

Geminate Stops in Anatolian: Evidence and Typological Implications

MA Comparative Indo-European Linguistics

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Abstract

*This thesis investigates the synchronic and diachronic identity of the Anatolian stops, and their implications for Proto-Indo-European phonology and subgrouping. Ever since Sturtevant (1932), it has been known that etymologically Hittite cuneiform VC-CV (fortis) spellings go back to PIE *t, and V-CV (lenis) spellings to *d/d^h. This has been taken to stand either for a synchronic voicing or length contrast. Through an examination of the origins and use of Hittite cuneiform, combined with phonological evidence, it is concluded that the underlying contrast must be length. A typological survey of geminate evolution and Proto-Anatolian phonology further concludes that this contrast must be original, and cannot emerge from a voicing contrast. Therefore the Nuclear-Proto-Indo-European *t~*d~*d^h contrast is an innovation, and a *t:~*t~*? system must be reconstructed for Proto-Indo-European. This is evidence of a significant innovation that Proto-Anatolian did not take part in, and thus strong evidence for the Indo-Hittite Hypothesis.*

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Section I: Introduction

1.1 Introduction

1.1.1 Anatolian and Indo-European

From the moment that Bedřich Hrozný deciphered Hittite in 1915, it was obvious that the oldest attested Indo-European (IE) language was strikingly different compared to previously known Indo-European languages. Traditional Indo-European hallmarks such as the feminine gender, the dual number, or familiar **so-/to-* demonstratives are absent in Hittite. *r/n* heteroclitics, which are mostly vestigial in other IE languages, are abundant. The Hittite verb is also difficult to reconcile with the traditional model of the Proto-Indo-European (PIE) verb: Hittite does not have the aorist or perfect aspects, nor are there any obvious reflexes of the subjunctive or optative moods. Verbal endings of the Hittite *hi-* conjugation (which function as simple presents) do have a strong formal resemblance to the PIE perfect endings, which makes the picture even more confusing. Phonologically Hittite is most famous for retaining some of de Saussure's *coefficients sonantiques* as the laryngeal *h*, validating the laryngeal version of de Saussure's theory. After the decipherment of Hittite, Lydian, Lycian, and Carian were correctly identified as Indo-European, and appeared to corroborate the uniqueness of the newly established Anatolian subgroup.

The initial reaction to the Anatolian problem was to interpret Anatolian divergences as negative innovations rather than archaisms, and thus retain PIE as outlined in Brugmann's *Grundriss* more or less intact. This position, the *Schwund-Hypothese*, dominated the discussion for most of the 20th century (cf. e.g. Eichner 1975 and Rieken 2009). An alternative approach, first presented by Emil Forrer in 1921, argued that the best way to reconcile the Anatolian data with PIE was to posit Hittite as a sister to the rest of the IE languages by deriving both PIE and Proto-Anatolian (PA) from an ancestral Proto-Indo-Hittite (PIH) language. This Indo-Hittite (IH) hypothesis was further championed by Edgar Sturtevant (1933), and his name remains closely associated with the theory. A third, less unified, school of thought argued that while the 'nuclear' IE languages (PNIE)¹ did undergo a significant period of common innovation and that

¹ Also referred to as 'classical' or 'core' Indo-European. This paper will refer to PIE ancestral to PA as PIE, and PIE ancestral to all the subgroups besides Anatolian as PNIE. This is not a statement for or against Indo-Hittite: it is merely a practical way to refer to the pertinent stages of PIE branching and development. Virtually any other terminology, be it Early PIE vs. Late PIE, Indo-Hittite vs. PIE, or PIE vs. PIE⁻¹, could be adopted without any relevant change in meaning.

PIE reconstructions should be significantly revised in light of Anatolian, the differences are not significant enough to warrant two distinct subgroups. This outline is best exemplified by Watkins (1969), Meid (1975) and Neu (1985).

The current *communis opinio* is best described as reconciliation between these three views: most scholars agree that Anatolian is relatively archaic, and that Anatolian-speakers were the first ones to branch out from the PIE speech-community. PNIE thus did go through a notable period of common innovation, but nonetheless most Anatolian ‘archaisms’ are to be taken as negative innovations, and very few advocate for radically revising PIE based on Anatolian. There is still, however, a notable and growing minority that advocates for the IH model. This group includes scholars such as Alwin Kloekhorst, Norbert Oettinger, and Don Ringe.

Because most of the Indo-Hittite skirmish has been fought in the realm of nominal and verbal morphology, the problems posed by Anatolian synchronic and diachronic phonology have not received as much attention as their morphological counterparts. Besides Kuryłowicz’s discovery of laryngeal retention, Anatolian and PA phonology has had relatively little impact on the reconstruction of PIE. This is not to say that the topic has not been subject to serious academic discussion: landmark works on it include Melchert’s *Anatolian Historical Phonology* (1994), Kimball’s *Hittite Historical Phonology* (1999), and Kloekhorst’s *Etymological Dictionary of the Hittite Inherited Lexicon* (2008). Nonetheless, the effort to confront and solve problems present in both the synchronic and diachronic study of Anatolian phonology has been less concentrated than the effort expended on solving the morphological challenges presented by Anatolian.

1.1.2 The Anatolian Stops and Sturtevant’s Law

The most contentious issue in contemporary Anatolian phonology is the phonological nature of the geminate spellings of stops in the cuneiform Anatolian languages, and their possible historical development. The debate was triggered when one of Sturtevant’s students, C.L. Mudge, noted that the intervocalic geminate spelling of *-pp-* in Hittite tended to go back to PIE **p* (Sturtevant 1932: 2). Sturtevant developed this idea further, and argued that overall geminate spellings go back to PIE voiceless stops, and that singletons can be traced back to voiced stops or voiced aspirate stops. This *VC-CV < *t*, *V-CV < *d/d^h* correspondence is referred to as ‘Sturtevant’s Law.’ The vast majority the evidence for Sturtevant’s Law comes from

Hittite, due to the sheer enormity of the Hittite corpus. Nonetheless, it has been demonstrated to apply to both Cuneiform Luwian and Palaic, even if they are more modestly attested.

The contrast of geminate vs. single spelling for stops is referred to as fortis vs. lenis. This is because no strong consensus has been reached on the phonological nature of the contrast, and the terms are vague enough to accommodate different interpretations.² Overall, the debate is dominated by three lines of argumentation: 1) fortis indicates a voiceless stop and lenis indicates voiced stops, 2) fortis signifies an aspirated voiceless stop and lenis signifies a plain voiceless stop, and 3) fortis stands for a long voiceless stop (i.e a geminate stop) and lenis stands for a short voiceless stop. For a long time, the *communis opinio* favoured position 1), but has slowly shifted slightly in favour of 3). 2) remains a distinctly minority position, and is mainly advocated by Gamkrelidze (1968), Gamkrelidze and Ivanov (1995) and Bomhard (2001). Position one counts amongst its supporters Hart (1983), Eichner (1992) and Kimball (1999). 3) is supported by e.g. Melchert (1994),³ Kümmel (2007), Kloekhorst (2008), and van den Hout (2011).

The purpose of this paper is thus twofold: firstly, it is to investigate and establish the synchronic phonology of Anatolian fortis ~ lenis spelling. Secondly, it aims to explore the diachronic implications that the synchronic contrast has for both PA and PIE. The paper is thusly divided into four sections. The introduction will outline the epistemic and methodological considerations related to evaluating the phonology of Anatolian geminate stops. The second deals with the actual Anatolian data, and is composed of two parts: an analysis of the orthography of the Hittite cuneiform script, and an analysis of the linguistic data. The third section will deal with the synchronic and diachronic typology of geminates, and will discuss the implications of the second section on the history of PA and PIE. The fourth section is a conclusion, summing up the results of the investigation.

² It is also referred to as tense vs. lax by e.g. Watkins.

³ Recently Melchert has been more ambiguous about his position: “For the sake of simplicity we here describe the contrast in stops as one of voicing, but we do not mean thereby to take a definitive stance on this issue” (Hoffner and Melchert 2008: 35).

1.2 Epistemic and Methodological Considerations

1.2.1 PIE Phonology

The debate on Anatolian fortis-lenis spelling is related to debate on the overall phonology of the PIE stops. Since the discovery of Sturtevant's Law, it has mostly been assumed that fortis-lenis denotes a voice contrast simply because PIE is thought to have had a voice contrast, and the correspondence matches it.

In the 19th century, four series were reconstructed for the PIE stops: voiceless, voiceless aspirate, voiced, and voiced aspirate. The voiceless aspirates were problematic: they were only directly observed in Sanskrit and Greek, only Sanskrit preserved a four-way contrast, and the reflexes of voiceless aspirates were indistinguishable from plain voiceless stops in non-Greek or Indic IE languages. After Jerzy Kuryłowicz's discovery of laryngeal retention in Hittite, the voiceless aspirate series became analysable as a combination of a voiceless stop + laryngeal, and was eliminated (Clackson 2007: 40-43).

It is important to note that in precise phonetic terms voiced aspirates are nearly impossible to articulate. According to Ladefoged "such a sound has yet been observed in any language" (Ladefoged 1971: 9). It is unlikely that PIE had them. Instead, Sanskrit voiced aspirates and their Indic reflexes are phonetically 'breathy voiced,' also known as 'murmured,' [d̪] or [d̪ʰ].⁴ Currently this analysis is extended to PIE in standard theory (Weiss 2009: 3-5). Murmur is characterised by contactless vibration of the vocal folds with a slightly higher airflow than in normal voicing (Ladefoged and Maddieson 1996: 48).⁵

Despite these elaborations, the resultant PIE stop system (henceforth 'standard' theory) remains typologically problematic. As Roman Jakobson observed, there is no attested language that has voiced aspirates but lacks voiceless aspirates (Jakobson 1958: 23).⁶ The PIE voiced series also displays other well-documented irregularities: to name a few, the phoneme **b* is marginally distributed, and plain voiced stops do not appear twice in the same root (Hopper 1973: 157).

⁴ The 'murmured' interpretation for Classical Sanskrit is based on phonetic descriptions of the sounds by Sanskrit philologists (Allen: 36).

⁵ This paper will continue to use the traditional term 'voiced aspirate.'

⁶ Although the PIE system being unattested makes it very improbable, it does not rule it out *a priori*.

It has been suggested that the Bornean language Kelabit has a stop system that counters Jakobson's dictum and is more or less the same as the one reconstructed for PIE. However, Kelabit's 'voiced aspirates' are neither voiced aspirates nor murmured stops: instead they are voiced onsets followed by a voiceless aspirate, e.g. [bp^h] in [əbphaʔ], 'water.' Blust maintains that Kelabit's voiced aspirates are nonetheless analysable as [+voice] and [+aspiration], providing a parallel for PIE (Blust 2006: 313). Because phonetically they are neither pure voiced aspirates nor murmured stops, it is debated whether or not they constitute counterevidence for Jakobson's observation. Kümmel thinks this the case (2012: 294), Kloekhorst does not (forthc. I: 14). Whatever the case my might from a more abstract phonological point of view, phonetically a direct parallel for PIE (with a [t] ~ [d] ~ [d̥]) contrast is yet to be attested.

As a response to this problem, Hopper (1973) and Gamkrelidze and Ivanov (1973) independently presented typologically more plausible models for the PIE stops, in which the voiced stops were in fact ejectives. Ejectives stops are sounds created by a closing the glottis and increasing pressure in the oral cavity. Once the oral closure is opened the excess pressure is released, and the stop gains a distinctive 'burst' (Ladefoged and Maddieson: 79). Languages with ejectives, such as Hausa or Yucatec Mayan, often have root constraints similar to PIE (Hopper: 161). Another view holds that the voiced series was actually preglottalised, with

partial or nearly full glottalic closure preceding a voiceless stop (Kortlandt 1988: 355).⁷ Theories incorporating some kind of glottalic phonation for PIE are collectively known as ‘glottalic’ theories. Although more convincing in synchronic typology, glottalic theories tend to have problems with diachronic plausibility (Kümmel: 296-299).⁸ The reasoning behind an individual glottal theory or its relative strengths and weaknesses vis-à-vis the standard model are not relevant here; it suffices to note that glottalic theories have been discarded by most scholars. A summary of relevant positions is as follows:

Neogrammarian	Brugmann (1897)	<i>*t</i>	<i>*d</i>	<i>*d^h</i>	<i>*t^h</i>
‘Standard’	Mayrhofer (1987) ⁹	<i>*t</i>	<i>*d</i>	<i>*d^h</i> [d̥]	
	Weiss (2009)	<i>*t</i>	<i>*d > *d</i>	<i>*d > *d^h</i> [d̥]	
Glottalic	Gamkrelidze & Ivanov (1995)	<i>*t^h</i>	<i>*t^ʔ</i>	<i>d^h</i>	
	Beekes (2011)	<i>*t:</i>	<i>*^ʔt</i>	<i>*t</i>	

Fig. 1 Theories of the PIE stop system in the dental series

For interpreting the nature and evolution of Anatolian stops, the nature of the voiceless and voiced aspirate series is relevant. Roughly speaking, those in favour of fortis ~ lenis being a voice contrast work with the traditional **t ~ *d ~ *d^h* system. Bomhard (2001) analyses Hittite fortis spelling as *t^h*, and uses it to support Gamkrelidze and Ivanov’s glottalic model. **READ KLOEKHORST EMAIL AND CHECK** The geminate nature of Anatolian fortis stops is usually part of a specific version of the glottalic theory, which argues for a **t: ~ *^ʔt ~*

⁷ Clackson has passingly suggested merging preglottalisation with the traditional model. Voicing is no longer seen as a matter of voiced vs. unvoiced, but as a continuum of different vocalisations. Most segments of that continuum, such as murmur, have some form of glottalic involvement. Preglottalisation comes in several minute varieties, and is generally labelled as ‘creaky voice’ by Maddieson and Ladefoged. Clackson suggests that a voiceless ~ creaky voice ~ breathy voice system might be worth pursuing for PIE (Clackson 2007: 48).

