The phonetics and phonology of the Hittite dental stops

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Abstract: This article provides a comprehensive analysis of the phonetics and phonology of the Hittite dental stops, which is especially based on a detailed treatment of the usage of the cuneiform signs TA and DA in all positions in the word, and in all chronological stages of Hittite.

Keywords: Hittite, phonology, phonetics, cuneiform script, Indo-European linguistics

Introduction

The cuneiform syllabary that was taken over by the Hittites from their North Syrian neighbours possesses in its *CV* series separate signs to distinguish voiceless from voiced stops, e.g. TA vs. DA, KA vs. GA, KI vs. GI, etc. Since in Hittite the members of such sign pairs are sometimes used interchangeably (e.g., the word for 'they eat' is spelled *a-**ta**-an-zi* as well as *a-**da**-an-zi*, the word for 'he opens' is spelled ***ki**-nu-uz-zi* as well as ***gi**-nu-uz-zi*, etc.), it is generally stated in the Hittitological literature that in spelling the choice between the signs for the voiceless stop and the signs for the voiced stop is random, and that the use of a specific sign in a given word has no bearing whatsoever on the phonology of the stop it denotes (e.g. Melchert 1994: 13-14; Kimball 1999: 89-90; Hoffner and Melchert 2008: 16; Patri 2009: 89), a view that I, too, adhered to in my etymological dictionary of Hittite (Kloekhorst 2008: 21).

In a series of recent articles (Kloekhorst 2010a; 2013; fthc.) I have retracted this view, however, arguing that in some periods of Hittite the signs for the voiceless stops (TA, KA, KI, etc.) in some positions in the word do represent phonologically different sounds from those represented by the signs for the voiced stops (DA, GA, GI, etc.).

In the present paper I will provide a follow-up on these articles, presenting all additional evidence regarding the pair TA vs. DA that I have gathered over the last years, which results in a detailed analysis of the phonetics and phonology of the Hittite dental stops in all positions in the word throughout the entire Hittite period.

Dental stops in intervocalic position: the OH situation

In Kloekhorst 2013, an article that dealt with the phonetic difference between the signs TA and DA in Old Hittite, I argued that in Old Hittite we have to distinguish three dental stops in intervocalic position, namely:

1. A geminate spelled stop that is always written with the sign TA, *(-)Vt-ta(-)*, and that etymologically corresponds with PIE **t*. It was argued that this consonant phonetically represents a voiceless long stop [t:], which in this article will be called **fortis**.

2. A geminate spelled stop that is written both with the sign TA and with the sign DA, *(-)Vt-ta(-)* and *(-)Vd-da(-)*, and that etymologically corresponds with the PIE cluster **TH*. It was argued that this consonant phonetically represents a voiceless long post-glottalized stop [t:ʔ], which in this article will be called **ejective**.

3. A single spelled stop that is written both with the sign TA and the sign DA, °*V-ta(-)* and °*V-da(-)*, and that etymologically corresponds with PIE **d* and **d*^{h}. It was argued that this consonant phonetically represents a voiced short stop [d], which in this article will be called **lenis**.

Although the lenis stop is in this position voiced, it was argued that its voice is only allophonic and that the basic distinction between the fortis and the lenis stop is length instead of voice.[1] We can therefore set up the following three dental phonemes for Old Hittite:

fortis /t:/
ejective /t:ˀ/
lenis /t/

In the article mentioned, only the Old Hittite situation was investigated, but not the Middle and New Hittite one. I will therefore do so here.

Dental stops in intervocalic position: the MH and NH situation

There can be no doubt that of the three dental phonemes that have to be distinguished for Old Hittite, at least the fortis and lenis stops must have remained distinct phonemes also after the OH period: in MH and NH texts, too, they are consistently distinguished in spelling, namely by geminate vs. single spelling, respectively (= Sturtevant's Law). The status of the ejective stop in Middle and New Hittite is less clear, however.

The postulation of an intervocalic ejective stop /t:ˀ/ in Old Hittite was based on the existence of four words that show in OS texts geminate spelling with the sign DA, *(-)Vd-da(-)*, which correlates with the etymological presence of a cluster of a dental stop + laryngeal in their reconstructed preform: *paddaḫḫi* 'I dig' < *$b^h od^h h_2$-, *paddar / paddan-* 'basket' < *$péth_2$-r / *$p(e)th_2$-én-, *piddāi* 'he flees' < *$pth_{1/2}$-ói-ei*, and *uddār* 'words' < *uth_2-ór*. They thus contrast with the Old Hittite words that show consistent geminate spelling with the sign TA, which always correlates with the etymological presence of a **t* in their preform. Since in Akkadian a spelling *(-)Vd-da(-)* can also be read as *(-)Vṭ-ṭa(-)*, i.e. as containing a geminate emphatic stop, which phonetically must have been a long post-glottalized stop [t:ˀ],[2] it was argued that in Hittite, too, the spelling *(-)Vd-da(-)* in these four words represents the presence of a long ejective stop /t:ˀ/, which can then be regarded as the regular outcome of an intervocalic cluster **-TH-*.[3]

The first step required to determine to what extent the ejective stop is still a separate phoneme in MH and NH times is to investigate the spelling of these four words in MS and NS texts: how often do they show spelling either with the sign TA or with the sign DA?

padd(a)-^{i} 'to dig':[4] In OS texts, we only find the 1sg.pres.act. form *pád-da-aḫ-ḫi*, but in MS and NS texts also other relevant forms are attested. In MS texts, we find no forms spelled with TA, but one form spelled with DA (3pl.pres.act. *pád-da-a-an-zi* (1x)). The ratio of forms spelled with the sign TA to forms spelled with the sign DA is thus 0 : 1 = 0%. In NS texts, we find no forms spelled with TA, but 31 forms spelled with DA (1sg.pres.act. *pád-da-aḫ-ḫi* (5x), 3sg.pres.act. *pád-da-a-i* (8x), *pád-da-i* (5x), 3pl.pres.act. *pád-da-an-zi* (3x), *pád-da-a-an-zi* (5x), 1sg.pret.act. *pád-da-aḫ-ḫu-un* (1x), 3sg.pret.act. *pád-d*[*a*-...] (1x), 3sg.pres.mid. *pád-da-a-ri* (1x), part. *pád-da-an-t*° (2x)). The ratio of forms spelled with the sign TA to forms spelled with the sign DA is thus 0 : 31 = 0%. If we combine the MH and NH numbers, we arrive at 0 : 32 = 0%.

[1] This was argued on the basis of the presence in Hittite of clusters consisting of a lenis and a fortis stop, like the one in *e-ku-ut-ta* 'he drank' /ʔékʷt:a/. If the basic distinction between the lenis and the fortis stops would have been voice, we would expect to find voice assimilation in such clusters, yielding either two fortis stops, ***e-ek-ku-ut-ta*, or two lenis stops, ***e-ku-ta* (cf. Kloekhorst 2008: 2; fthc.: 1-2). Since this did not happen, the distinction between the two kinds of stops apparently was not voice. This argument is corroborated by the fact that, as we will see below, after obstruents the lenis dental stop is realized as a short voiceless stop [t], whereas the fortis dental stop is in that position realized as a long voiceless stop [t:]. The only distinction between the two is length, which therefore can be regarded to have been the basic distinction between the two stops.

[2] Kouwenberg 2003: 81-2.

[3] Kloekhorst 2013: 127-31.

[4] All numbers are based on the attestations of this verb as gathered in CHD P: 235-6.

paddar / paddan- 'basket': In OS texts, we find five attestations spelled with DA (nom.-acc.sg. *pád-da-r*° (1x), dat.-loc.sg. *pád-da-ni* (1x), *pád-da-a-ni* (1x), [*p*]*ád-da-ni-i* (1x), *pád-da*[*-ni*] (1x)), and four attestations with TA (nom.-acc.sg. *pát-ta-ar* (2x), instr. *pát-ta-ni-it* (2x)).[5] In MS texts, we find no forms spelled with TA, but five forms spelled with DA (dat.-loc.sg. *pád-da-ni* (5x)),[6] yielding a ratio of 0 : 5 = 0%. In NS texts, we find three forms spelled with TA (dat.-loc.sg. *pát-ta-a-ni* (1x), instr. *pát-ta-ni-it* (2x)) and 27 spelled with DA (dat.-loc.sg. *pád-da-ni-i* (10x), *pád-da-a-ni* (3x), *pád-da-ni* (11x), instr. *pád-da-ni-it* (1x), abl.(?) *pád-da-n*[*a-az*] (1x), uncl. *pád-da-na-aš* (1x)),[7] yielding a ratio of 3 : 27 = 10%. If we combine the MH and NH numbers, we arrive at 3 : 42 = 6,7%.

piddai-^{i} 'to flee':[8] In OS texts, we find two attestations of this verb spelled with DA (3sg.pres.act. *píd-da-a-i* (2x)), and none spelled with TA. In MS texts, we find no forms spelled with TA, and seven forms spelled with DA (3sg.pres.act. *píd-da-a-i* (2x), *píd-da-i* (1x), 3sg.pret.act. [*p*]*íd-da-iš* (1x), *píd-da-a-it* (1x), 2sg.imp.act. *píd-da-a-i* (2x)), yielding a ratio of 0 : 7 = 0%. In NS texts, we find six forms spelled with TA (3sg.pres.act. *pí-it-t*[*a-i*] (1x), *pít-ta-a-iz-zi* (2x), 3pl.pret.act. *pít-ta-a-er* (2x), imperf. *pít-ta-iš-k*° (1x)) and thirty forms with DA (3sg.pres.act. *píd-da-a-i* (1x), *píd-da-a-iz-zi* (3x), 1pl.pres.act. *píd-da-a-u-e-ni* (1x), 3pl.pres.act. *píd-da-a-an-zi* (2x), *píd-da-an-zi* (1x), 2sg.pret.act. *píd-da-it-ti* (1x), 3sg.pret.act. *píd-da-a-iš* (6x), *píd-da-a-it* (2x), *pí*[*d-d*]*a-it* (1x), 3pl.pret.act. *píd-da-a-er* (1x), 2sg.imp.act. *píd-da-i* (1x), *píd-da-a-i* (2x), 2pl.imp.act. *píd-da-at-ten* (1x), *píd-da-a-at-tén* (1x), imperf. *píd-da-a-eš-k*° (1x), *píd-da-a-iš-k*° (1x), *píd-da-iš-k*° (2x), *píd-da-eš-k*° (2x)), yielding a ratio of 6 : 30 = 16,7%. If we combine the MH and NH numbers, we arrive at 6 : 37 = 13,9%.

