew of F. KLUGE, Beiträge zur Geschichte der germanischen Conjugation. Englische Studien 3: 148–164.
—— 1880. Germanisch ā ē ō in den endungen des nomens und die entstehung des o (a2). Beiträge zur Geschichte der deutschen Sprache und Literatur 7: 482–547.
—— 1906. Semitisch und Indogermanisch I (Konsonanten). København: Hagerup.
—— 1911. Vergleichendes indogermanisch-semitisches Wörterbuch. Göttingen: Vandenhoeck & Ruprecht.
OETTINGER, Norbert. 1979. Die Stammbildung des hethitischen Verbums. (Erlanger Beiträge zur Sprach- und Kunstwissenschaft 64.). Nürnberg: Carl.
—— 2004. Die Entwicklung von $h_3$ im Anatolischen und hethitisch arāi "erhebt sich". In: A. HYLLESTED et al. (eds.), Per Aspera Ad Asteriscos: Studia Indogermanica in honorem Jens ELMEGÅRD RASMUSSEN sexagenarii Idibus Martis anno MMIV, 397-405.
PEDERSEN, Holger. 1938. Hittitisch und die anderen indoeuropäischen Sprachen. (Det Kongelike Danske Videnskapbernes Selskab, Historisk-filologiske Meddelelser 25: 2.) København: Levin & Munksgaard.
PUHVEL, Jaan. 1965. Evidence in Anatolian. In Werner WINTER (ed): Evidence for Laryngeals: Work Papers of a Conference in Indo-European Linguistics on May 7 and 8, 1959. (Janua linguarum series maior 11.) The Hague: Mouton, 79-92.
—— 1984ff. Hittite Etymological Dictionary. (Trends in Linguistics. Documentation 1.) Berlin: Mouton.
PYYSALO, Jouna. 2013. System PIE: The Primary Phoneme Inventory and Sound Law System for Proto-Indo-European. (Publications of the Institute for Asian and African Studies 15.) Helsinki: Unigrafia. https://helda.helsinki.fi/handle/10138/41760

—— 2016. Does the Laryngeal Theory have a Theory? On the Incompatibility of a Viable Three-Laryngeal Model with the Anatolian Data. Wékwos 2: 195-215.

PYYSALO, Jouna & Juha JANHUNEN. 2018a. Indo-European Linguistics in the 21st Century (1): From trilaryngealism to monolaryngealism: returning to Oswald SZEMERÉNYI. Proto-Indo-European Linguistics 2018/1: 1-14. http://pielinguistics.org/pdf/FromTrilaryngealismToMonolaryngealism-returningToOswaldSzemerenyi.pdf

—— 2018b. Indo-European Linguistics in the 21st Century (2): On the Inconsistency of Frederik KORTLANDT's Distributional Trilaryngealist Model. Proto-Indo-European Linguistics 2018/2: 1-5. Url: http://pielinguistics.org/pdf/onfrederikkortlandtsdistributionaltrilaryngealistmodel.pdf

RIEKEN, Elisabeth (2010). Review of A. KLOEKHORST, Etymological Dictionary of the Hittite Inherited Lexicon. Kratylos 55: 125–33.

RIX, Helmut et al. (eds.). 2001. Lexicon der indogermanischen Verben: die Wurzeln und ihre Primärstammbildungen. Wiesbaden: Reichert.

SZEMERÉNYI, Oswald. 1967. The New Look of Indo-European: Reconstruction and Typology. Phonetica 17: 67-99.

—— 1970. Einführung in die vergleichende Sprachwissenschaft. Darmstadt: Wissenschaftliche Buchgesellschaft.

—— 1996. Introduction to Indo-European Linguistics. Translation from Einführung in die vergleichende Sprachwissenschaft, 4th edition, 1990, with additional notes and references. Oxford: Clarendon Press.

TISCHLER, Johann. 1977-2016. Hethitisches etymologisches Glossar. Mit Beiträgen von Günter NEUMANN und Erich NEU. (IBS 20.) Innsbruck: Institut für Sprachwissenschaft der Universität Innsbruck.

—— 1980. Hethitisch ḫ und die Rekonstruktion des indogermanischen Phoneminventars. In: Manfred MAYRHOFER & Martin PETERS & Oskar E. PFEIFFER (eds), Lautgeschichte und Etymologie. (Akten der VI. Fachtagung der Indogermanischen Gesellschaft.) Wiesbaden: Reichert, 495-522.

UNTERMANN, Jürgen. 2000. Wörterbuch der Oskisch-Umbrischen. (Handbuch der Italischen Dialekte III.) Heidelberg: Winter.

WALDE, Alois & J. B. HOFMANN,.1938. Lateinisches etymologisches Wörterbuch. 3., neuarbeitete Auflage von J. B. HOFMANN I-II. Heidelberg: Winter.

WEEDEN, Mark. 2011. Spelling, phonology and etymology in Hittite historical linguistics. Bulletin of the School of Oriental and African Studies. 74: 59–76. doi:10.1017/s0041977x10000716.

ZEILFELDER, Susanne. 1997. Heth. hapusa(s)- 'Schaft, Penis' und die Frage des dritten Laryngals. HS 110: 188–210.

ZGUSTA, Ladislav. 1951. La théorie laryngale. 1951. Archív Orientální 19: 428-472.