⁸ One of the proposed arguments in favour of pre-glottalisation (in addition to synchronic typology and the series being supposedly preserved in Armenian, Anatolian and Germanic) is its ability to give a diachronic account of certain phenomena, such as Lachmann’s Law in Latin, Winter’s Law in Balto-Slavic, and Proto-Germanic sound shifts (Beekes: 128-134). This is, however, contested. For example, it is debated whether pre-glottalisation is really needed to explain Winter’s or Lachmann’s Law (Kümmel: 299-301), and Winter’s law itself is completely dismissed by some scholars (Patri 2005: 290).

⁹ From Garret (1991: 794).

**t* contrast. This approach is best exemplified by Beekes (2011), Kloekhorst (2008) and Kortlandt (1988). It is important to note that one's model for PIE does not directly dictate one's analysis of the Anatolian fortis ~ lenis contrast. For instance Melchert (1994) argues that fortis represents synchronic consonantal length, but works within the traditional model for PIE. The synchronic analysis is not critical for PIE phonology: the diachronic analysis of how the synchronic system came about is.

The most immediate problem with incorporating the problem of the Anatolian stops within a wider theoretical framework is the risk of circular reasoning. Preconceived notions of the language ancestral to PA can and most probably will affect the weighting of different possibilities for the Anatolian stop system, even if the primary data analysed is solely Anatolian. The existence of a teleological 'default' answer also discourages rigorous typological analysis, even if one's default assumption requires a typologically implausible or unattested development. The result is that the evidence for the Anatolian stop system is rarely analysed on its own terms, but is often subsumed under a broader framework that comes with unrelated baggage. Using a reconstructed proto-language to elucidate phenomena in an attested daughter is not inherently harmful. When attempting to understand PA, it can be immensely helpful. Nonetheless the risk of circular reasoning is always present, and must be kept in mind.

This paper does not aim to evaluate the impact of Anatolian stops on the PIE phonological system as whole. The aim is to investigate what diachronic implications geminate stops in Anatolian might have for the PIE voiceless and voiced series alone. It will be assumed that the PIE voiceless and voiced series were in fact just that, and the possible pathways for **t* > *t*:, **d*/**d^h* > *t* will be investigated. If the typological plausibility of **t* > *t*:, **d*/**d^h* > *t* is not very high, it will be compared to the alternative possibility that the PIE voiceless series and voiced were a geminate voiceless and plain voiceless series. Theories are only as strong as their explanatory power: a theory might explain some phenomena but fail to explain others. This paper seeks to explore such phenomena and posit the most probable answer.

1.2.2 Subgrouping and Branching

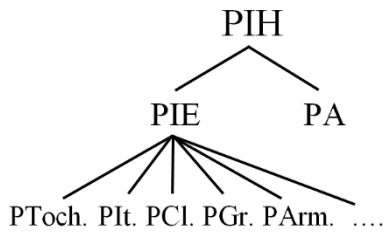


Fig. 2 Indo-Hittite *Stammbaum*

Another issue that arises when analysing the Anatolian stops is fitting in the results with different models of Indo-European branching. In the case of binary branching, languages A and B descend from a hypothetical parent AB. If a feature is present in both A and B, it is reconstructed into AB. If a feature is present in A but not B (or vice versa), typology must be

invoked in order to decide whether or not the feature is an innovation of the daughter, or a retention from AB. In the Indo-Hittite model, or any other approach in which PNIE and PA are sisters, PIE and PA form two nodes both descending from PIH. In this case evaluating what kind of stop system to reconstruct is uncomplicated: one merely chooses the typologically more plausible or common one.

With the traditional PIE model, things become more complicated. In the classical *Stammbaum* PIE is the direct ancestor to approximately ten well-attested daughters. If one of the ten daughters exhibits a stop system that is different to the other daughters but at the same time is typologically far more likely to preserve the original situation, does one follow the principle of economy and reconstruct the system attested in the majority of the daughters, or does one reconstruct the typologically more plausible scenario?

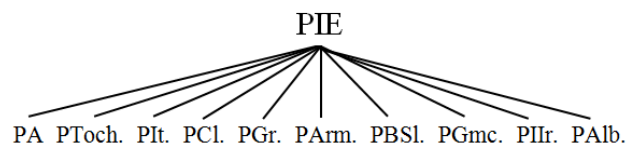


Fig. 3 Traditional *Stammbaum*

Today, most scholars accept that PNIE underwent common innovations that set it apart from PIE. Widely agreed-upon innovations include the feminine gender (Luraghi: 437) and certain semantic shifts in lexemes (**KLOEKHORST, Garcia, Eichner, Melchert**). It is also widely agreed that Anatolian was the first daughter to branch off from PIE (**LITERALLY ANYONE**). What is less agreed upon is the relevance of these two subgroups, and their

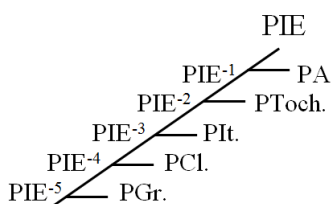


Fig. 4 Contemporary PIE Model

implications for PIE: "... in response to proposals like those of Meid (1975) there has developed a widespread view that we need not view the problem as strictly a choice between Anatolian as another descendant of PIE like any other

subgroup or Anatolian and PIE as representing branches of ‘Indo-Hittite’” (Melchert forthc.: 5). Instead, most scholars view PIE after the departure of Anatolian as PIE⁻¹, PIE after the departure of Tocharian as PIE⁻², and so on, with each level representing the common innovations and archaism present in the PIE speech-community at that particular historical moment (Melchert forthc.: 52).¹⁰

This approach acknowledges the diachronic aspect of Meid’s controversial spatial-temporal model (1975). At first sight it appears to be more descriptively accurate than either the ‘traditional’ model or the IH one. However, it offers no easy formal procedure for weighting any contradictory evidence presented by the daughters. In fact, it does not even contradict either one: if the differences between PIE, PIE⁻¹, PIE⁻³ and so on are minimal to non-existent, it is a more detailed version of the traditional model. If the differences between PIE and PIE⁻¹ are significant enough, it becomes a more detailed version of the IH hypothesis.¹¹

The issue over branching is essentially an issue of subgrouping. A subgroup is reconstructed only if a set of languages exhibits a critical amount of non-trivial and common innovations that other languages in the family do not share. What constitutes a significant innovation is more or less agreed upon (Clackson: **XXXX**). What constitutes a sufficient amount of significant innovations is more controversial. It is practically universally accepted that PNIE innovated the feminine gender, but whether or not this and other acknowledged innovations are enough to prove that PNIE and PA are sisters is disputed. The deeper problem is that there is no universal way to define what constitutes a given language. All that exists is a continuum of variation in signifier-signified pairs, with mutual intelligibility often acting as an arbitrary cut-off point.¹² Just like descriptive linguists can somewhat arbitrarily disagree over whether to call the ends of a continuum separate dialects or languages, historical linguists can disagree over subgrouping for similar reasons. Although some of the facts pertinent to Indo-

¹⁰ This model, and specifically Meid’s, has been derisively referred to as a ‘*Stammfluss*’ by Lehrman (1996: 77).

¹¹ To be more precise, it becomes the Indo-Hittite model if PIE and PIE⁻¹ are different enough *and* if PIE⁻¹ shares a critical amount of exclusive, non-trivial innovations with PIE⁻ⁿ, where $n > 1$.

¹² Evolutionary biology has a similar problem when attempting to define what constitutes a species. The traditional definition of ‘a set of organisms capable of producing sexually viable offspring’ has obvious problems when attempting to define asexually reproducing species, or when describing their speciation. It also fails to do justice to the phenomenon of sexually reproducing ring species, where population A can reproduce with B and B with C, but C and A cannot reproduce. As with language and variation in signifier-signified pairs, all that exists in biological terms is a continuum of genetic variation, with the capability to produce sexually viable offspring acting as an arbitrary cut-off point.

Hittite are disputed, the ambiguity of the criteria means that disagreement over subgrouping may in principle exist even if all the facts are agreed upon.

The vagueness of the current *communis opinio* is thus apparent: something that can be argued to be a subgroup has been identified, but an outright binary model is mostly rejected. Kloekhorst has argued that “each one of [mentioned innovations in lexical semantics or morphology from PIE to PNIE] is conclusive evidence that the Anatolian branch was the first one to split off from the mother language. Whether one calls this mother language Proto-Indo-European, Proto-Indo-Hittite or something else is only a matter of terminology” (Kloekhorst 2008a: 25-6). He is echoed by Merrit Ruhlen, who states that “taxonomy and genetic relationship [are] confused... [Early Indo-European and Late Indo-European] are simply different names for Indo-Hittite and Indo-European.”

This strong taxonomic approach is not necessarily correct. Wolfgang Hock has brought attention to the critical and often-neglected fact that different cladistics models and *Stammbaums* are ultimately an emergent property of the criteria used to determine relationships (i.e. common traits or features) rather than an intrinsic property of language as an object of inquiry. The same cladistics models can be used to map out relationships within wildly different things, from texts to genes (Hock 2000: 124). Furthermore, as the evolutionary biologist Stephen Jay Gould points out, cladistic models merely create hierarchies of similar traits: one can build a cladistic tree without evolution even taking place amongst the objects mapped.

Theoretically the presence of just one shared, exclusive innovation in the subset of a sample justifies the creation of a sub-group, no matter how trivial or diachronically shallow it is. This is, however, not how historical linguists approach the issue in practice. Historical linguists reconstruct subgroups only if the subgroup shows a critical amount of common, exclusive and non-trivial innovations (**Leskien, Brugmann, Meillet**). Because a cladistic tree is the secondary product of the criteria used in the qualitative analysis of the data, using a *Stammbaum* to justify a subgroup is circular.¹³

¹³ In recent years there has been an increase in attempts to quantify innovations and thus automate the subgrouping process. However, because quantitative values are usually not inherent in the data and the value given to a certain kind of innovation is the result of a qualitative analysis, the process is ultimately qualitative and dependent on traditional scholarship. Computational attempts vary wildly in both methodological and empirical rigour. cf. Ringe, Warnow and Taylor (2002) for a relatively reasonable attempt, and Gray and Atkinson (2003) for a dubious one. For a discussion on the general challenges of the computational approach, cf. Ringe and Anthony (2015).

Ultimately either one accepts Indo-Hittite based on a qualitative analysis or one does not: adopting one model over another will not solve the underlying disagreement. As mentioned earlier, the contemporary model can describe both the traditional model and the Indo-Hittite hypothesis, depending on one's qualitative analysis. If one accepts Indo-Hittite, then one weights Anatolian data based on the binary branching scenario. If not, one is faced the conundrum of typology vs. economy. For the *communis opinio* the current cladogram is, roughly speaking, simply a nuanced version of the traditional model.

The results of this paper have direct bearing on the issue of Indo-Hittite. If it is concluded that the traditional PIE stop system is in fact a PNIE innovation, it would be significant evidence in favour of Indo-Hittite. On the issue of typology vs. economy, typology will be favoured. The stance taken is that it is preferable to root one's analysis in empirical observations of natural languages rather than assume an implausible development based on theoretical presumptions. This principle also applies to analysing the Anatolian data: whether geminate spelling for stops represents voice, aspiration or length must be examined first and foremost in terms of synchronic data. Only if the synchronic data is contradictory or highly ambiguous do theoretical considerations - i.e. models of PIE phonology - become relevant.

Section II: Geminate Stops in Anatolian - Evidence

2.1 The Anatolian Languages: An Overview

2.1.1 The Attested Anatolian Languages

The Anatolian family is composed of nine languages: Hittite, Cuneiform Luwian, Hieroglyphic Luwian, Palaic, Lycian, Lydian, Carian, Pisidian, and Sidetic. The first six are relatively well-attested and understood to a varying degree. Carian is well-attested, but poorly understood (Adiego 2006: 6). Pisidian and Sidetic are both poorly attested and barely understood. Hittite, CLuw., and Palaic date to the 2nd millennium BCE. HLuw. is attested in both the second and first millennia BCE. The remaining languages are attested in the first millennium BCE, and Pisidian is known from some thirty funerary inscriptions from the first and second centuries CE (Adams and Mallory 1997: 12-13). CLuw. and HLuw. show very small differences, and they are considered to be mutually intelligible dialects of the same language, deriving from a

common Proto-Luwian parent (Watkins 2008: 32). Whether the variation is diatopic or diachronic is debated.¹⁴

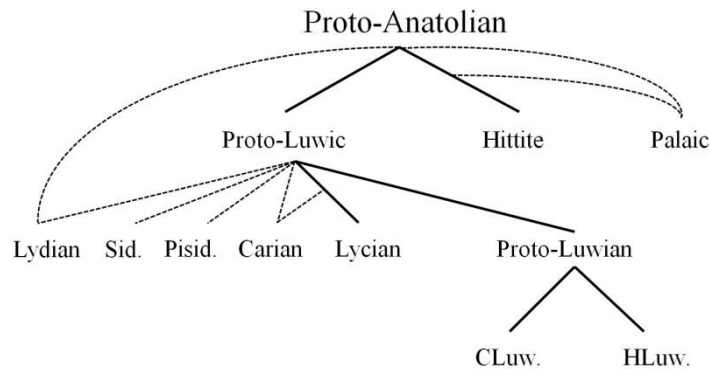


Fig. 5 The Anatolian language family. Agreed-upon connections appear as solid lines, speculative ones are dotted. Note that the speculative connections are speculative in the strongest sense of the word.

