Contractual Obligation:

Underspecification Theory and Vowel Coalescence in Ancient Greek Contract Verbs

Sam Katz

Advisor: Roslyn Burns

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Department of Linguistics
Yale University
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Abstract:

In Ancient Greek, there is a group of verbs called "contract verbs" that show interesting vowel coalescence between the end of the verbal root and the beginning of the inflectional suffix. Different vowels behave differently. For example, the forms φιλέ-ει [file-e:] > φιλεῖ [file:] (he/she loves), ὁρά-ει [hora-e:] > ὁρᾷ [hora:] (he/she sees), and δηλό-ει [dɛ:lo-e:] > δηλοῖ [dɛ:lo] (he/she shows). The uncontracted form is given as the dictionary citation, but the contracted form is more likely in actual text.

In my senior essay, I offer an overview of the changes observed in these verbs and propose a phonological explanation of the phenomenon. My main proposal is that there is a language-internal pressure to maximize positive feature specification. I show that this process can occur leftward, rightward, or in both directions at once.

Forsan et haec olim meminisse iuvabit.
-Vergil, *Aeneid* 1.203

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Χαῖρε!

1 Ancient Greek Contract Verbs

"Contract verb" is a term used by classicists to refer to a subset of verbs in Ancient Greek which undergo "contraction" at the meeting of the verb stem and inflectional suffix. When mentioning these words, the convention is to write their uncontracted forms, e.g. αἱρ**έω** [haɪreɔ:], ἐρωτ**άω** [erɔ:taɔ:], δηλ**όω** [dɛ:loɔ:] (the verbs for "grasp," "ask," and "show" respectively). Outside of the dictionary, however, these words would generally appear as αἱρ**ῶ** [haɪrɔ:], ἐρωτ**ῶ** [erɔ:tɔ:], δηλ**ῶ** [dɛ:lɔ:], having undergone a contraction which obscures the underlying vowels.

In this paper, I argue that this contraction occurs via a process of vowel coalescence (specifically feature spreading) motivated by a linguistic obligation to maximize positive feature specification. In order to accomplish this I employ the framework of Underspecification Theory (UT) similar to that of Avery & Rice (1987) in their work on coronals. de Haas (2010) also employs Underspecification Theory in his examination of this phenomenon, but makes certain assumptions about the vowel inventory of Classical Attic in order to employ a theory of radical underspecification, while I assume a larger vowel inventory and consequently employ a theory of contrastive underspecification.

The rest of this paper is organized as follows: Section 2 describes the three subcategories of contract verbs. Section 3 describes the theoretical assumptions of the paper, and relates the sound changes observed in the contraction process. Section 4 describes the framework of Underspecification Theory and the feature specifications of the vowel inventory. Section 5 explains the mechanics of contraction, and provides examples of the process at work. Section 6 concludes.

2 Types of Contract Verbs

There are several classes of verbs in Ancient Greek, each with robust paradigms of conjugation. As previously stated, this paper will focus on three groups of verbs which are very nearly regular, but still show intriguing variations with respect to morphology and accent. Verbs from these three groups, known collectively as "contract verbs," are distinguished by their stems, which end in one of three short vowels: -ε, -α, or -ο. These three vowels yield three subcategories of contract verbs: ε-contracts such as the verb φιλέω [fileɔ:] (to love), α-contracts such as the verb ὁράω [horaɔ:] (to see), and ο-contracts such as the verb δηλόω [dɛ:loɔ:] (to show).

What distinguishes these contract verbs from regular verbs in Ancient Greek is the apparent contraction of their stem-final short vowel and the initial vowel of whatever ending is being attached. Take, for example, the regular verb ἐθέλω. In the present tense, that verb would be conjugated as shown below in (1). Note that the provided transcriptions are broad.

1.

	Singular	Plural
1st	ἐθέλ-ω [eθel-ɔ:]	ἐθέλ-ομεν [eθel-omɛn]
2nd	ἐθέλ-εις [eθel-e:s]	ἐθέλ-ετε [eθel-ete]
3rd	ἐθέλ-ει [eθel-e:]	ἐθέλ-ουσι [eθel-o:sɪ]

Compare this to an ε-contract such as φιλέω. The following two tables show the conjugation of this verb. Table (2) shows the uncontracted forms of the verb, as would be found in its dictionary citation.

2.

