

Voiceless high vowels and syncope in older Indo-European

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The aim of this contribution is to discuss some potential cases of loss of high vowels in older Indo-European that might have involved voiceless vowels. Section 2 argues that loss of *u* and *i* before some sibilant clusters in Avestan could be caused by devoicing. In section 3, two phenomena in Hittite are treated: conditioned loss of final *i* in at least two Hittite verbs stems (3.1), and the emergence of the Anatolian ‘labiolaryngeal’ /χ^w/ (3.2). Section 4 deals with two interconnected problems in Indo-Iranic and IE, namely ‘laryngeal metathesis’ and roots variably enlarged by **i*. It is proposed that these cases can be explained by a process of devoicing and loss of high vowels in voiceless environments, potentially followed by morphological restructuring. All these cases seem to show similar tendencies that can lead to vowel loss in special environments.

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1. Introduction

While vowel reduction is a well-known phenomenon in many later IE languages (cf. e.g. Rix 1966 for Latin, McCone 1996: 127-137 for Old Irish), it is apparently less frequent in the earliest attested stages of IE (around 3300 BP), i.e. in Hittite, Old Indo-Iranic and Ancient Greek. Szemerényi’s (1964) attempt at establishing many cases of ‘irregular’ syncope already in PIE was not altogether successful: many of his examples, such as the explanation of PIE **snusó-* ‘daughter-in-law’ as a syncopated derivative of PIE **sūnu-/sunu-* ‘son’ have not found much support (this proposal is not even discussed in later etymological dictionaries such as Mayrhofer 1996: 771; Kroonen 2013: 463).

However, when we look more closely at those oldest stages, we can find some rare cases of ‘irregular’ vowel loss, always involving high vowels in the context of voiceless obstruents (especially fricatives). This could be explained by the assumption of vowel devoicing, recalling the voiceless vowels of Japanese (Tsuchida 2001) or Comanche (Armogost 1985). A more precise description and explanation of such cases has not yet been given. Such cases are discussed in this article: section 2 deals with three Avestan words, section 3 investigates two different cases

in Hittite, and section 4 deals with possible cases of an even earlier, Common IE development resulting in two different phenomena.

2. Avestan

In Avestan, the oldest attested Iranian language, we find some few words where etymologically expected *u* and *i* are absent:

2.1. Avestan *xštuua-*

The ordinal numeral ‘sixth’ is Av. *xštuua-* (masc. nom. *xštuuō*, acc. *xštūm*; fem. *xštūi*) /xʃt(u)wa-/, instead of expected **xšuš-tá-* < Proto-Indo-Iranic (PIIr.) **šuš-thá-* < Proto-Indo-European (PIE) **suks-tHó-* (cf. Hoffmann 1965: 254 = 1975: 190; Emmerick 1992: 322f.; Viredaz 1997: 142; Hoffmann & Forssman 2004: 73, 184). This word would be a regular zero grade¹ derivative of the basic numeral PIE **swéks* ‘six’ > PIIr. **šwátš* > **šwaš* > Av. *xšiuuaš* /xʃwaʃ/, OIA *ṣát* (cf. Emmerick 1992: 298f.; Viredaz 1997; Lubotsky 2000). Such an ordinal is probably also continued by Old Prussian (*w*)*uschts* from older **suštas*.² In later Iranian, the ordinal was replaced by new formations (**šwaš-ama-* or **šwaš-ta-*), so there is no further evidence within Iranian for the shape of the old ordinal.

The same type of archaic zero grade formation is found in OIA *pak-thá-* ‘fifth’ < PIIr. **pak-thá-* < **pṛk^w-tHó-* from **pénk^we* ‘five’ (> PIIr. **pánka* > OIA *páñca*, Av. *pañca*). An original Proto-Iranic (PIr.) cognate **paxθa-* was apparently changed to **puxθa-* > Av. *puxða-* /puxθa-/, Khot. *pūha-*, with *u* taken over from the neighbouring ordinal numerals *(*x*)*turíya-* ‘fourth’ > Av. (-*x*)*tūriia-* and **šušta-* ‘sixth’ (cf. Hoffmann 1965: 254 = 1975: 190; Emmerick 1992: 321f.).

2.2. The pronoun *xšma-*

One variant of the oblique stem of the second person plural pronoun is *xšma-* ‘you (plural)’ /xʃma-/ < PIr. **šma-* for expected **ušma-* (cf. Hoffmann & Forssman 2004: 73; 161). The other variant is *yūšma-* /juʃma-/ < **yušma-* with initial *y-* taken over from the nominative *yūš/yūžəm*, as also occurred in OIA *yušmá-* (nom. *yūyám*). The same variation is also found in the derived possessive pronouns *xšmāka-* ~ *yūšmāka-* (cf. Kuiper 1991: 39f.; Hoffmann & Forssman 2004: 73, 169). The original base must have been PIIr. **ušmá-* < (P)IE **usmé-*, cf. Greek **usmé-* > **uhmé-* > *umme-/hūme-* (cf. Sihler 1995: 380). The base **uš-* < **us-* is the zero grade of PIE **wos/wes* ‘you’ (oblique), cf. enclitic **was* > Av.

vā/vō, OIA *vas* beside (emphatically?) lengthened **wōs* in Latin *uōs*, Common Slavic **vas-*, *vy* etc.

