THE PHONOLOGY OF VERBAL REDUPLICATION IN ANCIENT GREEK:

AN OPTIMALITY THEORY APPROACH

by

SAM ZUKOFF

(Under the Direction of Jared S. Klein)

ABSTRACT

This thesis sets out to develop a constraint grammar for Ancient Greek within the framework of Optimality Theory that can economically and thoroughly account for the diversity of forms and patterns within the reduplicated categories of the verbal system. Analyzing the reduplicative morphemes to have a morphologically fixed vowel, I propose a constraint ranking that unites the patterns and ascribes the variation to differences in syllabification and alignment considerations. The exceptional patterns of the reduplicated presents and the enigmatic Attic Reduplication are explained as lexicalized archaisms generated by a minimally different constraint grammar of an earlier period of the language. This thesis thus seeks to integrate cutting-edge theoretical techniques with traditional historical methods to create a fully integrated account of reduplication in Ancient Greek, such that the conclusions drawn here may yield new insights not only into the synchronic state of Ancient Greek but also on the nature of reduplication in Proto-Indo-European.

INDEX WORDS: Ancient Greek, verbal reduplication, Optimality Theory (OT), Correspondence Theory, syllabification, Attic Reduplication, coalescence, Proto-Indo-European (PIE), lexicalization, Structural Role (STROLE)

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DEDICATION

To my brother. Don’t give up, don’t ever give up.

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I cannot possibly properly thank the innumerable people who have helped me in the writing of this thesis, and who have helped me reach this point in my academic career, but I will try nonetheless.

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CHAPTER 1

INTRODUCTION

From the very outset of linguistic investigation of Ancient Greek, and of reconstructed Proto-Indo-European itself, reduplication has been recognized as a phenomenon which is simultaneously simple to describe yet difficult to thoroughly account for, particularly when the goal is comparative reconstruction. In the ancient Indo-European daughter languages, as well as in Proto-Indo-European itself, morphological marking was carried out chiefly by a combination of vowel alternation (traditionally called "ablaut") and suffixation. To this rule, there are but three exceptions.[1] One is the "nasal infix," an apparent present-tense derivational marker whose semantics are thoroughly elusive; and another is a prefixal marker of past tense known as the "augment," whose status as an Indo-European element is unclear. But the only exception which is both well-understood and well-attested across the daughter languages is reduplication.

Reduplication is a "process" whereby affixed to a base element is a phonetic string that, unlike normal affixation, is in some way dependent on the phonetic material of the base element for its form and shape. Reduplication in Proto-Indo-European and its daughter languages is prefixal and primarily used to mark verbs (although there are sporadically attested reduplicated nouns). This reduplication is interesting not only because it stands outside of the normal pattern of suffixation, but because there are so many peculiarities about its form across the various daughter languages. Among the attested Indo-European languages, reduplication remains as a

[1] Not including the addition of preverbs.

productive process only in Greek and Indo-Iranian (particularly in Sanskrit and Avestan);[2] however, it is present to a greater or lesser degree across virtually all of the language branches. In the goal of reconstructing the precise patterns of the reduplicative processes in Indo-European, until relatively recently, the enterprise was attempted through the direct comparison of attested cognate forms, as is the normal methodology of comparative linguistics and the comparative method. But, with the advent of generative linguistics in the second half of the twentieth century, and particularly with the rise of Optimality Theory (OT; Prince and Smolensky, 1993) and its unique mechanisms for description and explanation of reduplication, it has become apparent that such direct comparison of forms is not the best manner in which to approach this problem. In one of the first and only works that has attempted to use an OT framework to examine Indo-European reduplication, Keydana articulates exactly this point: "Indo-European reduplication patterns have always been reconstructed by comparing reduplicated forms in attested languages…What actually has to be compared are not individual forms but grammars" (2006: 62 *abstract*).

