Variation and Change in Anatolian Reduplication

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§1 Introduction

§1.1 Asymmetries in Anatolian reduplication: Recent work on the phonology of Anatolian verbal partial reduplication (Dempsey 2015; Yates and Zukoff 2016) has established that Proto-Anatolian (PA) exhibited asymmetries in the treatment of roots with different types of initial consonant clusters.

- Reduplicative patterns reconstructed for PA — and the Hittite and Luwian treatments of these types — are given in (1) (per Yates and Zukoff 2016):

(1)

Base Shape[a]	Hittite	Luwian	**Proto-Anatolian**	Proto-Indo-European
CVX–	CV-CVX–	CV-CVX–	*CV-CVX–	*CV-CVX–
TRVX–	TRV-TRVX–	TV-TRVX–	***TV-TRVX–**	*TV-TRVX–
STVX–	*i*STV-STVX–	(TV-STVX–)[b]	***STV-STVX–**	*SV-STVX–
VCX–	VC-VCX–	VC-VCX–	—	—

[a] *C* = any consonant, *T* = obstruent, *R* = sonorant consonant, *S* = [s], *V* = vowel, *X* = optional string of additional segments
[b] Attested, but not synchronically generated.

§1.2 PA reduplication in IE perspective: This reconstruction aligns PA with Proto-Indo-European (PIE) and its oldest daughter languages, which show similar asymmetries in reduplication, i.e. (2).

(2)

	CVX–	TRVX–	STVX–	NON-DEFAULT STRATEGY
Sanskrit	*ja-gam–*	*pa-prac^h–*	*ta-st^{h}a–*	C_2-copying
Greek	*le-lu–*	*ke-kri–*	*e-stal–*	Non-copying
Gothic	*hai-hait*	*gai-grot*	*stai-stald*	Cluster-copying
PA	**ĝi-ĝis–*	**bV-brV–*	**stu-stu–*	Cluster-copying

· *TRVX–* bases show the same default C_1V copying pattern as *CVX–* bases.

· *STVX–* bases — along with a subset of other initial-cluster types in some cases — show a different, non-default copying pattern.

⇒ PA system is basically identical to Gothic.

· Recent phonological analyses (of aspects) of IE reduplication include Fleischhacker (2005); Keydana (2006, 2012); Sandell (2011, 2013); DeLisi (2015); Zukoff (2014, 2015a, to appear); Zukoff and Sandell (2015); see also Steriade (1982, 1988).

§1.3 PCR in IE: What causes the STVX– roots to consistently show non-default behavior?

- Zukoff (2015a,b) develops an analysis based on the "POORLY-CUED REPETITIONS PRINCIPLE" (PCR):

  (3) A CVC sequence containing identical consonants ($C_\alpha VC_\alpha$) is only licensed when both of the consonants are cued by robust release-related phonetic cues (namely *release burst* and *consonant-to-sonorant transitions*), so as to counteract perceptual diminishment caused by repetition.

- The recurring distinction between *TRVX–* and *STVX–* reduces to the different phonetic properties of TR and ST clusters:

  (i) TR clusters contain the requisite robust release-related phonetic cues to C_1 (cf. Wright 2004).

  ⇒ The C_1-copying reduplication output ***TV-TR****VX–* (e.g. *papra*) **is** licensed.

  (ii) In ST clusters, C_1 is not cued by any of these release-related phonetic cues.

  ⇒ The C_1-copying reduplication output ^{x}***SV-ST****VX–* (e.g. ^{x}*sasta*) **is not** licensed.

  · Some other copying pattern must apply instead.

- This pattern of repetition licensing is effected in the grammar of the IE languages by an active markedness constraint we call PCR.

§1.4 The puzzle:

- PCR is essential in generating PA reduplicative patterns, but plays no role in the synchronic grammar of Hittite or Luwian.

  · In particular, reduplication of vowel-initial roots in each language directly violates PCR.

  · Thus, PCR must be **inactive** in both languages, i.e. demoted to the bottom of the grammar.

⇒ So how did Anatolian go from a system where PCR was active to one where it is completely inactive?

§1.5 Proposal: Independent phonological changes in Hittite and Luwian eliminate the distinction between *TRVX–* and *STVX–* roots in reduplication, allowing learners to converge on a PCR-free analysis:

◇ Luwian synchronically lacks *STVX–* roots due to sound change: PA **#sT– > #T–*.

◇ Hittite renews cross-linguistically rare onset "skipping" *TV-TRVX–* reduplicative pattern with onset "full copy" *TRV-TRVX–* pattern. This allowed for speakers to reanalyze the *(i)STV-STVX–* pattern as driven by the same preference for full onset copying, rather than by PCR.

§1.6 Roadmap:

- §2 – A brief overview of the Hittite and Luwian data
- §3–4 – The synchronic reduplicative grammars of Hittite & Luwian; demonstrate the *inactivity* of PCR
- §5 – The synchronic reduplicative grammar of Proto-Anatolian; demonstrate the *activity* of PCR
- §6 – Outline pathways of change from PA to Hittite and Luwian.

  · Appendix I contains a complete list of reduplicative stems that are securely paired with attested bases in Anatolian.

§2 Hittite and Luwian Data

There are four relevant distinctions by root/base-type: (i) *CVX–*, (ii) *VCX–*, (iii) *TRVX–*, and (iv) *STVX–*.