Due to the scarcity of material and poor understanding of most Anatolian languages, the phylogenetics of Anatolian are poorly understood. The only agreed-upon connections are that Hittite is sister to Proto-Luwic, which is parent to Lycian and Proto-Luwian. Other genetic relationships are fiercely debated. Lydian in particular is strikingly different from the other Anatolian languages, and presents a great challenge both to Anatolian phylogenetics and the reconstruction of PA.

Hittite is by far the most attested and understood Anatolian language. It is first attested in personal names attested in Assyrian trade documents from the trade post (*kārum*) at Kaneš c. 1900 BCE (Roux 1992: 231-232). However, despite familiarity with the Old Assyrian cuneiform script, the Hittites did not begin to write until around 1600 BCE, after the establishment of the Hittite Kingdom. The Hittite corpus numbers approximately 30,000 tablets and fragments, is almost equal to the Vedic corpus in size, and comes in a fairly wide variety of genres (van den Hout 2011: 4). It follows that most of our understanding of the more minor Anatolian languages and PA is strongly based on our understanding of Hittite, and Hittite will play a privileged role in Anatolian linguistics for the foreseeable future. Nonetheless, the past decades have seen great advances in the study of Luwian and Lycian; a purely Hittite approach to the study of Anatolian is no longer tenable.

¹⁴ It has been argued by Yakubovich that a third Luwian dialect is attested in a small set of texts that is mostly composed of hymns dedicated to the sun god Ištānu. However, most scholars contend that the Ištānuwian texts are too poorly understood for any definitive conclusion to be reached (Watkins 2008: 32).

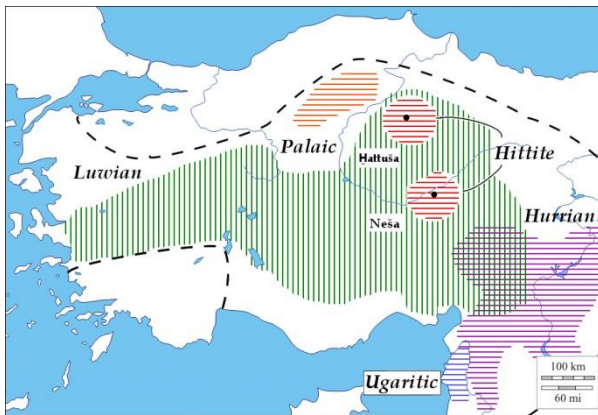


Fig. 6 The Languages of AnFig. 7 The Languages of Anatolia c. 1st millennium BCE

Out of the Anatolian languages, Hittite, Cuneiform Luwian and Palaic display geminates that adhere to Sturtevant’s Law (Melchert 1994: 15). Because these geminates are present in the only two solidly agreed-upon branches, Hittite and Luwic, they are reconstructed for PA and do not constitute an innovation of only one Anatolian branch. They are all written in the Hittite cuneiform script, and were written down either by Hittite scribes or scribes bilingual in Hittite. Based on CLuw., Hieroglyphic Luwian is also thought to possess geminates, but the HLuw. writing system only allows logographs and *CV* and *V* signs; the presence of geminates is only comparatively inferred. Lycian is widely known for extensive gemination and peculiar consonant clusters. However, most of them are considered either ellisions or otherwise secondary (**GUSMANI?**). Therefore this paper will focus on the Hittite, CLuw. and Palaic evidence.

2.1.2 Proto-Anatolian Stop System

The cuneiform Anatolian texts do not appear to mark a three-way distinction between reflexes of PIE **t*, **d*, and **d^h*. The only distinction that is orthographically marked is the fortis ~ lenis spelling distinction, contrast is virtually always intervocalic. Practically all scholars argue for a

merger of the **d* and **d^h* series into one ‘lenis’ series, whereas the **t* ‘fortis’ series is directly continued (**SOMEONE**). In word-initial position fortis spelling is extremely cumbersome, and no orthographic distinction is made between voiced and unvoiced signs.¹⁵ In the attested cuneiform languages, stops in word-initial position appear to be fortis. The best-understood alphabetically written languages, Lycian and Lydian, do not retain a word-initial distinction between inherited fortis ~ lenis: PIE **tri-* ‘three’ yields Lyc. *trppeme*, ‘threefold,’ PIE **du-* ‘two’ > Lyc. *tup̃me*, ‘twofold,’ PIE **d^heh₁-* ‘to put’ > Lyc. *tadi* ‘puts’ (Kimball 1999: 259). However, some conditioned sound changes suggest that this was not the case for PA: **ti-* yields /z-/ and **d^hi-* > /s-/ in Hittite, whilst in Luwian they both yield *ti-*, e.g. CLuw. *tiyat-* ‘sun-god’ vs. Hitt. *šīuatt-* ‘day,’ < PIE **diéuot*, meaning that a word-initial fortis ~ lenis distinction must be reconstructed into PA (Kloekhorst 2010: 200).

Melchert suggests that some etymologically unexpected fortis spellings in reduplicated Hittite forms might suggest that the original distinction (which is voice for Melchert) has also disappeared in attested Hittite. Reduplicated words, such as *titti-* ‘install,’ < PIE **d^heh₁-* ‘to put, to place,’ *dudduuarant-* ‘lame’ < **d^heu-* show fortis spelling, whereas reduplicated sibilants and resonants do not, e.g. *šiši-* ‘shoot,’ *ninink-* ‘to raise,’ suggesting that the stop categories have merged together in the pre-history of Hittite (Melchert 1994: 18-19). He also somewhat speculatively suggests that this feature spread as an areal feature across Anatolia (Melchert 1994: 20).

One of the more significant developments in the stop system from PIE to PA is the series of Proto-Anatolian lenitions, in which fortis consonants become lenis when they appear:¹⁶

- 1) After an accented long vowel or diphthong:

$$\acute{V}CCV > \acute{V}CV \quad \acute{V}i/uCCV > \acute{V}i/uCV^{17}$$

- 2) Between unaccented vowels:

¹⁵ Kloekhorst (2010) has argued that in word-initial position voiceless and unvoiced signs are used contrastively, with e.g. TA denoting [t] and DA glottalic [tʔ], via an assimilation of PIE clusters **dh₃-* and **d^hh₁-* into Hit. [tʔ] via PA **dʔ-* and Pre-Hittite **tʔ-*. Kloekhorst (2013) also argues that word-internal dental geminate stops spelled with the voiced/emphatic signs represent post-glottalised a geminate [t:ʔ]. However, he takes these to be secondary developments, and they are thus not directly relevant to the current investigation.

¹⁶ At least Melchert also takes this to also affect intervocalic voiceless **h₂*, and argues that the resulting lenition yields an intervocalic voiced laryngeal. This according to him is expressed with lenis spelling, and fortis spelling stands for voiceless (Melchert 1994: 68).

¹⁷ Instead of using T and D for fortis is and lenis like Yoshida (2011), CC and C are used because they can be taken to refer to fortis ~ lenis spelling, rather than T and D, which stand for voice.

ṼCCVCCV > ṼCCVCV





These lenitions were first discovered by Eichner (1973: 79-83), and further cemented by Morpurgo-Davies (1983: 262). Adiego (2001) argued that these two lenitions can be unified by analysing PA as a moraic language, where the first mora of the Ṽ sequence is accented but the second is not, thus Ṽ = ṼV. The new Proto-Anatolian lenition rule would thus be that fortis stops become lenited when between unaccented morae (Yoshida 2011: 95-96):

3) $\mu CC\mu > \mu C \mu$, where μ is an unaccented syllable and μ an accented one.
 L L L L L H

2.2 Orthographic Evidence

2.2.1 The Hittite Cuneiform Syllabary

Hittite, Palaic and Cuneiform Luwian all utilise the same Hittite adaptation of the Near-Eastern logo-syllabic cuneiform script. The Hittites used their adaptation of the script not only to write Hittite and the other Anatolian languages, but also used it to write Akkadian (Griffith: 12). The Hittite cuneiform script is a syllabary with some logographs, and consists of *V*, *VC*, *CV* and *CVC* signs, although the *CVC* signs are relatively rare. The syllabic system makes writing some consonant clusters impossible, and the ‘dead’ sounds (usually vowels) are inferred from variation in spelling. The earliest attested Hittite cuneiform text, the Zukraši fragment, dates from around 1600 BCE (van den Hout 2009: 22).

Hittite cuneiform has signs that contrast voiced stops and voiceless stops in *CV* signs, just like Akkadian written in the Old Babylonian script: *TA*  and *DA* , *PA*  and *BA* , etc. Like Akkadian written in the Old Babylonian script, *VC* signs do not distinguish between voice, and only the first consonants of *CVC* signs do (Kimball 1999: 81). Unlike the Akkadians, the Hittites do not use the available voice contrast, and in most cases voiced and voiceless signs are in almost free variation. For example, we find in Hit. both *a-ta-an-zi* and *a-da-an-zi*, ‘they eat,’ *ta-ga-a-an* and *da-ga-a-an*, ‘on the ground,’ *ad-da-aš* and *at-ta-aš*, ‘father,’ etc. (Hoffner and Melchert 2008: 16). A few words and forms do favour one sign over the other: for the verb *dai-/ti-^{hi}*, ‘to put,’ the 3.sg.act.pres is virtually always written *da-a-i*, not ***ta-a-i*. Conversely its 3.pl.act.pres, *ti-ja-an-zi*, is almost only attested with the voiceless sign (Watkins 2008: 10). Due to the above, practically all scholars working on Anatolian acknowledge that the signs used

in Akkadian to write voiced stops do not indicate voice in Anatolian, and variation is taken to be scribal convention rather than a reflection of phonological reality (XXXXXXX).¹⁸ This applies to Hittite, Palaic, and Cuneiform Luwian texts alike (Melchert 1994: 13).

One orthographic contrast that Hittite cuneiform does possess for stops is geminate spelling, e.g. Hit. *še-kan*, ‘cubit’ vs. *še-ek-kan* ‘known,’ *a-ap-pan*, ‘behind, later’ vs. *a-pa-*, ‘that’ (Hoffner and Melchert 2008: 35, van den Hout 2011: 14). Resonants, sibilants, and laryngeals also have minimal pairs with geminate and singleton spelling: *a-na* vs. *an-na*, *a-ša* vs. *aš-ša*, *a-ḥa* vs. *aḥ-ḥa* (Watkins 2008: 10). For resonants, the geminate ~ singleton contrast is generally considered to be length, barring a few exceptions (Melchert 1994: 24, Kimball 1999: 46). This also applies to laryngeals and sibilants, although Kimball and Melchert argue that PIE **h₂* splits into a voiceless **h* and a voiced **h̥* in PA, and that this phonemicised distinction is expressed by fortis ~ lenis spelling in e.g. *pa-a-aḥ-ḥur* [pa:hur] and *la-a-aḥ-ui* [la:hui] (Kimball 1999: 47, Melchert 1994: 21-22).

For the stop system, those who argue for synchronic voice based on Sturtevant’s Law and the classical model of PIE argue that Hittite cuneiform uses geminate spelling in lieu of the Akkadian signs to indicate voice for stops. Bomhard and Gamkrelidze argue geminate spelling to stand for voiceless aspirates, also based on Sturtevant’s Law and their model of the glottalic theory (). The arguments for synchronic voice are largely based on the following: 1) the geminate spellings etymologically correspond to single voiceless stops, and therefore Anatolian must continue what is considered to be the PIE stop system, 2) because Hittite cuneiform does not make use of the voiced-unvoiced signs used in Akkadian, it must use geminate ~ singleton spelling to make the distinction instead, and 3) the Hittites possibly adopted the cuneiform script from the Hurrians, who allegedly also use geminate spelling to indicate voicing.

There are two main theories on the provenience of the Hittite cuneiform script: the first one assumes it to come from the Old Babylonian script used to write Akkadian in Alalah, northern Syria c. 1600-1550 BCE (Kloekhorst 2008: 32). The second theory argues that it is based on a Hurrian adaptation of the Old Akkadian script, which was transmitted to the Hittites via Hurrian influence on Northern Syria from the start of the second millennium BCE (Hart 1983: 105-106).¹⁹ As mentioned before, the Old Babylonian script distinguishes voice in CV

¹⁸ Although as mentioned in footnote **NUMBERRR** cf. Kloekhorst (2010) for another view.

¹⁹ There is a third theory, namely that the Hittites and Hurrians independently adopted the same version of the Old Akkadian syllabary, the so-called ‘Nuzi syllabary’ found in Northern Mesopotamia c. 2500 BCE (Gamkrelidze

stops and initial voice in some *CVC* stops. Hurrian, in turn, does not have phonemic voice, but has phonemic length (Wegner 2000: 37). It does have phonetic voice, which is partially expressed in geminate ~ singleton spelling (Wilhelm 2008a: 84). Second only to Sturtevant's Law, the argument that the geminate spelling for stops stands for voice largely rests on the assumption that the Hittites adopted writing from the Hurrians, and developed through Hurrian a convention of writing voiceless stops with geminate spelling. However, if the Hittites adopted writing from the Old Babylonian script and Akkadian, the argument for fortis ~ lenis indicating voice is greatly weakened.

2.2.2 Hurrian Origin

The oldest known cuneiform texts that are not purely logographic emerge in ancient Sumer, Southern Mesopotamia, around 3200 BCE (Cooper 1996: 37). The first language known to have utilised it is Sumerian, although whether or not the Sumerians were the ones to invent it is unknown (Kramer 1963: 302). The Northern Mesopotamian Akkadians took over the script to write their own language between 2500-2000 BCE. Akkadian cuneiform writing from this period is known as the Old Akkadian script. The Proto-Semitic stop system had a three-way contrast of voiceless ~ voiced ~ emphatic, and Akkadian is assumed to have preserved this (Huehnergard and Woods 2008: 95). However, the Old Akkadian script does not systematically distinguish this three-way opposition. This Old Akkadian script in turn differentiated into other, descendant scripts, such as the Old Babylonian script, attested c. 1900-1500 BCE. In Syria and Mesopotamia, the Old Babylonian script developed distinct signs for voiced, unvoiced, and emphatic stops (Beckman: 523). The related Old Assyrian script, attested c. 1900-1650 BCE and used to write the first attestations of Indo-European, also develop this distinction (Larsen: 56).