uddar / uddan- 'word': The only relevant form of this word attested in OS texts is the nom.-acc.pl. form, which was attested once as *ut-ta-a-ar*, but once as *ud-d*[*a*$^{?}$*-*]*a*$^{?}$*-ar* as well.[9] In MS and NS texts, we also find other forms of this word that are spelled either with TA or with DA. In MS texts, this word is attested four times with the sign TA (gen.sg. *ut-ta-na-a-aš* (1x), nom.-acc.pl. *ut-ta-a-ar* (2x), erg.pl. *ut-ta-na-a-an-te-eš* (1x)), and 58 times with the sign DA (gen.sg. *ud-da-na-a-aš* (2x), *ud-da-na-aš* (1x), dat,-loc.sg. *ud-da-ni-i* (18x), *ud-da-ni* (1x), abl. *ud-da-na-a-az* (1x), *ud-da-na-az* (4x), *ud-da-na-za* (1x), nom.-acc.pl. *ud-da-a-ar* (29x), erg.sg. *ud-da-na-an-za* (1x)),[10] yielding a ratio of 4 : 58 = 6,5%. In NS texts, we find seven times a spelling with TA (gen.sg. *ut-ta-na-aš* (2x), nom.-acc.pl. *ut-ta-a-ar* (5x)) and 135 times with DA (gen.sg. *ud-da-na-aš* (2x), dat.-log.sg. *ud-da-ni-i* (20x), *ud-da-ni* (5x), *ud-da-a-ni-i* (3x), erg.sg. *ud-da-na-an-za* (4x), abl. *ud-da-na-az* (4x), nom.-acc.pl. *ud-da-a-ar* (89x), *ud-da-ar* (4x), erg.pl. *ud-da-na-a-an-te-eš* (1x), [*u*]*d-da-na-an-te-eš* (1x)),[11] yielding a ratio of 7 : 135 = 4,9%. If we combine the MH and NH numbers, we arrive at 11 : 193 = 5,4%.

We see that in MS and NS texts in all four words the number of forms spelled with the sign DA is much larger than the number of forms spelled with TA.

The next step is to answer this same question for the words that in OS texts are consistently spelled with the sign TA, and that therefore must contain a (non-ejective) fortis stop /t:/: how are these spelled in MS and NS texts? Since it would be too time consuming to investigate all relevant words, I have

[5] Cf. Kloekhorst 2013: 127.
[6] See Kloekhorst 2014: 358 for attestations.
[7] See CHD P: 241 for attestations (note that the "passim" mentioned for KUB 27.67 refers to ii 19, iii 13, 18, 24; and that ^{GI}*pád-da-a-ni* as cited for KUB 9.6 i 3 is in fact ^{GI}*pát-ta-a-ni*).
[8] Numbers based on the attestations as gathered in CHD P: 352f.
[9] Cf. Kloekhorst 2013: 129.
[10] For attestations, cf. Kloekhorst 2014: 319^{1234} (gen.sg.), 454 (dat.-loc.sg.), 299 (erg.sg.), 320 (abl.), 240^{896} (nom.-acc.pl.), 299 (erg.pl.).
[11] For attestations, cf. Kloekhorst 2014: 319^{1235} (gen.sg.), 454 (dat.-loc.sg.), 299 (erg.sg.), 320 (abl.), 240^{870} (nom.-acc.pl.), 299 (erg.pl.).

selected a few representative examples that are attested often enough to give statistically relevant numbers.

> *katta* 'down' < **ḱmto*: In OS texts, this word is consistently spelled *kat-ta* (33x), with the sign TA, and never with the sign DA. Also in MS and NS texts it is always spelled *kat-ta* (ca. 700 times in my files), and never ***kad-da*. The ratio of spellings with the sign TA to spellings with the sign DA is therefore 100%.
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> *kitta(ri)* 'he lies' < **ḱéito(ri)*: This word is in OS texts consistently spelled *ki-it-ta* (23x),[12] with the sign TA, and never with the sign DA. Also in MS and NS texts it is in the overwhelming majority of cases spelled *ki-it-ta(-ri)* (ca. 200 times in my files), with the sign TA. Only three times do we find *ki-id-da(-ri)*.[13] The ratio of spellings with the sign TA to spellings with the sign DA is thus 200 : 3 = 98,5%.
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> *lukkatta* 'it dawns' < **lukoto*:[14] This word is in OS texts in all its four attestations spelled with the sign TA, and not with the sign DA.[15] Also in MS and NS texts it is always (more than 20 times) spelled with the sign TA (*lu-uk-kat-ta*, *lu-ug-ga-at-ta*, *lu-kat-ta*), and never with the sign DA. The ratio of forms spelled with TA to the forms spelled with DA is thus 100%.
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> *nutta* 'and to you' < **nu=tuo*: This word is in OS texts attested once as *nu-ut-ta*,[16] spelled with the sign TA. In my files of MS and NS texts, it occurs ca. 230 times as *nu-ut-ta*, with the sign TA, and once as *nu-ud-da* (KUB 33.70 iii 16 (OH/NS)), with the sign DA. The ratio of forms spelled with TA to forms spelled with DA is thus 230 : 1 = 99,6%.

In all these words the ratios of the number of forms spelled with the sign TA to the number of forms spelled with the sign DA (100%, 98,5%, 100%, and 99.6%, respectively), are totally opposite to the ratios of TA to DA in the words *padd(a)-*^{i}, *pattar / paddan-*, *piddai-*^{i} and *uddar / uddan-*, which were 0%, 6,7%, 13,9%, and 5,4%, respectively. This massive difference in spelling between these two groups of words proves that also in MH and NH times the ejective dental stop /t:ʔ/ was still phonemically distinct from the fortis dental stop /t:/.

This finding has some interesting consequences for several other words and morphemes.

> *apadda(n)* 'there, thither': This word, which is unattested in OS texts, is in MS and NS texts spelled as follows:[17] eleven times do we find a spelling with the sign TA (*a-pa-at-ta* (3x), *a-pa-a-at-ta* (6x), *a-pát-ta-an* (2x)), and 92 times a spelling with the sign DA (*a-pád-da* (53x), *a-pád-da-an* (38x), *a-pa-da-an* (1x)).[18] The ratio of spellings with TA to spellings with DA is thus 11 : 92 = 10,7%, which matches the ratios of *padd(a)-*^{i}, etc. I therefore conclude that this word must have contained an ejective stop as well: /ʔapat:ʔa(n)/. Melchert (2008: 369-70), reconstructed this form as ending in **-éd-h_2o*, in which **-h_2o* would be the preform of the allative ending that is attached to the stem **h_1ob^{h}éd-* as visible in dat.-loc.sg. *apedani*, etc. According to Melchert, the short *a* of the medial syllable of *apadda* reflects an earlier **e* that has been colored to *a* because it stood before a cluster **-dh_2-*. This idea is now confirmed by the spellings with DA, which point to the presence of the ejective stop /t:ʔ/ and forms an independent argument in favor of a reconstruction with a cluster **-TH-*. It should be noted, however, that since I rather reconstruct the all.sg. ending as **-o*, and not as **-h_2o*,[19] I cannot accept all details of Melchert's

[12] Cf. Kloekhorst 2014: 419[1623] for attestations.
[13] *ki-id-da* (KBo 3.21 ii 9 (MH/MS)), *ki-id-da-ri* (KUB 30.15 obv. 6, 13 (OH/LNS)).
[14] Cf. CHD L-N: 75 for attestations.
[15] *lu-ug-ga-at-ta* (StBoT 25.4 iv 21 (OS)), *lu-uk-kat-ta* (StBoT 25.3 ii 30, iv 7 (OS)), [(*lu-uk-kat-t*)]*a* (StBoT 12+ i 31 (OS)).
[16] *nu-ut-ta* (KUB 43.27 i 8 (OS)).
[17] Counts based on the attestations listed in HW^2 A: 168-70.
[18] Twice do we find the spelling *a-pát-tén*, but its interpretation is unclear.
[19] Cf. Kloekhorst 2008: 161.

etymology. To my mind, we should rather interpret *apadda* as reflecting *$h_1ob^héd^hh_2e$*, a form that consists of the pronominal oblique stem *$h_1ob^hé$- (cf. gen.sg. *apel* 'of his', etc.) to which the locatival element *-d^hh_2e is attached that is known from Gr. ἔνθα 'there' and Skt. *ihá* 'here', and which may also be present in Hitt. *anda* 'into' < *h_1n-d^hh_2e.[20]

natta 'not': This word is in OS, MS and NS texts consistently spelled *na-at-ta* (more than 150 times in my files), with the sign TA, and never **na-ad-da.[21] We should therefore analyze it as /nat:a/, with a fortis, and not an ejective stop. The etymology of this word is not fully clear. It is obviously related to **ne* 'not' as attested in many IE languages, but details regarding its latter part are unclear. Melchert (2008: 372) proposes to reconstruct *$né$-th_2oh_1, a form that structurally would be the same as Skt. *táthā* 'thus' and *káthā* 'how', and in which the *e* would be colored to *a* because of the following *-*TH*- cluster (just as in *apadda* < *$h_1ob^hed^hh_2e$). Although especially this latter argument is attractive (it is otherwise difficult to account for the Hitt. *a* in *natta* vis-à-vis the **e* found in the **ne* as reflected in all other IE languages, cf. Melchert 2008: 371), I would rather expect that a preform *$néth_2oh_1$ should have yielded Hitt. **/nát:$^?$a/, spelled **na-ad-da*. Melchert's etymology can therefore hardly be correct. I am unable, however, to offer an alternative one.

