

# Reduplication in Ancient Greek

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## 1 Introduction

### REDUPLICATION:

- A word-formation process that creates a new grammatical category by *copying* part of the base word and affixing it to the base word (as a prefix or suffix).
- For any given word of the category, which sounds comprise the reduplicative affix will depend on which sounds are in the base word, rather than being consistent across all the different base words.

- Ancient Greek uses reduplication to create perfect tense forms (“I have X’ed”), exemplified in (1).

### (1) Reduplication in the Ancient Greek perfect tense

Root		Perfect Tense		Gloss
√ <i>kalup-</i>	‘cover’	κεκάλυπται	[ <u>ke</u> -kalup-]	‘s/he has covered’
√ <i>pemp-</i>	‘send’	πέπεμπται	[ <u>pe</u> -pemp-]	‘s/he has sent’
√ <i>dō-</i>	‘give’	δέδωκα	[ <u>de</u> -dō-]	‘I have given’
√ <i>lu-</i>	‘loosen’	λέλυχα	[ <u>le</u> -lu-]	‘I have loosened’
√ <i>sōs-</i>	‘save’	σέσωσμαι	[ <u>se</u> -sōs-]	‘I have saved’

#### Notes on transcription

- [ɔ] = the vowel in *caught*
- [ɛ] = the vowel in *bed*
- a macron above a vowel (V̄) means that vowel is long

- The initial consonant of the root is repeated, followed by the vowel [e], followed by the root.
- ▷ *Notation*: the “reduplicant”, which is the part of a reduplicated word that is the result of the copying process, is indicated by underlining.

- However, not all roots make their perfect tense form in exactly this way.

### (2) Other types of perfect tense forms

Type	Root	Perfect Tense
a. <i>e</i> -prefixation	√ <i>stel-</i>	‘prepare’ ἔσταλα [e-stal-]
b. Vowel lengthening	√ <i>onoma-</i>	‘name’ ὠνόμαα [ōnoma-]
c. “Attic Reduplication”	√ <i>ager-</i>	‘gather’ ἀγᾶγερμαι [ <u>ag</u> -āger-]

**Goals of today's talk:**

- Identify the different ways that Ancient Greek can make perfect tense forms.
- Formalize an analysis of the different patterns based on the types of sounds that make up the root.
- Explore the properties and historical origins of the irregular “Attic Reduplication” pattern.
- Formalize an analysis of that pattern's irregular behavior, and show that it accounts for another set of irregular forms as well.

**2 The Phonemic Inventory of Ancient Greek**

- The distribution of the different patterns are determined by the phonological properties of the segments (i.e. sounds) in the root (specifically, the initial string of segments), so it will be helpful to know Ancient Greek's full segmental inventory.

(3) Ancient Greek consonantal inventory

		<i>Place of Articulation</i>				
		Bilabial	Alveolar	Velar	Glottal	
<i>Manner of Articulation</i>	Voiceless Stops	p	t	k		} <b>Obstruents</b>
	Voiceless Aspirated Stops	p <sup>h</sup>	t <sup>h</sup>	k <sup>h</sup>		
	Voiced Stops	b	d	g		
	Fricatives		s, z(d)		(h)	
	Nasals	m	n	[ŋ]		} <b>Sonorants</b>
	Liquids		l, r			

- The important division among the consonants is the difference in manner of articulation indicated by the horizontal line.
  - Above the line are “obstruents” — consonants with a high degree of oral closure
  - Below the line are “sonorants” — consonants with a lesser degree of oral closure (more like vowels)
  - ★ Liquids and nasals (and also vowels) are [+sonorant], stops and fricatives are [-sonorant]
- The important division among the vowels is between short and long, particularly among the non-high monophthongs.

(4) Ancient Greek vowel inventory (Smyth 1920:8–9)a. Monophthongs (short and long)

	Front	Back
High	i ī	u ū
Mid (close)	e ē	o ō
Mid (open)	ē	ō
Low	a ā	

b. Diphthongs

	Front	Back
Short	ai, ei, oi, ui	au, eu, ou
Long	āi, ēi, ōi	ēu

### 3 Consonant-Initial Roots in the Perfect Tense in Ancient Greek: Reduplication vs. *e*-Prefixation

#### 3.1 Data

- All roots that start with a single consonant followed by a vowel make their perfect tense form with reduplication like we saw in (1) above, repeated here:

#### (5) Reduplication with roots beginning in CV

Root		Perfect Tense	
$\sqrt{kalup-}$	‘cover’	κεκάλυπται	[ <u>k</u> e-kalup-]
$\sqrt{pemp-}$	‘send’	πέπεμπται	[ <u>p</u> e-pemp-]
$\sqrt{d\bar{o}-}$	‘give’	δέδωκα	[ <u>d</u> e-d $\bar{o}$ -]
$\sqrt{lu-}$	‘loosen’	λέλυκα	[ <u>l</u> e-lu-]
$\sqrt{s\bar{o}s-}$	‘save’	σέσωσμαι	[ <u>s</u> e-s $\bar{o}$ s-]

- Based on these forms, we can make several generalizations about how reduplication works in these cases:

#### (6) Properties of reduplication

- (i) The first consonant of the root is copied, not some other consonant:
  - $\sqrt{kalup-} \rightarrow$  ke-kalup-, not \*le-kalup- or \*pe-kalup-
- (ii) The reduplicated consonant is always followed by [e], regardless of the root vowel (i.e., the root vowel is not copied):
  - $\sqrt{kalup-} \rightarrow$  ke-kalup-, not \*ka-kalup- or \*ku-kalup-
- (iii) One segment is copied, but not any more than that (e.g., not a full syllable):
  - $\sqrt{kalup-} \rightarrow$  ke-kalup-, not \*kale-kalup- or \*kalupe-kalup-
  - \* *Later, we actually will see a case where we do copy a little more than one segment, but only under very particular circumstances.*

- For some roots that start with two consonants plus a vowel (CCV), we find the exact same pattern:

#### (7) CCV roots with reduplication

Root		Perfect Tense	
$\sqrt{kri(n)-}$	‘decide’	κέκριμαι	[ <u>k</u> e-kri-]
$\sqrt{grap^h-}$	‘write’	γέγραφα	[ <u>g</u> e-grap <sup>h</sup> -]
$\sqrt{pneu-}$	‘breathe’	πέπνυμαι	[ <u>p</u> e-pnū-]
$\sqrt{tla-}$	‘suffer’	τέτλακα	[ <u>t</u> e-tlā-]

- Based on the generalizations in (6), these forms are what we should expect.
  - They each copy the first segment of the root, followed by [e], and don’t copy anything else.
  - $\sqrt{kri-} \rightarrow$  ke-kri-, not \*re-kri- or \*ki-kri- or \*kre-kri- *etc.*

- However, there's another set of CCV roots that disobey this pattern, illustrated in (8).
  - Instead of showing reduplication, these roots just have the [e] prefixed to the root.

(8) CCV roots without reduplication: e-prefixation

Root		Perfect Tense		
√ <i>stel-</i>	'prepare'	ἔσταλκα	[e-stal-]	not *[ <u>se</u> -stal-]
√ <i>skep-</i>	'view'	ἔσκεπται	[e-skep-]	not *[ <u>se</u> -skep-]
√ <i>kten-</i>	'kill'	ἔκτονα	[e-kton-]	not *[ <u>ke</u> -kton-]
√ <i>pseud-</i>	'lie'	ἔψευσμαι	[e-pseus-]	not *[ <u>pe</u> -pseus-]

**MAJOR QUESTION:**

What distinguishes the CCV roots that show reduplication from the ones that show just *e*-prefixation?

- There is a generalization to be made about the types of consonant sequences (“clusters”) in the two different sets of roots in terms of the feature [ $\pm$ sonorant].
  - All of the cases where  $C_1C_2V$  roots exhibit reduplication,  $C_2$  is [+sonorant], i.e. a liquid or a nasal (a sonorant consonant)
  - All of the cases where  $C_1C_2V$  roots fail to exhibit reduplication and instead show just *e*-prefixation,  $C_2$  is [−sonorant], i.e. a stop or a fricative (an obstruent)
- We can leverage this generalization for an explanation of where we get reduplication and where we don't.
- Consider what would happen if reduplication were carried for the different root types:
  - ▷ *Notation:* R = sonorant consonant, T = obstruent, V = vowel, C = any consonant, X = optional segments

(9) Results of (would-be) reduplication with different root types

a.	$C_1VX$	→	✓	$\boxed{C_1e-C_1}VX$
b.	$C_1R_2VX$	→	✓	$\boxed{C_1e-C_1}R_2VX$
-----				
c.	$C_1T_2VX$	→	✗	$*\boxed{C_1e-C_1}T_2VX$ → ✓ $e-C_1T_2VX$

- In all cases, copying the first root consonant creates the same sequence:  $\boxed{C_1eC_1}$ .
  - I'll refer to this as a “consonant repetition”, where instances of an identical consonant are separated only by a vowel.
- The difference between the types is what sort of segment follows the consonant repetition.
  - For CV roots (9a), the consonant repetition is followed by a vowel.
    - Vowels are [+sonorant] segments.
  - For CRV roots (9b), the consonant repetition is followed by a sonorant consonant.
    - Sonorant consonants are [+sonorant] segments.
  - For CTV roots (9c), the consonant repetition is followed by an **obstruent**.
    - ⇒ **Obstruents are [−sonorant] segments.**

- We can use the difference in the context following the consonant repetition to characterize the distribution of when you get reduplication and when you don't:
  - Reduplication occurs when the following context is [+sonorant].
  - Reduplication does not occur when the following context is [–sonorant].
- Therefore, we can explain the distribution by saying that there is a *constraint* on the application of reduplication in Ancient Greek:
  - Reduplication is allowed except when it would create a consonant repetition which is immediately followed by a [–sonorant] segment.