Hurrian was spoken in the ancient Near East the northern stretches of the Fertile Crescent, from the Zagros Mountains to the Mediterranean coast. It is attested in Akkadian as in the form of personal names starting around 2230 BCE (Wegner 2000: 15).²⁰ The first definite attestation comes c. 2150 BCE from the victory stele of Narām-Sîn of Akkad, who boasts of capturing the Northern Mesopotamian king of Azuḫinnu, Taḫiš-atili; the ending *-atili*, 'strong,' is distinctively Hurrian (Wilhelm 1996: 336). The first Hurrian cuneiform texts date from

2008: 169). This theory is omitted due to the fact that it runs into most of the same problems as the Hurrian-origin theory, and subsequently fails to match the data as well as the Old Babylonian theory.

²⁰ For the sake of consistency, this paper will give dates following the short chronology.

around 2000 BCE, but between 2000-1500 BCE attestations of Hurrian cuneiform are very sparse. The corpus from this period is composed of a dozen or so short and mostly unintelligible texts found outside the Hurrian-speaking heartlands, such as Larsam in Babylonia, and some of the cities of the Middle Euphrates, such as Mari and Tuttul. Most of the extant Hurrian texts date to the latter half of the 2nd millennium BCE, and the clear majority comes from the royal archives in Ḫattuša (Wilhelm 2008a: 82-83).

Wegner (2000: 37) divides Hurrian orthographic traditions and possible dialectal isoglosses into two groups: one found in Mari and Northern Mesopotamia, and another found in Mitanni, Syria and Ḫattuša. The former tradition forms the corpus of the oldest attested cuneiform Hurrian texts, c. 2000-1500 BCE. The language encoded in the latter tradition, however, appears to be more archaic. The text most important to our understanding of Hurrian cuneiform, the ‘Mitanni Letter’ found in Amarna, Egypt, dates only from around 1355 BCE, and is written according to the Mitanni-Ḫattuša tradition (Wegner 2000: 38).

Based on the Mitanni-Ḫattuša orthographic tradition, Hurrian has voiceless intervocalic geminate stops, written *VC-CV* (Wegner 2000: 37).²¹ According to Wegner, in the Mari-Mesopotamian orthographic tradition, “wurde die für das Hurritische phonematische Verdoppelung der intervokalischen Konsonanten graphisch häufig nicht oder gar nicht wiedergegeben” (Wegner 2000: 37). Hurrian also has no phonemic voice, and unlike Hittite uses only one of the two possible Akkadian signs for a stop, e.g. *PA* instead of *BA*, *TA* instead of *DA*, *DU* instead of *TU* and so forth. A few exceptions aside, it does not use Akkadian signs for emphatic stops (Wilhelm 2008a: 84). Phonetic voice is betrayed through Hurrian loanwords in Akkadian, and texts written by Ugaritic-speaking scribes with the Ugaritic consonantal-alphabetic-cuneiform system. Voicing is strictly positional: obstruents are voiced only when they are 1) intervocalic and single, 2) next to the resonants /m/, /n/, /l/ or /r/, or 3) word-final. They remain unvoiced in all other positions, marking voice as clearly allophonic (Wilhelm 2008a: 84).

The argument for a Hurrian origin of Hittite cuneiform is based on a number of similarities between Hurrian and Hittite cuneiform: they both use the Akkadian sign for *pi* as *wV*, do not use the voicing distinction present in the Old Babylonian script, do not make use of

²¹ Only one language, Urartian (spoken c. 9th-6th centuries BCE in modern Armenia and written with an Akkadian cuneiform script), is known to be related to Hurrian. For a while it was speculated to be a daughter of a dialect of Hurrian, but is now considered a sister. Only a very few consonants are written as geminates, even though the cuneiform orthography allows it. (Wilhelm 2008b: 105-108).

the special signs for Akkadian emphatic or voiced stops, and use archaic notation for Akkadian sibilants (Gamkrelidze 2008: 169, Hart 1983: 103). In Hittite, the Akkadian emphatic velar sign *QA* only appears as an allograph of *KA* and *GA*, and in Hurrian found at Mari *QA* is also homophone of *ka* (Speiser 1941: 13). According to Hart and Kimball, it is therefore possible that the Hittites learned writing through the Hurrians, who used the Old Akkadian script instead of the Old Babylonian script as the basis for their cuneiform.

However, as Kammenhuber (1969: 89) notes, these are not necessarily shared orthographical innovations, since they can be explained as shared retentions of the Old Akkadian script, and do not require contact as an explanation. Furthermore, the lack of systematic use for the Akkadian voiced and emphatic signs does not necessarily imply that one syllabary directly influenced the other. It can be simply explained by the fact that neither Hittite nor Hurrian had emphatic or voiced stops, and therefore never made use of the respective signs.

Just comparing cuneiform Hittite and cuneiform Hurrian is problematic, since the Hittite corpus mainly comes from Ḫattuša, Maşat Höyük, and Ortaköy, all geographically close to each other (van den Hout 2011: 3). Resultantly they are very uniform in synchronic orthography and dialect (Watkins 2008: 7),²² although diachronic change in orthography and obviously language does take place (Kimball 1999: 46). Hurrian orthography, on the other hand, varies widely based on both time and space, even though it is dividable into two broad orthographies. Not only do the oldest examples of Hurrian cuneiform mostly ignore marking down voiceless geminate stops, but the corpus from Mari actually uses Old Babylonian voiced stop signs where appropriate (Speiser 1941: 13). Arguing for a Hurrian adoption is therefore not enough; one must argue for a specific Hurrian syllabary for the Hittites to adopt. Based on the Hurrian of the Amarna letter, a case may be made for an affinity with the Hittite syllabary. But the script of the Amarna letter, written in 1355 BCE, cannot be taken as the starting point for possible Hurrian influence on Hittite cuneiform, alleged to start around 1900 BCE according to Hart (1983: 109). The older cuneiform material, even if orthographically more varied, must act as the point of comparison.

There are other factors, common to all or most cuneiform Hurrian, that argue more directly against a Hurrian origin. Hittite cuneiform is characterised by a copious use of Sumero-

²² This is most probably due to the fact the extant Hittite texts were all produced by a small, geographically close scribal class following the conventions of only one central, administrative state. Only a few tablets suggest dialectal variation for Hittite (Watkins 2008 : 7).

and Akkadograms, whereas in contrast all cuneiform Hurrian (including the material from Hattuša) is marked by an almost complete absence of both (Gamkrelidze 2008: 171). Hurrian uses the sign *GE/I* to denote /Ke/ and *KE/I* for /Ki/, a trait absent in Hittite cuneiform (Wegner 2000: 37-38). Outside the Mari corpus that marks voice for stops, Hurrian cuneiform adopted either the voiced or unvoiced sign for a stop sign; Hittite cuneiform preserves both, even if the contrast is not always productive (Wilhelm 2008a: 84). Cuneiform Hurrian from Mari and in the Mitanni letter render the phoneme /s/ with the standard Akkadian *SV* signs, whereas Hittite uses the *ŠV*-series to mark /s/. Broadly speaking, Mari Hurrian represents some of the most archaic known Hurrian cuneiform known, and is more likely to represent the kind of Hurrian syllabary the Hittites would have encountered than the Mitanni letter. Had the Hittites adopted Hurrian cuneiform from either one of these syllabaries, they would have no reason to use *Š*-signs for /s/ (van den Hout 2009: 18).

In Kimball's view, "Unlike Akkadian, Hurrian had a length distinction and voicing was allophonic. Stops were automatically voiceless when initial and in intervocalic position when long but were voiced in intervocalic position when short. The intervocalic long voiceless stops were conventionally written double. Scribes adapting the syllabary for Hittite... [if they] were native speakers of Hittite, which probably had phonemic voicing, would have tended to hear and spell Hurrian single intervocalic stops as voiced and to hear and spell double stops as voiceless" (1999: 54). As Kloekhorst (2008: 36) points out, Kimball's argument is circular: she assumes that Hittite has phonemic voice, and uses this to argue that the geminate spelling betrays voice. Without any *a priori* assumptions about the phonology of PIE and consequently Anatolian, all Hurrian demonstrates is that from 1500 BCE onwards the geminate spelling of stops was systematically used in the ancient Near East to express phonemic length, bolstering the argument that Anatolian fortis spelling is a length, not voice, contrast.

The Hurrian hypothesis is highly doubtful from a historical point of view as well. Although the Hittites came into contact with the Assyrian variant of the Old Akkadian cuneiform script c. 1900 BCE through the Assyrian *kārum* at Kaneš, and hypothetically might have come in touch with Hurrian cuneiform via Northern Syria between then and 1600 BCE, there is no evidence for the Hittites ever adopting any form of cuneiform writing during this period. The first cuneiform text that we know to be Hittite comes from a spearhead reading dating around 1750 BCE, and reads 'Palace of Anitta, Great Prince.' It is written in the Old

Assyrian dialect of Akkadian using the Old Assyrian script (van den Hout 2015: 100).²³ After that, the first Hittite cuneiform texts date from the early 16th century BCE, around the era of Ḫattušili I. Before and in between 1750-1600 BCE, the only suggestions Hittite of writing are seals and cylinders found at Kaneš between 2000-1700 BCE, which later developed into the Anatolian hieroglyphs used to write HLuw. and possibly Hittite (van den Hout 2015: 100). During this period they are purely symbolic or logographic, but from about 1650 BCE onwards these seals come to combine with each other to create simple phrases, and develop into HLuw. by the early 14th C. BCE (Yakubovich 2015: 205).²⁴

Given that the Hittites possessed an indigenous system for book-keeping and marking property, and that there is no evidence of a Hittite literary tradition before 1600 BCE, there is no historical evidence or rationale for the Hittites adopting cuneiform Hurrian or Akkadian before 1600, which coincides with the emergence of a centralised Hittite Kingdom and a need for complex administration.²⁵ Even if the Hittites adopted cuneiform from the Hurrians, the Hurrian they would have encountered most probably did not write down intervocalic geminates, or did so only sporadically. It is even possible that the Hurrian they encountered might have used special signs for voiced stops, begging the same question as with the Old Babylonian alternative. It is also possible that the Hittites took over cuneiform writing from an unattested Hurrian tradition which did write down geminates in the early 2nd millennium BCE, but such a scenario is completely speculative.

²³ The Anitta text is often considered to be the oldest text in the Hittite language, and is claimed to date from the same period. However this is not definite, since one of the three fragments composing the text dates to the 16th century BCE, and the two others to the 13th century BCE (Neu 1974: 5-6). Based on the spearhead and the fact that the archives of Ḫattuša shift their principal language from Akkadian to Hittite only in the 15th-14th C. BCE (van den Hout 2009: 22), van den Hout argues that it was probably written in Akkadian, and only later translated into Hittite (van den Hout 2015: 100). Neu argues that it was originally written in Hittite based on the fact that in the text Anitta orders “these words,” *‘ke uddar,’* to be fixed on the gate of Neša in sight of the people, which he takes to mean that it must be in Hittite so the people could understand it (Neu 1974: 133). This is not necessarily correct, since literacy was extremely rare at the time, and public writing was a symbolic expression of power. However, his argument that the unique use of the Indo-European reflex for ‘god’, ^dšiuš, points to extreme archaism has merit, since all other Hittite texts use Sumerographic alternatives such as ^dUTU (sun god), DINGIR (god), etc. (Neu 1974: 133).

²⁴ The Assyrian cuneiform on the ‘Anitta’s spear,’ being a superfluous statement of possession, is also culturally suggestive of a society that only recently became literate (van den Hout 2013: 10:30-11:30).

²⁵ Gamkrelidze (2008) also rejects the Hurrian hypothesis, and finds the source of Hittite cuneiform in the Alalaḫ Akkadian syllabary. However, he argues that the Zukraši fragment is proof that the Hittites wrote cuneiform before 1700 BCE. This argument is rather conjectural, and is not supported by robust evidence.

2.2.3 Akkadian Origin

Argument for an Old Babylonian genesis via Northern Syria is supported by the fact that the *ductus*, form, of the Old Hittite Script is most closely matched by the cuneiform syllabary used to write Akkadian in Northern Syria (van den Hout 2015: 103). During the 17th century BCE the region had developed a unique style of the Old Babylonian cuneiform script that was distinct from the Babylonian Standard script. This script, attested at Alalakh (ancient Antioch, modern Antakya) and Yamhad (modern Aleppo), was used to write Akkadian, the regional administrative and trade language (van den Hout 2015: 102).

Like Hittite cuneiform, Alalakh cuneiform used Sumerograms, and utilised both the voiced and unvoiced signs available to the script. Interestingly, Akkadian written in with Alalakh syllabary did use the voiced stop signs to mark only voice, but used them to mark both voiced and emphatic consonants. It also uses the sign *PI* to mark *wa* (Gamkrelidze 2008: 173). In terms of both form and content, is a far better match than Hurrian. A plausible historical point of contact is also known: a late Hittite copy of a bilingual Hittite-Akkadian text from a golden statue of Ḫattušili I (c. 1586-1556 BCE) boasts of Ḫattušili's campaigns in Northern Syria, and explicitly mentions the sacking of Alalakh:

From Güterbock and Otten (1960: 15-21).