-tta (2sg.pret.act. ending of the *ḫi*-conj.): This ending is generally connected with the 2sg. perfect ending as found in Sanskrit (*-tha*) and Greek (-θα) and that is reconstructed as *-th_2e. On the basis of the foregoing, we would expect this ending in postvocalic position to have yielded Hitt. /-t:$^?$a/, which then should be spelled ...-*Vd-da*. Yet, this is not the case. Although it is unattested in OS texts, in MS and NS texts this ending is in postvocalic position always spelled ...-*Vt-ta* (*ḫal-za-it-ta* (OH/NS) 'you screamed', *na-it-ta* (OH/MS) 'you turned', *pa-it-ta* (OH/MS) 'you gave', *da-a-at-ta* (MH/MS) 'you took', etc.), which rather points to a phonological shape /-t:a/, with a fortis, non-ejective /t:/.
As we will see below, there are indications that although PIE *-*TH*- did in Hittite develop into an ejective stop /t:$^?$/ in postvocalic position (as well as after *n* and in word-initial position), it yielded a non-ejective fortis stop /t:/ when preceded by an obstruent, **r*, or **l*. This means that the 2sg.pret.act. ending of the *ḫi*-conjugation would originally have two allomorphs, namely postvocalic and postnasal /-t:$^?$a/ vs. /-t:a/ in other positions. It seems quite possible to me that in such a situation one of the variants ousted the other, and the spelling ...-*Vt-ta* clearly indicates that in this case it is the ending /-t:a/ that has become the productive one.
Support in favor of this theory may come from the spelling of the corresponding 2sg.pres.act. ending. Whereas the normal spelling of this ending in postvocalic position is ...-*Vt-ti*, we do find in OS texts two forms with the spelling ...-*Vd-di*: *pé-e-da-ad-d*[*i*] (KUB 33.59 ii 2 (OS)) and *ú-da-ad-di* (KUB 33.59 iii 3 (OS)). Although not all details regarding the phonetic difference between the signs TI and DI have been clarified, it seems attractive to assume that these two forms spell the original postvocalic ending /-t:$^?$i/ (< *th_2e+*i*), which later on was replaced by the postconsonantal variant /-t:i/, spelled ...-*Vt-ti*.

We can conclude that in intervocalic position the phonemic three-way distinction between fortis /t:/, ejective /t:$^?$/ and lenis /t/ (phonetically realized as [t:], [t:$^?$], and [d], respectively) was retained as such throughout the history of Hittite.[22]

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[20] Cf. Kloekhorst 2013: 139 for this etymology of *anda*.
[21] Cf. CHD L-N: 409.
[22] There are two words that do not fit the pattern seen thus far because they show a considerable amount of spellings both with *(-)Vt-ta(-)* and with *(-)Vd-da(-)*.
The verb *ḫatt-*$^{a(ri)}$, *ḫazziḫe/a-*^{zi} 'to make a hole, to pierce, to prick' shows besides spellings with the sign TA (*ḫa-at-ta(-...)*, 54 attestations in my files), also quite a few spellings with the sign DA (3sg.pres.mid. *ḫa-ad-da(-ri)*, 3pl.pres.act. *ḫa-ad-da-an-zi*, ptc. *ḫa-ad-da-an-t°*, etc., 18 attestations in my files). Its ratio of TA vs. DA spellings, namely 54 : 18 = 75%, is too low to classify this verb as belonging to the words containing the phoneme /t:/, but also much too high for belonging to the group containing /t:$^?$/. Interestingly, the DA-spellings all stem from NS texts, at which period the active stem of this verb, which originally was *ḫazziḫe/a-*^{zi}, has been reshaped to *tarn(a)*-class inflecting *ḫatta-*^{i} / *ḫatt-* (e.g. 3sg.pres.mid. *ḫa-at-ta(-a)-i*, *ḫa-ad-da(-a)-i*). It therefore

Dental stops after *n*: the OH situation

In Kloekhorst 2013, I also treated the spelling in Old Hittite texts of dental stops after *n*. It turned out that for this position we have to distinguish three different stops as well, namely:

1. A stop that is consistently spelled with the sign TA, °*n-ta(-)*, and that therefore was interpreted as a voiceless stop, [t]. Etymologically, the cluster [nt] corresponds with PIE **nd*.

2. A stop that is consistently spelled with the sign DA, °*n-da(-)*, and that therefore was interpreted as a post-glottalized stop, [t^{ʔ}]. Etymologically, the cluster [nt^{ʔ}] corresponds with PIE **nTH*.

3. A stop that is spelled both with the sign TA and with the sign DA, °*n-ta(-)* and °*n-da(-)*, and that was interpreted as a voiced stop, [d]. Etymologically, the cluster [nd] corresponds with PIE **nt* and **nd^{h}*.

I did not discuss the question, however, how these postnasal stops correlate with the intervocalic stops. In other words: what is the phonemic status of these stops that are found after *n*? It seems obvious to me that the three postnasal stops can be equated with the three intervocalic stops in the following way:

1. The postnasal voiceless stop [t] is to be equated with the intervocalic fortis stop /t:/.
2. The postnasal post-glottalized stop [t^{ʔ}] is to be equated with the intervocalic ejective stop /t:^{ʔ}/.
3. The postnasal voiced stop [d] is to be equated with the intervocalic lenis stop /t/.

In other words, the phonemic length contrast between, on the one hand, the fortis and ejective stops and, on the other, the lenis stop is in postnasal position phonetically realized as a voice contrast:

1. /nt:/ is realized as [nt].
2. /nt:^{ʔ}/ is realized as [nt^{ʔ}].
3. /nt/ is realized as [nd].

An interesting outcome of this equation is the fact that although in intervocalic position PIE **d* and **d^{h}* merge (into the lenis stop /t/) and remain distinct from PIE **t* (which yielded the fortis stop /t:/), after **n* a merger took place between PIE **t* and **d^{h}* (which yielded lenis /nt/ = [nd]), whereas PIE **d* remained distinct (as fortis /nt:/ = [nt]). This is in my opinion directly linked to the fact that the pre-Proto-Anatolian correspondents of PIE **t*, **d* and **d^{h}* were */t:/, */^{ʔ}t/ and */t/, respectively.[23] In intervocalic position the pre-glottalic feature of */^{ʔ}t/ was reinterpreted as a separate phoneme, */ʔ/ (which was subsequently lost with compensatory lengthening of the preceding vowel), causing a merger of */^{ʔ}t/ and */t/ into Hittite /t/, which contrasted with /t:/. Yet, after **n* the length of */t:/ was lost, causing it to merge with */t/ into */nt/, which through voice assimilation yielded [nd]. Moreover, */^{ʔ}t/ remained distinct because when also in this position its pre-glottalic feature was reinterpreted as a separate phoneme, */n^{ʔ}t/ > */nʔt/, this glottal stop blocked any voice assimilation, causing */nʔt/ to develop into [nt]. In the case of **nTH*, we have to assume that, just as in intervocalic position, the laryngeal caused a preceding stop to lengthen,[24] which therefore was not subject to voice assimilation either. We can set up the following chronology in order to explain all the facts:

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seems quite possible to me that the original /t:/ of the verbal root /hat:-/ has been replaced by /t:^{ʔ}/ by analogy with the verb *padda-^{i} / padd-* 'to dig' /pat:^{ʔ}(a)-/, which shows the same *tarna*-class inflection, and which is semantically close (cf. also the derivatives *ḫatteššar* 'hole, pit' and *patteššar* 'pit, hole in the ground').
The noun *atta-* (c.) 'father' is spelled both *at-ta(-)* (ca. 70% of its attestations) and *ad-da(-)* (ca. 30% of its attestations), and thus does not fit the numbers belonging with the phonemes /t:/ and /t:^{ʔ}/ either. Since this noun is clearly a word originating from childrens' language, we may be allowed to assume that it contains a unique sound, namely a long voiced stop /d:/ (cf. Eng. *daddy*).

[23] Cf. Kloekhorst 2012: 258-9; 2014: 230-5, 405-14, 574-83; and fthc. for the reconstruction of pre-glottalized voiceless short stops (/^{ʔ}p/, /^{ʔ}t/, etc.) as the pre-Proto-Anatolian correspondents of the PIE mediae (**b*, **d*, etc.).

[24] Cf. Kloekhorst 2013: 130-1.

			(1)		(2)		(3)			
PIE *nt	~	pre-PAnat. */nt:/	>	*/nt/	>	*/nt/	>	[nd]	=	/nt/
PIE *nd^h	~	pre-PAnat. */nt/	>	*/nt/	>	*/nt/	>	[nd]	=	/nt/
PIE *nd	~	pre-PAnat. */n^{ʔ}t/	>	*/n^{ʔ}t/	>	*/nʔt/	>	[nt]	=	/nt:/
PIE *ntH	~	pre-PAnat. */nt:ʔ/	>	*/ntʔ/	>	*/nt:ʔ/	>	[nt^ʔ]	=	/nt:^{ʔ}/
PIE *nd^hH	~	pre-PAnat. */ntʔ/	>	*/ntʔ/	>	*/nt:ʔ/	>	[nt^ʔ]	=	/nt:^{ʔ}/
PIE *ndH	~	pre-PAnat. */n^{ʔ}tʔ/	>	*/n^{ʔ}tʔ/	>	*/nʔt:ʔ/	>	[nt^ʔ]	=	/nt:^{ʔ}/

1. Loss of consonantal length after **n*, causing the merger of */t:/ and */t/ into */t/.
2. Lengthening of a short consonant by a following laryngeal, causing the shift of */tʔ/ to */t:ʔ/, and reinterpretation of the pre-glottalic feature of */^{ʔ}t/ as */ʔ/.
3. Voice assimilation of */nt/ to [nd], but not of */nt:/. The presence of a */ʔ/ between */n/ and */t/ blocks the assimilation. Subsequent loss of interconsonantal */ʔ/, and a reinterpretation of the cluster */t:ʔ/ as a post-glottalized stop /t:^{ʔ}/.

In Kloekhorst 2013, I only treated the Old Hittite situation regarding dental stops in postnasal position, not the Middle and New Hittite one, which I will do here.

Dental stops after *n*: the MH and NH situation

First, I will treat the fate of the ejective stop. We have seen above that in OS texts the ejective stop /t:^{ʔ}/, which after *n* is phonetically realized as [t^ʔ], was indicated in spelling by the consistent use of the sign DA, e.g. in *an-da(-an)* 'into; inside'. If we investigate the spelling of this word in MS and NS texts, we find more than 2400 attestations spelled *an-da(-an)*, with the sign DA, and only two attestations with the sign TA, namely *an-ta*^{ʔ} (KBo 20.10 i 4 (OH/OS or MS)) and *an-tạ-an* (KUB 20.76 iv 8 (OH/NS)) (note that in both cases the sign TA is either broken or questionable). It is therefore justified to say that also in the post-OH period *anda(n)* is consistently spelled with the sign DA. To my mind, this indicates that it has retained its ejective stop as a phonemic entity: /ənt:^{ʔ}a(n)/.