### 3.2 Analysis

- We can think of this in terms of *ordered rules*, where rule application is subject to certain constraints.<sup>1</sup>
  - Specifically, there is a constraint on consonant repetitions:

**CONSTRAINT ON CONSONANT REPETITIONS (\*C<sub>α</sub>VC<sub>α</sub>T):**

Consonant repetitions which are immediately followed by a [–sonorant] segment are not permitted.

⇒ This constraint exerts its influence over the reduplication rule.

- To generate the different types of perfect forms for consonant-initial roots, we will need two rules:

(10) *Analysis of the perfect* (for consonant-initial roots)

1. Prefix [e] to the root
2. Prefix a copy of the root-initial segment **unless the result would violate \*C<sub>α</sub>VC<sub>α</sub>T**

- The derivations of the three different root types is shown in (11):

(11) Perfect stem formation for consonant initial roots

	<b>C<sub>1</sub>VX</b>	<b>C<sub>1</sub>R<sub>2</sub>VX</b>	<b>C<sub>1</sub>T<sub>2</sub>VX</b>
Input:	/kalup/	/kri/	/kton/
Rule 1: <i>e</i> -prefixation	e-kalup-	e-kri-	e-kton-
Rule 2: reduplication	<u>k</u> e-kalup-	<u>k</u> e-kri-	<b>blocked by *C<sub>α</sub>VC<sub>α</sub>T</b> (✗ <u>k</u> e-kton-)
Output:	[ <u>k</u> e-kalup-]	[ <u>k</u> e-kri-]	[e-kton-]

<sup>1</sup> For a fuller analysis framed within Optimality Theory (Prince & Smolensky 1993), see Zukoff (2017a,b).

## 4 Vowel-Initial Roots in the Perfect Tense in Ancient Greek: The Regular Pattern — Vowel-Lengthening

### 4.1 Data

- For roots which begin in a vowel, the normal pattern of perfect stem formation is not reduplication, but rather lengthening of the initial vowel.

(12) Vowel-lengthening perfects (forms from Smyth 1920:147, Schwyzer 1939:65)

Root	Perfect Tense
√ <i>onoma-</i> ‘name, call’	ὠνόμακα [ōnoma-]
√ <i>ort<sup>h</sup>o-</i> ‘set upright’	ὄρθωκα [ōrt <sup>h</sup> ō-]
√ <i>et<sup>h</sup>el-</i> ‘wish’	ἤθελκα [ē <sup>h</sup> el-]
√ <i>elpid-</i> ‘hope’	ἤλπικα [ēlpi-]
√ <i>angel-</i> ‘announce’	ἄγγελκα [ānggel-]
√ <i>ag-</i> ‘lead’	ἄγμαι [āg-]

- The normal relationships between short and long vowels are:
  - /e/ → [ē]
  - /o/ → [ō]
  - /a/ → [ā] (in Attic-Ionic, [ā] has become [ē]; see, e.g., Sihler 1995:48–52)

- The key to understanding the vowel-lengthening pattern is Ancient Greek’s process of “vowel contraction”.

### 4.2 Vowel Contraction and Syllable Structure

- Ancient Greek exhibits a phonological process called “vowel contraction”:
  - When there are two adjacent vowels (which cannot make a diphthong), they are fused into a single long vowel which preserves certain features of the two original vowels.

(13) Examples of vowel contraction

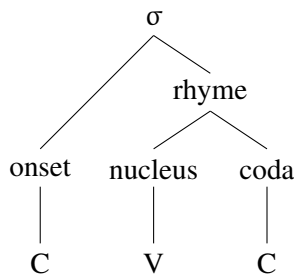
a. /tīma-omen/ ‘we honor’	→ τιμῶμεν [tīmōmen]
b. /p <sup>h</sup> ile-ete/ ‘you (pl.) love’	→ φιλεῖτε [p <sup>h</sup> ilēte]
c. /e-dēlo-e/ ‘s/he was showing’	→ ἐδῆλοῦ [edēlō]

(14) Vowel contraction outputs (Smyth 1920:19–21; de Haas 1988)

V <sub>2</sub>	/a/	/e/	/o/
/a/	ā	ā	ō
V <sub>1</sub>	/e/	ē ~ ā	ē <ει>    ō <ου>
/o/	ō ~ ā	ō <ου>    ō <ου>	

- **Question:** What motivates vowel contraction? **Answer:** A desire to improve syllable structure.