This does not necessarily mean that the Hittites became acquainted with the Alalakh through conquest. Trade and steady diffusion are equally plausible, and some Assyrian cuneiform tablets written in a *ductus* that appears to be intermediary between the Old Assyrian and Alalakh-Hittite syllabaries allow for this possibility (Rubio 2007: 46, Hecker 1990: 55-60).

“And the following year I went to (the city of) Alalakh and destroyed it. Thereafter I went to (the city of) Ḫarsuḫa, and from Ḫarsuḫa I went to (the city of) Tašiniya. I destroyed these lands, but I took their goods and filled my palace with goods”

As with Hurrian, consonantal length was contrastive in Akkadian. Gemination is especially common at morpheme boundaries. With a few exceptions, the geminate spelling of consonants always stands for phonemic and phonetic length (Huehnergard and Woods 2008: 93). However, the Akkadian texts are far less rigorous in their geminate spelling than the Hittite or late Hurrian texts: Old Akkadian dialects rarely wrote down geminates, and even the later ones (such as Old Babylonian) are inconsistent with their geminate spelling. Thus Old Babylonian *inaddiššum*, ‘s/he will give to him,’ is found as *i-na-di-šum*, *i-na-ad-di-šum*, *i-na-di-iš-šum*, and *i-na-ad-di-iš-šum*. This also holds for minimal pairs, such as *ipparras*, ‘it will be cut,’ and *iparras*, ‘it will cut’ (Huehnergard and Woods 2008: 93). Thus although Akkadian writing for geminates was inconsistent, it suggests that the Hittites would have used geminate spelling for stops to write down phonemic length; after all, special signs for voice were already present in the Alalah script, but are not used in Hittite cuneiform.




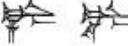














Sign Value	Alalah		Hittite "Old" Shapes
	Babylonian Standard Forms (ca. 25%)	New Syrian Sign Forms (ca. 75%)	
AL			
AZ/UK			
IK			
LI			
QA			
SAR			

Fig. 8 Comparison of Old Babylonian Standard, Alalah and Old Hittite Cuneiform Scripts. Adapted from van den Hout (2015: 102-105).

In conclusion, an adoption of the Old Babylonian script via Akkadian used in Alalah c. 1600 BCE matches the Hittite cuneiform script far better than a Hurrian adoption. This is because the form of the Alalah script, as well as its use of Sumerograms and the voiced ~ unvoiced stop sign pairs available to the Old Babylonian script, are all present in Alalah Akkadian. Hurrian cuneiform lacks some of the voiced and unvoiced signs used in Hittite cuneiform, and lacks both Sumerograms and Akkadograms. Hittite, Hurrian and the Alalah script all use the *PI* sign as *wV*. Using *GE/I* to denote /Ke/ and *KE/I* for /Ki/ is not found in Hittite cuneiform. The shared lack of use for emphatic stops is explained that both Hittite and Hurrian lack emphatics. The shared lack of consistent use for voiced signs is explainable by the idea that both Hittite and Hurrian lacked voice. The Akkadian source also has a specific, attested

point of contact congruous with the historical emergence Hittite cuneiform writing, whereas the date and area of a Hurrian adoption is purely speculative. The ductus of the Alalah script is also a better match for Hittite cuneiform than the attested (and highly varied) Hurrian scripts.

Furthermore, the kind of cuneiform Hurrian the Hittites would of come in contact with very rarely, if ever, wrote down intervocalic voiceless geminates. Hurrian-speakers systematically wrote down geminate stops only from the 16th century BCE onwards, after Hittite expansion into Hurrian areas. It is possible that the Hittites innovated geminate spelling to write down voiceless stops, and this is argued by e.g. Kammenhuber (1969 **DO MORE**). Gamkrelidze argues that the geminate spelling was innovated to write voiceless aspirates. However, both arguments presuppose that Anatolian had either a voice or aspiration contrast; neither Kammenhuber nor Gamkrelidze cite a synchronic reason for assuming voice and aspiration respectively. They both simply assume Anatolian possessed them, based on their respective models of PIE. In terms of actual evidence, all that can be said is that fortis ~ lenis spelling for stops was used by both Akkadian and Hurrian speakers to express phonemic length. This supports the idea that underlying the Anatolian fortis ~ lenis contrast is one of phonemic length, not voice or aspiration.

2.2.4 The Hittite Use of Geminate Spelling

Based on what we know of the origins of the Hittite cuneiform script and the conventions of the surrounding scripts, there is no reason to assume that fortis ~ lenis stands for voice. The evidence overwhelmingly points to synchronic a synchronic length contrast. Kammenhuber's suggestion that the Hittites innovated a new way to express voice is possible, but highly unlikely given that the script they adopted already had the means to do so.

As mentioned in section 2.2.1, Hittite cuneiform was not used only for the Anatolian languages: it was also used to write down Akkadian. Because Akkadian was the regional lingua franca used in trade and diplomatic correspondence, the presence of Akkadian texts at Hattuša does not mean that Hattuša necessarily had a large Akkadian-speaking population; most scribes were probably Hittite-speakers, and texts from Boğazköy include bilingual syllabaries and lexical lists that were probably used by Hittite scribes to learn the cuneiform script and Akkadian (Bryce 2002: 59-60).

The argument for the lenis spelling standing for voice would be strengthened if the Hittites would have used fortis and lenis spelling for Akkadian unvoiced and voiced stops

respectively. However, this is not supported by the corpus of Akkadian texts found in Ḫattuša, known to as Boğazköy-Akkadian. When writing Akkadian, the Hittite scribes use the Alalah voiced/emphatic signs when writing Akkadian voiced or emphatic consonants (Melchert 1994: 13). As for fortis ~ lenis spelling for voice, “here seems to be no trace of this orthography in Bo. Akk.” (Durham 1976: 371). The theory that fortis stands for aspiration would be supported if the Hittites used geminate spelling for Akkadian emphatics. It appears that this has not been thoroughly investigated, and outside Gamkrelidze’s glottalic theory there is no reason to assume or expect this.

Another factor against fortis spelling standing for voice or aspiration is the fact that this theory is only applied to the stop system, and occasionally laryngeals. As Kloekhorst (forthc. I: 3) notes, these analyses are never extended to the resonants or sibilants, and only rarely to the laryngeals. In both Hurrian and Akkadian geminate consonants are always geminate consonants, and geminate spelling does not signify different things for different kinds of sounds. The only reason to assume this for Hittite cuneiform is knowledge of the ancestor of Proto-Anatolian: it is not supported by any synchronic evidence. Overall, the orthographic evidence only supports the thesis that geminate spelling stands for a length contrast.

2.3 Phonological Evidence

In addition to orthographic evidence, there are a number of phonological facts that argue against a voice distinction. Anatolian almost certainly possesses labiovelars inherited from PIE. For Hitt. *ekuzi*, ‘s/he drinks,’ we find the spelling *e-uk-zi* alongside the more common *e-ku-zi*, suggesting that the labial rounding is produced simultaneously with the velar. Synchronically Hittite /u/ also dissimilates into /m/ next to a /u/. Forms such as the 1.pl.pres.act of *eku-*, ‘to drink,’ appear as *akueni*, not ***akumeni*, implying a synchronic root /ek^w-/, not /eku-/ (LINDEMANN Melchert 1994: 92). The root also takes the consonantal 3.sg.pret.act. ending *-tta* instead of the *-t* of vocalic roots. The form ‘s/he drank,’ *ekutta*, usually spelled *e-ku-ut-ta* but sometimes appearing as *e-uk-ta*, is problematic under the voicing interpretation, because there would be strong pressure for voice assimilation: compare e.g. PIIr. **jug-tá-* > Skt. *yuktá*, PIIr. **Haugh-ta* > Av. *aogədā* (Kloekhorst forthc. I: 1-2). If the stops underwent devoicing, ***e-ek-ku-ut-ta* would be expected, but this is unexpected. If they underwent devoicing, *e-uk-ta* would be the strongly preferred form, but this is not the case either (Kloekhorst forthc. I: 1). It must be noted that this does not rule out aspiration, but as established previously, there is no reason to assume aspiration on orthographic grounds.

In general, the Anatolian languages lack reflexes where a voiced stop would have devoiced, and thus appear with geminate spelling, next to a voiceless stop. This would be an environment where aspiration would not be plausible. Some, such as Čop (1953) have argued that the Hitt. iterative *akkuške-*, would be such an example, with the /s/ devoicing /g^w/, yielding /ak^wske-/. However, aspiration before a sibilant is just as likely in such an environment, and other examples do not follow this pattern, e.g. Hitt. *nana(n)kušš(ije)* ‘to grow dark,’ < PIE **no-nok^ws* (Melchert 1994: 17). Another problem is the word *nekuz*, ‘twilight, evening,’ which unambiguously derives from the PIE root **nek^w*- ‘night,’ and positing a PIE root **neg^w*- is problematic because regressive voice assimilation from **neg^w-t-s* cannot be ruled out (Melchert 1994: 17-18).

Other facts argue directly for synchronic length. In pre-Hittite, */i/ becomes short in closed syllables, but remains long in open syllables: e.g. OH *kišha*, ‘I become,’ comes from pre-Hitt. /kīsha/, which in turn derives from PIE **ǵéis-h₂e*.²⁶ Here, the sibilant and laryngeal close the syllable, shortening the /ī/. Hitt. *kīša*, ‘he becomes,’ derives from PIE **ǵéis-o*, and thus **éi* > /ī/. However, Hitt. *kitta*, ‘he lies’ in the middle voice, has a short /i/. If the geminate in *ki-it-ta* stood for a single unvoiced stop */t/ in pre-Hittite, the syllable would remain open and we ought to find a long /ī/, as with ^{LÚ}*kīta*- ‘cult functionary.’ If the geminate stood for */t:/, the long stop would act as a closing factor for the syllable (Kloekhorst forthc. I: 2).

Within the attested Hittite corpus, OH /ā/ in closed and non-final syllables begins to shorten to /a/ in MH, with the process becoming complete in NH. OH *šipānti*, ‘he libates,’ *iškarḫi*, ‘I stab,’ MH *tamāšzi* ‘he oppresses,’ become NH *šipanti*, *iškarḫi*, and *tamašzi* respectively. This also happens with stops spelled as geminates: OH *dāttēn* ‘you must take,’ *dātti* ‘you take,’ *šākki* ‘he knows’ become NH. *datten*, *datti* and *šakki*. This development does not happen with singleton stops: OH *sākuua-*, ‘eye,’ and *antuḫšātar*, ‘humanity, population,’ do not undergo this development. Once again this discrepancy is accounted for by the fact that geminate spelling stands for a long stop (Kloekhorst forthc. I: 2).

Thus the available phonological evidence also strongly favours length over voice. The evidence does not disprove aspiration as much as it merely does not contradict it. Because the orthographic system and phonological evidence greatly favour phonemic length in the

²⁶ PIE **éi* usually monophthongises to Hitt. /é/, but in front of velars it becomes /ī/ in Hittite (Kloekhorst 2008: 122).

Anatolian stop system, it must be concluded that there is no reason to presume any interpretation other than that fortis stop spelling in Anatolian represents phonological length.

Section III: Geminate Stops in Anatolian - Implications

3.1 Innovation or Archaism?

There is no reason to presume that the cuneiform Anatolian languages exhibit anything other than a length contrast in their stop system. It is also established that the long stops are reflexes of the PIE **t* series, whereas the short stops go back to the PIE **d* and **d^h* series. The two possibilities presented by the data are: 1) the length contrast is an Anatolian innovation, and 2)

the voice contrast is a NPIE innovation. Hypothesis 1) is supported by our knowledge of the other IE languages, and thus the principle of economy. Nonetheless, position 1) cannot be presumed to be true by default, given the strong unidirectionality of certain kinds of linguistic change. Like any other hypothesis, it must be argued for. Hypothesis 1) has, by and large, remained the *communis opinio*. It is argued for by e.g. Melchert (1994), Kimball (1999), and Kümmel (2012). Hypothesis 2) is a distinctly minority position, with Kloekhorst (2008, forthc. I) as the most prolific scholar working within the framework. In this account, the singleton series derives from the PIE **ʔt* and **t* series, whereas the geminate series is directly preserved intervocally by Anatolian. Hypothesis 1) thus requires fortition for all three series in Anatolian, whereas 2) only requires the merger of the traditional **d* and **dʰ*.

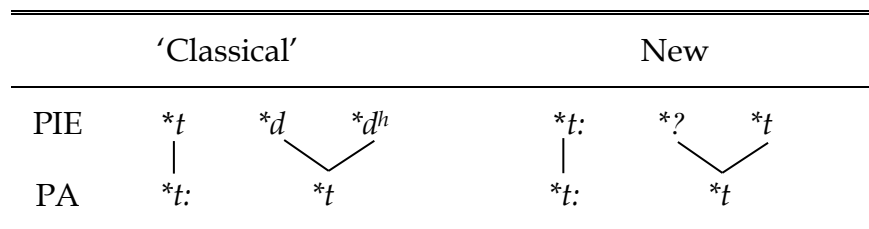


Fig. 9 Two possible developments of the PIE stops in Anatolian, exemplified by the dental series.

As stated in the introduction, the purpose of this paper is not to validate either individual model. It merely seeks to explore whether or not **t > t:*, **d/*dʰ > t* is a typologically plausible development for Anatolian. If this is not the case, the argument will be made that Anatolian preserves a length contrast present in its ancestor. From a purely Anatolian point of view, this length contrast appears to be voiceless, **t:* ~ **t/*ʔ*. Before the diachronic typology of geminates in Anatolian can be discussed, the phonetics, phonology and typology of geminates inventories in general must be established.