The presence of a phonemic fortis stop, /t:/, which after *n* is phonetically realized as [t], was based on the consistent spelling in OS texts of the form *ši-pa-an-ta-an-zi* 'they libate' with the sign TA, which was supported by the consistent spelling of its corresponding 3sg. form *ši-pa(-a)-an-ti / iš-pa(-a)-an-ti* 'he libates' with the sign TI, and its derivative *iš-pa-an-tu-uz-zi-* 'libation vessel' with the sign TU. These words were therefore interpreted as [sip:əntántsi] = /sip:ənt:ánt^s:i/, [sip:ǻnti] = /sip:ǻnt:i/, [ɨspǻnti] = /ɨsp:ǻnt:i/, and [ɨspəntutsi-] = /ɨsp:ənt:ut^s:i-/, respectively. They thus contrast with words that in OS texts are spelled both with the sign TA and with the sign DA (or with TI as well as DI, or TU as well as DU), which rather points to the presence of a lenis stop, /t/, which after *n* was realized as a voiced stop, [d], e.g. *e-ša-an-ta*, *e-ša-an-da* 'they sit down' [ʔḗsənda] = /ʔḗsənta/, *a-ša-an-tu*, *a-ša-an-du* 'they must be' [əsándu] = /əsántu/.

If we now look at the spelling of the form for 'they libate' in MS and NS texts, we find that there it is spelled both with TA and with DA, however: *ši(-ip)-pa-an-ta-an-zi*[25] as well as *ši(-ip)-pa-an-da-an-zi*.[26] Likewise the form for 'libation vessel', which in MS and NS texts is spelled *iš-pa-an-tu-uz-zi-*[27] as well as *iš-pa-an-du-uz-zi-*.[28] They thus are in the post-OH period spelled the same way as words that contain a lenis /t/. We must therefore assume that their OH /t:/, which was realized as a voiceless [t], has in the post-OH period changed to /t/, which was realized as [d], probably due to voice assimilation: OH [sip:əntántsi] = /sip:ənt:ánt^s:i/ > MH/NS [sip:əndántsi] = /sip:əntánt^s:i/ and OH [ɨspəntutsi-] = /ɨsp:ənt:ut^s:i-/ > MH/NH [ɨspəndutsi-] = /ɨsp:əntut^s:i-/.[29]

[25] Attested 9 times in my files of MS and NS texts.
[26] Attested ca. 60 times in my files of MS and NS texts.
[27] Attested ca. 45 times in my files of MS and NS texts.
[28] Attested ca. 30 times in my files of MS and NS texts.
[29] Note that the 3sg.pres.act. form of 'to libate' is also in MS and NS texts consistently spelled with the sign TI: *ši-pa-an-ti*, *ši-ip-pa-an-ti*, BAL-*an-ti*, never **-an-di*. The rationale behind this fact is not yet clear to me, and needs further investigation.

This does not mean, however, that in the post-OH period after *n* the contrast between fortis and lenis stops has been given up. Consider the word *kuenta* 'he killed'. Etymologically, this form is generally reconstructed as **g^{wh}én-to*, in which the ending is the 3sg.mid. ending **-to*,[30] which has replaced the original 3sg.pret.act. ending **-t* because the latter was regularly lost in post-consonantal position. On the basis of what we have seen above, we would expect the sequence **-nt-*, through a pre-PAnat. */-nt:-/, to have developed into OH [-nd-] = /-nt-/, with a lenis stop /t/. Yet, if we look at the spelling of the word *kuenta* in MS and NS texts,[31] we find that it is always (32 times) spelled with the sign TA (26x *ku-en-ta*, 5x *ku-e-en-ta*, 1x *ku-in-ta*), and never with the sign DA. This spelling thus rather points to the presence of a voiceless, i.e. fortis stop, [t] = /t:/: [k^{w}énta] = /k^{w}ént:a/.
Does this mean that our view on the development of the cluster **-nt-* is incorrect? To my mind, this is not the case. As we will see below, after all other consonants other than **n*, PIE **t* regularly develops into a fortis stop. This means that in all verbs in which the stem ends in a consonant other than **n*, the verbal ending **-to* regularly developed into /-t:a/ with a fortis /t:/, e.g. **h$_1$ég^{wh}-to* > Hitt. *e-ku-ut-ta* 'he drank' /ʔék^{w}t:a/. Only after an **n* we would expect the ending to have developed into /-ta/, with a lenis /t/ (which after *n* was realized as a voiced stop, [-nda]). It seems unproblematic to me to assume that this allomorphy between /-t:a/ and /-ta/ was levelled out in favor of the fortis variant. Also, when after the OH period the sequence /nt:/ = [nt] underwent voice assimilation to /nt/ = [nd], the fortis character of the dental stop of the ending *-tta* was again restored, resulting in *ku(-e)-en-ta* [k^{w}énta] = /k^{w}ént:a/, not **[k^{w}énda] = **/k^{w}énta/.

Dental stops after obstruents
Although it was stated in Kloekhorst 2013: 131 that in Old Hittite texts after the consonants *ḫ, k, p,* and *š* only the sign TA is found, and never DA, no conclusion was attached to this fact. I will therefore treat this fact in more detail here. The absence of DA after obstruents is not limited to OS texts; also in MS and NS texts we virtually only find the sign TA following *ḫ, k, p,* and *š*.[32] To my mind, this virtual complete absence of spellings with the sign DA after obstruents indicates that the dental stops that occur in this position were phonetically neither ejective nor voiced.
The absence of ejectives in this position is interesting, since there are certainly Hittite words that in their preform contain a cluster of obstruent + **TH*, cf. e.g. *ḫaštai-* 'bone' < **h$_{2/3}$ésth$_1$oi-*,[33] or the 2sg.pret.act. ending *-tta* as treated above. This means that in such sequences either the laryngeal was lost without causing glottalization (**-CTHV-* > */-Ct:ʔV(-)/ > Hitt. /-Ct:V(-)/), or that the laryngeal at first did cause glottalization (**-CTHV-* > */-Ct:ʔV(-)/ > pre-Hitt. */-Ct:^{ʔ}V(-)/), after which the glottalization was lost, yielding Hitt. /-Ct:V(-)/. The latter scenario effectively entails that after obstruents original ejectives have in pre-Hittite times merged with the fortis stops.
The absence of voiced stops could at first sight be interpreted as a sign that in this position original fortis and lenis stops have merged into a single stop, which is realized as voiceless. Yet, there are indications that we have to distinguish two types of stops in this position.
The first type of stop is found in words that show spelling alternations like the one between *e-uk-ta* and *e-ku-ut-ta* 'he drank', and between *li-in-ik-ta* and *li-in-kat-ta* 'he swore'. In these words, postconsonantal spelling with the sign TA, *°C-ta(-)*, alternates with geminate spelling in graphic intervocalic position, *(-)Vt-ta(-)*. This clearly shows that the dental stop in these words was a long voiceless stop, [ʔék^{w}t:a] and [linkt:a], and we may therefore interpret it as a fortis stop: /ʔék^{w}t:a/ and /línkt:a/. Since in these cases the dental stop etymologically goes back to PIE **t* (**h$_1$ég^{wh}to*, **h$_1$lénǵ^{h}to*), it shows that in such clusters fortis stops were retained as such.

[30] Kloekhorst 2008: 800-1.
[31] It is unattested in OS texts.
[32] I have counted in my files 244x *°ḫ-ta(-)* vs. 3x *°ḫ-da(-)*; 190x *°k-ta(-)* vs. 2x *°k-da(-)*; 144x *°p-ta(-)* vs. 7x *°p-da(-)* (4 of which occur in a single text, namely KBo 18.54); and 3013x *°š-ta(-)*, vs. 17x *°š-da(-)*. We see that the number of spellings with the sign DA is negligable when compared to the number of spellings with the sign TA. Moreover, the spellings with DA do not seem to occur in any systematic way.
[33] Although normally in Hittite a PIE **t* undergoes assibilation to *z* when followed by an **i*, this is not the case in the oblique cases of 'bone' (e.g. gen.sg. *ḫaštiia̯š*), which have retained their **t*. This can only be explained by the presence of the laryngeal between **t* and **i*, which then blocked the assibilation. Since the assibilation in **ti* is a specifically Hittite development, the laryngeal must have been still present at that moment, and can have been lost only later on. In that sense, the laryngeal did leave a trace in this word, albeit not glottalization.

The second type of stop is found in the word *a-ku-ta-al-l*° 'container of water',[34] where we find a dental stop that is spelled single. Since it is likely that the preceding *-ku-* represents a labiovelar (because *aku-* can then be derived from the verbal stem *h_1g^{wh}- 'to drink'), we can assume that, although the *t* is in graphic intervocalic position, it is in fact post-consonantal. The spelling with the sign TA indicates that it is voiceless, whereas the single spelling indicates it was short. We can therefore assume that the word phonetically must have been [ək^{w}tal:-], with a voiceless short [t], which undoubtedly must be interpreted as the lenis stop /t/: /ək^{w}tal:-/.
These words, in which the dental stops are in a graphic intervocalic position but in fact stand in a postconsonantal position, show that both fortis and lenis stops can occur in this position, and that the former is realized as a voiceless long stop, [t:], but the latter as a voiceless short stop, [t]. This means that spellings of the structure °*C-ta(-)* can in principle denote both /°Ct:a(-)/, with a fortis stop, and /°Cta(-)/, with a lenis stop, and that one can only decide between the two either on the basis of alternative spellings where the dental stop occurs in graphic intervocalic position, or on the basis of etymological considerations.