Also in later Iranian, we mostly only find reflexes of **šma-* and no evidence for **ušma-* (nor **yušma-*), cf. MP *šm-*, Parth. *šm-/šm-*, Sogd. (?) *šm-* /*ʃm-*/, Yaghnobi *šumox*, Oss. *smax*. The only clear exception is Khot. *uma-* in *umāvu* ‘your’ < **ušmāyu* < **ušmākam*, etc. However, in some languages, a later regular loss of initial **u-* is possible. A similar loss of initial *a* took place in forms of the 1st person pronoun **ahma-*, Av. *ahma-*, viz. Sogd. *mʰx*, Yaghnobi *mox*, Oss. *max*.

2.3. The verb stem -xšta-

The usual present stem of *stā-* ‘to stand, to step’ is *hišta-* /*hišta-*/ ‘to step, stand’ (cf. Hoffmann & Forssman 2004: 73, 184), going back to a thematic reduplicated stem < PIr. **si-št-a-* < PIIr. **sī-šth-a-* < pre-PIIr. **si-stH-a-* (cf. OIA *tīṣṭha-* with renewed reduplication). However, we find a shorter variant *-xšta-* / *-xšta-*/ with two preverbs, namely *fra-xšta-* ‘step forward’ and *ā-xšta-* ‘step towards’. The stem *hišta-* with preserved *i* is found in the simplex verb and with the preverbs *auua-*, *niš-*, *pa’ti-*, *pa’ri-*, *ham-*, *us(ə)-*, *upa-*. This distribution could be explained by accentuation. Although the accentuation of Avestan is not transmitted in existing manuscripts, there are good reasons for assuming the same accentuation as in the closely related Old Indo-Aryan which therefore can be used as a proxy for the original Iranian accentuation (cf. de Vaan 2003: 599-602). The Avestan preverbs *fra*, *ā* were probably accented **frá-*, **á-*, cf. OIA *prá*, *á*, while all the other preverbs either end in a consonant or in an originally unaccented vowel (cf. OIA *áva*, *úpa*, *pári*, *práti*), so that we can assume Avestan **áwa-*, **úpa*, **pári*, **páti*. Thus, it seems that the stem *xšta-* without *i* only appears after an originally accented vowel (in **frá-*, **á-*), while the full stem *hišta-* is preserved everywhere else. This distribution points to a loss of the syllable containing *i*, but only in an environment immediately after an accented vowel, where reduction is especially likely.

2.4. The verb stem -xšta-

To explain these cases of apparent syncope, we could assume that the unaccented high vowels *u* and *i* were reduced to such an extent that they were no longer perceived and eventually lost. It is clear that this happened only under very specific conditions. The context suggests the following: (a) initial position or a preceding voiceless sound – *h/š* – and (b) a following postalveolar sibilant (there are no examples with other sibilants or fricatives), and (c) accent on the following or the immediately preceding vowel.

The change was no longer fully productive, cf. the preserved vowel *u* in **xšustá-* > Av. *xšusta-* ‘washed’, where analogical restitution of *u* is however possible. Other potential counterexamples have originally accented vowels: cf. Av. *uštra-* ‘camel’ = OIA *úštra-*, Av. *huška-* ‘dry’ = OIA *śúška-*. Due to the absence of a direct OIA cognate, this cannot be assured, but is plausible in Av. *uštana-* ‘power of life’; *hišca-* ‘to follow’; *hišku-* ‘dry’. The change never appears before prevocalic sibilants, nor before other fricatives or stops.

In detail, the sound change may have happened as follows (cf. Japanese /hit/ = [çit] ~ [çt]):

- (1) **ʃoʃta-* > *ʃʷoʃʷta-* > *ʃʷəʃʷta-* > (*ʃʷ*)*ʃʷta-* > *ʃʷtʷa-* > #*ʃtwa-* > #*xʃtwa-*
‘sixth’
(with regular **ʃ* > #*xʃ*)
- (2) **#oʃma-* > #*oʃma-* > #*əʃʷma-* > #*ʃʷma-* > #*ʃʷma-* = /*ʃma-*/ > #*xʃma-* ‘you, your’
(labialization probably did not spread to the labial nasal)
vs **joʃma-*, **ahma-*
- (3) **'a(:)-hiʃta-* > *'a(:)-hiʃta-* > *'a(:)-çʃta-* > *'a(:)-çəʃta-* > *'a(:)-çʃta-* > (*'a(:)-*
ʃta- >) *'a(:)-xʃta-* ‘stand’
vs *'hiʃta-* and *-hiʃta-* ‘stand’ (probably with secondary accent after unaccented prefix syllables?)