(15) Syllable structure



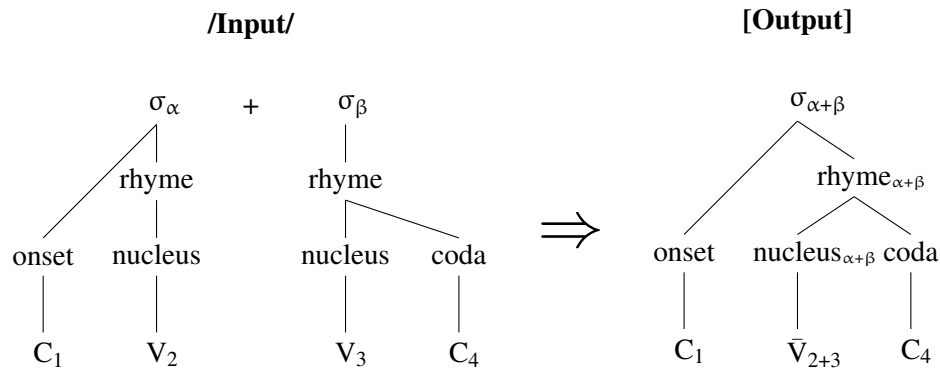
- Syllables are divided into 3 parts: onset, nucleus, and coda.
  - Nucleus and coda are themselves part of a constituent called the rhyme.
- All syllables have nuclei, which is where the vowel is located.
- Syllables may optionally have a coda (consisting of one or more consonants), though these are slightly dispreferred.
- Syllables may optionally have an onset (consisting of one or more consonants), **though these are strongly preferred.**

- We can formalize the preference for syllables to have onsets with another constraint:

<b>CONSTRAINT ON ONSETLESS SYLLABLES (ONSET):</b>
Syllables must have onsets.

- The preference for syllables to have an onset (the ONSET constraint) drives contraction.
  - $\sigma_\beta$  can acquire an onset by merging with  $\sigma_\alpha$ . This requires merging of the vowels.
  - As a way of preserving the fact that there were originally two vowels, the merged vowel surfaces as a long vowel.

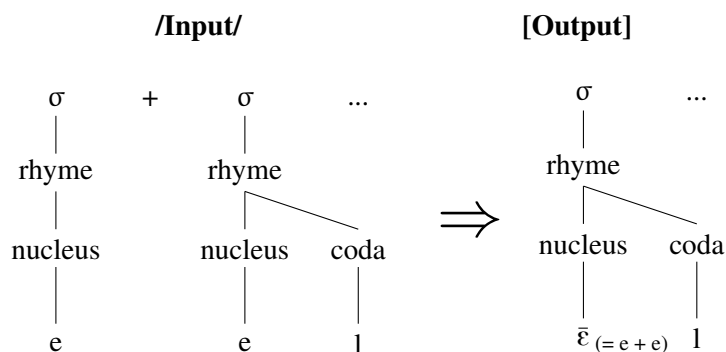
(16) Contraction in terms of syllable structure



### 4.3 Analysis of Vowel Lengthening in the Perfect: Lengthening is Contraction

- ⇒ The vowel-lengthening pattern in the perfect can be viewed as the result of the [e] seen in the other perfects **contracting** with the initial vowel.
- If we assume that vowel-initial roots also undergo *e*-prefixation, the same contraction process can generate the long vowel in the perfect from [e] + the root-initial vowel.
  - Neither syllable underlyingly has an onset, so by merging them, we reduce the number of onsetless syllables from 2 to 1.

(17) Contraction of [e] + root-initial vowel in the perfect:  $\sqrt{elpid-} \rightarrow$  perfect [ēlpi-]



★ Note that some of the vowel quality facts resulting from normal contraction are slightly different than the vowel quality facts which result from vowel-lengthening in the perfect. These discrepancies can be reconciled formally (Zukoff 2017a:47–48), so I will not discuss them here.

- The ONSET constraint that drives vowel contraction can also help explain why we don't see reduplication in this pattern (i.e. no overt copying).
  - If you copied the first segment of the root — which, for these roots, is a vowel — you would be *creating* an extra onsetless syllable, which would then have to be resolved through contraction.
    - $\sqrt{onoma-} \rightarrow *//\underline{o}e\text{-onoma-//}$
  - By not copying the root-initial segment, you avoid creating extra bad syllable structure.
- We can thus posit that there is another condition on the copying rule, which is that it fails to occur if doing so would create an onsetless syllable (i.e. violate ONSET).
- We also need to add the contraction rule (after the *e*-prefixation rule).