· See Yates and Zukoff (2016) for more details.

- In both Hittite and Luwian (and Lycian), whenever the root begins in a C_1V sequence, the reduplicant is C_1V, as shown in (4):

(4) **Reduplication with CVX– bases**

	GLOSS	BASE	REDUPLICATED STEM	
Hitt.	'happen'	*kiš–*	*kikkiš–*	[ki-kːis-]
	'wipe'	*warš–*	*wawarš–*	[wa-warsː-]
	'demand'	*wēk–*	*wewakk–*	[wé(ː)-wakː-]
CLuw.	'take'	*la–*	*lala–*	[la-la-]
	'give'	*pī(ya)–*	*pipišša–*	[pi-pi-]
HLuw.	"	**pa–*	*pi-pa-sa–*	[pi-pa-]
Lyc.	"	*pije–*	*pibije–*	[pi-βi-]

· There are several different sub-patterns for the reduplicative vowel (copy vocalism, fixed [i], fixed [e]); in addition, some root-initial consonants show gemination in reduplication. These issues do not impact our analysis, and we leave them aside for the present.

- Vowel-initial bases in both Hittite and Luwian show a *VC-VCX–* reduplicative pattern, e.g. (5):

(5) **Reduplication with VCX– bases**

	GLOSS	BASE	REDUPLICATED STEM	
Hitt.	'mount'	*ark–*	*ararkiške–*	[ar-ark-]
CLuw.	'wash'	*īlḫa–*	*ililḫa–*	[il-ilχa-]

- For *obstruent* + *sonorant*–initial bases (TRVX–), Hittite displays a cluster-copying pattern *TRV-TRVX–*, while Luwian has the standard IE skipping pattern *TV-TRVX–*, as shown in (6):

(6) **Reduplication with TRVX– bases**

	GLOSS	BASE	REDUPLICATED STEM	
Hitt.	'blow'	*par(a)i–*	*parip(p)ar(a)i–*	[pri-pːr(a)i-]
	'kneel'	*ḫal(a)i–*	*ḫaliḫal(a)i–*	[χli-χ(ː)l(a)i-]
CLuw.	'carry off'	*par(a)–*	*papra–*	[pa-pra-]

- For inherited *s* + *obstruent*–initial roots (PIE/PA **STVX–*), Hittite and Luwian again diverge.

(7) **Reduplication with STVX– bases**

	GLOSS	BASE	REDUPLICATED STEM	
Hitt.	'become evident'	*istu–*	*išdušduške–*	[istu-stu-]
CLuw.	*'become evident'	PA **stu–*	*dušduma/i–*	[tu-stu-]
	*'bind'	PA **sh₂(o)i–*	*ḫišḫi(ya)–*	[χi-sχi-]

· Hittite shows copying of the full cluster (as in *TRVX–* bases), plus a prothetic [i].

· The initial [i] must be epenthetic, and outside of the reduplicant proper; if the root were underlyingly vowel-initial, we would expect the copy pattern for *VCX–* roots, yielding **is-istu–*.

· Luwian synchronically lacks *STVX–* bases; the Luwian reduplicated forms in (7) are relics of the PA **STV-STVX–* pattern, with *lautgesetzlich* deletion of **s* in Pre-Luwian (cf. §6.3 below).

§3 Synchronic Analysis of Hittite Copying Patterns

§3.1 CVX– bases in Hittite

- Most of the interesting analytical points arise in the cluster-initial roots; the *CV-* copying pattern to CVX– roots will largely follow from any approach to reduplication.
- One interesting point: post-nuclear consonants (e.g. C_2 in a C_1VC_2 root) are not generally copied; the exception will be with vowel-initial roots — see below.
- A markedness constraint disfavoring consonant clusters will suffice to capture this generalization:

(8) *CC: *Assign one violation for each consonant cluster.*

- We could alternatively/additionally use the constraint ALIGN-ROOT-L (*assign one violation mark * for each segment which intervenes between the left edge of the word and the left edge of the root*) for this purpose, as in Zukoff (to appear) on Greek.
- Since consonant clusters are generally allowed to surface outside of reduplication, *CC must be dominated by the faithfulness constraints which could repair a cluster, namely MAXC-IO and DEPV-IO.

- Copying one post-nuclear consonant (candidate 10b) or both post-nuclear consonants (candidate 10c) adds a gratuitous violation of *CC, since there are now more consonant clusters than necessary.
- *CC thus advocates for a smaller reduplicant; this consideration outweighs the constraint which prefers fuller copying, MAX-BR:

(9) MAX-BR: *Assign one violation mark * for each segment in the base without a correspondent in the reduplicant.*

(10) CVX– roots: *warš-* 'wipe' → *wa-warš-*

	/RED, wars–/	*CC	MAX-BR
a. ☞	wa-wars-	*	**
b.	war-wars-	**!	*
c.	wars-wars-	**!*	

§3.2 TRVX– bases in Hittite: Roots with initial *obstruent* + *sonorant* (TR) clusters copy both root initial consonants, plus the reduplicative vowel; e.g. *prai-* 'blow' → *pri-prai-*.