Reduplication is an inherently synchronic process. The variability of the reduplicant can only be explained through the active creation of forms by speakers at the moment of production. With this in mind, in order to properly address the question of the nature of the reduplicative processes of Proto-Indo-European, we first need access to the *grammars* of the attested languages in which the forms are produced, not just the forms themselves. These grammars will have been inevitably affected by diachronic development which has led to divergence in the reduplicative patterns. However, they must all sprout from a common source *grammar*. By understanding the relevant constraints and their rankings in the daughter languages, the grammar

[2] Reduplication's status in Anatolian is still in the process of being determined.

for Proto-Indo-European can be reconstructed as that which can most easily produce all of the attested systems.

But in order to undertake this venture of reconstruction, we first must formulate the grammars of the attested languages, keeping a special eye out for archaisms that might reflect earlier stages of the grammar that will more closely conform to the proto-language. The goal of this thesis, therefore, is to use Optimality Theory to develop the constraint grammar of Ancient Greek that is responsible for its reduplicative patterns. While this investigation will constantly have an eye towards the reconstruction of Proto-Indo-European reduplication, and will make use of the cognate processes elsewhere in the Indo-European family as comparative evidence when relevant, it will also address a number of pressing issues about the mechanisms of reduplication in Optimality Theory.

1.1. The facts: the reduplicative formations of Ancient Greek

Ancient Greek preserves reduplication in each of the three tense-stems of its verbal system: present, aorist, and perfect. The aorist is a simple past tense, roughly equivalent to what is often called the preterite in other languages. The perfect, in Classical Greek at least, is a resultative past tense, generally translated with the English "present perfect" (*I have X'ed)*. The perfect is often believed to have had a stative value in Proto-Indo-European. These are the three tense-stems reconstructed for Proto-Indo-European. In the parent language, tense stems were differentiated in a number of ways. These include ablaut, aspectual derivational suffixes, inflectional endings, and, in certain instances, reduplication. In Greek, as in Indo-European (according to the majority opinion, at least), the perfect is obligatorily and productively marked by reduplication. The perfect tense, therefore, will serve as the primary source of evidence in our investigation of the form of reduplication in Greek. Additionally, reduplication could optionally mark the present and the aorist; however, the attestations of these are obviously much less frequent than for the perfect. The basic shape of the reduplicant across the three tense-stems is extremely similar. The aorist reduplicant is essentially identical to that of the perfect, and the present reduplicant differs only in the quality of its vowel. Yet, the difference in productivity of the process in the different tenses will ultimately lead to an interesting interaction between them on certain verbs.

Since reduplication is obligatory and productive in the perfect tense, its forms display the widest variation in the shapes in which they surface. This will therefore be the category most illuminating for the examination of the synchronic grammar of reduplication. In the perfect tense, we can observe a clear distinction between the treatment of consonant-initial roots and vowel-initial roots. There are a number of further distinctions within these two groups. Within the consonant-initial roots, the two major categories are *copying roots* and *non-copying roots*.

(1) Perfect Tense Forms – Consonant-initial Roots

Copying Roots					
Initial Single Consonant (CV)					
Root		Present Tense		Perfect Tense	
dɔ̄-	‘give’	δίδωμι	[di-dɔ̄-]	δέδωκα	[de-dɔ̄-]
lu-	‘loosen’	λύω	[lu-]	λέλυκα	[le-lu-]
pemp-	‘send’	πέμπω	[pemp-]	πέπεμπται	[pe-pemp-]
Initial Consonant + Sonorant Consonant (CRV)					
Root		Present Tense		Perfect Tense	
kri-	‘separate, distinguish, decide’	κρίνω	[krī-n-]	κέκριμαι	[ke-kri-]
tla-/tlɛ̄-	‘suffer, dare’	τλάω	[tla-]	τέτληκα	[te-tlɛ̄-]
tam-/tmɛ̄-	‘cut’	τάμνω	[tam-n-]	τέτμημαι	[te-tmɛ̄-]
pneu-	‘breathe’	πνέω	[pne-]	πέπνυμαι	[pe-pnū-]