(18) *Analysis of the perfect* (for vowel-initial roots)

1. Prefix [e] to the root
2. Prefix a copy of the root-initial segment **unless the result would violate**
  - Ⓐ  $*C_{\alpha}VC_{\alpha}T$
  - Ⓑ ONSET
3. Perform contraction to reduce the number of onsetless syllables

• The derivation of the pattern for vowel-initial roots (right hand column) is shown in (19), alongside the other two patterns:

(19) Perfect stem formation

	$C_1(R_2)VX$	$C_1T_2VX$	$/V_1CX/$
Input:	/kri/	/kton/	/onoma/
Rule 1: <i>e</i> -prefixation	e-kri-	e-kton-	e-onoma-
Rule 2: reduplication	<u>k</u> e-kri-	<b>blocked by <math>*C_{\alpha}VC_{\alpha}T</math></b>	<b>blocked by ONSET</b> (✗ <u>o</u> e-onoma)
Rule 3: contraction	n/a	n/a	ōnoma-
Output:	[ <u>k</u> e-kri-]	[e-kton-]	[ōnoma-]



## 5 Vowel-Initial Roots in the Perfect Tense in Ancient Greek: The Irregular Pattern — “Attic Reduplication”

### 5.1 Data

- Not all vowel-initial roots make their perfect by lengthening the vowel.
- A small set of vowel-initial roots instead employ the “Attic Reduplication” pattern. Some examples are given in (20):

(20) Vowel-initial roots that exhibit Attic Reduplication perfects

Root		Perfect Tense		
$\sqrt{eleut}^h$	‘go, come’	ἐλήλυθα	[e $\bar{l}$ -ēlut <sup>h</sup> -]	not *[ēlut <sup>h</sup> -]
$\sqrt{en(e)k}$	‘bring’	ἐνήνοχα	[en-ēnok <sup>h</sup> -]	not *[ēnok <sup>h</sup> -]
$\sqrt{ager}$	‘gather together’	ἀγάγερμαι	[ag-āger-]	not *[āger-]
$\sqrt{akou}$	‘hear’	ἀκᾶκοα	[ak-āko-]	not *[āko-]
$\sqrt{od}$	‘smell’	ὄδωδα	[od-ōd-]	not *[ōd-]
$\sqrt{or}$	‘stretch’	ὄρωρα	[or-ōr-]	not *[ōr-]

- We can summarize the properties of these forms as:

(21) Properties of Attic Reduplication:  $\sqrt{V_1C_2X} \rightarrow \underline{V_1C_2}\text{-}\bar{V}_1C_2X\text{-}$

- The initial VC sequence is copied
- The root-initial vowel is lengthened

- Within Ancient Greek, there is nothing to distinguish the types of vowel-initial roots that have Attic Reduplication from the types of roots that show just vowel-lengthening. However, there is a clear distinction when we consider their etymologies:

⇒ All of the roots which have Attic Reduplication perfects can be reconstructed as having an initial **laryngeal** in Proto-Indo-European (the reconstructed parent language of Greek, Latin, Sanskrit, and many others).

### 5.2 Laryngeals and the Origin of the Attic Reduplication Pattern

- The laryngeals are a set of consonants reconstructed for Proto-Indo-European (PIE) based on internal and comparative evidence (de Saussure 1879).

★ For an introduction to laryngeal theory, consult, for example, Mayrhofer (1986:121–145), Fortson (2010:62–64, 81–83), Byrd (forthcoming).

- They are partially attested in the Anatolian languages, but have been lost in all other IE branches.
- Their exact phonetic characteristics are unknown, but they are generally identified as having been fricatives with constriction in the rear of the vocal tract.

- The most commonly recognized reconstructed phonemic inventory of PIE contains three laryngeals:
  - $h_1$ ,  $h_2$ , and  $h_3$  (collectively H)
- In many respects, the three laryngeals display equivalent diachronic effects as one another.
  - One reason that we know there must have been three different laryngeals is the “triple reflex” in Greek.

- As represented in (22), in each of several environments where we can reconstruct a laryngeal, each of the three different (non-high) vowel qualities are found in Greek.