Dental stops after *r* and *l*

Also the words in which dental stops follow the resonants *r* and *l* (note that in genuine Hittite words we never find a dental stop following *m*) were left out of consideration in Kloekhorst 2013. I will therefore treat these here.
First I will look at the spelling of dental stops after *r*. In OS texts, the 3sg.pres.mid. form for 'he stands' is consistently spelled *ar-ta(-ri)* (7 times), with the sign TA, and never with the sign DA. This indicates the presence of a voiceless stop: [ərta(ri)]. Also in MS and NS texts, this word is consistently spelled with TA (ca. 160 times in my files), and never with DA, showing that also in Middle and New Hittite times it contained a voiceless stop, [ərta(ri)]. Etymologically, this word is generally assumed to reflect a preform *h_3*r-to(-)*, which would mean that here the PIE sequence *-*rt*- yielded Hitt. [-rt-]. This differs from the outcome of PIE *-*t* after *-*n*, where it underwent voice assimilation to OH [d]. Yet, since the *-*t* in *h_3*r-to(-)* is part of an ending, it cannot be excluded that an analogy to verbal stems ending in an obstruent has taken place (cf. the case of *kuenta* 'he killed' as treated above). In order to investigate the regular outcome of PIE *-*rt*- in Hittite, it is better to treat words in which analogical influence can be excluded.
A possible candidate is the verb *ḫuu̯art-^{i} / ḫurt-* 'to curse' and its derivative *ḫurtai- / ḫurti-* 'curse', which on the basis of an etymological connection with OPruss. *wertemmai* 'we swear' may be reconstructed as *h_2*uort- / *h_2*urt- and *h_2*urt-oi- / *h_2*urt-i-*, respectively.[35] Unfortunately, both words are unattested in OS texts, but in MS and NS texts, they both occur spelled with the sign TA as well as with DA: e.g. 1sg.pret.act. *ḫur-ta-aḫ-ḫu-un* and *ḫur-da-aḫ-ḫu-un*; acc.pl. *ḫur-ta-a-uš* and *ḫur-da-a-uš*.[36] These spellings point to the presence of a voiced stop [d], which would mean that in these words PIE *-*rt*- has undergone voice assimilation to [-rd-]. Since the dental stop is part of the root, it cannot have been influenced analogically, which would mean that we should regard this development as the phonologically regular one, whereas the presence of [t] in [ərta(ri)] must then be due to restoration of the ending. It should be noted, however, that because of the absence of OS attestations of *ḫuu̯art-^{i} / ḫurt-* and *ḫurtai- / ḫurti-*, we cannot be certain whether the voice assimilation of *-*rt*- to [-rd-] had already taken place before Old Hittite, or is instead a post-OH development. Moreover, since the etymology of *ḫuu̯art-^{i} / ḫurt-* and *ḫurtai- / ḫurti-* is not fully secured (a reconstruction with root-final *d^{h} has been proposed as well, cf. footnote 35), these conclusions must remain tentative anyway.
The outcome of the PIE sequence *-*rd*- is more clear, since it is present in the oblique stem of the word for 'heart', *ḱrd-, a word that is well attested in Hittite. In OS texts, the oblique cases of 'heart' are spelled *kar-ta*[-...] (KBo 25.107, 4 (OS)), *kar-ta-az=(š)-mi-it* (StBoT 25.7 iv 6 (OS)), *kar-ti-i=š-mi* (KBo 22.2 obv. 13 (OS)), *kar-di-i=š-ši* (KBo 25.102 ii 6 (OS)) and *kar-di-i=š-mi* (StBoT 25.3 i 12

[34] Attested twice: instr. *a-ku-ta-al-li-it* (KUB 9.20, 5), *a-ku-ta$^{!}$-al-li-it* (KUB 2.13 i 8 (text: *-ga-*)).
[35] Cf. Puhvel HED 3: 436, Kloekhorst 2008: 373, LIV^{2}: 292. Note that Sturtevant's connection (1930: 128) with Lat. *verbum* 'word', Lith. *vardas* 'name', OPr. *wirds* 'word', Goth. *waurds* 'word' would point to a root *h_2*uerd^{h}*-, with a *d^{h}.
[36] Cf. Puhvel HED 3: 433f. and Kloekhorst 2008: 372-3 for attestations.

(OS)). Although no attestations with DA are found, the alternation between TI and DI[37] points to the presence of a voiced stop: [gərd-].[38] This is supported by the attestations from MS and NS texts, where the oblique cases of 'heart' are spelled *kar-ta(-)* as well as *kar-da(-)*, and *kar-ti(-)* as well as *kar-di(-)*,[39] pointing to the presence of a voiced dental stop as well: [gərd-]. The development of PIE *-*rd*- to OH [-rd-], with a voiced stop, differs, however, from the development of PIE *-*nd*-, which, through pre-PAnat. *[-n^{ʔ}t-], yielded OH [-nt-], with a voiceless stop, which phonemically was fortis, /-nt:-/. We therefore must assume that in the PIE cluster *-*rd*-, which for pre-PAnatolian can be assumed to have been *[-r^{ʔ}t-], first the pre-glottalic feature of the dental stop was lost, yielding pre-Hitt. *[-rt-], after which the cluster underwent voice assimilation to OH [-rd-]. Since this latter cluster contrasts with the cluster [-rt-] as found in *arta(ri)*, we should interpret [-rd-] phonologically as /-rt-/, with the lenis stop /t/, and [-rt-] as /-rt:-/, with the fortis stop /t:/.

The outcome of the PIE cluster *-*rTH*- may be visible in the verb *šarta-^{i} / šart-* 'to wipe, to rub', if this really reflects a root **serd^{h}h$_{2/3}$-*.[40] In OS texts, this verb is attested three times, namely in 3sg.pres.act. *šar-ta-i* (KBo 17.18 ii 16 (OS), KBo 17.43 i 14 (OS), KUB 36.110 rev. 20 (OS)). Although the numbers are low, the absence of spellings with the sign DA seems to indicate that the dental stop of this word was not ejective, but rather plain voiceless: [sartai]. After *r*, the cluster *-*TH*- therefore seems to behave in the same way as after obstruents, namely that it loses its laryngeal without causing glottalization. Yet, since *-*rd^{h}H*- seems to have yielded OH [-rt-], and not [-rd-], we may assume that the laryngeal did lengthen the preceding stop before it was totally lost. So the PIE cluster *-*rd^{h}H*-, which in pre-PAnatolian terms can be written as *[-rtʔ-], first yielded pre-Hitt. [-rt:ʔ-] (through lengthening of the *[t] because of the following laryngeal), after which its outcome in Old Hittite was [-rt-]. Although the verb *šarta-^{i} / šart-* is not well attested in younger texts,[41] we do find a 3sg.pres.act. form [*šar-*]*da-a-iz-zi* (Bo 4869 ii 3 (StBoT 25: 103) (undat.)), which may indicate that the post-OH form of this verb was [sard°], with a voiced stop. The development of OH [-rt-] to MH/NS [-rd-] would then be identical to the development of OH [-nt-] (the outcome of PIE *-*nd*- = pre-PAnat. *[-n^{ʔ}t-]) to MH/NH [-nd-].

For the position after *l*, the material is scanty, too. There are, as far as I know, no good examples for the development of the PIE clusters *-*lt*- and *-*ld*-. The cluster *-*ld^{h}*- is attested in the verb *māl(t)-^{i} / malt-* 'to recite' that is generally derived from the PIE root **meld^{h}-*.[42] Its 3sg.pres.act. form is in OS texts attested 10 times as *ma(-a)-al-di*, with the sign DI, and once as [*ma-*]*ạ-al-ti*, with the sign TI.[43] Although the relative number of attestations with the sign DI is remarkably high, I assume that this form must be interpreted as [mā́ldi], with a voiced stop [d].[44] This would mean that the PIE cluster *-*ld^{h}*-, which should correspond with pre-PAnat. */-lt-/, through voice assimilation yielded OH [-ld-]. Also in MS and NS texts, we find the spelling *ma(-a)-al-di* next to *ma(-a)-al-ti*, but also 1sg.pres.act. *ma-al-da-aḫ-ḫi* besides *ma-al-ta-aḫ-ḫi*,[45] clearly pointing to the presence of a [d].

The PIE cluster *-*lTH*- may be visible in the word for 'shoulder', *paltan-*, which can be reconstructed as **pélth$_{2}$-n*, **plth$_{2}$-én-*.[46] In OS texts, it is attested only once, namely in the instr. form [*pa*]*l-ta-an-*

[37] If we are allowed to assume that in Old Hittite times, just as after *n*, also after *r* the pair TI vs. DI shows the same distribution in spelling as TA vs. DA.

[38] For the assumption that the initial consonant was phonetically a voiced stop [g-], see Kloekhorst 2014: 426[1666].

[39] Cf. Puhvel HED: 190-1 for attestations.

[40] Cf. Kloekhorst 2008: 737-8 for this reconstruction.

[41] Cf. CHD Š: 290-1.

[42] Cf. Kloekhorst 2008: 550-1.

[43] Cf. Kloekhorst 2014: 268 for attestations.

[44] Again, assuming that in Old Hittite times, just as after *n*, also after *l* the pair TI vs. DI shows the same distribution in spelling as TA vs. DA.

[45] Cf. CHD L-N: 132 for attestations.

[46] Although this word is usually cited as an *a*-stem *paltana-* (thus CHD P: 79-80; Kloekhorst 2008: 622; Puhvel HED 8: 76-9; Tischler HEG P: 401-2), Giorgieri (1992: 72-4) has convincingly argued that the OH instr. form *paltant* (KBo 30.30 rev. 5 (OS) [*pa*]*l-ta-an-t=a-at=kán* ~ KUB 58.111 rev. 13 (OH/NS) *pal-*[*t*]*a-an*[*-t=a-at=kán*]) shows that the noun for 'shoulder' originally was an *n*-stem, and not an *a*-stem. According to Giorgieri, *n*-stem forms are also found in the two nom.sg. forms attested in KUB 43.53 i 7, 24. The former of these (i 7) is cited in CHD (P: 80) as "*pa*[*l*]*-t*[*a-n*]*a-aš-ša-pa*" (following Neu (StBoT 25: 26), who reads the form as "*pạl-t*[*a-n*]*a-aš-ša-pa*"), i.e. as *paltanašš=a=pa*, but Giorgieri rather reads it as *pạl-t*[*a-aš-*]*ši-ša-pa*. The latter (i 24) is

t=a-at=kán (KBo 30.30 rev. 5 (OS)). The spelling with the sign TA instead of the sign DA seems to indicate that this word did not contain an ejective stop. We therefore may assume that after **l* the sequence **-TH-* behaves the same as after **r* and obstruents, namely that it loses its laryngeal without causing glottalization. Although the one attestation with the sign TA is not enough to prove whether the stop was voiceless or voiced, I assume that, just as in *šartai* = [sartai], the OS form *paltant* represents [pəltan-], with a voiceless [t]. In MS and NS texts, we find attestations spelled with the sign DA as well (cf. CHD P: 79 for attestations), showing that the OH sequence [-lt-] in younger times has undergone voice assimilation to [-ld-].
All in all, we can conclude that after **r* and **l* the outcome of the dental stops in Old Hittite seems to be the same as after obstruents, namely that etymological **t* yields the fortis stop /t:/, that etymological **d* and **d*^{h} merge into the lenis stop /t/, and that clusters with a laryngeal, **-TH-*, after having undergone lengthening of the dental stop, lose their laryngeal without causing glottalization, and thus merge with the fortis stop, /t:/. The only difference is that after *r* and *l* the difference between the fortis and lenis stops is phonetically realized as a difference in voice, namely [t] vs. [d]. Moreover, after the Old Hittite period the fortis stops yield lenis stops, which phonetically can be explained as a case of voice assimilation.