Initial Aspirated Consonant (C^h(R)V)					
Root		Present Tense		Perfect Tense	
p^{h}eug-	‘flee’	φεύγω	[p^{h}eug-]	πέφευγα	[pe-p^{h}eug-]
t^{h}ε̄-	‘place, put, make’	τίθημι	[ti-t^{h}ε̄-]	τέθηκα	[te-t^{h}ε̄-]
t^{h}nε̄-	‘die, be killed; perish’	θνήσκω	[t^{h}nε̄-]	τέθνηκα	[te-t^{h}nε̄-]
k^{h}ar-	‘rejoice at; welcome’	χαίρω	[k^{h}air-][3]	κεχάρηκα	[ke-k^{h}ar-]
Non-copying Roots					
Initial Consonant + Obstruent Consonant (COV)					
Root		Present Tense		Perfect Tense	
kten-	‘kill’	κτείνω	[ktēn-]	ἔκτονα	[e-kton-]
p^{h}t^{h}i-	‘decay, wane’	φθίνω	[p^{h}t^{h}i-n-][4]	ἔφθιμαι	[e-p^{h}t^{h}i-]
sper-	‘sow’	σπείρω	[spēr-]	ἔσπαρμαι	[es.par-]
zdeug-	‘yoke’	ζεύγνῡμι	[zdeug-]	ἔζευγμαι	[ez.deug-]
pseud-	‘lie, speak/play/be false’	ψεύδομαι	[pseud-]	ἔψευσμαι	[ep.seus-]
Initial Geminate Roots					
Root		Present Tense		Perfect Tense	
seu-	‘chase’	σεύω	[seu-]	ἔσσυμαι	[e-sseu-]
^{h}rε̄g-	‘break, scatter’	ῥήγνυμι	[^{h}rε̄g-]	ἔρρηγμαι	[e-rrε̄g-]
^{h}reu-	‘flow, stream’	ῥέω	[^{h}re-]	ἐρρύηκα	[e-rru-]

For vowel-initial roots, we likewise have a two-way major division, between forms with initial-vowel lengthening and so-called *Attic Reduplication*.

(2) Perfect Tense Forms – Vowel-Initial Roots

Vowel lengthening					
Root		Present Tense		Perfect Tense	
erū-	‘protect’	ἔρῡμαι	[erū-]	εἴρῡμαι	[ērū-]
^{h}elk-	‘draw, drag’	ἕλκω	[^{h}elk-]	εἵλκυσμαι	[^{h}ēlk-us-]
ag-	‘lead’	ἄγω	[ag-]	ἦγμαι	[ε̄g-]
amelg-	‘milk’	ἀμέλγω	[amelg-]	ἤμελγμαι	[ε̄melg-]
op^{h}el-/op^{h}lε̄-	‘owe; be obliged’	ὀφέλλω	[op^{h}el-]	ὤφληκα	[ɔ̄p^{h}lε̄-]

[3] *k^{h}airɔ̄ < *k^{h}ar-yɔ̄.*

[4] Also with root vowel [-ī-].

Attic Reduplication					
Root		Present Tense		Perfect Tense	
ed-	'eat'	ἔδω	[ed-]	ἔδηδα	[edēd-]
ar-	'join, fit together'	ἀραρίσκω	[ar-ar-]	ἄρηρα	[arēr-]
ol-	'destroy'	ὄλλῡμι	[ol-]	ὄλωλα	[olōl-]
ela(u)-	'drive'	ἐλαύνω	[elau-]	ἐλήλαμαι	[elēla-]
ako(u)-	'hear'	ἀκούω	[akou-]	ἀκηκοα	[akēko-]
oreg-	'stretch, reach'	ὀρέγω	[oreg-]	ὀρώρεγμαι	[orōreg-]

These are the major patterns and sub-patterns of reduplication in the perfect tense. While reduplicated formations are found in the present and the aorist, each formation will be essentially identical to one of the patterns described here. Additional examples will be adduced when relevant throughout the thesis.

1.2. The corpus: What do we mean by *Ancient Greek*?

There have been many works in recent years dealing with the phonology and morphology of Ancient Greek within various frameworks of generative linguistics. While most of these works claim to be studies of Ancient Greek, their true scope is often significantly more limited. This precise criticism is leveled by Aitchison (1975:126) in her review of Sommerstein (1973). Sommerstein, as many others, confines his study of *Ancient Greek* to just the dialect of Classical Attic, the dialect spoken in Athens from the early 5th C. BC to the late 4th C. BC (Sommerstein, 1973: 1). This is a thoroughly reasonable endeavor, as this dialect is by far the most widely attested and linguistically complete and regular. However, this ends up neglecting the several centuries of earlier-attested *Ancient Greek* texts and inscriptions. *A priori*, this is not necessarily improper. But the facts bear out that the earlier forms of the language are indeed more archaic in many ways. Therefore, if one's goal is developing a phonological system or grammar to be used for comparative and/or historical purposes, omitting the earlier language will necessarily be detrimental.