In contrast to these Avestan cases, the other phenomena discussed in sections 3 and 4 all involve root or stem-final vowels that are segmentally lost in at least some forms. But they agree in showing reduction and loss especially in consonantal and voiceless environments.

3. Hittite

In Hittite, we find two quite different cases: alternating verb stems with or without final (3.1) and the segmental loss of stem-final **u* after a preceding back fricative (3.2).

In the Anatolian subbranch of IE, there is some evidence for different types of accent-triggered reduction: In Proto- or Common Anatolian, there was a shortening of unaccented vowels, and there was lenition (probably also shortening) of fortis consonants after long vowels (necessarily accented and hence followed by an unaccented syllable) or between unaccented vowels; these two conditions can be unified by the assumption that the second mora of long vowels was unaccented, so that

lenition occurred between unaccented morae (cf. Melchert 1994: 60-61; Adiego 2001). Evidence for long vowels (written ‘plene’³ in the syllabic script) can therefore be used as evidence for accent, since unaccented vowels had been shortened, and so we have some information about the placement of stress in Hittite.

Within Hittite, there was some reduction of unaccented **e* with a change to either *i* (in closed syllables) or a vowel written as <a>, probably corresponding to [ə] at least in posttonic open syllables (see Melchert 1994: 137-140). This seems to be shown by the distribution of the variants of the present 1st plural endings <-*wa-ni*> /-wəni/ vs <[°]*u/-ú-e-ni*>⁴ /weni/ and 2nd plural endings <[°]*t-ta-ni*> /-ttəni/ vs <[°]*t-te-ni*> /-tteni/. The former variant with reduced vowel occurs mainly immediately after the accented syllable, cf. 1st plural *wa-al-ḫu-wa-ni* /wáɫχ-wəni/, *ú-wa-te-wa-ni* /úwatè-wəni/ vs the unreduced variant in *a-tu-e-ni* /at-wéni/, *pé-en-ni-ú-e-ni* /pénni-wèni/ (with secondary accent on the third syllable?). There are some counterexamples to this distribution, but it remains clear that the variant with <a> /ə/ only appears in unaccented position, while the vowel *e* was preserved under primary or secondary accent.

Two special cases in Hittite appear to involve a complete reduction of short high vowels to zero:

3.1. Stem-final *i/j*

There is a hitherto unnoticed alternation of stem-final *i/j* with zero found in at least two verbs. The variant with *i* is found before endings and suffixes beginning with vowels as well as in the endingless form, while the variant without a vowel is found before endings starting with consonants:

- (4) The first case is the athematic middle verb stem /χ^wétt(i)-/ ‘to pull, to draw’:
 The variant /χ^wétti-/ is found in:
 pres. 3rd singular MH/MS⁵ *ḫu-It-tia-ri* /χ^wétti-ari/
 3rd plural OS *ḫu-e-et-tian-ta* OS, *ḫu-(u)It-ti-ia-an-ta*, MH/MS *ḫu-It-ti-an-ta* /χ^wétti-anta/
 past 3rd singular OS *ḫu-It-ti-ia-ti* /χ^wétti-ati/
 imp. 3rd singular NS *ḫu-It-ti-ia-ru* /χ^wétti-aru/
 participle OS *ḫu-It-ti-an-t°* /χ^wétti-ant-/
 imp. 2nd singular active OH/MS *ḫu-It-ti* /χ^wétti-Ø/

The syncopated variant /χ^wétt-/ is in complementary distribution with the unsyncopated one and is found in the following forms:

- pres. 1st singular NS *ḫu-It-ta-aḫ-ḫa-ri* /χ^wétt-χχari/
 2nd singular OH/MS *ḫu-e-ez-ta* /χ^wéts-ta/ (with *t.t* > *ts.t* following a general rule)

past 1st singular NS *ħu-It-ta-ah-ħa-at* /χ^wétt-χχat/
3rd singular past NS *ħu-Iz-za-aš-ta-ti* /χ^wéts-tati/
imp. 2nd plural NS active *ħu-e-za-at-tén* /χ^wéts-ten/

The active thematic verb *ħu-(u-)It-ti-ia-* / *ħu-It-ti-e-* /χ^wétti-e-/, a variant stem with the same meaning, also fits this distribution, since it shows *i* followed by a vowel.