Dental stops before consonants

When standing before another consonant, dental stops are usually only written with signs of the shape *Vt*, which in Akkadian can be read *Vd* and *Vṭ* as well. Such spellings (e.g. *ḫa-at-k*° 'to close') therefore do not say anything about the phonetic realization of these stops. Occasionally, we find an alteration in the spelling of a dental stop before a consonant. For instance, the verb 'to install' is spelled *ti-it-nu-*, but more often *ti-it-ta-nu-*. This implies that the dental stop was long and voiceless: [tit:nu-]. Another case is the verb 'to cause to dry up', which is spelled *ḫa-at-nu-*, but also once *ḫa-da-nu-*. This seems to imply that in this verb the dental stop was short and voiced: [hadnu-]. A third case is the verb 'to confiscate', which is usually spelled *ap-pa-at-ri*°, but also once *ap-pa-ta-ri*°. This implies that the stop was short, but it cannot be decided whether it was voiced or voiceless: [əp:atrie/a-] or [əp:adrie/a-].
Note that in all case the dental stop precedes a resonant. We may therefore assume that only here a distinction between fortis /t:/ (realized as a long, voiceless stop [t:]) and lenis /t/ (realized as a short voiced stop [d]) was made. There is no evidence for the ejective /t:$^{?}$/ in this position. Since *tit(ta)nu-*^{zi} etymologically probably reflects **d*^{h}*i-d*^{h}*h*$_{1}$*-neu-*, we may assume that before consonants original ejectives eventually merged with the fortis stops.
Although before resonants a distinction between /t:/ and /t/ was made, we may assume that before stops this distinction was neutralized. Since e.g. *ḫatk-*^{i} is never spelled ***ḫa-at-ta-k*°, ***ḫa-ta-k*° or ***ḫa-da-k*°, we may assume that the phonetic realization of the dental stop in this position was short and voiceless: [t].

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cited in CHD (P: 80) as "[*pal-ta-n*]*a-aš-ši-ša*!(text *-ta*)*-aš-ta*" (whereas Neu (StBoT 25: 26) reads "[*pal-t*]*a-<na>-aš-šit*$^{!}$*-ta-aš-ta*"), i.e. *paltanaš=šiš=ašta*, but Giorgieri is clearly right in reading [*pal-t*]*a-aš-ši-ta-aš-ta*. Because of the form *pạl-t*[*a-aš*]*ši-ša-pa* in i 7, which Giorgieri analyses as *paltaš=šiš=apa*, he assumes that the form [*pal-t*]*a-aš-ši-ta-aš-ta* must be analyzed as "*paltaš=šiš*$^{!}$*=ašta*". The form *paltaš* would then be the nom.sg. form of a common gender *n*-stem noun *paltan-*, just as the nom.sg. form of the common gender *n*-stem noun *ḫāran-* 'eagle' is *ḫāraš*. I fully agree with Giorgieri's analyses, except for one detail: I would personally rather interpret the form [*pal-t*]*a-aš-ši-ta-aš-ta* as attested in line i 24 as representing *palta(n)=šši̯t=ašta*, and read the form from line i 7 as *pạl-t*[*a-aš*]*ši-tạ-pa = palta(n)=šši̯t=apa*, i.e. as containing a nom.sg. form *paltan* from a neuter *n*-stem *paltan-*. In this way, the several sumerographic acc.sg. forms ^{UZU}ZAG(.LU)*-an* (cf. CHD P : 79 for attestations) may then be seen as representing *paltan*, and not *paltanan*. Moreover, the interpretation of this noun as neuter would also better fit the acc.pl. form *pal-ta-na* (KBo 8.91 obv. 15 (MS)), which in CHD (P: 79) is unconvincingly read as *pal-ta-na*[*-aš*]. Furthermore, it explains the suffix accentuation in dat.-loc.sg. *paltani* /pəltáni/ and dat.-loc.pl. *paltānaš* /pəltánas/ (cf. Kloekhorst 2014: 456), which can now be explained by reconstructing a PIE proterodynamic neuter *n*-stem **pélth*$_{2}$*-n*, **plth*$_{2}$*-én-* (cf. e.g. Kloekhorst 2008: 622 for the root etymology). The specific *a*-stem forms that point to a common gender noun *paltana-* are only found in New Hittite texts (nom.sg.c. *pal-ta-na-aš* (KBo 1.42 ii 13, iv 14 (fr.) (NH/NS)), acc.sg. ^{UZU}*pal-ta-na-a*[*n*] in Bo 3640 iii$^{?}$ 9 (NS), acc.pl.c. *pal-ta-nu-uš* (KBo 1.42 ii 32 (NH/NS)), and can, as Giorgieri (1992: 73) stated, easily have been the result of a NH thematizisation of an original *n*-stem *paltan-*.

Dental stops in word-initial position: the OH situation

In Kloekhorst 2010a: 202-7 and Kloekhorst fthc., I treated the spelling of dental stops in word-initial position in Old Hittite texts, and argued (1) that consistent spelling with the sign TA denotes the presence of a plain voiceless stop [t], which corresponds with PIE **t*, **d*, and **d*^{h}; (2) that consistent spelling with the sign DA rather points to the presence of a post-glottalized stop [t^{ʔ}], the outcome of PIE **TH*-; and (3) that alternation in spelling between the signs TA and DA represents the presence of a voiced stop [d], which only occurs in loanwords. It was argued that we should equate these three stops with the intervocalic ones in the following way:

1. The word-initial voiceless stop [t] is to be equated with the fortis stop /t:/.
2. The word-initial post-glottalized stop [t^{ʔ}] is to be equated with the ejective stop /t:^{ʔ}/.
3. The word-initial voiced stop [d] is to be equated with the lenis stop /t/.

As we have seen, the voiceless stop [t], which we now can identify as the fortis stop /t:/, derives from PIE **t*, **d*, and **d*^{h}, which means that these apparently have merged at some point in the prehistory of Hittite. This merger can be dated on the basis of the following argumentation.

Dental stops followed by the vowel **i* are in Hittite subject to assibilation. This assibilation does not occur in Luwian (cf. CLuw. *tiu̯at-* 'sun-god' vs. Hitt. *šiu̯att-* 'day' < **diéu̯ot-*) and therefore cannot have been Proto-Anatolian, but must have been specifically Hittite. Since the outcome of word-initial **ti̯-*, which yields Hitt. *z-* [t͡s-],[47] is different from the outcome of **di̯-*, which yields Hitt. *š-* [s-],[48] we see that at this moment in time the fortis and the lenis stop were still phonemically distinct.[49] The merger of word-initial PIE **t*, **d*, and **d*^{h} into a single stop, [t-] = /t:-/, must therefore have been specifically Hittite as well.

Apart from giving evidence for the relative dating of the merger of the initial fortis and lenis stops, it was argued in Kloekhorst fthc. that the assibilation also provides a crucial argument for determining the exact phonetic difference between the fortis and lenis dental stops at that moment. As we have seen, the outcome of PIE **ti̯-* is Hitt. *z-*, i.e. [ts-], whereas the outcome of PIE **di̯-* is *š-*, i.e. [s-]. The difference in outcome between the two would be inexplicable if the two clusters would phonetically have differed from each other in voice: we would then expect either an outcome [ts-] vs. [dz-], or [s-] vs. [z-], but not [ts-] vs. [s-]. Instead, the difference in outcome between **ti̯-* and **di̯-* can only be explained by assuming that at that time the phonetic difference between the fortis and the lenis dental stops was one in consonantal length: **ti̯-* = *[t:j-] > *[t:^{j}-] > [ts-], whereas **di̯-* = *[tj-] > *[t^{j}-] > [s-].[50] In other words, at the time of assibilation, i.e. in pre-Hittite, post-Proto-Anatolian times, the fortis dental stop (corresponding to PIE **t*) was a long voiceless stop, *[t:-], and the lenis stop (corresponding to PIE **d* and **d*^{h}) a short voiceless stop, *[t-].[51] Later on, in Old Hittite, the two have merged into a short voiceless stop [t-], which is consistently spelled with the sign TA. Although phonetically the fortis and the lenis stop have merged by loss of length of the fortis stop, as is typologically common,[52] it is synchronically best to phonologically interpret the outcome of this merger as the fortis stop /t:/, since a new word-initial dental stop [d-] has entered the language through loanwords (spelled both with TA and with DA), which within the overall phonological system of Old Hittite is best interpreted as corresponding with the lenis stop /t/ that in some other environments is realized as [d] as well.

[47] E.g. *tieh$_2$-* > *za*$_{\underline{ḫ}}$*ḫ*$_{\underline{ḫ}}$*-* 'battle', cf. Kloekhorst 2008: 1019-20.

[48] E.g. **diēu-* > Hitt. *šīu̯-* 'god', cf. Kloekhorst 2008: 763-4.

[49] Although we do not have good examples for the outcome of PIE **d*^{h}*i̯-* in Hittite, it seems safe to assume that it would have yielded the same result as **di̯-* since in almost all other contexts the PIE stops **d* and **d*^{h} have merged in Hittite as a lenis stop.

[50] Cf. Kloekhorst 2008: 92 for this analysis, although at that time I had not yet realized its consequences.

[51] As stated in Kloekhorst fthc., although phonemic consonantal length in word-initial position is cross-linguistically rare, it certainly is attested, for instance in the Thurgovian dialect of Swiss German, in Pattani Malay, in Leti, etc.