The fullest theoretically-informed account of reduplication in Ancient Greek is Steriade (1982). While she makes extensive use of the diachronic facts, the grammar she develops is centered on Classical Attic alone. Her account in no way suffers from this, but it does reinforce the notion that a fuller treatment of the earlier language's reduplicative patterns needs still to be undertaken. This is the endeavor that will be taken up in this thesis.

Thanks to the detailed philological exposition of Laar (2000), this goal is now much more feasible. Laar has collected all of the verb forms attested in the early language.[5] He has defined *the early language* as those forms occurring before 500 BC.[6] He freely admits that this is somewhat arbitrary, but it is well-motivated precisely for the reasons discussed above. After this time, a majority of the sources are written in the Classical Attic dialect, which has already been so thoroughly studied. Therefore, excluding those forms from this thesis will allow a clearer picture of the earlier, more archaic periods of the language. He does, however, include in his corpus the works of the Attic tragedians and poets Sophocles, Euripides, and Aristophanes, as well as the historian Herodotus, who writes in the Ionic dialect. The works of these authors date from various times throughout the 5th C. BC. In this thesis, I will attempt to make note of any forms used as evidence which are attested first/only in these authors. All other forms are taken to be reflective of a language state at least as archaic, and generally more archaic, than Classical Attic.

[5] He omits certain forms from his study for various reasons, which he discusses in the Introduction and Chapter 1. I do not believe that the forms left out will contradict the arguments and conclusions made in this thesis, but I am not certain of this.

[6] Laar includes also Mycenaean forms. I will generally not make use of these.

The distinctions between these language states are not terribly significant in dealing with the primary reduplicative patterns of consonant-initial roots. However, major statable differences can be observed in the treatment of vowel-initial roots. This directly relates to the relative archaism of the different periods, as the integration of vowel-initial forms into the linguistic system appears to have begun relatively shortly before the attested period, and expanded continuously as time progressed.[7] For this reason, the differences between the earlier language and Classical Attic will be directly addressed when discussing vowel-initial roots.

The motivation for relying on the forms of the early language, rather than Classical Attic, is to weed out as much inner-Greek development as possible. Attic is a standardized literary language and therefore is liable to have been even more regularized than other dialects of similar antiquity. But that aside, since the goal of this thesis is to provide a basis on which to do comparative reconstruction of constraint grammars, any evidence which allows us access to an earlier stage of the grammar will be ideal. Even using the more archaic language, we will see that two sets of exceptional forms – reduplicated presents with their associated perfects, and Attic Reduplication – can shed light on a yet more archaic period of development, possibly dating back to Proto-Indo-European.

1.3. <u>The Approach: Optimality Theory and Correspondence Theory</u>

Traditional approaches have been unable to explain many of the peculiarities of reduplication in Ancient Greek in an elegant and principled manner. More recent works using contemporary theories of phonology and morphology have been more successful in coherently

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[7] It is believed by many that Proto-Indo-European had no vowel-initial roots. Those roots which had earlier been reconstructed as vowel-initial are now generally reconstructed with an initial laryngeal. Following this view, vowel-initial roots would not have been part of the linguistic system of (Pre-)Greek until later developments eliminating certain initial consonants created *bona fide* vowel-initial roots.

accounting for the facts. The first of these was Steriade (1982, 1988), who made use of Autosegmental Phonology (Goldsmith, 1976) and Lexical Phonology (Kiparsky, 1982). More recently Fleischhacker (2005) and Keydana (2006) have employed Optimality Theory (Prince & Smolensky, 1993),[8] although from very different perspectives. This thesis will also use Optimality Theory (OT).