- (5) The second case is the athematic middle verb *pars(i)-* ‘to break’:
The variant /*parsi-*/ is attested as follows:
pres. 3rd singular OS *pár-ši-ia*, OH/MS *pár-aš-ši-ia*, MH/MS *pár-ši-ia-ri* /*pársi-a(ri)*/
3rd plural OS *pár-ši-an-ta*, *pár-ši-an-da*, *pár-ši-ia-an-da* /*pársi-anta*/
imp. 3rd plural NS *pár-ši-an-da-ru* /*pársi-antaru*/
participle OS *pár-ši-an-*, *pár-ši-ia-an-* /*pársi-ant-*/

The syncopated variant /*pars-*/ is also in near-complementary distribution with /*parsi-*/, the only exception being one attestation of the 3rd plural with the stem /*pars-*/ instead of /*parsi-*/:

pres. 1st singular OS *pár-aš-ħa*, *pár-aš-ħa-ri* /*párs-χ(χ)a(ri)*/
3rd plural (once) OS *pár-ša-an-da* /*párs-anta*/
active pres. 3rd singular (young) MH/NS *pa-ar-ši*, NS *pár-ši* /*párs-i*/
1st plural OS *pár-šu-wa-ni* /*párs-wəni*/

So the general picture shows a stem ending in *-i/j-*, which loses this *-i-* before consonants. There may be two further cases of such athematic middle verb stems with unaccented *-i-*, but no diagnostic forms with consonantal endings are attested for them: *ħāli-* ‘to kneel’; *marki-* ‘to refuse, reject, forbid’.

This stem type of middle verbs can be compared to active weak stems like *mēmi-*, *nanni-*, *wiwi-*; *penni-*, *onni-*, *uppi-*, *dāli-* and the suffix *-anni-* (Kümmel 2012). Loss of *i* is not observed here, probably because it follows a sonorant in most of these stems and most relevant endings also start with sonorants (the only exception is discussed in the next paragraph).

A possible explanation for the peculiar alternation in the middle verbs /χ^wétt- ~ χ^wétti-/ and /*pars-* ~ *parsi-*/ could be that stem-final *i* was lost between voiceless consonants, if the preceding syllable was accented (with possible analogical spread to the position before voiced consonants). I have only found one counterexample to this, namely past 3rd singular *up-pí-iš-ta* /*úppista*/ ‘sent’, imp. 2nd plural *up-pí-iš-ten* /*úppisten*/ ‘send!’ from *uppa-*/*uppi-* ‘to send’. However, *pst* resulting from loss may have been an impossible cluster, liable to prevent syncope, or to be reversed by epenthesis.

The assumed phonetic developments in detail are:

- (6) $*^1\chi^w\text{et}:\text{r}\chi:\text{a} > *^1\chi^w\text{et}:\text{r}\chi:\text{a} > *^1\chi^w\text{et}:\chi:\text{a}$ ‘I draw’
(probably early since it does not feed Hittite $*\text{ti} > \text{tsi}$)
- (7) $*^1\chi^w\text{et}:\text{t}:\text{a} > *^1\chi^w\text{et}:\text{t}:\text{a} > *^1\chi^w\text{et}:\text{t}:\text{a} > *^1\chi^w\text{et}:\text{st}:\text{a}$ ‘you draw’
(with application of the general rule $\text{t.t} > \text{ts.t}$)
- (8) $*^1\text{parsr}\chi:\text{a} > *^1\text{parsr}\chi:\text{a} > *^1\text{parsr}\chi:\text{a}$ ‘I break’
 ${}^1\text{parsit}:\text{a} > *^1\text{parsit}:\text{a} > *^1\text{parst}:\text{a}$ ‘you break’.

3.2. The labialized fricative χ^w

Another case is the rise of Anatolian labialized so-called ‘laryngeals’ (of which only one may really have been a laryngeal). Kloekhorst (2006) has shown that Common Anatolian had a monophonematic labialized dorsal/back (probably uvular) fricative going back to a sequence of PIE ‘laryngeal’ $*h_2 + *u$. This sound also appears before consonants, so that in an original sequence $*h_2u$, the vowel u was lost and left consonantal labialization.

- (9) The clearest example is present 3rd singular $/\text{tar}\chi^w\text{tsi}/ < \text{tar-}\underline{u}\text{-zi, tar-}\underline{h}\text{-zi} >$ ‘overcomes’, where the alternating spellings can only be explained by synchronic labialized $/\chi^w/$ (cf. Kloekhorst 2008: 835-8). This means that older $*t(e)r\chi-u-$ must have changed into $*ter\chi^w-$ $> /\text{tar}\chi^w-/$ in this form and in other forms built on this stem. Other probable cases (without variable spellings that could serve as a proof) of this phenomenon are the following:
- (10) $< \text{ša-an-}\underline{h}\text{-u} > /s\text{an}\chi^w-/$ ‘to roast’ $< *sen\chi u-$ $< \text{PIE } *senh_2-u-$
- (11) $< \text{la-a-}\underline{h}\text{-u} \sim \text{la-}\underline{h}\text{-u} > /l\bar{a}b^w- \sim \text{lab}^w-/$ ‘to pour’ $< *lobu-$ $< \text{PIE } *loh_3-u-$
($/b/ < \text{PIE } *h_3$ is the lenis counterpart of $*\chi < *h_2$, cf. Melchert 2011).