- The crucial constraint in preferring the cluster-copying candidate *pri-prai-* (13a) over a cluster-reducing CV reduplicant candidate *pi-prai-* (13b) is CONTIGUITY-BR:

(11) CONTIGUITY-BR
*Assign one violation mark * if two segments which are contiguous in the base have correspondents in the reduplicant that are not contiguous.*

- To make use of this constraint for the current example, we must assume that the reduplicative vowel corresponds either to the entire diphthong of the base [ai], or the first base vowel [a].
- This problem does not arise with monophthongal nuclei, as in the *STVX–* example below.

- As long as this constraint dominates the constraint dispreferring copying the cluster, *CC, the cluster-copying candidate is selected as the winner.
- A third candidate, *ri-prai-* (13c), is one which copies the second root consonant rather than the first. This succeeds in reducing the cluster (maximally satisfying *CC) without violating CONTIGUITY-BR, but does so at the expense of another constraint, ANCHOR-L-BR, which is undominated in Anatolian:

(12) ANCHOR-L-BR
*Assign one violation mark * if the leftmost segment of the reduplicant does not correspond to the leftmost segment of the base.*

- With the ranking shown in the tableau below, we select the cluster copying candidate.

(13) TRVX– roots: *prai-* 'blow' → *pri-prai–*

/RED, prai-/	ANCHOR-L-BR	CONTIGUITY-BR	*CC
a. ☞ pri-prai-			**
b. pi-prai-		*!	*
c. ri-prai-	*!		*

§3.3 STVX– bases in Hittite: Roots beginning in #ST comprise a special case of cluster-initial roots.

- In Hittite, they display the same cluster-copying pattern as do TRVX– roots, but they additionally display prothesis of [i] to the (word-initial) reduplicant cluster: *istu–* 'become evident' → *istu-stu–*.

⇒ This complication follows directly from the independent process of prothesis to initial ST clusters.

- Prothesis must still be synchronically active (even if, diachronically speaking, it has already applied to all its potential targets), as this root does not behave like vowel-initial roots, i.e. *[x] is-istu–*.

  · Therefore, input-output mapping: /stu–/ → [istu–] (root stored with initial #ST-cluster)

- To generate prothesis, the constraint militating against initial ST clusters (*#ST, 14a) must outrank the constraint militating against epenthesis (DEPV-IO, 14b). This is illustrated in (15).

  · DEPV-IO must also be dominated by other faithfulness constraints whose violation could repair an initial ST cluster, for example MAXC-IO, which penalizes consonant deletion.

  · Additional considerations are necessary to select prothesis over cluster-internal epenthesis. These are not crucial for the current argument, so they are omitted.

(14) Constraints involved in epenthesis:

a. *#ST
*Assign one violation mark * for each word-initial ST cluster.*

b. DEPV-IO (= Don't epenthesize a vowel.)
*Assign one violation mark * for each output vowel without an input correspondent.*

(15) Epenthesis to ST roots: /stu-/ → [istu-]

/stu-/	*#ST	DEPV-IO
a. stu-	*!	
b. ☞ istu-		*

- Since ST roots are indeed stored underlyingly with an initial ST cluster, these roots can act just like other cluster-initial roots (i.e. TRVX–), subject to the additional condition of prothesis, which applies now to the reduplicant cluster rather than the base cluster.

- This results from combining the constraints and rankings already established independently for TRVX– roots in reduplication (13), and STVX– roots in isolation (15). This is shown in (16):

(16) STVX– roots: /stu-/ → [istu-stu-]

/RED, stu-/			*#ST	ANCHOR-L-BR	CONTIGUITY-BR	DEPV-IO	*CC
a.		stu-stu-	*!				**
b.	☞	istu-stu-				*	**
c.		su-stu-			*!		*
d.		tu-stu-		*!			*

- The simple cluster-copying candidate (16a), which is equivalent to the pattern for TRVX– roots, is impossible here, because that would result in an initial ST cluster (prohibited by undominated *#ST).
- Copying a non-root-initial consonant (16d) is again suboptimal (for violating ANCHOR-L-BR).
- Lastly, the candidate which just copies the root-initial *s* (16c) is not permitted because it violates CONTIGUITY-BR, as the *s* and the vowel are not adjacent in the root while they are in the reduplicant.

⇒ This leaves (16b), which is equivalent to the cluster-copying candidate (16a), except that it additionally has prothesis before the reduplicant. As long as DEPV-IO is dominated by the three highest-ranked constraints, this candidate remains optimal.

· It is crucial that the epenthetic *i* does not belong to the reduplicant proper, as this would lead to a fatal ANCHOR-L-BR violation.

§3.4 VCX– bases in Hittite: Vowel-initial roots show VC copying: *ark-* 'mount' → *ar-ark-isk–*.

- This pattern follows completely from the ranking necessary to generate the *iSTV-STVX–* pattern above.

(17) VCX– roots: *ark-* 'mount' → *ar-ark-*

/RED, ark-/			ANCHOR-L-BR	CONTIGUITY-BR	*CC
a.		ark-ark-			**!
b.	☞	ar-ark-			*
c.		ak-ark-		*!	*
d.		r-ark- / k-ark-	*!		*

- Copying from non-root-initial position (17d) provides ideal syllable structure, but incurs a high-ranked ANCHOR-L-BR violation.
- Copying the vowel and the second root consonant (17c) violates CONTIGUITY-BR.
- Copying the full post-nuclear cluster (17a) yields an unnecessary *CC violation.

⇒ Copying the root-initial vowel and the first post-nuclear consonant (winning candidate 17b) doesn't violate any extra constraints, and is selected as optimal.