[52] Cf. Kümmel 2007: 135.

Dental stops in word-initial position: the MH/NH situation

Words that in OS texts are consistently spelled with the sign DA (*dā-^{i} / d-* 'to take' and *dai-^{i} / ti-* 'to put') show also in MS and NS texts consistent spelling with DA. Yet, words that in OS texts are exclusively spelled with the sign TA, are in MS and NS texts spelled with the sign DA as well. Consider, for instance, the word *tamai- / tame-* 'other', whose ratio of spellings with the sign TA to spellings with the sign DA is in OS texts 7 : 0 = 100%, in MH/MS texts 22 : 3 = 88%, and in NH/NS texts 55 : 44 = 56%. Likewise the noun *tagān(ze/ipa-)* 'earth', whose ratio of TA to DA is in OS texts 6 : 0 = 100%, in MS texts 17 : 1 = 94%, and in NS texts 13 : 62 = 17%.[53] In both cases we see that, although in OS texts these words are exclusively spelled with the sign TA, in MS and especially in NS texts we encounter many spellings with the sign DA as well. In Kloekhorst 2010: 209, I tried to explain this phenomenon by stating that "the sign DA is taking over the place of TA, eventually on its way to ousting it completely", and that "[t]his probably indicates that on a phonetic level, the opposition between word-initial /ta-/ and /t^{ʔ}a-/, which was still present in OH times, is disappearing from MH times onwards". In the meantime I have changed my mind, however. I now regard the fact that *dā-^{i}* and *dai-^{i}* keep on being consistently spelled with the sign DA, also in MS and NS texts, as an indication that their initial ejective stop was retained as such in post-OH times. So /t:^{ʔ}ā-/ = [t^{ʔ}ā-] 'to take' and /t:^{ʔ}ai-/ = [t^{ʔ}ai-] 'to put' remain unaltered throughout Hittite. Moreover, in the case of the words that in OS texts are exclusively spelled with the sign TA but in MS and NS texts start being spelled with the sign DA as well, I now regard this fact as an indication that their initial voiceless stop [t-] after the Old Hittite period starts to undergo a voicing to [d-]. Since this development of OH voiceless [t-] to MH/NH [d-] in phonological terms can be described as a development of fortis /t:-/ to lenis /t-/, we can say that this is a case of a post-OH word-initial lenition.

All in all, we can set up the following chronology of sound laws to account for the dental stops in initial position.

PIE		pre-PAnat.	(1)	PAnat.	(2)	pre-Hitt.	(3)	OH	(4)	MH/NH
**t-*	~	*[t:-]	>	*[t:-]	>	*[t:-]	}	[t-] = /t:-/	}	[d-] = /t-/
**d-*	~	*[^{ʔ}t-]	}	*[t-]	>	*[t-]				
**d^{h}-*	~	*[t-]								
								[d-] = /t-/		
						influx from loanwords:				
**tiV-*	~	*[t:iV-]	>	*[t:iV-]	>	*[tsV-]	>	[tsV-] = /t^{s}:V-/	=	[tsV-] = /t^{s}:V-/
**diV-*	~	*[^{ʔ}tiV-]	}	*[tiV-]	>	*[sV-]	>	[sV-] = /sV-/	=	[sV-] = /sV-/
**d^{h}iV-*	~	*[tiV-]								
**tH*	~	*[t:ʔ-]	>	*[t:ʔ-]	}	*[t:ʔ-]	>	[t^{ʔ}-] = /t:^{ʔ}-/	=	[t^{ʔ}-] = /t:^{ʔ}-/
**dH*	~	*[^{ʔ}tʔ-]	}	*[tʔ-]						
**d^{h}H*	~	*[tʔ-]								

(1) Loss of the pre-glottalic feature of *[^{ʔ}t-], causing it to merge with *[t-].

(2) Assibilation of *[t:-] and *[t-] because of a following **i*; lengthening of *[t-] to *[t:-] because of a following */ʔ/.

(3) Phonetic loss of length in word-initial position, causing *[t:-] and *[t-] to merge in [t-], and [t:^{ʔ}-] to shorten to [t^{ʔ}-]. Influx of [d-] from loanwords.

(4) Merger of OH [t-] and [d-] into MH/NH [d-].

Dental stops in word-final post-vocalic position

In word-final post-vocalic position, there is only one way that dental stops are spelled, namely with the signs *at*, *e/it*, and *ut*. It is therefore usually assumed that Hittite knew only one type of dental stop in

[53] Cf. Kloekhorst 2010: 208.

this position. Since in Akkadian these signs are ambiguous with regard to the dental stop they contain (besides *Vt*, they can be read *Vd* and *Vṭ* as well) we cannot on the basis of these signs say anything about the phonetic rendering of the word-final dental stops. We therefore have to look for other evidence.

On the basis of the form *pa-i-ta-aš* 'he went', which consists of the 3sg.pret. form *pait* 'went' to which the enclitic pronoun *=aš* '(s)he' is added, and in which the word-final dental stop of *pait* is intervocalically spelled as a singleton, i.e. as a lenis stop, Melchert (1994: 85) states that in word-final position "[v]oiced stops have been generalized" (note that according to Melchert lenis stops were distinctively voiced).[54] Yet, as I have argued in Kloekhorst 2008: 24 and Kloekhorst fthc., the form *paitaš* cannot be used as evidence, since the single spelling of *t* in this form is grammatically relevant.

More telling is the case of the gen.sg. of the word *šeppitt-* 'grain'. In OS texts, this form is spelled *še-ep-pí-da-aš*, pointing to a phonetic form [sep:idas], which can phonologically be interpreted as /sép:itas/, with a stem-final lenis /t/ = [d]. It is generally assumed that this lenis /t/ derives from PIE **t* through the second Anatolian lenition rule, which states that original fortis stops are lenited when standing between two unaccented vowels in a posttonic position,[55] so PIE **sépitos* > OH [sép:idas] /sép:itas/. Already in Old Hittite, the form *še-ep-pí-da-aš* is replaced by *še-ep-pí-it-ta-aš*, however, with geminate spelling of the *-tt-*, pointing to the presence of a long voiceless stop [t:], which can phonologically be interpreted as fortis /t:/. It is commonly thought that this means that the original stem-final fortis consonant of *šeppitt-* < **sépit-* has been restored throughout the paradigm. The question is, however, what the exact model was for this restoration. As I have argued in Kloekhorst fthc., all oblique cases of the word *šeppitt-* (including the nom.-acc.pl. form) contained an ending starting in a vowel, **sép-it-V°*, which means that in all these forms the stem-final **t* regularly would have undergone lenition to /t/ = [d]: **sép-it-V°* > Hitt. /sép:itV°/ = [sép:idV°]. These forms therefore cannot have been the source on the basis of which the fortis /t:/ was generalized. This means that we are only left with the nom.-acc.sg.n. form *šeppit* as the possible source for restoration of the stem-final fortis /t:/. As a consequence, we must assume that this word represents /sép:it:/ = [sép:it:], containing a word-final postvocalic fortis /t:/. Since in the labiovelar series there is evidence for a distinction between word-final lenis and fortis stops, namely in *tak-ku* /tak^{w}:/ 'if' < **tok^{w}e* vs. *e-ku* /ʔék^{w}/ 'drink!' < **h$_1$ég^{wh}*, it was argued in Kloekhorst fthc. that it is likely that this distinction was made in the dental series as well, and that *še-ep-pí-it* /sép:it:/ < **sépit* probably contrasted with e.g. *e-et* /ʔḗt/ 'eat!' < **h$_1$éd*.[56]

As far as I am aware, there is, besides fortis /t:/ and lenis /t/, in word-final, post-vocalic position no trace of a third phoneme that can be identified with the ejective phoneme /t:^{ʔ}/.

Dental stops in word-final post-consonantal position

In word-final post-consonantal position the presence of dental stops is rare, since in pre-Hittite a sound law **-CT# > *-C#* has taken place (e.g. nom.-acc.sg.n. *appan* 'taken' < **h$_1$pónt*). This means that the few cases of word-final post-consonantal dental stops that we do find therefore must all be the result of restoration.

One such case is found in the OH adverb *mānḫanda*, *māḫḫanda* 'just as' (the latter of which is the regular outcome of the former within Old Hittite). This adverb is spelled in OS texts with the sign DA (*ma-a-an-ḫa-an-da*, *ma-a-aḫ-ḫa-an-da*) as well as TA (*ma-a-aḫ-ḫa-an-ta*),[57] which points to the presence of a [d]. Since this word develops in the post-OH period to *māḫḫan*, I have in Kloekhorst 2010b argued that the dental stop in *mānḫanda*, *māḫḫanda* was word-final, [mānhand] > [māh:and], which in the post-OH period regularly was lost, yielding MH *māḫḫan* [māh:an]. The original form *mānḫanda* [mānhand] was explained as a univerbation of the adverb [mān] and a form [hand], which was argued to originally have been the nom.-acc.sg. form of the noun *ḫant-* 'forehead' < PIE **h$_2$ent-*.

[54] A view that has been followed by many scholars, e.g. Vanséveren 2006: 40; Hoffner and Melchert 2008: 36; Rieken 2011: 40; Van den Hout 2011: 65.

[55] Eichner 1973: 100[86]; Morpurgo Davies 1982/83: 262; Kloekhorst 2014: 559-64.

[56] As stated in Kloekhorst fthc., although cross-linguistically it is rare to find a contrast in consonantal length in word-final position, there are certainly languages that have such contrasts, like e.g. Tashlhiyt Berber, Moroccan Arabic, the Wixli dialect of the Lak language, and Tabasaran.

[57] Cf. Kloekhorst 2010b: 218[5] for attestations.

The word-final dental stop of [hand] must then have been restored on the basis of the other forms of the paradigm of this word, which contained a [d] as well (cf. the OS spelling of the dat.-loc.sg. form *ḫa-an-ti*[58] besides *ḫa-an-di*,[59] pointing to [handi]), which is the regular outcome of PIE **t* after an **n*. Since the [d] of [hand] is taken over from the forms of the paradigm in which it stood in word-internal position, the word *mānḫanda*, *māḫḫanda* cannot be used as an argument for the development of word-final dental stops per se.