Unlike the cases mentioned in 2 and 3.1, a completely voiceless environment appears not to be necessary, cf. 1st singular $\text{tar-}\underline{u}\text{-mi} / \text{tar}\chi^w\text{mi}/$, but here we may also assume later analogical spread to such positions. The phonetic development might have been as follows:

- (12) $*^1\text{tar}\chi^w:\text{ots}:\text{i} > *^1\text{tar}\chi^w:\text{ots}:\text{i} > *^1\text{tar}\chi^w:\text{ts}:\text{i}$
and perhaps also $*^1\text{tar}\chi^w:\text{umi} > (*^1\text{tar}\chi^w:\text{umi} > ?) {}^1\text{tar}\chi^w:\text{mi}$.

The rise of this new phoneme, labialized $/\chi^w/$, which joined the already existing labialized velar stops, probably occurred already in Proto-Anatolian (cf. Kloekhorst 2006). A second source for it was prevocalic $*\chi w$ monophthongized to $*\chi^w$, cf. present 3rd plural $\text{tar-}\underline{u}\text{-}\underline{h}\text{-a-an-zi}$

/tarχ^w-antsi/, past 3rd plural *tar-ḥu-e-er*, *tar-uḥ-ḥe-e-er* /tarχ^w-ēr/. This means that there is a potential alternative explanation for the apparent change of *χu > χ^w in preconsonantal position. It may not reflect a regular phonetic process, but could also have been introduced analogically for original χu, taken over from paradigmatically alternating antevocalic χ^w. It does not seem possible to decide between these alternatives, but the rise of the new phoneme would be easier to explain if it was fed by two sound changes instead of just one.

4. Proto-Indo-Iranic and Common IE

Already in prehistoric IE, we have potential evidence for two types of similar developments, namely earlier changes of IE ‘laryngeals’:

4.1. ‘Laryngeal’ metathesis

Original PIE *Hi/Hu shows a regular ‘metathesis’ to *iH/uH in some cases, viz. *gHi-tó- > *giHtó- > OIA *gītá-* ‘sung’ (from *gaHi- ‘to sing’) or even *siHu-tó- > *sjuH-tó- > OIA *syūtá-* ‘sewed’. This phenomenon may in fact be explained by vowel reduction with subsequent vowel epenthesis, viz. *gHi-tó- > *gHⁱtó- *gⁱHtó- > *giHtó- ‘sung’ and *siHu-tó- > *siH^wtó- > *si^wHtó- > PIIr. *sjuHtó- ‘sewed’ (cf. Kümmel 2016a: 218). This metathesis cannot be explained through syllable structure optimization since there is no parallel metathesis in forms with *eH, *aH, *oH. Therefore, an explanation starting from a special reduction of high vowels might be preferred. This process produced a merger of the root type ending in *^oeHI- and that ending in *^oeIH- in their zero grade forms, both ending in *^oIH- at least before suffixes starting with (voiceless) obstruents. For example, a root *d^heHi- would form a zero grade adjective *d^hHi-tó- turning into *d^hiH-tó-, identical to the same type of adjective *d^hiH-tó- derived from a root *d^heiH-.

4.2. Enlarged roots

A similar process may explain variation in some ‘enlarged’ IE roots ending in ‘laryngeal’ + *i/j (cf. Rasmussen 1989 for a detailed overview of possible cases). These IE roots were probably originally extended by a suffix *-i- which was later incorporated into the root (cf. Lubotsky 2011). Such roots show an alternation between variants with *i/j and variants without this extension, and their distribution points to phonetic conditioning, as already argued by Rasmussen (1989).

For examples, Iranian doublets like *wi-kāy-a- > Av. *vikaiia-* and

**wi-kā-θa-* > Parth. *wigāh* ‘witness’ show an alternation of root morphs between *-kāy-* and *-kā-* depending on the following sound. They reflect older **kaHy-* and **kaH-* < **k^weh₁j-* and **k^weh₁-* (for the root shape **k^weh₁i-* see Weiss 2016b). The cumulative evidence of such roots in the Indo-Iranic material shows that the *i*-less variants appear to be regular before voiceless obstruents, while the longer form is preferred elsewhere, i.e. before vowels and sonorants, cf. the following data:

- (13) PIIr. **d^haHi-* < **d^heh₁(i)-* ‘to suck’:
 **d^haHi-nú-* > OIA *dhenú-* = Av. *daēnu-* ‘female animal, cow’
 **d^haHi-naH-* > OIA *dhénā-* ‘stream of milk’
 **d^haHy-as-* > OIA *dháyas-* = Av. *-dāiih-* ‘nourishment’
 **d^haHy-aH-* > **dāyā-*, **dāyakā-* > Kurd. *dê*, MP *dāyag* ‘wet nurse’
 **d^haH-triH-* > OIA *dhātri-* ‘wet nurse’
 **d^haH-rú-* > OIA *dhāru-* ‘sucking’ (only once; with unexpected loss of *i*)
- (14) PIIr. **čaHi-* < **k^hh₃(i)-*⁶ ‘to sharpen’:
 **čaHi-ni-* > Av. *saēni-* ‘sharp’
 **čaH-ta-* > Iran. **cāta-ka-* ‘smooth’ > Bactrian $\sigma\alpha\delta\gamma\omicron$, NP *sāda*
 **čaH-tra-* > Iran. **cāθra-* > Oss. *sart* ‘chisel’
- (15) PIIr. **d^haHi-* < **d^heH(i)-* ‘to see, look, view, think’:
 **d^haHi-naH-* > Av. *daēnā-* (trisyllabic) ‘view, religion’
 **d^haHi-man-* > Av. *daēman-* ‘eye, face’
 d^hi-d^haHy-a* > perfect 3rd singular OIA *dīdhāya = Iran. **didāya* > Av. *diḍaiia* ‘looks’
 **d^hi-d^haH-t(i)* > present stem 3rd singular **didāt(i)* > Av. *diḍāiti*, *diḍāt* ‘sees, saw’
- (16) PIIr. **gaHi-* < **geH(i)-* ‘to sing’:
 **gáHy-a-* > present OIA *gáya-*
 **gáH-thaH-* > OIA *gáthā-* = Av. *gāθā-* ‘song’
 **gáH-s-* > aorist OIA *gās-*
- (17) PIIr. **kaHi-* < **k^weh₁(i)-* ‘to perceive, respect’:
 **káHy-a* > present OIA *cáya-* ‘perceive, observe, respect’ (= OCS *čaje-* ‘to wait for’)
 **kaHy-a* > Iran. **kāya-* ‘perception, perceiving’ > Av. *-kaiia-*, MP *-gāy*
 **kaH-taH-* > Iran. **kātā-* ‘perception, respect’ > Oss. Digor *kadæ* ‘fame, honour’
 **kaH-tha-* > Iran. **kāθa-* ‘perception, perceiving’ > Parth., MP *-gāh*
 **káH-ru-* > OIA present *cāru-* ‘esteemed, pleasant’ (with unexpected loss of *i*)
- (18) PIIr. **paHi-* < **páh₃(i)-* ‘to drink’:
 **páHi-ya-* > OIA *-péya-* ‘drinking’

**paHy-áya* > causative OIA *pāyáya* ‘to give to drink’
 **páH-tra* > OIA *pátra* ‘drinking vessel’
 **páH-s/t* > aorist OIA *pá(s)*-

- (19) PIIr. **paHi*- < **pah₂(i)*- ‘to protect’:
 **páHi*-, cf. **poh₂i-men*- > Greek *poimén-* = Lithuanian *piemen-* ‘shepherd’
 **paHy-ú*- > OIA *pāyú*- = Av. *pāiiu-* ‘shepherd’
 **paH-trá*- > OIA *pātrá*- = Iran. **pāθra-* ‘protection’ > MP *pās*, Parth. *pāhr*, Sogd. *pāš/pārθ*
- (20) PIIr. **saHi*- < **seh₁(i)*- ‘to release, let loose’:⁷
 **sáHi-naH*- > OIA *sénā*- ‘missile; army’ = Av. *haēnā*- ‘army’
 **sáHy-a-ka*- > OIA *sáyaka*- ‘missile’
 **sáH-tu*- > OIA *sátave* ‘releasing’
- (21) PIIr. **staHi*- < **stah₂(i)*- ‘to steal’:
 **staHi-ná*- > OIA *sténá*- ‘thief’
 **stáHi-ya*- > OIA *stéya*- ‘theft’
 *(*s*)*taHy-ú*- > OIA (*s*)*tāyú*- = Av. *tāiiu-* ‘thief’
 *(*s*)*taHy-a*- > Av. *tāiia-* ‘theft’
 *(*s*)*táH-ti*- in Slavic **tāti*- > OCS *tatъ* ‘thief’

Cf. also loss in zero grade in **ápa-kHi-ti*- > PIIr. **ápa-kH-ti*- > OIA *ápa-citi*- ‘respect’ vs metathesis in first syllable in **kHi-tí*- > PIIr. **kiHtí*- > OIA *cítí*- ‘respect’ (cf. Weiss 2016a: 884); OIA *ni-cirá*- ‘observant’ could go back to **ni-kHi-rá*- without metathesis. However, the development in zero grade forms is a different topic and cannot be discussed here.