§4 Synchronic Analysis of Luwian copying patterns

- Hittite and Luwian agree on their surface patterns for CVX– and VCX– roots; their differences arise only in cluster-initial roots.
  - · Unlike Hittite, Luwian retains the PIE/PA skipping pattern for TRVX– roots.
  - · Luwian lacks a synchronic pattern associated with STVX– roots because it lacks /sTVX–/ roots (§6.3).

§4.1 TRVX– bases in Luwian:

- Whereas Hittite shows cluster-copying for TRVX– roots (*TRV-TRVX–*), Luwian shows the more typical IE pattern of single-consonant copy: *TV-TRVX–*.
- We can select the Luwian pattern by taking the ranking proposed for Hittite and reversing the ranking of CONTIGUITY-BR relative to *CC:

(18) TRVX roots: *para-* 'carry off' → *pa-pra–* (cf. Hittite *prai-* → *pri-prai–*)

/RED, p<a>ra-/		ANCHOR-L-BR	*CC	CONTIGUITY-BR
a.	pra-pra-		**!	
b. ☞	pa-pra-		*	*
c.	ra-pra-	*!	*	

- This is the pattern we reconstruct for PA, and we can use the same ranking to generate it.

§4.2 VCX– bases in Luwian, and the ranking of PCR: Just like in Hittite, vowel-initial roots in Luwian show VC copying (e.g. *ilḫa–* 'wash' → *il-ilḫa–*). As shown in (19), this reduplicative pattern can be analyzed just like the identical Hittite pattern (cf. §3.4).

· The different relative ranking of *CC and CONTIGUITY-BR between Hittite and Luwian does not affect the outcome of the derivation.

(19) VCX– roots: *ilḫa–* 'wash' → *il-ilḫa–*

/RED, ilχa-/		ANCHOR-L-BR	*CC	CONTIGUITY-BR	PCR
a.	ilχ-ilχa-		**!		
b. ☞	il-ilχa-		*		*
c.	iχ-ilχa-		*	*!	
d.	l-ilχa- / χ-ilχa-	*!	*		

◇ This *VC-VCX–* pattern (in both languages) is very interesting from an Indo-European perspective.

- As mentioned in the introduction, the standard IE distribution of skipping to TRVX– roots (*TV-TRVX–*) vs. alternative pattern to other cluster types (always including STVX– roots) can be explained by the POORLY-CUED REPETITIONS PRINCIPLE (PCR), which projects the constraint in (20) (simplified slightly for present purposes):

(20) PCR: *Assign one violation mark * for each sequence of repeated identical consonants ($C_\alpha VC_\alpha$) that surfaces in pre-obstruent position.*

- The VC-copying pattern to VRT– roots in (19) violates PCR, as it places a consonant repetition (*lil*) before an obstruent (χ).

◇ Therefore, the PCR constraint must be **inactive** (i.e. at the bottom of the ranking) in Hittite and Luwian, even though it is active in the grammars of virtually all other IE languages with reduplication, *including Proto-Anatolian* (see below).

§5 Cluster-initial Bases in Proto-Anatolian: Evidence for PCR

§5.1 PA reconstruction: Based on the presence of the skipping pattern in Luwian, and the sound change evidence for #ST clusters (§6.3), we reconstruct the Proto-Anatolian reduplication patterns as in (21). (See Yates and Zukoff 2016 for more detailed argumentation.)

- This distribution is entirely parallel to Gothic (see, e.g., Keydana 2006, 2012, Zukoff and Sandell 2015).

(21)

	CV-CVX–	TV-TRVX–	STV-STVX–
Proto-Anatolian	*ĝi-ĝis–	*bV-brV–	*stu-stu–
Gothic	*hai-hait*	*gai-grot*	*stai-stald*

- PA did not yet have vowel-initial roots; the *VC-VCX*– pattern arises independently in Hittite and Luwian (as argued in §6.4 below).

§5.2 PA synchronic analysis: A high-ranked PCR constraint generates the distribution.

- The default C_1-copying candidate (22b) cannot surface here because it violates PCR.
- With the ranking ANCHOR-L-BR ≫ *CC, mis-anchoring (22c) is worse than copying the entire cluster, so (22a) is selected as optimal.

(22) PA STVX bases: **STVX– → *STV-STVX–* (PA **stu– → *stu-stu–* > Hitt. *išdušdu–*, CLuw. *dušdu–*)

/RED, STVX-/			ANCHOR-L-BR	PCR	*CC	CONTIGUITY-BR
a.	☞	STV-STVX– (*stu-stu–*)			**	
b.		SV-STVX– (*su-stu–*)		*!	*	*
c.		TV-STVX– (*tu-stu–*)	*!		*	

- When C_1-copying would not lead to a PCR violation, namely for TRVX– bases, the ranking *CC ≫ CONTIGUITY-BR allows for the skipping pattern to win out.

(23) PA TRVX– bases: **TRVX– → *TV-TRVX–* (e.g. PA **brV– → *bV-brV–* > Luw. *pa-pra–*)

/RED, TRVX-/			ANCHOR-L-BR	PCR	*CC	CONTIGUITY-BR
a.		TRV-TRVX– (*pra-pra–*)			**!	
b.	☞	TV-TRVX– (*pa-pra–*)			*	*
c.		RV-TRVX– (*ra-pra–*)	*!		*	

§5.3 Constraint re-ranking and the demise of PCR in Anatolian: The Anatolian languages show different reduplicative patterns — and thus independent constraint re-ranking — with respect to PA.