3.2 Synchronic Geminate Typology

3.2.1 Cross-linguistic Geminate Typology

Phonetically, phonemically long stops are characterised by a longer acoustic closure compared to single stops. Depending on the language and phonetic environment, the closure time is usually one and a half to three times longer for geminates than for single stops (Ladefoged and Maddieson 1996: 93). Geminates are characterised by two very strong tendencies: geminate integrity and geminate inalterability. Geminate inalterability refers to their strong resistance to

leniting phenomena, such as voicing, spirantisation, flapping, gliding, or spontaneous loss. Geminate integrity in turn refers the geminate tendency to strongly resist epenthesis rules; the geminate is a single phoneme, and thus cannot be broken up (Blevins 2004: 183-184).²⁷

A language may have phonetic but not phonological geminates: e.g. Modern English *greenness*, [ɡri:n:əs], or German *zahllos*, [t͡sa:l:o:s]. These are known as ‘fake,’ ‘post-lexical,’ or ‘concatenated’ geminates, and they usually occur at morpheme or word boundaries, or as a result of conditioned assimilation (Armosti 2012: 223). ‘Lexical’ or ‘true’ geminates (/t:/) tend to exhibit different properties compared to the ‘fake’ C₁C₁ clusters.²⁸ A language may have both true and false geminates, as in Tashlhiyt Berber and Cypriot Greek. In Tashlhiyt Berber, different phonological rules apply to fake and true geminates (Ehrenhofer 2013: 21), and in Cypriot Greek they are unaspirated, unlike true geminates (Armosti 2012: 223).²⁹

Cross-linguistically, geminates are most often found intervocalically preceding or following a stressed vowel (Thurgood 1993: 18). This appears to be due to pragmatic pressure: experimental data shows that geminate obstruents are most easily perceived when between two vowels (Pajak 2009: 270). However, geminates can also be found word-initially, as with e.g. Maltese, Cypriot Greek, and Chuukese (Galea et al. 2015: 1, Davis 2011: 5)³⁰ and word-finally, as is the case with Moroccan Arabic, Hungarian, Estonian, and Wolof (Davis and Topintzi 2014: 2). They can also be found in consonant clusters, albeit rarely. Interconsonantal geminates are very rare, but possible (Pajak 2009: 270). Word-final geminates seem to be somewhat more common than word-initial geminates (Davis and Topintzi 2014: 1).

In general, geminate stops are more common than geminate sonorants. At least in intervocalic position this is explainable due to sonorants being less salient next to vowels compared to obstruents (Pajak 2009: 270). Voiced obstruents are less likely to be geminates than voiceless ones (Dimitrieva 2012: 1). However, cross-linguistic surveys show that geminate

Fig. 10 The geminate inventories of Dobel, Palauan, and Anejoñ. From Blevins (2008: 14).

²⁷ Blevins (2004: 169-170) argues that there are at least three counterexamples to this ‘universal’: the Ratak dialect of Marshallese, Lule Sami, and possibly Modern Hebrew. The Hebrew example may vary depending on one’s theoretical analysis, and Blevins’ source for Lule Saami, Engstrand, explicitly states that “epenthesis is restricted to clusters containing nonhomorganic consonants. Consequently, it does not occur in word forms such as *man’ná* [long geminate [m:]] and *válldá*” (Engstrand 1987: 106). The counter to the universal is thus not as strong as Blevins suggests.

²⁸ There is no fully established orthography for phonological geminates: they can be noted both as /t:/ and /tt/. This paper will follow the former for true geminates, and the latter for ‘fake’ C₁C₁ clusters.

²⁹ Fake geminates are also often just one of many potential phonetic realisations, e.g. in Southern Saami there appears to be almost free variation between preaspiration and geminates in some words, and especially at morpheme boundaries (Enguehard 2014: 51-52).

³⁰ Muller lists at least 29 languages with word-initial geminates (Muller 2001: 207-235).

inventories come in great many shapes and sizes, and offer historical linguists few useful universals to work with. Some languages, such as Dobel, geminate all their consonants. Palauan geminates only /l/ and /r/, whereas Anejoñ geminates only some obstruents (Blevins 2008: 14).

Dobel	Palauan	Anejoñ
b t d kw φ s m n ŋ l r w j ?	p t k d s m n ŋ l r w ?	p pw t k ʃ f θ s v ɣ m ^w m n p ŋ l r w j h
b: t: d: kw: φ: s: m: n: ŋ: l: r: w: j: ?:	l: r:	p: pw: t: k:



3.2.2 Synchronic Typology of the Anatolian Geminates

The Hittite geminate inventory includes all or nearly all the Hittite consonants, depending on whether one considers the geminate ~ singleton spelling of the laryngeal to stand for voice. Because the pragmatics of Hittite cuneiform syllabary only allow the spelling of intervocalic geminates, it is assumed by Melchert (**van den hout**) that Anatolian only allowed intervocalic geminates. This is strictly speaking not correct, as demonstrated by the Hitt. iterative *akkuške-*, /ak^w:ske-/; it thus seems that on rare occasion at least Hittite allowed geminate stops to participate in consonant clusters if adjacent to at least one vowel. Hitt. *na-na-ku-uš-ši-ia*, ‘to grow dark,’ /nanak^w:s:i(e/a)/ (Kloekhorst 2008: 91) demonstrates that geminate sibilants can also do this. Hittite also allows for some word-final geminates: *takku*, /tak^w:/ ‘if’ and *nekku* /nek^w:/ ‘neither.’ This is evident from the orthographic form that /k^w:/ obligatorily takes: evidence for other word-final geminates is much harder to adduce because of the limitations of the syllabic script. (Kloekhorst 2010)

Kloekhorst (forthc. I) has argued that the Hitt. n.nom-acc.sg *šepit*, ‘grain,’ is phonologically /sep:it:/, from PIE **sépitōs*. The oldest OH attestations of the gen.sg. of *šepit* is *še-ep-pí-da-aš*, with a short /t/, but this becomes replaced by *še-ep-pí-it-ta-aš* already in OH. According to Kloekhorst, this change is generally considered to be a case of paradigmatic levelling rather than sporadic sound change. However, following the second Anatolian lenition (cf. section 2.1.2), all the oblique cases would have undergone the lenition as well, leaving no model for the /t:/ to be restored except from the nom-acc.sg /sep:it:/ (Kloekhorst forthc. I: 6-7). As it stands, word-final geminates are attested for /k^w:/, and an argument can be made for /t:/. Since word-final geminates are already attested in Hittite, the virtual /-t:/ is possible, and finding more examples like it is a potentially fruitful avenue of research on the synchronic and diachronic nature of the Anatolian geminate stops.

The existence of word-final geminate stops in Anatolian is significant because if the PIE voiceless series was in fact a voiceless geminate series, it is possible that Anatolian developed some word-final geminates through the apocope of word-final vowels, as is the case *takku* and *nekku*, < PIE **tok^we* and **nek^we* (Kloekhorst forthc. I: 6).³¹ The theory that PIE *T* is actually *T̥* also predicts that PIE words beginning and ending with classical voiceless stops do so with long voiceless stops: Anatolian allowing word-final geminates adds credence to the idea that this was also possible in PIE.

At this point it is also important to bring to mind the obvious fact that cuneiform Hittite is, first and foremost, an imperfect writing system. In Melchert's words "we must bear in mind that for native speakers writing systems are merely mnemonic devices, which need give only enough information to assure the correct interpretation. This holds true even more for the present [Hittite] case, where the readers are members of a small professional elite" (Melchert 1994: 15). Old Babylonian scribes did not systematically write down phonemic geminates, even when the words they wrote down had minimal pairs. Often context alone was enough for scribes to infer the correct pronunciation. In the same way the early Hurrian syllabaries did not write down geminate stops, or only wrote them down sporadically, even though the kind of Hurrian they wrote down almost certainly had geminates. It is well possible that Hittite scribes wrote down geminates intervocalically, but due to the extremely cumbersome and confusing process needed to write word-initial and word-final geminates, simply omitted them in non-word-internal position.

As an example of the pragmatics of writing sometimes trumping phonology, Melchert cites how *nu-kán*, 'nu + unknown particle'³²/nu=kan/, [nuk:an] is spelled *nu-uk-kán* a handful of times in OH, but *nu-ut-ta*, 'nu + 2.sg.dat.-loc/acc.' /nu=ta/, [nut:a] is always spelled that way. The geminate /k/ is further confirmed by the clitic chain *nu-ut-ták-kán*. There is no reason suspect a lenition affecting *nu-kán* but not *nu-ut-ta*. Melchert proposes that the reason for this is the simple fact that the sign UD/T, , is far simpler to write than the sign UG/K,  (Melchert 1994: 13-14).

³¹ A similar development can be found in Estonian, where word-final geminates derive from the loss of vowels in open unstressed syllables. Finnish preserves these geminates: e.g. Fi. *miekka* [miek:a], Est. *mõõk* [mɤ:k:], 'sword' (Viitso: 161)

³² Some of the enclitic particles in Hittite, such as =*kán*, have an unknown semantics. In MH-NH it might have some relationship with local adverbs (Josephson 2007: 144), but for OH *ah* discourse-topicalising function has also been proposed.

In regards to geminates and voice, Melchert (1994: 20) assumes the existence of a few secondary voiced geminates in Anatolian. He takes them to be phonetically voiced but phonologically part of the *T*: series. According to Melchert, a large number of these come from Čop's law. Čop's law states that Hittite **-eCV-* sequences yields CLuw. *-aCCV-*, via a historical PIE **-é-* that is preserved as *e* in Hittite (Čop 1970: 94-95). Examples include **médu-* > CLuw. *maddu-* 'wine,' **mélit-* > *mallit-* 'honey.' Melchert further adduces individual sporadic changes, such as Hitt. *kappi-*, [kob:i] 'small' from PIE **kombi-* through voiced gemination via the assimilation of **-mb-* (Melchert 1994: 20).

Melchert's scenarios are possible if Anatolian, since there is evidence of allophonic voicing in the voiceless short stops.³³ However, gemination processes usually lead to devoicing because the build-up of supraglottal air pressure makes it harder to vibrate the vocal folds (Blevins 2004: 179). In Nubian gemination at morpheme boundaries lead to the degemination of all the consonants except the voiced stops /d/, /dʒ/, /g/, which devoiced instead (Blevins 2004: 180). /b/ did geminate in Nubian because labial stops create larger supraglottal cavities than stops produced at the back, and thus allow more time for voicing (Blevins 2004: 180). Thus *kappi-* being [kob:i] is more plausible than *maddu-* [mad:u], though it is still speculative.

3.3 Diachronic Typology of the Anatolian Stops

Melchert (1994: 18) cites two examples in support of a diachronic transition from a voice contrast to a length contrast in stops. Firstly, he cites Zvelebil's treatment of the history of Dravidian as a precedent for a voice contrast becoming a length contrast. According Melchert's account of Zvelebil (1970), Proto-Dravidian *T~D > T:~T* in intervocalic position in Old Tamil and Malayālam (Melchert 1994: 18). However, Zvelebil never actually argues for this in the work that Melchert cites. As Kloekhorst (forth. I: 17) notes, Zvelebil argues the opposite, stating that that pre-Proto-Dravidian stops were short and voiceless by default, and had voiced single allophones in intervocalic position. He then argues that through the assimilation of consonant clusters, PD developed intervocalic voiceless geminates, which were in turn preserved in Old Tamil and Malayālam (Zvelebil 1970: 82-83).

Emeneau (1967) does argue for a *T~D > T:~T* development, on the basis that most Dravidian languages have a voice contrast, and that voiced consonants tend to be phonetically shorter than their voiceless counterparts. However, virtually all dravidologists today reject this

³³ ADD THE EVIDENCE

account, and reconstruct voiceless geminates into PD, but no phonological voice (cf. e.g. Subrahmanyam 1983, Steever 1998, Krishnamurti 2003). The current *communis opinio* is that voicing emerged individually in different branches from different sources. Contact with Indo-Aryan, phonemisation of intervocalic voiced allophones, and voicing assimilation with nasals are all secondary sources of voiced stops in Dravidian languages (Subrahmanyam 1983: 269-281). In e.g. Middle Tamil voice emerged as the result of a large areal shift in syllabic structure to heavily favour $\bar{V}C$ and VCC syllables, making voiced allophones more marked. Thus e.g. PD **pāṭu* ‘to sing’ : **pāṭ-tam*, ‘song,’ preserved in Old Tamil, shift to Middle and Modern Tamil *pāḍu* : *pāṭ-V-* (Krishnamurti 2003: 40).

Secondly, Melchert cites the treatment of Germanic loanwords in Finnish. Finnish, and Uralic languages in general, have borrowed amply from Indo-European. The two largest sources of IE loans into Finnish are Germanic and Baltic. Germanic loans in Finnish range in time from Proto-Germanic, e.g. PGmc. **hrengaz*, Fi. *rengas*, ‘ring,’ PGmc. **druhtinaz*, ‘leader, leader of a warband’ Fi. *ruhtinas* ‘lord, sovereign’ (Stiles: 45, Schulte 2002: 773) to different stages of Swedish (Fi. *synti*, Swe. *synd* ‘sin,’ Fi. *likka*, Swe. *flicka*, ‘girl’). Finnish does not have a voice contrast, although a voiced dental /d/ appears in some words as a part of consonant gradation.³⁴ Instead, Finnish distinguishes phonemic length for consonants in intervocalic position. PGmc., on the other hand, had a voice distinction.