Our account will make primary use of Correspondence Theory (CT; McCarthy & Prince, 1995). CT was an early revision of OT, designed to clarify and unify the constraint inventory and the mechanisms of the OT framework. (Pre-Correspondence Theory OT is often referred to as Containment Theory. Keydana (2006) suffers greatly from his use of Containment Theory-style constraints, rather than CT.) Since its inception, CT has been the prevalent model for basic OT work.[9]

CT is based upon the identification and evaluation of *correspondence relationships* between segments at different levels of representation. As originally formulated by McCarthy & Prince (1995: 4):

> "Correspondence Theory is set within Optimality Theory, and our argument will call crucially on three fundamental ideas of OT: parallelism of constraint satisfaction, ranking of constraints, and faithfulness between derivationally-related representations. Correspondence Theory extends the reduplicative copying relation of McCarthy & Prince (1993a) to the domain of input-output faithfulness, and indeed to any domain where identity relations are imposed on pairs of related representations."

CT posits a discrete family of *correspondence* constraints that are applicable across any relational dimension where one string is in some way related to another string. The dimensions

[8] For an introduction and overview of OT, consult Kager (2007).
[9] This thesis will confine itself to standard monostratal OT. For details on stratal OT and other new derivational-OT models, consult the recent works of McCarthy: http://works.bepress.com/john_j_mccarthy/subject_areas.html#2010.

they propose are input-output (IO), base-reduplicant (BR), input-reduplicant (IR),[10] and tone to tone-bearer (Ibid., 122). They also reference the potential for transderivational correspondence relationships, proposed by Benua (1995). This has developed into the output-output (OO) correspondence dimension, which demands faithfulness between morphologically related outputs. This is the OT instigator of what have been long recognized as "paradigm uniformity" effects (Kager, 2007: 257).

Along each of these correspondence dimensions, the family of correspondence constraints evaluates the faithfulness of the relationships between segments. The members of this constraint family proposed by McCarthy & Prince (1995) are essentially accepted today as the full set of correspondence constraints. Taken from McCarthy & Prince (1993: 16, 122-4),[11] they are as follows:[12]

MAXIMALITY (MAX) – Every element of S_1 has a correspondent in S_2
= *No Deletion*

DEPENDENCE (DEP) – Every element of S_2 has a correspondent in S_1
= *No Insertion*

IDENTITY(F) (IDENT(F)) – Corresponding segments have identical values for feature F = *No Feature Changing*

CONTIGUITY (CONTIG) – (a) The portion of S_1 standing in correspondence forms a contiguous string (= *No Skipping*); (b) The portion of S_2 standing in correspondence forms a contiguous string (= *No Intrusion*)

[10] They are less confident in this dimension of correspondence. They outline its use in Chapter 6 (pp. 110-7), but do not base the validity of the theory on its inclusion. It is still an open question whether this correspondence relationship should be included in the theory. Many issues related to it find better solutions in more recent derivational OT approaches.

[11] Also reproduced in Kager (2007: 248-52) with additional commentary.

[12] S_1 and S_2 are related strings. S_2 is taken to be in some way dependent on S_1. In, the IO relationship, the input is S_1 and the output is S_2. In the BR relationship, the base is S_1 and the reduplicant is S_2.

ANCHOR – Any element at the designated periphery (i.e. *left-edge* or *right-edge*) of S_1 has a correspondent at the designated periphery of S_2

= *No Insertion or Deletion at edges*

LINEARITY – S_1 is consistent with the precedence structure of S_2, and vice versa

= *No Metathesis*

UNIFORMITY (UNIF) – No element of S_2 has multiple correspondents in S_1

= *No Coalescence*

INTEGRITY (INTEG) – No element of S_1 has multiple correspondents in S_2

= *No Breaking/Splitting*

The account to be developed in this thesis will make extensive use of these constraints across the different correspondence dimensions, primarily input-output and base-reduplicant, but also output-output.