- Generating the set of changes that characterize the attested Anatolian languages requires the separate re-ranking of just three constraints in Hittite and Luwian, i.e. (24):

(24)

PA	PCR	≫	*CC	≫	CONTIG
Luwian	*CC	≫	CONTIG	≫	PCR
Hittite	CONTIG	≫	*CC	≫	PCR

- The set of changes can thus largely be characterized by two changes in rankings:

  (i) PCR is rendered *inactive* in Hittite and Luwian, and is demoted to the bottom of the grammar; this allows for the emergence of the *VC-VCX*– pattern.

(ii) Hittite additionally shows a reversal of CONTIG and *CC, generating cluster-copying as the default pattern for cluster-initial roots, i.e. the *TRV-TRVX–* pattern.

◦ **Why** does PCR cease to be operative between PA and the Anatolian languages?

§6 Inner-Anatolian phonological change & reduplication

§6.1 The demise of PCR — a hypothesis: The demotion of PCR is observed in (synchronically) vowel-initial roots (< **h₁eC–*), but is an effect rather than a cause of this change.

- We propose that the demotion of PCR is due to Hittite- and Luwian-internal phonological changes affecting *TRVX–* and *STVX–* in reduplication (cf. §6.2–6.3 below).
  - · After the loss of (prevocalic word-initial) **h₁*, reduplication of newly vowel initial roots would have been generated by the innovative grammar.
  - · This analysis assumes that **h₁* (in certain positions) was a post-PA development at the earliest; the evidence for this "late" chronology is discussed in §6.4.

§6.2 From PA to Hittite: The crucial innovation of Hittite was the renewal of the inherited onset "skipping" reduplication (**TV-TRVX–*) with full onset copy reduplication (*TRV-TRVX–*).

- The onset skipping pattern is cross-linguistically rare, with direct parallel (only?) in Klamath (Barker 1964; Steriade 1988).
  - · This typological asymmetry possibly reflects a bias toward full onset copy (i.e. high-ranked CONTIGUITY-BR).
- In OT terms, this pattern amounts to the promotion of CONTIGUITY-BR over *CC, i.e. (25) > (26).

(25) Proto-Anatolian

/RED, prV–/		*CC	CONTIG
a.	prV-prV–	**!	
b. ☞	pV-prV–	*	*

>

(26) Pre-Hittite I

/RED, prai–/		CONTIG	*CC
a. ☞	pri-prai–		**
b. (*)	pi-prai–	*!	*

- This change — from the PA grammar in (25)/(27) to Pre-Hittite in (26)/(28) had significant implications for the analysis of *STVX–* roots:
- At the stage in (28), the losing candidate (b) violates both CONTIGUITY-BR and PCR.
- But unlike PCR, CONTIGUITY-BR is independently necessary to account for TRV-TRVX– reduplication.

⇒ In the absence of direct evidence for PCR, Hittite learners converged on a simpler analysis — the *STV-STVX–* pattern was reanalyzed as driven by CONTIGUITY-BR, and PCR was demoted to the bottom of the grammar, i.e. (29).

(27) Proto-Anatolian

/RED, stu-/		PCR	*CC	*CONTIG
a. ☞	stu-stu-		**	
b.	su-stu-	*!	*	*

∨

(28) Pre-Hittite I

/RED, stu-/		PCR	CONTIG	*CC
a. ☞	stu-stu-			**
b.	su-stu-	*!(?)	*!(?)	*

∨

(29) Pre-Hittite II

/RED, stu-/		CONTIG	*CC	PCR
a. ☞	*(i)*stu-stu-		**	
b.	su-stu-	*!	*	*

- Provided that the innovations in (28–29) chronologically *precede* the loss of **h₁* (in at least #_V), the new grammar generates *VC-VCX–* reduplication straightforwardly:

(30) PIE/Proto-Anatolian

/RED, *h₁Vrĝʰ–/	PCR	*CC	*CONTIG
a. ☞ h₁V-h₁Vrĝʰ–		*	
b. h₁Vr-h₁Vrĝʰ–		**!	

(31) Pre-Hittite III (= Hittite)

/RED, ark–/	CONTIG	*CC	*PCR
a. ☞ ar-ark–		*	*
b. ark-ark–		**!	
c. ak-ark–	*!	*	

  - Prior to the change, **h₁VC–* roots would reduplicate like ordinary *CVX–* roots, i.e. (30).
  - After (i) constraint re-ranking and (ii) loss of **h₁*, these newly vowel-inital roots in Hittite are correctly predicted to show *VC-VCX–* reduplication, i.e. (31).

- A summary of the proposed changes from PA to Hittite and their relative chronology is given in (32):

(32)

Stage	**Ranking**
(I) Proto-Anatolian	PCR ≫ *CC ≫ CONTIG
TRVX– roots: Skipping pattern changes to cluster-copying pattern *Indeterminacy about ranking of PCR vis-à-vis STVX– roots*	
(II) Pre-Hittite I	PCR ?? CONTIG ≫ *CC
PCR is unnecessary to account for STVX– roots, so it is demoted	
(III) Pre-Hittite II	CONTIG ≫ *CC ≫ PCR
**h₁ deletes / #_V* *Newly vowel-initial roots fed into grammar, generate VC-VCX– pattern*	
(IV) Pre-Hittite III / Hittite	CONTIG ≫ *CC ≫ PCR

§6.3 From PA to Luwian: The crucial innovation of Luwian was the elimination of *STVX–* roots from the lexicon.