The distribution suggests regular loss of unaccented **i* before **t* and **s*, i.e. between voiceless obstruents, as the ‘laryngeals’ **h₁* and **h₂* were probably voiceless fricatives (for the likely phonetics of the ‘laryngeals’, see Kümmel 2007: 327-336; Weiss 2016a). This may have happened via devoicing as in the metathesis cases mentioned above. The phonetic development might have been as follows:

- (22) PIE **k^wohitaχ* > **k^wh₁itaχ* > **k^wçtaχ* > ... > **kahtah* > PIIr. **ka:ta*:
 (cf. (17))
- (23) PIE **paχ₁itróm* > **paχ₁i^hitróm* > *paχ^hitróm* > **pah^htram* > PIIr. *pa:^htrem*
 (cf. (19))

However, the alternation is also found with **h₃* (most probably a voiced [ʁ]), where devoicing is less probable. If such cases have to be included in the list above, we would either have to assume that the

loss of **i/j* was a kind of amalgamation by coarticulation, or that *i* was devoiced by the influence of the following *t*:

- (24) **'p̥r̥w̥itr̥om* > **'p̥r̥w̥itr̥om* > **'p̥r̥w̥itr̥om* > **'paɣtram* > **'pa:trem* (cf. (18)).

However, there is no other evidence for a devoicing between a voiced consonant and **t*.

Two further complications must be mentioned. First, the data given above also (weakly) suggest loss before PIr. **r*, which had developed both from PIE **r* and possibly from PIE **l*, cf. **d^héh₁-lu-* > Greek *thēlus* 'female', cf. **d^haH-rú-* (cf. (13)), **k^áH-ru-* (cf. (17)). This seems to contradict the assumption that voicelessness is the main factor here, but the cases are not so numerous that an explanation by regular sound change is necessarily the best option.

The second problem is that original morphological differences may be invoked, and perhaps should be preferred to explain the phonetically less expected cases, such as the problem just mentioned, viz. **k^áH-ru-* instead of expected **k^áHi-ru-*. Therefore, it remains difficult to ascertain the original distribution of variants in every detail.

While metathesis is also found with **Hu*, it is noteworthy that no *u*-less variants are found in the root type with original **^oeHu-*, where **u/w* was apparently always preserved (but see the Proto-Anatolian change **χw* > **χ^w*, cf. 3.2 above). For example, **dah₂u-* 'to burn' changed into PIr. **dahu-* > Iranian **dhau-* > **thau-* > **θau-* (Kümmel 2016a: 82-83), but never into **dah-* > **dā-*. Does this mean that there was less phonetic reduction with **u*, or should this rather be explained by better phonological preservation due to labialization being a more distinctive cue?

4.3. Morphological consequences

The alternations in 4.1 and 4.2 had morphological consequences. They led to a potential confusion between roots with rhymes in **^oeH-*, **^oeHI-*, and **^oeIH-*. This could happen because the first two types merged into forms with a full grade (as in **stáh-s-* from **stah-* and **páhi-s-* > **páhs-* from **pahi-*) before some voiceless consonants (only with **i*), and the second two merged in zero grades (cf. **pHi-tá-* > **piHtá-* from **paHi-* and **krih-tá-* 'bought' from **kraiH-*), and later partly also in full grades before (voiced) consonants, when **H* was lost. This could lead to analogic creation of new variants, disturbing the original root shape:

4.3.1. Analogical spread of °Vi-

After *VHi > Vi, the variant °Vi- could spread analogically also to the position before *t*, *s* etc., and/or antevocalic *Vj could replace *VHj > Vj in roots ending in *°eHi-, making them appear like roots in *°eiH-. Likewise, roots in *VHu- could develop a secondary variant in *Vu-.

4.3.2. Analogical spread of °VH-

After the loss of *i, the variant °VH- (> Vi-) could be analogically spread to the position before sonorants (if such formations did not come from the basic unextended root).

Some probable examples of both changes can be found in Indo-Iranic:

Type 4.3.1 *°eiH- for *°eHi-

- (25) From PIIr. *d^haHi- ‘to see’ (see 15), we find Iranian *dai-θra- > Av. dōiθra- ‘eye’ instead of *dā-θra- (vs homonymous *dāθra- ‘sickle’ > from dā- ‘to cut’).
- (26) From PIIr. *kaHi- (see 17), the OIA perfect has the stem cikay- ‘to perceive’ instead of cikāy- < *ki-kaHy-. This stem was probably back-formed from 3rd singular cikāya after the model of 3rd singular jigāya ~ stem jigáy- ‘to have won’ < *gigáy- (the long vowel of the 3rd singular arose by Brugmann’s lengthening of original *o in open syllables).
- (27) Perhaps also the present OIA dhāya- = Oss. dæj- developed from PIIr. *d^hāya- ‘to suck’ (cf. (13)) instead of expected *d^hāya- < *d^hāHy-a- from PIE *d^heh₁i-. Alternatively, *d^hāya- could also reflect *d^hh₁-éje-. It should be noted that the Ossetic verb may have undergone secondary shortening (cf. ræj- ‘to bark’ < *rāya-), but this is not possible in OIA.