## (22) Laryngeal outcomes in Greek — the triple reflex

	Laryngeal Contexts		
	Vocalization *H / {C,#}_C	Coloration *He / #_	Coloration and Lengthening *eH / _{C,#}
*h <sub>1</sub>	e	e	ē
*h <sub>2</sub>	a	a	ā
*h <sub>3</sub>	o	o	ō

\* Notations: “/” = ‘in the context of’, “#” = word boundary

- The connection between Attic Reduplication and the laryngeals has long been recognized in the Indo-European literature (e.g., Kuryłowicz 1927, Beekes 1969, Suzuki 1994, Keydana 2006). The most telling piece of evidence is that we find exactly the triple reflex in the Attic Reduplication forms.
    - No roots which have Attic Reduplication perfects have an initial high-vowel; all begin in [e,a,o], the outcomes of laryngeals in word-initial position (“vocalization”/“coloration”).
    - The long vowels of the second syllables of the Attic Reduplication forms are limited to [ē,ā,ō], the outcomes of \*-eH- sequences in the “coloration and lengthening” environment.
- ⇒ The vowels associated with the Attic Reduplication pattern are thus exactly those vowels associated with laryngeal reflexes. When coupled with comparative etymological evidence for initial laryngeals in these roots, it is safe to assert a connection between Attic Reduplication and laryngeals.
- The table in (23) repeats the data from (20), but now with the reconstructed form of the roots with their initial laryngeals.

## (23) Vowel-initial roots that exhibit Attic Reduplication perfects

	Root (Ancient Greek < *PIE)			AR Perfect in Ancient Greek	
**h <sub>1</sub>	√ <i>eleut<sup>h</sup></i>	<	*h <sub>1</sub> lewd <sup>h</sup>	‘go, come’	ἐλήλυθα [e <sub>l</sub> -ēlut <sup>h</sup> -]
	√ <i>en(e)k</i>	<	*h <sub>1</sub> nek̄	‘bring’	ἐνήνοχα [en-ēnok <sup>h</sup> -]
**h <sub>2</sub>	√ <i>ager</i>	<	*h <sub>2</sub> ger	‘gather together’	ἄγᾶγερμαι [ag-āger-]
	√ <i>akou</i>	<	*h <sub>2</sub> kow	‘hear’	ἀκᾶκοα [ak-āko-]
**h <sub>3</sub>	√ <i>od</i>	<	*h <sub>3</sub> ed	‘smell’	ὄδωδα [od-ōd-]
	√ <i>or</i>	<	*h <sub>3</sub> er	‘incite’	ὄρωρα [or-ōr-]

- Now that we know the Attic Reduplication forms should be reconstructed with laryngeals, we can use the sound laws indicated in (22) to reconstruct the shape of these forms in Pre-Greek.
- ⇒ My claim (following the works mentioned above) is that the form that we want to reconstruct as the pre-cursor of Attic Reduplication is: **HC-e-HCeC-**

- Now I'll show how the application of the laryngeal sound laws can derive the attested Attic Reduplication pattern from this pre-form.
  - The sounds laws that characterize the correspondences in (22) are provided in (24).
  - The diachronic derivation of the Attic Reduplication forms into Ancient Greek is shown in (25).

(24) Laryngeal-related sound changes (Notations: “>” = ‘becomes’, “//” = ‘adjacent to’)

1. Vocalization:  $H_i > V_i / \{C, \#\}_C$ 
  - i.  $h_1 > e$
  - ii.  $h_2 > a$
  - iii.  $h_3 > o$
2. Coloration:  $e > V_i // H_i$ 
  - i.  $e > e // h_1$
  - ii.  $e > a // h_2$
  - iii.  $e > o // h_3$
3. Lengthening:  $VH > \bar{V} / \_C$ 
  - i.  $eh_1 > \bar{e}$
  - ii.  $ah_2 > \bar{a}$
  - iii.  $oh_3 > \bar{o}$

★ Under these formulations, the lengthening rule must follow the coloration rule. Otherwise, the relative orderings of the rules are not crucial.

(25) Diachrony of Attic Reduplication perfects

a. Diachronic developments

Pre-Greek	$*\sqrt{HCeC}$	$\rightarrow$	$*\underline{HC-e-HCeC-}$
	$\Downarrow$		$\Downarrow$
Ancient Greek	$\sqrt{VCeC}$	$\rightarrow$	$\underline{VC-\bar{V}CeC-}$

b. Historical derivation

<b>Pre-Greek</b>	$*[h_1\text{le}h_1\text{lut}^h\text{-}]$	$*[h_2\text{ge}h_2\text{ger-}]$	$*[h_3\text{de}h_3\text{d-}]$
Rule 1: Vocalization	$e\text{le}h_1\text{lut}^h\text{-}$	$a\text{ge}h_2\text{ger-}$	$o\text{de}h_3\text{d-}$
Rule 2: Coloration	$e\text{le}h_1\text{lut}^h\text{-}$	$a\text{ga}h_2\text{ger-}$	$o\text{do}h_3\text{d-}$
Rule 3: Lengthening	$e\bar{e}\text{lut}^h\text{-}$	$a\bar{g}\bar{a}\text{ger-}$	$o\bar{d}\bar{o}\text{d-}$
<b>Ancient Greek</b>	$[e\bar{e}\text{lut}^h\text{-}]$	$[a\bar{g}\bar{a}\text{ger-}]$	$[o\bar{d}\bar{o}\text{d-}]$