Another group of words where we find a word-final dental stop is formed by archaic instrumentals of *r*-stems and *r/n*-stems. Especially the word denoting 'by hand' is telling, since it is spelled both *ki-iš-šar-ta* and *ki-iš-šar-at*, indicating that the dental stop in such instrumentals is really word-final. The dental stops of these forms must have been restored on the basis of instrumentals of nouns with a stem ending in a vowel (e.g. *ganut* 'by knee'). Etymologically, this dental stop is often reconstructed as **-d*, but this need not be correct.[60] As I have explained in Kloekhorst 2008: 799, Anatolian evidence rather points to an original **-t*.[61] On the basis of our treatment of word-final dentals in the post-vocalic position as given above, we would now expect that after vowels this ending would have yielded Hitt. /-t:/.

In OS texts, we find that the instrumental of *r/n*-stems is spelled as follows: *ša-kán-da* (KBo 22.2 obv. 2 (OS)) 'with grease' and *ú-i-ta-an-ta* (StBoT 25.56 i 5 (OS)) 'with water'. The fact that the ending is spelled both with the sign TA and with the sign DA indicates that it consists of a voiced stop, [-d]. This contrasts with its post-vocalic shape, which is /-t:/. Apparently, also in word-final position an original */t:/ when standing after *n* was shortened and subject to voice assimilation, just as it was in word-internal position.[62]

In MS and NS texts, we do find instrumentals in *-anda* and *-anta* as well, but these are usually found in younger copies of OH compositions. In MH compositions, the instrumentals of *r/n*-stems rather end in *-enit*, a renewed form that undoubtedly is created because the OH instrumental ending in [-and] regularly lost its word-final stop (just like OH *māḫḫanda* [māh:and] lost its stop, yielding MH *māḫḫan* [māh:an]).

In the case of the instrumental of the word for 'hand', we find in OS texts three attestations spelled with the sign TA, *ki-iš-šar-ta*,[63] but none with the sign DA. Although numbers are low, this could mean that in this word the ending consists of a voiceless stop, [-t]. If this is indeed the case, it would mean that, unlike after *n*, after *r* no voice assimilation has taken place. The difference in the outcome of the dental stop /-t:/ after *r* and *n* need not surprise too much: as we have seen above, also in word-internal position, *r* and *n* have a different effect on the dental stops following them. Just like in the instrumentals in *-anda*, *-anta*, the OH instrumental form *kiššarta* [kiš:árt] is replaced in the post-OH period, namely by *kiš(ša)ret* [kiš:rét:], probably because the post-consonantal word-final stop of the former form was regularly lost.[64]

If it is indeed correct that in Old Hittite after an *r* the instrumental ending is [-t], whereas after an *n* it is [-d], we may assume two different phonemes in this position, and I would equate the voiceless stop [t] with the fortis phoneme /t:/, and the voiced stop [d] with the lenis phoneme /t/. As far as I am

[58] *ḫa-an-ti* (KBo 6.2 ii 8 (OS), KBo 17.30 iii 6 (OS)).

[59] *ḫa-an-di* (IBoT 1.121 rev. 17 (OS), KBo 25.37 rev. 8 (OS), KBo 25.38, 7 (OS)).

[60] Although Sanskrit did not know an opposition between word-final *t* and *d*, its ablative forms that correspond with the Hittite instrumental are often cited as ending in *-d*, e.g. *mád* 'from me', *tvád* 'from you', etc. This is undoubtedly done on the basis of the presence of a *d* in the OLat. thematic abl.sg. ending *-ōd* (> Class. Lat. *-ō*). Yet, since word-final **t* regularly yielded OLat. *-d* (e.g. 3sg.opt. **$h_1$siéh$_1$t* > OLat. *sied* 'he be', Weiss 2009: 155), we cannot on the basis of Sanskrit and Latin decide whether we should reconstruct the ending with a **t* or a **d*.

[61] The argument runs as follows. Since within Hittite the ablative in *-z*, which can only reflect pre-Hittite **-ti* and not **-d$^{(h)}$i*, can be seen as a derivative of the instrumental in *-(e/i)t* (addition of the locative particle / ending **-i*), it strongly suggests that the latter ending goes back to **-(e)t* with a **t*.

[62] Note that these developments must have taken place not until after the ending of the instrumental was restored in these *r/n*-stems, which may be information that can be used when setting up a relative chronology of the linguistic prehistory of Hittite.

[63] Cf. Kloekhorst 2014: 422 for attestations.

[64] Cf. Kloekhorst 2014: 422-3 for a detailed analysis of the inner-Hittite diachronic development of the instrumental form of 'hand'.

aware, there is in word-final, post-consonantal position no trace of a third phoneme that could be identified with the ejective phoneme /t:ˀ/.

Dental stops: conclusion

We can conclude that Hittite knew three phonemically distinct dental stops: a fortis one, /t:/; an ejective one, /t:ˀ/; and a lenis one, /t/. In Old Hittite, the distinction between fortis and lenis was present in all position in the word; it was not until after the OH period that in some specific environments the fortis and lenis series merged. The ejective is only distinctively present in word-initial, intervocalic and post-nasal position: in all other environments it had probably merged with the fortis series already in pre-Hittite times. The phonetic realization of the three phonemes differs per environment, as indicated in the table below:

	phonological value	phonetic realizations per environment								
		#TV-	-VTV-	-nTV-	-r/lTV-	-CTV-	-tR-	-tC-	-RT#	-VT#
fortis	/t:/	[t]	[t:]	[t]	[t]	[t:]	[t:]	--	[t]	[t:]
ejective	/t:ˀ/	[tˀ]	[t:ˀ]	[tˀ]	--	--	--	--	--	--
lenis	/t/	[d]	[d]	[d]	[d]	[t]	[d]	[t]	[d]	[t]

Although in word-initial position and after resonants the synchronic phonetic distinction between the fortis and the lenis stops is one in voice ([t] vs. [d], respectively), it was argued above that for the word-initial position this distinction originally was one in consonantal length and not in voice. I therefore assume that this originally was the case in the position after resonants as well, just as it synchronically still is after obstruents, so *[t:] vs. *[t]. In intervocalic position, the phonetic distinction between the fortis and the lenis stops is one in both length and voice, namely [t:] vs. [d], respectively. Because the distinction is marked in a two-fold, and therefore redundant, way, and because after obstruents the distinction is one in length only (as it originally was in word-initial position), it seems obvious to me that the voiced character of the lenis stops in intervocalic position is allophonic. I therefore regard it justified to set up for all positions in the word an underlying phonemic difference for the fortis vs. lenis stops that consists of consonantal length only: /t:/ vs. /t/.

The ejective stop is in intervocalic position realized as a post-glottalized long stop, [t:ˀ], but in word-initial and post-nasal position as a post-glottalized short stop, [tˀ] (in the other positions it does not seem to occur). Since the fortis stop, which underlyingly is long, [t:], is in word-initial and post-nasal position realized as a short stop, [t], we can assume the same thing for the ejective stop. This indicates that the length of the intervocalic variant is original, and that the underlying phoneme should be set up as a post-glottalized long stop /t:ˀ/. One could argue, however, that in this way it is redundantly marked vis-à-vis the fortis and the lenis stops (/t:/ and /t/, respectively), and that it would suffice to set up the ejective stop as post-glottalized only, /tˀ/. Yet, since in intervocalic position the consonantal length is relevant for whether the preceding vowel stands in an open or closed syllable, I rather keep the long character of the ejective stop expressed in my phonemic representation of it, and therefore write /t:ˀ/.

An overview of the development of PIE **t*, **d*, **d^h* and **TH* in Hittite can be given as follows (note that the outcomes are given in their phonetic, not phonological shape):

<table>
<tr><th></th><th></th><th colspan="2">#TV-</th><th>-VTV-</th><th colspan="2">-nTV-</th><th colspan="2">-r/lTV-</th><th>-CTV-</th></tr>
<tr><th>PIE</th><th>pre-PAnat.</th><th>OH</th><th>M/NH</th><th>O/M/NH</th><th>OH</th><th>M/NH</th><th>OH</th><th>M/NH</th><th>O/M/NH</th></tr>
<tr><td>*TH</td><td>*[t:ʔ]</td><td colspan="2">[t^ʔ]</td><td>[t:^ʔ]</td><td colspan="2">[t^ʔ]</td><td rowspan="2">[t]</td><td rowspan="2">[d]</td><td rowspan="2">[t:]</td></tr>
<tr><td>*t</td><td>*[t:]</td><td rowspan="3">[t]</td><td rowspan="3">[d]</td><td>[t:]</td><td colspan="2" rowspan="2">[d]</td></tr>
<tr><td>*d^h</td><td>*[t]</td><td rowspan="2">[d]</td><td colspan="2" rowspan="2">[d]</td><td rowspan="2">[t]</td></tr>
<tr><td>*d</td><td>*[ʔt]</td><td>[t]</td><td>[d]</td></tr>
</table>

<table>
<tr><th></th><th></th><th>-tR-</th><th>-tC-</th><th>-VnT#</th><th>-VrT#</th><th>-VT#</th></tr>
<tr><th>PIE</th><th>pre-PAnat.</th><th>O/M/NH</th><th>O/M/NH</th><th>OH</th><th>OH</th><th>O/M/NH</th></tr>
<tr><td>*TH</td><td>*[t:ʔ]</td><td rowspan="2">[t:]</td><td rowspan="4">[t]</td><td>?</td><td>?</td><td>?</td></tr>
<tr><td>*t</td><td>*[t:]</td><td>[d]^a</td><td>[t]^a</td><td>[t:]</td></tr>
<tr><td>*d^h</td><td>*[t]</td><td rowspan="2">[d]</td><td rowspan="2">?</td><td rowspan="2">?</td><td rowspan="2">[t]</td></tr>
<tr><td>*d</td><td>*[ʔt]</td></tr>
</table>

[a] When restored analogically.

Outlook

The phonetic and phonological interpretation of the Hittite dental stops as presented in this article are for the largest part based on an analysis of the distributions in usages of the signs TA and DA. The distributions between, on the one hand, the signs TE, TI and TU, and, on the other, the signs DE/I and DU have only been taken into account in the analysis of the spelling of dental stops following resonants (*n*, *r*, and *l*), and in the spelling of initial stops in Old Hittite (cf. Kloekhorst 2010a: 209-11). A full analysis of their usage in other positions in the word remains an important task for the future.

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