Type 4.3.2 *°eH-

- (28) From PIE *poh₃i- ‘to drink’ (cf. (19)), we find *pāH-na- > OIA pāna- ‘drinking, drink’ instead of expected *pāHi-na-.
- (29) From PIE *seh₁i- (cf. (20)), we find *-sāH-na- > OIA -sāna- = Av. -hāna- ‘rest’ instead of expected *sāHi-na-.
- (30) Perhaps *d^haHrú- and *káHru- could show analogical spread of the *i*-less root variant, since *r is not a probable trigger for loss, as already discussed above.

However, all these words could also have been formed from the

unextended root, and this is hard to exclude in our present state of knowledge.

5. Conclusions

Phenomena such as those discussed here seem to indicate that reduction of (high) unstressed vowels may be found even in languages with little vowel weakening and syncope, if they are supported by a voiceless environment. Under the phonetic influence of voiceless consonants, vowels can become partially or completely devoiced. This facilitates the perception of vowel features as belonging to adjacent consonants. Especially consonants prone to undergo palatalization or labialization favour such development.

For the Avestan cases discussed in 2, no other explanation is known, and the ‘metathesis’ in 4.1 must also be due to some phonological process. For the other cases involving stem-final high vowels, morphological explanations might be invoked instead of a phonological explanation: analogical generalization of the prevocalic stem variant would explain 3.2; while for the alternations found in 3.1 and 4.2, an original morphological difference is possible, but this would not explain the apparently phonologically conditioned distribution of the variants.

Abbreviations

acc. = accusative; Av. = Avestan; fem. = feminine; IE = Indo-European; Hitt. = Hittite; imp. = imperative; Khot. = Khotanese (Saka); Kurd. = Kurdish (Kurmanji); masc. = masculine; MH = Middle Hittite; MP = Middle Persian; MS = Middle Script (Hittite); NH = Neo-Hittite; nom. = nominative; NS = New Script (Hittite); OCS = Old Church Slavonic; OIA = Old Indo-Aryan (Vedic and Sanskrit); OP = Old Persian; OS = Old Script (and Old Hittite); Oss. = Ossetic; Parth. = (Middle) Parthian; PIE = Proto-Indo-European; PIr. = Proto-Indo-Iranic; PIr. = Proto-Iranic; pres. = present; Sogd. = Sogdian.

Notes

¹ Zero grade is the vowelless variant in the IE morphological alternation called ‘ablaut’. Ablaut is a systematic, morphologically conditioned alternation between the simple vowels *e, *o (full grade), the long vowels *ē, *ō (lengthened grade) and zero. Zero grade shows a clear correlation with unaccented position and often occurs before an accented suffix, as in *suks-tHó- vs full grade *swéks.

² With secondary dissimilation of the initial sibilant (cf. Viredaz 1997: 116f.), Hoffmann & Forssman (2004: 73) consider an Italic preform *uštá- directly comparable to (w)uschts, but it is more probable that the Indo-Italic form had an initial sibilant. Old Prussian seems to be the only IE language where ‘sixth’ does not have an initial sibilant which makes an Old Prussian innovation more probable.

³ ‘Plene’ writing in the syllabic writing system of cuneiform means that a simple vowel sign is inserted beside or between signs already containing the same vowel, e.g. a-ap-pa instead of ap-pa, te-e-kán instead of te-kán, da-a-aḥ-ḥi instead of da-aḥ-ḥi.

⁴ The sign <°> is used to mark any preceding or following sequence within the word regardless of morphological boundaries, in contrast to the sign <-> implying a morphological boundary.

⁵ The labelling of attestations concerning the age of the text and the tablet (script) follows the Chicago Hittite Dictionary (CHD), i.e. OS = Old Script (and Old Hittite), MH/MS = Middle Hittite/Middle Script etc. The transliteration also follows the CHD, with the exception that cuneiform syllabic signs that can be read with e or i are transliterated with I if not disambiguated by an adjacent sign.

⁶ I use *ǎ to mark the vowel appearing instead of expected *e beside *h₃; it usually merges with *o in the attested languages but may still have been distinct in PIE. Its phonological status is not clear.

⁷ For the appurtenance of OIA (áva, vī) sã- ‘to release, unyoke’ to this root cf. Kümmel (2000: 549-550). However, it can also be derived from *sah₂i- ‘to bind’. For the structural argument made here, this is not important.

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