	Singular	Plural
1st	φιλέ-ω [fɪle-ɔ:]	φιλέ-ομεν [fɪle-omen]
2nd	φιλέ-εις [fɪle-e:s]	φιλέ-ετε [fɪle-ete]
3rd	φιλέ-ει [fɪle-e:]	φιλέ-ουσι [fɪle-o:sɪ]

Table (3) shows the conjugation of this verb after contraction has taken place. These are the forms most often found in the written record.

3.

	Singular	Plural
1st	φιλῶ [fɪlɔ:]	φιλοῦμεν [fɪlo:mɛn]
2nd	φιλεῖς [fɪle:s]	φιλεῖτε [fɪle:tɛ]
3rd	φιλεῖ [fɪle:]	φιλοῦσι [fɪlo:sɪ]

While these paradigms may not at a glance look too dissimilar to a regular verb, we can notice important distinctions regarding vowel quality. Notably, in the first and third person plurals, we see that ε [e] and ο [o] contract to ου [o:]. The paradigms for α-contracts and ο-contracts show further distinctions.

Below is a summary of all the changes which result from the "contraction" of these verbs.

4.

ε-contracts	α-contracts	ο-contracts
ε+ω=ω	α+ω=ω	ο+ω=ω
ε+ο=ου	α+ο=ω	ο+ο=ου
ε+ου=ου	α+ου=ω	ο+ου=ου
ε+ε=ει	α+ε=α	ο+ε=ου
ε+ει=ει	α+ει=ᾳ	ο+ει=οι

Additionally, any time the short stem vowel would be marked with an acute accent (ʹ) in the uncontracted form, the vowel or diphthong which results from contraction will be marked with a circumflex accent (˜). Thus, the uncontracted 3rd-person singular of φιλέω (to love) would be φιλέ-ει, but is contracted to φιλεῖ (he/she loves). This can be contrasted with the 2nd-person singular present active imperative (not shown in the tables above), which would be φίλε-ε uncontracted and φίλει (love!) after contraction. This change of the accent is not important to the phonological analysis of contraction, but is interesting enough to at least mention.

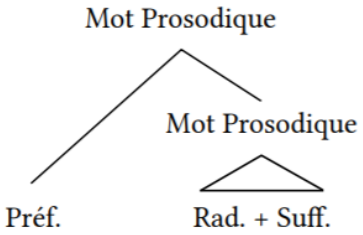
3 Theoretical Assumptions

3.1 Scope

This paper's exploration of contract verbs is confined to the Classical Attic dialect of Ancient Greek. This dialect was used in the region surrounding Athens, and is a dialect for which there is a relatively robust literary tradition.

The contraction which is the specific focus of this paper occurs only at the boundary of the verbal root and the inflectional suffix (contraction in nouns is not explored). The same contraction does not occur with common prefixes such as ἀπο- "away from." One possible reason for this is that verbal prefixes in Ancient Greek were largely derivational, while the suffixes from which contraction arises are all inflectional. Another explanation may have to do with prosodic word boundaries. The prosodic structure of a Greek verb is shown below in a graphic taken from Jatteau (2016).

5. $[_{MP}$ Préfixe $[_{MP}$ Radical + suffixes]]



As shown above, the root+suffix compose a smaller prosodic word than prefix+root+suffix, and it is possible that the contraction process is locally bound. Questions regarding contraction of inflectional prefixes such as the augment found in the aorist and imperfect tenses are left to future research.

3.2 Ancient Greek Vowel Inventory

Depending on the framework of phonological theory in which one is operating, it may be controversial to assert the existence of any inventory whatsoever (see Hayes (2009)). In the interest of brevity and theory-agnosticism, I will be using "inventory" to mean "the set of speech sounds that can be licitly produced according to the constraint ranking of a given language."

I will be assuming the phonological inventory of Ancient Greek (more specifically, the Classical Attic dialect) is as described by Bubenik (1983) and Sommerstein (1973), meaning that our vowel inventory contains the five short vowels {a,e,i,y,o} and the seven long vowels {a:,e:,ɛ:,i:,o:,ɔ:, u:}. Feature specifications (also taken from Bubenik (1983)) for these vowels can be found in Section 4. The correspondence of these sounds with Ancient Greek orthography is shown in the table below.

Short	
IPA	Ancient Greek
a	α
e	ε
ɪ	ι
o	ο
u	υ

6.

Long	
IPA	Ancient Greek
a:	α,ᾳ
e:	ει
ɛ:	η
i:	ι
o:	ου
ɔ:	ω
u:	υ

Taking these correspondences into account, we can come to a better understanding of the surface forms derived from contraction. These changes are shown below.