Phonetically, geminates are defined by a longer acoustic closure time compared to their singleton counterparts (Ladefoged and Maddieson 1996: 92). Voiced stops are also shorter than their voiceless counterparts. Therefore speakers of a language that has phonemic consonantal length, but no phonemic voice, readily interpret the voiceless ~ voiced contrast as a long ~ short contrast (Juntune 1973: 19-20). As first noted by Vilhelm Thomsen, Gmc. voiceless consonants (both singleton and geminate) appear in Finnish loans as geminates, and voiced consonants appear as short consonants: ON *kaup* ‘bargain,’ Go. *mitan* ‘to measure’ > Fi. *kauppa* ‘trade,’ *mitta* ‘measure,’ Go. *paida* ‘cloak, tunic,’ *hlaiba*, ‘bread’ > Fi. *paita* ‘shirt,’ *leipä* ‘bread’ (Thomsen 1870: 71-2).³⁵

³⁴ Finnic and Saamic are famous for consonant gradation, which is essentially a system of consonantal lenition taking place at morpheme boundaries. Resultantly Finnish verbs have two or three stem forms, ‘strong,’ ‘weak’ and for some a ‘consonantal’ one. /d/ appears as the weak stem form of /t/: e.g. *pata*, pot.sg.nom. vs. *padan*, pot.sg.gen. How consonant gradation works in PU is still very much debated, but it is thought to have existed (Bye 2007: 1-2).

³⁵ The language that would have taken the loans was obviously not Finnish, but something intermediary between late-Proto-Finnic and Pre-Finnish. At this stage it is believed that Finnish did not have phonemic voice.

This comparison is far from analogous. The treatment of Germanic loans in Finnish is an example of the transmission and parsing of data between two discrete systems: it is *not* an example of one system transitioning to another. The underlying connection between voice and length is a phonetic reality in some contexts, but the cognitive process of shifting from perceiving [+/-voice] as [+/- length] is different from the fact that a system lacking voice may map [+/-voice] as [+/- length]. Sound changes are only very rarely bi-directional: depending on the context, they are usually strongly unidirectional. Thus merely establishing a connection does not suffice, but diachronic typology must be consulted.

Typological literature in turn does not support the idea that $T\sim D > T:\sim T$ is common, or even attested. Blevins' (2009) inventory of the typology of geminate evolution presents the following pathways:

- | | |
|--|---|
| 1) Assimilation of C_1C_2 clusters | 2) Assimilation of C with vowel/glide |
| 3) Vowel Syncope between C_1VC_1 | 4) Lengthening under stress |
| 5) Expressive lengthening | 6) Boundary lengthening |
| 7) Reanalysis of voice contrast | 8) Reanalysis of C_1 - C_2 sequence |
| 9) Contact | |

From Blevins (2009: 26)

There is no well-attested case of 7). One possible example is Didinga, which has voiced consonants (Yigezu 2003: 164) and phonemic consonantal length (Blevins 2004: 176). Didinga also geminates all its consonants in syllable final position, resulting in a loss of phonemic distinction in that position as all stops are relegated to the geminate category. According to Blevins, if Pre-Didinga is reconstructed with syllable-final devoicing, this might be explainable by the fact that the voiceless consonants were reinterpreted as geminates. However this is only speculative, and is not supported by any inherited vocabulary (Blevins 2004: 176).

The one unconditional example in Blevins' survey is the proposed PD > Old Tamil and Malayālam shift, but by citing Steever (1998) she notes that Emeneau's research is not reflective of the current consensus (Blevins 2004: 176). Blevins notes that such voice ~ length

However, it appeared to have more voiced consonants that took part in consonant gradation: $*p\text{-}\beta, *k\text{-}\gamma, *t\text{-}\delta$. The δ fortified into /d/, and the rest were lost (Fromm and Sadeniemi 1956: 35-36). Traces of γ are still found in the 16th century genitive *lughun*, ModFi. *luvun*, root *luku-*, 'number, figure, chapter' (Juntune 193: 7). Although they existed, the voiced fricatives were not phonemic, and thus do not have a direct bearing on the phonology of Germanic loans.

mapping is found in loanwords to Thurgovian Swiss German (2004: 176-177, 2009: 39). Unfortunately this is an issue of phonetic-phonological mapping between two discrete systems, analogous to the case of Germanic loans into Finnish. The only unconditioned voice to length shift Kümmel (2007) is the PIE to PA development. In Blevin's words, "The difficulty of finding well-documented sound changes of this sort suggests that geminate/singleton contrasts are more easily reinterpreted as voicing contrasts than the reverse" (Blevins 2004: 177). This is not surprising, since lenitions are more trivial than fortitions.

Kloekhorst (forthc. I) sums up the typological literature on geminate evolution as follows: "[the] scenario [where Anatolian would unconditionally geminate voiceless stops] operates with a development that has not (yet) been found in any other language, and therefore is typologically weak" (Kloekhorst forthc. I: 16). This is clearly the case. Kümmel lists ten unconditioned cases of C: > C, five of C: > C at syllable boundaries, and six of unconditioned T: > T, noting that "allgemeine Kürzung von geminaten ist relative stark verbreitet. Dabei kann je nach Silbenstruktursystem durch Ersatzdehnung kompensiert werden oder nicht," (Kümmel 2007: 133-134). For an unconditioned gemination of unvoiced stops, Kümmel only lists one case - Proto-Anatolian.

According to Kümmel, "[in southern Upper German languages] besteht synchron eine Opposition zwischen stimmlosen Lenes und Fortes. Letztere werden ausserdem intervokalisch (besonders nach Kürze) geminiert. Die gleiche Opposition bei Resonanten wird nur als Geminatio : Nichtgeminatio realisiert. Geminatio bzw. Länge ist also ein (positionsabhängig) konkomitantes Merkmal der Fortislaute und kann auch sekundär in den Fortispositionen hergestellt werden. Analog dazu kann ähnliches auch für das Anatolische angesetzt werden." What Kümmel then posits is $*p, t, k > *p:, t:, k: / \check{V}_-V$ in PA (Kümmel 2007: 176).

Upper German dialects are known for possessing a tense ~ lax, or fortis ~ lenis, opposition in their stop systems. An exact definition of the difference has been problematic: the fortis consonants are never voiced, and tend to be aspirated. The pronunciation of the lenis consonants varies: they are to a large extent voiced in most environments, but after voiceless consonants or in word-initial position they can range from weakly voiced to unvoiced, with the aspiration of the fortis series preserving a contrast (Mangold 2005: 55-56). Like Melchert, Kümmel makes the argument that a) voiceless stops are longer than voiced stops b) intervocalic gemination of the voiceless series gives rise to a length contrast c) the length contrast then

supplants the voice contrast. Presumably, Kümmel proposes a chain shift, where as a result of $T > T: / \check{V}_V$, $T \sim D > T: \sim T / \check{V}_V$, leading to $T, D > T / \#_$ in PA, with the same probably happening in auslaut.

Although Kümmel suggests that instead of a stark voiced~unvoiced contrast PA had a more amorphous tense ~ lax one where voicing is only a part of the contrast,³⁶ $T \sim D > T: \sim T$ is still completely unattested, unlike unconditional degemination and voicing. Upper German does not have a phonological length contrast, and thus does not create a typological parallel. There are also other problems with Kümmel's account. Namely, an intervocalic position is one where one expects *degemination*, not gemination, as is amply attested by Kümmel's data (2007: 133-136), and is well-known in the typological literature. The only intervocalic position where one expects gemination is very specific: posttonic (cf. Thurgood 1993, Blevins 2004, 2005).

Synchronic evidence speaks for this as well. Dimitrieva (2007) has experimentally demonstrated that in Russian "geminates adjacent to a stressed vowel - preceding or following it - are more protected from degemination than geminates between two unstressed vowels." This is also supported by Dimitrieva (2012), which shows that in Russian and standard Italian perceptual distinctiveness for intervocalic geminates was lowest when both of the surrounding vowels were unstressed (Dimitrieva 2012: 153).³⁷ Kümmel's schema does not include stress, and is thus typologically weak. The other four unconditional geminations after \check{V} he lists do not establish good parallels for PA. They are either from dialectal Modern High German, Southern Bavarian, or both. One is $t > t: / \check{V}_$, and the rest are geminations of /l/, /m/, and /n/.

In addition to the problem of being completely unattested, there are other peculiarities with Kümmel's scenario. Firstly, there is no actual evidence for the fortition of intervocalic stops in PA. Instead we have the PA lenition, an opposite development. Furthermore, if one accepts Adiego's analysis, then the degemination takes place between two short vowels - exactly where typologically one would expect degemination, but Kümmel expects gemination. Secondly, it is clear that in anlaut PA shifts to the fortis series, even though word-initial devoicing is uncommon (Blevins 2004: 176), and word-initial degemination is, in Kümmel's words, 'almost inevitable' (Kümmel 2007: 135). If intervocalic voiceless stops did geminate in PA, it would seem more probable that the $T \sim D$ contrast in word-initial position would help make the $T > T: / \check{V}_V$ shift allophonic, rather than lead to word-initial devoicing. This is the

³⁶ First argued for by Speiser (1941).

³⁷ The stress-conditioning for distinctiveness was found to be negligible for American English speakers.

case with posttonic gemination: it tends to create allophonic length, but secondary changes are required for the change to be phonologised (Blevins 2008: 33). The argument that the gemination only affected voiceless stops is also rather arbitrary.

There is one strong piece of evidence for word-initial geminate stops in PA. Melchert (1994) and Kimball (1999) argue that the loss of a voicing distinction in word-initial position took place in the daughters of PA. Although it is possible, word-initial devoicing is uncommon (Blevins 2004: 176, Kümmel 2007: 140). Word-initial degemination, on the other hand, is common, and is thus more typologically plausible (Blevins 2004: 176). Kloekhorst (forthc. I) argues that a geminate /t:/ helps explain the assibilation of word-initial dentals in Hittite. As mentioned in section 2.1.2, word-initial dentals assibilate in before **i/j* in pre-Hittite (but not in e.g. Luwian), PIE **tj-* yielding Hitt. /t^s /, [t̪s], and **d̪j-* yielding /s/, [s].³⁸ According to Kloekhorst, if the difference between fortis and lenis was voice, the natural outcome of the assibilation would be either [t̪s] vs. [d̪z] or [s] vs. [z], not [t̪s] vs. [s]. Instead, he argues that these developments become more understandable when one posits the difference as length instead of voice, meaning that the development was in fact **t̪ = *[t:j] > *[t:ˀ] > [t̪s] = /t^s / and **d̪ = *[tj] > *[t̪] > [s] = /s/ (Kloekhorst forthc. I: 5).**

Kloekhorst's account is clearly more typologically sound than the voicing alternative. As mentioned, if the difference in the two stops were voice, the outcome would more probably be /ts dz/. This is the case with Modern Slovak and Polish, where a morphologically conditioned rule shifts /t/, /d/ > /ts/, /dz/ _ j (Hall and Hamann 2006: 1209). Kümmel (2007: 69) lists 11 cases of /ts/ > /s/ in various environments, all accompanied by a /dz/ > /z/ shift. A parallel can be found for the Anatolian case: In West Greenlandic, /t/ and /t:/ are fricativised into [ts] and [t:s] before /i/ (Hall and Hamann 2006: 1206). /ts/ > /s/ in turn is fairly trivial, as demonstrated by Kümmel's data. There is therefore good reason to believe that PA possessed word-initial geminates.

In conclusion, the typological data overwhelmingly supports hypothesis 2), that the Anatolian length contrast is original, and that PNIE degeminated its long stops and voiced its short stops. Hypothesis 1) requires one completely unattested sound change, i.e. unconditioned intervocalic gemination limited only to the voiceless stops, and one uncommon change of unconditioned devoicing. The overall shift of T:~T > T~D is completely unattested. Hypothesis

³⁸ **j* disappears when consonantal, but when vocalic it remains next to the assibilated dental.

2) on the other hand requires two trivial and well-attested shifts: unconditioned degemination, and voicing. Hypothesis 2) is also supported by the Hittite reflexes of **t̥i-* and **d̥i-*. They are typologically very surprising if PA possessed voice, but trivial if the contrast was length. The loss of fortis~lenis contrast in anlaut is also easier to explain if the difference were length instead of voice.

Based on the data in the past two sections, Kloekhorst (forthc. I: 17) proposes the following pull-chain for PNIE:

1. PNIE **t* undergoes voicing, possibly intervocalically at first.
2. The devoicing makes the length contrast superfluous.
3. The new contrast is generalised to all positions.

Unconditioned unvoiced > voiced shifts are well-attested: Kümmel lists 12 such examples, and more specifically conditioned ones are too many to mention (Kümmel 2007: 50-54). Direct parallels for the pull-chain that Kloekhorst suggests can be found in the Mari-Permic and Mordvinic branches of Uralic,³⁹ where the intervocalic voicing of stops triggered the neutralisation of the pre-existing length contrast found in the intervocalic stops (Sammallahti 1988: 532, Kümmel 2007: 134).

³⁹ Following the tree proposed by Häkkinen (2007).

3.4 PNIE Degemination

Based on the data in the previous section, it must be concluded that PNIE underwent a series of degemination and voicing in the stop series that PA did not partake in. Evidence of similar degemination in PNIE, but not Anatolian, would constitute good evidence of this being a PNIE innovation. It is well-known fact that PIE seems to have an aversion for surface-geminates (Meillet 1903 [1934]: 131). Synchronically, Sanskrit sandhi exhibits this as well. To name a few examples, root final labial stops dissimilate into dentals when followed by a labial stop (e.g. *ap-* ‘water’ + *-bhis* ‘instr.pl’ > *adbhis*, ***abbhis*); root final *s* dissimilates into a *t* when followed by the *-s-* of the future or sigmatic aorist (e.g. *vas-* ‘to dress oneself’ + *-sya* ‘future’ > *vat-sya-*) (Byrd 2010: 18), and geminate *r* is prohibited even across word boundaries: *punā ramate*, ***punar ramate* (Whitney 1950 [1889]: 179). For PIE, there are 5 widely-agreed upon degemination rules (Byrd: 16-18):⁴⁰

1) $Vss > Vs$

Geminate **s* degeminates when preceded by a vowel: PIE **h₁és-si* ‘to be (2.sg.)’ > Skt. *ási*, Gr. *éi.*, Hit. *ēšši*.