### 5.3 Analysis of Pre-Attic Reduplication in Pre-Greek

- This raises a new question: why is the Pre-Greek form  $\underline{HC-e-HCeC-}$  (with copying of two segments) when all the other cases where we see reduplication only copy one segment ( $\times \underline{H-e-HCeC-}$ )?
- I propose that this is due to a special response to a special version of the constraint on consonant repetitions, which was the motivation for the *e*-prefixation forms in Ancient Greek.
  - Specifically, Pre-Greek has a constraint on consonant repetitions involving a laryngeal:

**CONSTRAINT ON LARYNGEAL REPETITIONS (\*H<sub>α</sub>VH<sub>α</sub>C):**

Consonant repetitions, where the repeated consonant is a laryngeal, which are immediately followed by a consonant are not permitted.

- The way this constraint exerts its influence in Pre-Greek is slightly different than the way \*C<sub>α</sub>VC<sub>α</sub>T exerted influence in Ancient Greek:

(26) *Analysis of the perfect in Pre-Greek* (for laryngeal-initial roots)

1. Prefix [e] to the root
2. Prefix a copy of the root-initial segment
  - 2'. **If the result would violate \*H<sub>α</sub>VH<sub>α</sub>C, copy the root-second segment as well**

(27) Perfect stem formation in Pre-Greek

	C <sub>1</sub> R <sub>2</sub> VX	H <sub>1</sub> C <sub>2</sub> VX	
Input:	/kri/	/h <sub>2</sub> ger/	
Rule 1: <i>e</i> -prefixation	e-kri-	e-h <sub>2</sub> ger-	
Rule 2: reduplication	<u>ke</u> -kri-	<u>h<sub>2</sub>e-h<sub>2</sub>g</u> er- (violates *H <sub>α</sub> VH <sub>α</sub> C → triggers 2')	
Rule 2': copy C <sub>2</sub>	n/a	<u>h<sub>2</sub>ge</u> -h <sub>2</sub> ger-	
Output:	[ <u>ke</u> -kri-]	[ <u>h<sub>2</sub>ge</u> -h <sub>2</sub> ger-]	

#### 5.4 Analysis of Attic Reduplication in Ancient Greek

- The way to understand the behavior of the Attic Reduplication forms in Ancient Greek is to view them as a continuation of their precursors that still had laryngeals.
  - They are (partially) exempt from the normal grammar in Ancient Greek, and instead follow more closely the grammar of the earlier stage.
- The only difference is what condition/constraint drives Rule 2'.
  - In Pre-Greek, it was \*H<sub>α</sub>VH<sub>α</sub>C.
    - However, once the laryngeals are lost via sound change (cf. (24)), this constraint will obviously no longer be applicable.
  - At this point, a different constraint is able to take over its function: ONSET.
    - Since the laryngeal-initial roots are now vowel-initial roots (because of laryngeal vocalization), ONSET will end up having the same effect as \*H<sub>α</sub>VH<sub>α</sub>C used to.

(28) *Analysis of the irregular perfects in Ancient Greek* (Attic Reduplication)

1. Prefix [e] to the root
2. Prefix a copy of the root-initial segment
  - 2'. **If the result would create a new violation of ONSET, copy the root-second segment as well**
3. Perform contraction to reduce the number of onsetless syllables

(29) Irregular perfect stem formation in Ancient Greek (for formerly laryngeal-initial roots)

	$V_1C_2VX$
Input:	/ager/
Rule 1: <i>e</i> -prefixation	e-ager-
Rule 2: reduplication	<u>[ā-ē]</u> -ager- (extra violation of ONSET → triggers 2')
Rule 2': copy $C_2$	<u>ag</u> -e-ager-
Rule 3: contraction	<u>ag</u> -āger-
Output:	<u>[ag-āger-]</u>

**6 Irregular Consonant-Initial Roots** (likely to be skipped for time)

- An upshot of this approach to the irregularity of the Attic Reduplication forms is that it can explain a set of exceptions among the *consonant-initial* roots as well.
- In Ancient Greek, there are a few consonant-cluster-initial roots that make their perfects with reduplication even though we would expect them to have *e*-prefixation given the normal conditions on copying.
  - Forms like πέπτωκα [pe-ptō-] have a consonant repetition preceding an obstruent, and thus violate  $*C_\alpha VC_\alpha T$ .
  - The normal grammar would block copying, and yield instead just *e*-prefixation: \*[e-ptō-].
  - Therefore, we're going to need to view them as irregular forms, just like the Attic Reduplication forms.