7.

ε-contracts	α-contracts	ο-contracts
e+ɔ:=ɔ:	a+ɔ:=ɔ:	o+ɔ:=ɔ:
e+o=o:	a+o=ɔ:	o+o=o:
e+o:=o:	a+o:=ɔ:	o+o:=o:
e+e=e:	a+e=a:	o+e=o:
e+e:=e:	a+e:=a:	o+e:=oɪ

A few things stand out immediately. The first of these is that the output of contraction is always long (i.e. bimoraic). In almost all cases, this means the output is a single long vowel. The exception is [o]+[e:]=[oɪ], where the resultant long sound is instead a diphthong. In instances where input and output are essentially identical (such as [e]+[e]=[e:]), there is little to explain, as there are no changes in vowel quality.

The remaining sound changes can be divided into two subgroups: those where the output sound is present in the inputs (or a long variant thereof) and those where the output sound is novel relative to either input. These groups are represented below, with the left column showing outputs identical (length notwithstanding) to one of the two input vowels, and the right column showing outputs which are not found in either input.

8.

Output Present in Input	Novel Output
e+ɔː=ɔː	a+o=ɔː
e+o=oː	a+oː=ɔː
e+oː=oː	o+eː=oɪ
a+e=aː	
a+eː=aː	
a+ɔː=ɔː	
o+e=oː	
o+ɔː=ɔː	

Some consistencies across these two groups begin to stand out. It is worth noting that the order of the vowels undergoing contraction does not appear to matter. Whether the input is [e]+[o] or [o]+[e], the resulting output is [oː] both times. Additionally, we can make these notes: [a] plus any front vowel will yield [aː] ([a]+[e], [a]+[eː]), while [a] plus any back/round vowel will yield [ɔː] ([a]+[o], [a]+[ɔː], [a]+[oː]). When [o] is combined with a back/round vowel, that vowel will be the output. Otherwise, the output will be novel.

4 Underspecification Theory

To account for the differing behavior of the three types of contract verbs, I will be employing a linguistic framework known as Underspecification Theory (UT), as formulated by Kiparsky (1982). The fundamental conceit of UT is that, while all phonological units are defined in terms of distinctive features, not every feature is necessarily specified for every sound.

Imagine a language with the vowel inventory i,a,u, a cross-linguistically common inventory (see Hall (2011) for more). While these three vowels are easily distinguished along lines of height, backness, and roundness, we can observe that we can easily define these three sounds without specifying all three features for each. Following the model of Hall (2011), I will assume that distinctive features are specified by means of the Successive Division Algorithm (SDA) as expressed by Dresher & Nevins (2017). The SDA is provided below.

9. The Successive Division Algorithm

   (a) Begin with *no* feature specifications: assume all sounds are allophones of a single undifferentiated phoneme.

   (b) If the set is found to consist of more than one contrasting member, select a feature and divide the set into as many subsets as the feature allows for.

   (c) Repeat step (b) in each subset: keep dividing up the inventory into sets, applying successive features in turn, until every set has only one member.

Following this method yields two ways in which our hypothetical three-vowel inventory could be specified. These are illustrated below. Here and elsewhere in

this paper, "+" indicates the feature is present in a given segment, "-" indicates that it is absent, and " " indicates that it is unspecified.

10.

	i	a	u
low	-	+	-
back	-		+

11.

	i	a	u
back	-	+	+
low		+	-

In the former, [a] lacks a specified value for [back], while in the latter, [i] lacks a specified value for [low]. These sounds are said to be **underspecified**. UT will be particularly helpful when making predictions about vowel coalescence, as underspecified vowels are likely to assume the feature specification of their neighbors during coalescence. In the first example, we would expect [a] to vary significantly with respect to backness, while in the second, we would expect [i] to vary with respect to lowness.

Avery & Rice (1987) draws a distinction between two types of UT: radical UT, where only one value of a feature is present underlyingly (a feature can be "+" or " "), and contrastive UT, where both feature values can be found underlyingly (a feature can be "+," "-," or " "). The distinction is presented in the below examples taken from Avery & Rice (1987).

12. Radical Underspecification

	p	b	t	d	k	g	m	n	l	r
voice		+		+		+				

13. Contrastive Specification

	p	b	t	d	k	g	m	n	l	r
voice	-	+	-	+	-	+				

Bubenik (1983) presents the features of the vowel inventory for Classical Attic as shown in the table below.