2) $VTTV > VTsT$

An epenthetic **s* is added between two dental stops when preceded by a vowel: **h₁éd-ti* ‘eat (3.sg.)’ > **h₁étsti*, Hit. *ēzzazzi*, Welsh *ys*.

⁴⁰ The *métron* rule is not included due to conflicting data: it is supported by Latin, Gaulish, and parts of PGmc., but does not work for Greek, Sanskrit, and other sectors of PGmc.

3) $V_{ss\#} > \bar{V}_s\#$

Word-final [s:] degeminates, with compensatory lengthening of the preceding vowel:
**h₂áus-os-s* ‘dawn (nom.sg.)’ > **h₂áusōs*.

4) $V_{mm\#} > \bar{V}_m\#$

When preceded by a vowel, word-final [m:] degeminates with compensatory lengthening for the preceding vowel: **dóm-m* ‘house (acc.sg.)’ > **dóm*, Arm. *tun* ‘house,’ **d^hég^hom-m* ‘earth (acc.sg.)’ > *d^hég^hōm*.

5) $VR_1R_1V > V R_1V$

Geminate sonorants preceded by a vowel degeminate with no compensatory lengthening: **ném-mṇ* ‘gift’ > **ném-ṇ*, OIr. *neim* ‘poison.’⁴¹

As Kloekhorst (forthc. I: 18-19) demonstrates, Anatolian clearly did not undergo the degemination 1), as attested by Hit. *ēšši*, ‘to be 2.sg.’ The degemination in question is thus a clear PNIE innovation. Kloekhorst points out that an argument could be made for *ēšši* deriving from **h₁ési*, through a restoration of the 2.sg.pres. **-si*, as with Greek *éssi* (variant of *éi*) (Kloekhorst: forthc. I: 19⁷⁴). One could also posit a Čop-like law to account for it. However, he finds this implausible because “it is precisely the verb ‘to be’ that in all IE languages shows the strongest resistance against morphological regularizations, this does not seem likely” (Kloekhorst: forthc. I: 19⁷⁴). Not does ‘to be’ tend to resist regularisation in IE, but its tendency to do so is a well-known typological tendency that applies across language families, making *ēšši* a strong candidate for archaism (Campbell 1998: 202). Also, based on the unambiguous typological evidence presented in section 3.3, it must be concluded that PNIE underwent degemination Anatolian did not partake in, at least in the stop series. The intervocalic degemination of **-ss-* fits in very well with this account, and *ēšši* should thus be viewed as an archaism instead of an innovation seeking explanation.

Strictly speaking, rule 2) is not a straightforward case of degemination as much as it is a case of sibilant epenthesis. It is still synchronic in Hittite: OH ‘to eat’ 2sg.pres. is spelled *e-ez-ši*, reflecting /ēts:i/ from a preform **h₁éd-si*. By NH, the *mi*-conjugation ending *-šši* has been replaced by the *hi*-conjugation ending *-tti*, with an added *s* between the two dentals in *e-ez-za-a[t-ti]*, [ētst:i] (Kloekhorst forthc. I: 21).⁴² Within IE, dental assibilation does not occur only

⁴¹ Byrd argues that although **m* is the only resonant for which we have evidence of degemination, he “sees no reason to assume this does not apply for all the resonants” (Byrd 2010: 19).

⁴² Kloekhorst also briefly discusses possible reasons why the ‘double dental’ rule does not apply to the geminate /t:/ in Hittite, and arrives at the conclusion that /t:/ must be phonologically and phonetically distinct from /t/ + /t/. This is what the typological literature predicts, as /t:/ is a single phoneme subject to geminate

with **-d-+*-t-* segments, but with other ones as well, e.g. Greek *ἐπείσθην* (aor.pass. of *πείθω* ‘to persuade’) < **h₁e-b^heid^h-d^heh₁-m* (Kloekhorst forthc. I: 21⁸⁰). One could argue that this is evidence of a constraint against geminates in PIE. However, it is peculiar that loss with compensatory lengthening, or simple loss, did not take place, as with 1) and 3)-5). Such rules are attested in languages with geminates: Oromo, which has a full geminate inventory, loses root-final /d/, /ʔ/, /h/, with compensatory lengthening, even when combined with homorganic consonants: /hod/ -t-an- Ø/ > [ho:tan] (Kebede 2014 :193).

Epenthetic sounds are usually motivated by one of two things: 1) they exist to repair illicit structures, or 2) they ease phonetic realisation (Hall 2006: 387). In both cases the epenthetic sound tends to be a vowel, usually a [ə] when inserted between obstruents (Hall 2006: 419).⁴³ Because the double dental rule is so different from other PIE degeminations, and because if the epenthetic sound is a sibilant, it is more probably phonetic than rule-based.

A possible explanation lies in the articulatory realisation of homorganic stop clusters. In Tashlihyt Berber, T:-T and T-T: sequences can be realised in two ways: 1) aspiration or vowel epenthesis at phoneme boundary depending on stop quality, or 2) combination into long geminates.⁴⁴

Word/Phrase	Phonetic Stop Realisation	Gloss
a) /is t-ttu-t/ int 2.sg.-forget-2.sg.	[ist ^h t:ut]/[ist:ut]	‘did you forget?’
b) /is=tt t-ut/ int=do.3.f.sg. 3.f.sg.-hit	[ist: ^h tut]/[ist:ut]	‘did she hit her?’
c) /iyli d=ddir/ 3.m.sg.-climb prep=foot	[-id ^o d:ir]/[-id:ir]	‘he started climbing’
d) /tt-tabaa=t/ Impf-follow=do.3.m.sg.	[t: ^h taba:t]	‘follow him!’

Fig. 11 T-T: cluster realisation in Tashlihyt Berber (Dell and Elmedlaoui 2002: 146-147).

integrity, and thus cannot be broken up. /t:/ participating in the double dental rule would be extremely unexpected from a typological point of view.

⁴³ PIE schwa secundum is probably a classic case of phonetic epenthesis.

⁴⁴ Long geminates are simply geminates with longer closure duration than standard geminates. Phonological singleton ~ geminate ~ long geminate contrasts have so far only been found in Finnic and Saamic (Markus et al. 2013: 225).

The long geminate form is reported for a)-c), but not d). For all cases the position of the release is non-trivial: e.g. [t^ht:aba:t] is not allowed for d). Aspiration is often in variation with fake geminates, e.g. in Southern Saami preaspiration and fake geminates are in almost free variation in some words, especially at morpheme boundaries that often give rise to fake geminates anyway (Enguehard 2014: 51-52).⁴⁵ Aspiration in turn is often in free variation with affrication, as is the case with North Welsh English [t^h] and [t^s], both word-initial and final allophones of /t/ (Penhallurick 2004: 108-109). The Dutch linguist W. de Vries also reports similar variation amongst young people in Groeningen c. 1896, where instead of standard Dutch [kat] he reports forms such as [k^hat^h] and [k^hat^s] (de Vries 1942: 79).

As with Tashlhiyt, in PIE there is a strong motivation for speakers to avoid homophony at morpheme boundaries, and clearly mark homorganic stop boundaries with a stop release. Whenever a stop is released, the articulators will briefly pass through a point where they create turbulence. This is usually a part of the release, and affricates are stops that prolong the period of friction (Ladefoged and Maddieson 1996: 90). This is an especially trivial development with dentals, which are homorganic with sibilants. The motivation for a pre-PIE development of [T^h] > [T^s], or simply [T] > [T^s] at T-T boundaries is thus fairly obvious. This also helps explain why the epenthetic sound is a sibilant, rather than a typologically more common vowel, or why loss with vowel lengthening did not take place. The double dental rule therefore does not contradict a geminate identity for the *t series. Rather, a geminate identity actually helps explain this aberrant degemination rule. The s-epenthesis most probably became phonologised at some point, possibly in PIE based on the Hittite evidence.⁴⁶

There seems to be no trace of 3) or 5) in Anatolian. 4) is attested in Hit. *tēkan*, ‘earth nom.-acc.sg.’ via PIE **d^héǵ-ōm* (Kloekhorst 2008: 993). Thus it appears that PA branched off

⁴⁵ The fake geminates may obviously be phonologised at some point: cf. Kümmel.

⁴⁶ The above account is largely based around the Tashlhiyt treatment of /t/-/t:/ clusters, where /t/ + /t:/ can be expressed either with aspiration or a fake long geminate. There is no satisfying topological study of how /T/+/T:/ clusters tend to be expressed, since even heterorganic /C/ + /C:/ clusters are very rare, and most languages (especially easily accessible European ones) with real and/or fake geminates do not allow such clusters. Studies conducted on fake and true geminate articulation in Estonian (true in word-medially and finally, fake across word-boundaries) and English (fake at word boundaries) show variation. In one study one Estonian speaker showed two articulatory gestures with the true geminate /p:/, [pp], and one English speaker with inter-word [p#p], where one would expect [p:] for both (Lehiste et al. 1973). According to Blevins, “it is possible then, that the distinction between true and false geminates is, in some languages, a phonological contrast with no clear phonetic correlates” (Blevins 2004: 170). An interesting avenue of research would be thus to investigate whether languages with word-internal true and fake geminates, such as Tashlhiyt or PIE, have a greater tendency to have two articulatory gestures to avoid homophony. Possible languages to investigate (based on Muller’s database, pp. 207-234) include Circassian, Moroccan Arabic, Cypriot Maronite Arabic, Tamazight Berber, and some Malayo-Polynesian languages.

PIE just when PIE began to degeminate some of its geminates, but did not partake in the vast majority of them, as attested by *ēšši* and the Anatolian geminate stops. It is also interesting to note that the PIE degeminations only affect sibilants and resonants, which are typologically the two categories most likely to be missing from geminate inventories. This is based on phonetic reasons; the increased closure duration for resonants and sibilants is harder to perceive than for stops (Blevins 2005: 133, Pajak 2009: 270). It is therefore possible that the trivial degemination of word-final and possibly intervocalic sibilants and resonants preceded the degemination and voicing of the stops. Despite this, there is little evidence that PIE (as opposed to PNIE) had any real constraint against surface geminates.

Section IV: Conclusions

Based on investigation outlined in sections II-III, two things must be concluded. Firstly, there is no good evidence that fortis and lenis spelling in cuneiform Hittite stand for anything else besides a phonemic length contrast. This thesis is supported by the Alalah Akkadian origins of Hittite cuneiform, the regional use of fortis ~ lenis spelling as a proxy for length, and phonological evidence in the form OH /ā/ shortening to /a/ in MH when the syllable is closed by a fortis stop.

Secondly, it must be concluded that the attested Anatolian length contrast cannot emerge from an underlying voicing contrast. Current scholarship does not know a single case of a T~D > T:~T shift. It is therefore typologically very weak, and must be discounted as an explanation. The theoretically proposed pathway for this shift, spontaneous and non-stress related intervocalic gemination of all voiceless stops, is likewise unattested. On the other hand the reverse shift, T:~T > T~D, is attested in Mari-Permic and Mordvinic. The pathways for this change, intervocalic voicing and degemination, are also extremely well-attested. This means that PIE must have had a stop system composed of at least a single unvoiced *t and a long unvoiced *t: series, with a third unknown series merging with the single series in PA. The traditional *t~*d~*d^h system must be regarded as a PNIE innovation.

The outcome of this investigation predicts that not only did PIE have geminate stops intervocalically, but also word-initially and word-finally. This is supported by the Hittite

reflexes of PIE $*tj$ and $*dj$, which are typologically bizarre if the contrast were voice, but becomes trivial if it was length, showing that PA must have had a word-initial length contrast. There is also evidence that at least Hittite possessed word-final geminates in the paradigm of *šēppit*, ‘grain.’ Although languages with word-initial, final, and medial geminates are rare, they are nonetheless attested and known. Their typology is far sounder than that of an unattested T:~T > T~D shift.

In addition to increasing our understanding of the diachronic phonology of PIE and PNIE, the PNIE lenitions are strong evidence of a significant, non-trivial innovation that PA did not partake in. It is therefore very strong evidence for the Indo-Hittite hypothesis. Currently, there are two unambiguous data sets that argue for Indo-Hittite: 1) the PNIE innovation of the feminine gender, and 2) a large amount of lexical archaisms that show PNIE innovation.⁴⁷ There is also the more amorphous problem of reconciling the PIE perfect with the Hittite *hi*-conjugation.⁴⁸ To these one can also add the PNIE innovation of $*t\sim*d\sim*d^h < *t:\sim*t\sim*$?. As argued in the introduction, the issue of Indo-Hittite has not been about whether PNIE and PIE are different, but whether or not the differences are significant and whether there is a critical amount of them. Reshaping the PIE contrast system is definitely evidence of a very significant innovation. Although a case could be made that lexical differences and a third gender might not be sufficient basis for a subgroup, these two combined with a completely new stop system constitutes a significant number of non-trivial innovations that PA did not partake in, thus validating the Indo-Hittite hypothesis.

⁴⁷ There are at least 12 such cases: cf. Kloekhorst (2008 23-25), Oettinger (2014: 169), and Melchert (forthc.: 48). It is also good to note Melchert’s observation that as more etymologies are discovered, “further research is likely to reveal further instances of such semantic shifts not shared by Anatolian” (forthc.: 48).

⁴⁸ Jasanoff’s proposal of an $*h_2e$ conjugation is speculative at best, and has problems with its proposed ablaut pattern. Cf. Kloekhorst 2012 for an in-depth account. Cf. also Oettinger (2014) for an interesting but likewise very speculative proposal that PNIE innovated the perfect from a ‘proto-intensive.’

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