(30) Irregular consonant-initial perfects

Root	Perfect	Present
$\sqrt{pet-}$ 'fall'	πέπτωκα [ <u>pe-ptō-</u> ]	πίπτω [ <u>pi-pt-</u> ]
$\sqrt{stē-}$ 'stand'	ἔστηκα [ <u>he-stē-</u> ] ( < * <i>sestāka</i> )	ἵστημι [ <u>hi-stē-</u> ] ( < * <i>sistāmi</i> )
$\sqrt{mnē-}$ 'remind'	μέμνημαι [ <u>me-mnē-</u> ]	μιμνήσκω [ <u>mi-mnē-</u> ]

★ *mVmn* sequences act like they violate  $*C_\alpha VC_\alpha T$  even though *n* is not an obstruent

★ The initial *h* in ἔστηκα [héstēka] acts like it is a copy of the root-initial *s*, which is what it derives from historically.

⇒ All the roots that behave this way also have reduplicated presents; this is what determines membership in this irregular class.

- If we assume that these roots are subject to the same irregular grammar as the Attic Reduplication forms, rather than the regular grammar, then we derive the correct result.
  - This is because the  $*C_\alpha VC_\alpha T$  condition on the copying rule is absent in this grammar.
  - Therefore, copying is not blocked, and we derive a reduplicated form.
  - And since copying does not create a new ONSET violation, we do not predict copying  $C_2$  for these forms, even though that rule is part of this grammar.

- (31) *Analysis of the irregular perfects in Ancient Greek* (irregular consonant-initial roots)
1. Prefix [e] to the root
  2. Prefix a copy of the root-initial segment
    - 2'. **If the result would create a new violation of ONSET, copy the root-second segment as well**
  3. Perform contraction to reduce the number of onsetless syllables

- (32) Irregular perfect stem formation in Ancient Greek

Input:	/ptō/	/ager/	
Rule 1: <i>e</i> -prefixation	e-ptō-	e-ager-	
Rule 2: reduplication	<u>pe</u> -ptō-	<u>ae</u> -ager-	(extra violation of ONSET → triggers 2')
Rule 2': copy C <sub>2</sub>	n/a	<u>age</u> -ager-	
Rule 3: contraction	n/a	<u>ag</u> -āger-	
Output:	[ <u>pe</u> -ptō-]	[ <u>ag</u> -āger-]	

## 7 Conclusion

- We have seen that Ancient Greek has four different patterns for creating perfect tense forms:

- (33) Types of perfect tense forms

Type	Root		Perfect Tense
a. Reduplication	√ <i>kri</i> -	‘judge’	κέκριμαι [ke-kri-]
b. <i>e</i> -prefixation	√ <i>stel</i> -	‘prepare’	ἔσταλα [e-stal-]
c. Vowel lengthening	√ <i>onoma</i> -	‘name’	ὠνόμαα [ōnoma-]
d. “Attic Reduplication”	√ <i>ager</i> -	‘gather’	ἀγάγερμαι [ag-āger-]

- The first three types, which are the normal/productive patterns of the language, can all be captured through a single grammar containing three rules:

- (34) *The regular grammar of perfect tense formation*

1. Prefix [e] to the root
2. Prefix a copy of the root-initial segment **unless the result would violate**

$$\begin{cases} \textcircled{a} *C_{\alpha}VC_{\alpha}T \\ \textcircled{b} \text{ ONSET} \end{cases}$$
3. Perform contraction to reduce the number of onsetless syllables

- To derive the absence of copying in (33b) and (33c), we place conditions on the copying rule:
  - \*C<sub>α</sub>VC<sub>α</sub>T for the *e*-prefixation forms
  - ONSET for the vowel-lengthening forms

- Attic Reduplication is an irregular pattern, which is derived from a slightly different grammar:
  - (35) *The irregular grammar of perfect tense formation*
    1. Prefix [e] to the root
    2. Prefix a copy of the root-initial segment
      - 2'. **If the result would create a new violation of ONSET, copy the root-second segment as well**
    3. Perform contraction to reduce the number of onsetless syllables
- Their status as irregular comes from their unique history; namely, coming from roots that previously had an initial laryngeal.
  - The nature of the irregular grammar follows from the nature of the grammar at the time when the laryngeals were still present in the roots.
- Lastly, another irregular pattern — this time involving consonant-initial roots — can be explained by using the same irregular grammar that is needed for the irregular Attic Reduplication pattern.

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