14.

	i	i:	e	e:	ɛ:	a	a:	u	u:	o	o:	ɔ:
Long	-	+	-	+	+	-	+	-	+	-	+	+
Low	-	-	-	-	+	+	+	-	-	-	-	+
High	+	+	-	-	-	-	-	+	+	-	-	-
Front	+	+	+	+	+	-	-	-	-	-	-	-
Round	-	-	-	-	-	-	-	+	+	+	+	+

Applying the SDA to Ancient Greek, I propose that the features relevant to contraction are specified in the order [round] > [high] > [low] > [front]. This is represented in the table below.

15.

	i	i:	e	e:	ɛ:	a	a:	u	u:	o	o:	ɔ:
Round	-	-	-	-	-	-	-	+	+	+	+	+
High	+	+	-	-	-	-	-	+	+	-	-	-
Low			-	-	+	+	+	-	-	-	-	+

For example, this gives [i] the feature specification [-round, +high, —], and would give [ɔ:] the feature specification [+round, -high, +low].

5 Mechanics of Greek Vowel Contraction

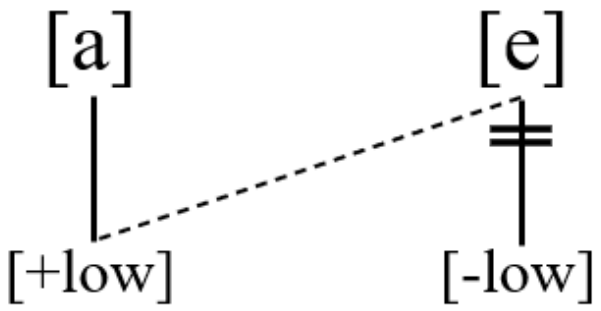
Avery & Rice (1989) mark the distinction between **fusion**, where an underspecified segment gains a specification where none previously existed (e.g. " " > "-"), and **spreading**, where an already specified feature changes has its value changed (e.g. "-" > "+"). What we see in Ancient Greek appears to be more of the latter, with positive specifications spreading amongst vowels involved in the contraction process. In general, there seems to be some language internal pressure to maximize specification, and to maximize positive specification in particular. Below is an example where the specification [+low] spreads in the contraction of [a]+[e]=[a:]. (15) summarizes the steps of the process, while (16) is an autosegmental representation a la Goldsmith (1979).

16. **Contraction of [a]+[e] > [a:]**

    Step One: [-round, -high, +low] + [-round, -high, -low]

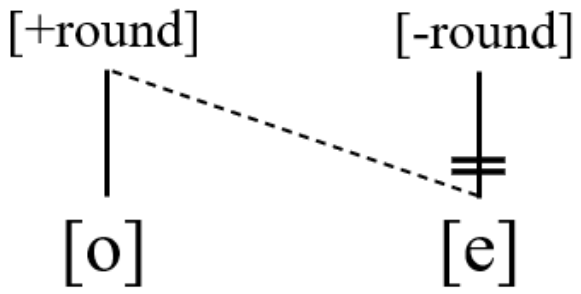
    Step Two: adopt all positive specifications (+low), resulting specification of [-round, -high, +low]

    Step Three: [-round, -high, +low] = [a]; output of contraction must be long, so resulting sound is [a:]



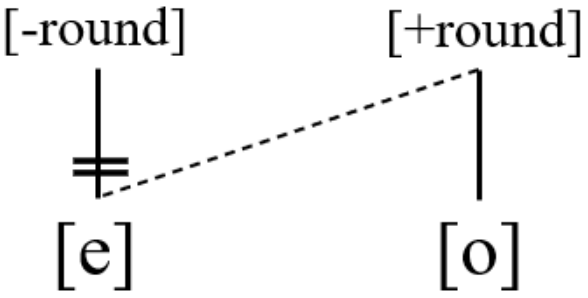
17.

This is an example of the feature [+low] spreading leftward. We see similar behavior for the feature [+round] in the contraction of [o]+[e]=[o:], as shown in the autosegmental representation below.