- This loss was due to regular sound change — specifically, to a new rule deleting PA **s* in **#sT*, i.e. (33).

⇒ Loss of **s* before obstruents in onsets, but retention elsewhere, e.g. (34) vs. (35):

(33) (Pre-)Luwian **s*-DELETION: **s* > ∅ / $_{\sigma}[$ ___ [–son]

(34)

	PA		CLuw.		Hitt.
a.	*sp or–	>	p arritti ‘spreads’	cf.	išp āri
	*st (e)h₃men–	>	t ummān ‘ear’		išt āmanan
b.	*st u(-stu)–	>	d ušdu(miš) ‘manifest; voucher’		išt u–
	*sh₂ i(-sh₂i)–	>	ḫ išḫiyanti ‘bind’		išḫ (a)i–

(35)

PA		CLuw.		Hitt.
*h₁é sh₂ -r̥	>	ā šḫ ar(-sa) ‘blood’	cf.	ē šḫ ar
*–o s-t i–	>	lump-a št i– ‘regret’		dalug-a št i– ‘length’
*h₁é s-t i	>	ā št i ‘is’		ē šz i

- As the innovative deletion rule became categorical, the /s/ of **sT*-initial roots would no longer surface in simplex verbal forms.

- This /s/ might have been recoverable if supported by alternations, but Luwian has no productive prefixing morphology other than reduplication.
- In principle, reduplicating verbal stems, like (34b) could have retained underlying root-initial /s/ …
  - But the historical simplex verbs corresponding to the attested reduplicated forms of **sT*-roots appear to have been lost (e.g. CLuw. *ḫāi** 'binds' : *ḫišḫi(ya)–*; cf. Hitt. *išḫ(a)i–*).

⇒ The lack of direct evidence for [s] led to *restructuring* of historically **sT*-initial roots, with /s/ uniformly lost from URs — i.e. PA */STVX–/ > Luw. /TVX–/.

- **STVX* and **CVX* roots would then merge as /CVX/.
- Lacking a synchronic contrast between /STVX/ and /TRVX/ roots, speakers have no motivation to posit PCR (which is doing no "work" in the grammar).

⇒ PCR was therefore re-ranked at the bottom of the grammar.

- A prediction of this analysis is that synchronically generated reduplicative forms to roots of either historical shape would at this stage show the same *CV-CVX–* pattern; thus PA */sTVX/ > Luw. */TVX/ → *TV-TVX–*. Clear (counter-)evidence for this claim is so far lacking; a possible positive example is CLuw. *dūp(a)i–* 'strike' (< PIE **(s)teup–*; cf. *LIV*^{2}: 602–3) → *dūdupa–* (hapax; see Melchert 1993:238), but the issue is confounded by cognate Lyc. *tub(e)i–* 'id.' and the problem of **s*-mobile.

- A summary of the proposed changes from PA to Luwian and their relative chronology is given in (36):

(36)

Stage	**Ranking**
(I) Proto-Anatolian	PCR ≫ *CC ≫ CONTIG
*Emergence of rule deleting *s in *#sT* *Deletion rule becomes categorical, eliminating evidence for /s/* **/sTVX/ roots are restructured as /TVX/*	
(II) Pre-Luwian I	PCR ?? *CC ≫ CONTIG
No synchronic contrast in cluster initial roots, thus no evidence for PCR. *PCR is demoted to the bottom of the grammar.*	
(III) Pre-Luwian II	*CC ≫ CONTIG ≫ PCR
**h_1 deletes / #_V* *Newly vowel-initial roots fed into grammar, generate VC-VCX– pattern*	
(IV) Pre-Luwian III / Luwian	*CC ≫ CONTIG ≫ PCR

§6.4 On the chronology of Anatolian laryngeal loss: The proposed analysis assumes a relatively "late" loss of **h_1 / #_V*.

- Specifically, its loss must be concomitant with or postdate the other changes affecting reduplication in cluster-initial roots, which necessarily occur within the daughter languages.

⇒ Loss of **h_1* in this environment must also occur separately in (the prehistory of) Hittite and Luwian.

- Several pieces of evidence suggest the loss of **h_1* was an independent development in these languages (§6.4.1–6.4.2).
  - Melchert (2015) now rejects the evidence for "limited Čop's Law," which would entail the loss **h_1 / #_V* in PA (cf. Melchert 1994:65).

§6.4.1 Blocking of **ns* assimilation: Inherited nasal-sibilant clusters regularly undergo assimilation to *–šš–* [-sː-] in Hittite, but **–nh₁s–* instead yields Hitt. *–nz–* [-nt͡s-] — e.g. (37a) vs. (37b) :

(37)
a. PA **dél/óns-u–* > Hitt. *daššu–* 'strong'
   PA **$h_2$óns-o–* > Hitt. *ḫāšša–* 'offspring'
b. PA **ǧénh₁-su* > Hitt. *kēnzu* 'lap'

- If **–ns–* assimilation is rightly a post-PA development (Melchert 1994:63), (37b) would argue for the retention of **h₁* into Hittite.

· On (37a), see Melchert (1994:163), and on (37b) Kloekhorst (2008:468–9) (for the morphology, cf. Hitt. *tepsu–* 'small' < PIE **dʰébʰ-su–*); see Byrd (2015:100–2) on the non-deletion of PIE **h₁* / *n_C*.

§6.4.2 Blocking of assibilation: Assibilation of **T* / _ yV (> Hitt. *–z–*, Luw. *–z–*, Lyc. *–z–*) is a PA feature, e.g. (38) (cf. Melchert 1994:62):

(38) PIE/PA **–tyo–* > Hitt. *šarāzziya–*, Lyc. *hrzze/i–* 'upper'
PIE/PA **h₂et-ye/o–* > Hitt. *ḫazziya–* 'strike (an instrument)'; HLuw. *ḫazi–* 'incise; write'

- But **–Th₁y–* > Hitt. *–Ty–*, e.g. (39) (Kimball 1999:404; cf. Melchert 1983:14):

(39) PIE/PA **dh₁-ye/o–* > Hitt. *tiya* 'bind' cf. Skt. *dyáti*, OAv. *(ni.)diiātąm*, Gk. *déō*
PIE/PA **d(h)h₁y-énti* > Hitt. *tianzi* 'place'

· With Melchert (1994:65), non-assibilation in 'place' may be analogical, but this explanation is excluded for 'bind' (on which see *LIV*²: 102). A separate Hittite development is assibilation of **T* / _ i (e.g. Hitt. *–zi* < PIE/PA **–ti* (3SG.PRS.); cf. CLuw. *–tti*).

§6.5 Relative chronology and reduplication: In view of §6.4.1–6.4.2, it is plausible to assume that:

- The loss of **h₁* in **h₁*-initial roots was subsequent to the other changes affecting reduplication in Hittite and Luwian.
- After the loss of **h₁*, these roots were subject to reduplication in accordance with the new synchronic grammar yielding the *VC-VCX* pattern.

§6.6 Support for the demotion of PCR? New PCR-violating reduplicative forms arise within Hittite:

(40) a. *titḫa* [tít͡χ(ː)a] 'thunders' (3SG.NPST.MID.)
b. *lilḫuwai* [lít͡χʷai] 'pours' (3SG.NPST.MID. (: *laḫ(ḫ)u–* 'pour')

- In the case of (40a), the PCR-violating cluster is demonstrably non-original, since PIE **Th₂V* > PA **TV* (e.g. Hitt. *paltāna–* 'shoulder' < **pl̥th₂-eno–*; cf. Melchert 1994:69).
- As argued by Oettinger (1979:514) and Dempsey (2015:304–6), (40a) is cognate with Ved. *tan^{i}–* 'id.', both from PIE **(s)tenh₂–*, with the developments in (41):

(41) PIE **tí-tn̥h₂-o* > (Pre-)Hitt. **títaχχa* > Hitt. *titḫa* 'thunders'

- Assuming in (41) *inner-Hittite* syncope of the vocalized syllabic sonorant (**a* < **n̥*) explains the synchronically irregular stem-final cluster **–tḫV–*.
  - Yet why was syncope allowed to create a new PCR-violating sequence [tít͡χ-]?
- At an early prehistoric stage (PA/Pre-Hittite I), syncope would have been blocked by PCR.
- But when PCR was subsequently demoted within Hittite, the blocking effect ceased to apply, and syncope occurred.

⇒ Independent evidence for the operation of PCR?

· For syncope in (41), cf. Hitt. *tit(ta)nu–* 'install' with spellings *<ti-it-nu->* (see Melchert to appear a). An alternative possibility (suggested by R. Sandell, p.c.) is that it was syncope itself applying in Pre-Hittite (I) that opacified PCR at this stage; however, the conditions for syncope in (Pre-)Hittite remain too poorly understood for any certainty.

- A similar set of developments may have lead to the emergence of (40b) *lilḫuwai*– (< PIE **leh$_3$-w*–).
- Reduplicative forms of (at least) the shape **LV-LT*– (*L* = liquid) are systematically unattested in the IE languages (cf. Sandell 2014).
  - For instance, there is no ^{x}*lelĝ*– (to the root of Lat. *lēgī*, TB *lyāka*, etc.) although there are several morphological contexts (e.g. PNIE perfect weak stems) where this configuration could have arisen.
- If this gap is non-accidental and driven by PCR at the PIE level, then [lí]χ^{w}- may have emerged within Hittite after the demotion of PCR (either via historical syncope or synchronically generated).
  - Potentially relevant is (hapax) spelling <*li-la-ḫu-i*> — the oldest attested form of the verb (cf. *CHD*, L–N:57) — which *could* directly reflect a pre-syncope stage.
  - As shown by Melchert (2011:130), the etymologically related [i]-reduplicated stem CLuw. *li-lūwa*– is an inner-Luwian creation to the (laryngeal-metathesized) base *lūwa*– 'pour' (< PIE **luh$_3$*– ← **lh$_3$u-C*–), and thus provides no evidence for an inherited reduplicated [i]-present with zero-grade of the root (as argued by Dempsey 2015:294).