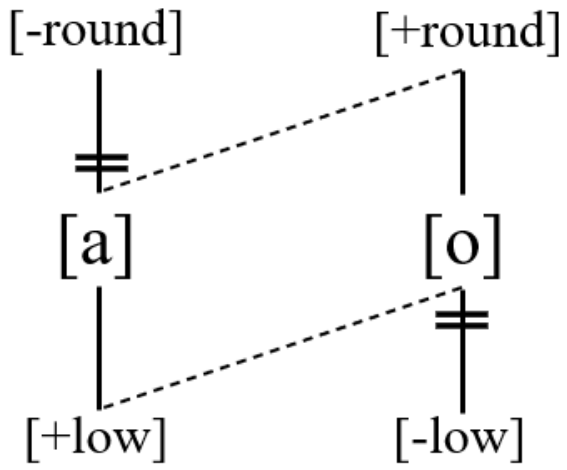
18.

Interestingly, we see this same process occur in the opposite direction. The autosegmental representation below displays the contraction of [e]+[o]=[o:], which shows leftward spreading of the [+round] feature.



19.

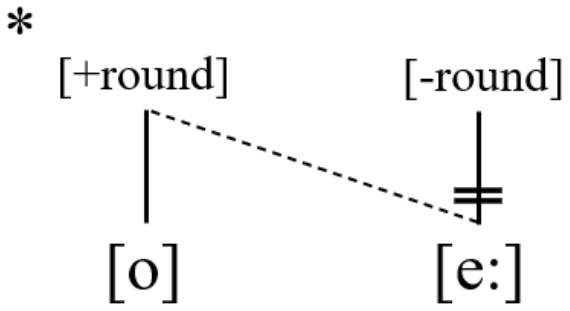
This suggests that the feature spreading process of vowel coalescence is not directional, which is further borne out by the below autosegmental representation of [a]+[o]=[ɔ:].



20.

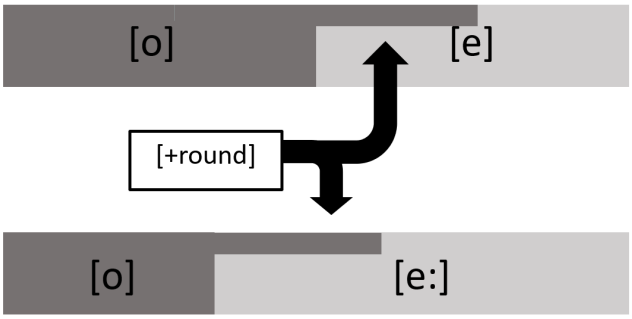
Here we see that not only is the process not directional, it can even be bidirectional. The feature [+round] spreads leftward while the feature [+low] spreads rightward.

One seemingly problematic case remaining is that of [o]+[e:]=[oɪ]. The proposed system of positive feature spreading would predict an output of [o:], as [+round] would spread rightward from the [o] onto the [e]. The expected process is shown below, but bear in mind that this does not correctly predict the output.



21.

A possible explanation for this unpredicted output is that the length of the long [e:] makes the underlying vowel more recoverable. Overlap of physical gestures in the production of different sounds is less likely to alter the quality of a long vowel. A visual aid is provided below.

22. 

In the higher image, the lip-rounding of [o] persists long enough into the production of the [e] that [e] is no longer recoverable, and so the output is received as [oo] or [o:]. In the lower image, the rounding does not persist long enough to overpower the underlying [e:], and so the output is different than expected. There is precedent for such accounts, such as Estes (2018)'s phonetics-based models of sound change, where long vowels were typically more recoverable than short in the development of the German umlaut.

In explaining the particular output of [oɪ], I turn to Bussmann (c2004.), who demonstrates a degree of targeting vagueness in the off-glides of diphthongs. Paired with the assertion of Bubenik (1983) that long [e:] is raised relative to [e], I propose that in the case of the long [e:], the vowel's extended duration makes its front-ness unambiguous, but the principle of off-glide vagueness applies to give us the resultant [oɪ] rather than [oe].

6 Conclusions

What we emerge with is a relatively simple model for the motivation and mechanics behind the contraction in these verbs. Contracting vowels are driven to maximize positive feature specifications, and do so via a process of feature spreading. The fact that only positive features spread in this way may be seen by some as evidence for radical underspecification and/or unary feature specifications, as one would expect the possibility of negative feature spread if both are truly present underlyingly.

Future research may also look at the phenomenon in Ancient Greek of the augment, which occurs in the aorist and imperfect tenses, and can produce changes in vowel quality which (somewhat) resemble those which appear in contract verbs. Additionally, I would be interested to see more cross-linguistic data, to determine whether maximal (positive) feature specification is a more widespread motivator of phonological processes.

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