§7 Conclusions (& discussion)

- The reduplicative patterns of the Anatolian languages differ from those reconstructible for PA (Yates and Zukoff 2016), which is indicative of *grammar change*.
  - Like the other ancient IE languages, PA reduplication shows effects of PCR (Zukoff 2015a,b).
  - Yet by attested Hittite and Luwian, PCR has been demoted to the bottom of the grammar, as shown especially by the innovative *VC-VCX*– reduplicative pattern.
- Proposed diachronic scenario for the change:
  - (i) Phonological changes affecting the reduplication of cluster-initial roots (*TRVX, STVX*) in Hittite and Luwian produced ambiguities in the learning data with respect to PCR, leading to its eventual demotion.
  - (ii) The problematic *VC-VCX*– reduplicative pattern emerged independently in each language after the post-PA loss of prevocalic word-initial **h$_1$*, when newly vowel-initial roots were input into the innovative synchronic grammar.

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§8 Appendix I: Paired Reduplicative Stems in Anatolian

- All examples of reduplicative stems paired with attested verbal bases in the Anatolian languages we judge to be secure are given in (42) with philological notes below:

(42)

	GLOSS	BASE	REDUPLICATED STEM		RED. VOCALISM
Hitt.	'mount'	*ark–*	*ararkiške–*	[ar-ark-]	COPY
	'sit'	*ēš–*	*ašāš–*	[as-á:s-]	COPY (?)
	'kneel'	*ḫal(a)i–*	*ḫaliḫal(a)i–*	[χli-χ(:)lai-]	COPY/[i]
	'become evident'	*ištu–*	*išdušduš[e]–*	[istu-stu-]	COPY
	'happen'	*kiš–*	*kikkiš–*	[ki-k:is-]	COPY/[i]
	'cut'	*kuwarške–*	*kuwakuwarške–*	[k^wa-k^war-]	COPY
	'pour'	*laḫ(ḫ)u–*	*lilḫuwa–*	[li-lχ^wa-]	[i](/*[e])
	'bend'	*lak–*	*lelakk–*	[lé(:)-lak:-]	[e]
	'chant'	*mald–*	*mammalt–*	[ma-malt-]	COPY
	'fall'	*mau(šš)–*	*mummiye–*	[mu-m:-]	COPY
	'blow'	*par(a)i–*	*parip(p)ar(a)i–*	[pri-p:r(a)i-]	COPY/[i]
	'shoot'	*šiye–*	*šišiye–*	[si-si-]	COPY/[i]
	'place'	*d(a)i–*	*titti–*	[ti-t:i-]	COPY/[i]
	'step'	*tiya–*	*titti–*	[ti-t:i-]	COPY/[i]
	'cry out'	*wai–*	*wiw(a)i(šk e–)*	[wi-w(a)i-]	COPY/[i]
	'wipe'	*warš–*	*wawarš–*	[wa-wars:-]	COPY
	'demand'	*wēk–*	*wewakk–*	[wé(:)-wak:-]	[e]
CLuw.	'run'	*ḫuiya–*	*ḫuihuiya–*	[χ^wi-χ^wi-]	COPY/[i]
	'wash'	*īlḫa–*	*ililḫa–*	[il-ilχa-]	COPY/[i]
	'take'	*la–*	*lala–*	[la-la-]	COPY
	'pour'	*lūwa–*	*lilūwa–*	[li-lu:-]	[i]
	'give'	*pī(ya)–*	*pipišša–*	[pi-p(:)i-]	COPY/[i]
	'break'	*malḫu–*/ *malwa–*	*mammalḫu–*/ *mammalwa–*	[má-m:alχ^w-] / [má-m:alwa-]	COPY(/*[e])
	'strike'	*dūp(a)i–*	*dūdupa–*	[tu-tupa-]	COPY
HLuw.	'exalt'	*sarla–*	*sasarla–*	[sa-sarla-]	COPY
	'release'	*sa–*	*sasa–*	[sa-sa-]	COPY
	'fill'	*su(wa)–*	*susu–*	[su-su-]	COPY
	'stand'	*ta–*	*tata–*	[ta-ta-]	COPY
Lyc.	'give'	*pije–*	*pibije–*	[pi-βi-]	COPY/[i]

- More paired stems are easily reconstructible for PA by Anatolian-internal comparison, e.g. Hitt. *lipp–* 'lick' : Luw(o-Hitt). *lilipa(i)–*; Hitt. *pašš–* 'swallow' : Luw(o-Hitt.) *pipašša(i)–*; Hitt. *nai–* 'turn' : CLuw. *nana–*; Hitt. *tar–* 'say' : CLuw. *tatariya–* / HLuw. *ta-ta-ra/i-ya–* [tatar(i)ya–] 'curse'; and significantly, Hitt. *išḫ(a)i–* 'bind' : CLuw. *ḫišḫi(ya)–*.
- The hapax verbal form cited by *CHD* (L–N: 58) as *lilakki*, can also be read *lelakki*, and together with *wewakk–* and *mēm(a)i–* assigned historically to the class of "iterative-intensive" *$*h_2e$*-conjugation **Cé-CoC–* reduplicating presents reconstructed by Jasanoff (to appear).
- The reduplicated stems of Hitt. 'sit' and 'step, assuming a standing position' are semantically irregular in that they have transitivizing semantics with respect to their bases, i.e. 'cause to sit' and 'cause to stand'. On the distinction between the homophonous reduplicated stems *titti–*, see Melchert (to appear a) (cf. Jasanoff 2010).