As is the guiding principle behind OT, these *correspondence* constraints (which could also be called *faithfulness* constraints) are in constant competition with two other major types of constraints. The more important type is the *markedness* constraints. These are constraints that demand minimally marked outputs. *Syllable well-formedness* constraints, which will prove exceedingly important in our analysis, are subsumed under this larger category. The last major constraint type is the *alignment* constraints, which dictate that edges of prescribed morphological categories coincide with prescribed edges of phonological categories, most often the prosodic word (PRWD) (McCarthy & Prince, 1993b; Kager, 2007: 117-24). *Alignment* constraints will be very significant for determining the size of the reduplicant.

It will be the interaction between the relevant constraints of these three types that will determine the optimal outputs in a language. Therefore, it is the goal of this thesis to identify what constraints are relevant in shaping the forms and patterns involved in reduplication in

Ancient Greek, and to establish a ranking of these constraints that fully and economically accounts for the diversity of the data.

1.4. Previous research

As discussed already, the study of reduplication in Ancient Greek has been taken up on numerous occasions in the past. There is thus plentiful research upon which to build the account herein, both from the traditional approaches of Indo-European studies and the newer methods of generative linguistics.

Descriptions of the reduplicative processes of the attested Indo-European languages, and attempts to reconstruct the reduplicative patterns of Proto-Indo-European, have been part of the field of Indo-European studies from the very outset. Surveys of the forms of reduplication across the Indo-European languages can be found throughout the early works, such as Schleicher (1861) and Brugmann & Delbrück (1897-1916). The forms of Greek are likewise detailed in the early Greek grammars, such as Curtius (1880: 152-6, §272-5), Monro (1891), Brugmann (1900: 259-62, §299-300), Smyth (1920), and Schwyzer (1939). Each is exhaustive in the enumeration of reduplicative types, but all precede by many years the advent of generative linguistics and thus do not attempt to account for the variation in a non-descriptive way. A successor to these works is Sihler (1995). While he does not make use of generative methodologies, his work benefits from the advancements in Indo-European studies made in the intervening century, particularly with respect to the effect of the laryngeals on reduplication. His account, however, includes a number of problematic stances that will be addressed.

One of the first major efforts at explaining Ancient Greek reduplication in a modern theoretical framework is Steriade 1982, which tackles reduplication and numerous other issues of prosodic phonology and morphology in Ancient Greek using a primarily autosegmental approach. Steriade 1988 builds further on this by employing a lexical phonology derivational framework to explain two of the reduplicative processes of Sanskrit, to which she compared reduplicative patterns of several other languages, including Ancient Greek. The arguments presented therein will be especially significant for the account to be developed below, as it demonstrates the importance of *onset transfer* in reduplication cross-linguistically.

Niepokuj (1997) is the first work to use generative principles in the goal of reconstructing the reduplication patterns of Proto-Indo-European. She provides a good overview of cross-linguistically common reduplication patterns outside of Indo-European, as well as a detailed survey of the major patterns attested in the Indo-European languages. Contrary to the prevailing theories, Niepokuj argues that reduplication was an optional marker of the tense-stems of Indo-European, including the perfect, and that it was used only when the use of ablaut would be in some way problematic. She also argues that Indo-European reduplicative formations did not display fixed segmentism (either phonological or morphological) with respect to the vowel of the reduplicant. She makes a number of very questionable assumptions and conclusions, and her account has largely been dismissed.[13]

The aims of Niepokuj's study are taken up in a far more systematic way by Keydana (2006, 2010). He tackles the reconstruction of reduplication in Indo-European using Optimality Theory. What is so innovative about these works is the way in which they approach the notion of reconstruction: "Indo-European reduplication patterns have always been reconstructed by comparing reduplicated forms in attested languages. In this paper I will argue that what actually has to be compared are not individual forms but grammars" (Keydana, 2006: 62 *abstract*). The trap that scholars have always fallen into in comparative reconstruction of reduplication is the

[13] See, e.g., Kulikov (2005: 448-9, n. 3).

need for absolute correspondence between forms. Even Sihler (1995: 488, §443) is guilty of this. Keydana's proposal, which will be whole-heartedly followed in this thesis, is that, since reduplicative forms are so thoroughly affected by the synchronic grammar, and are subject to change based on changes in the grammar, it must therefore be *grammars* which are compared, not *forms*. Earlier scholars had little basis for such an investigation, since it was difficult to define in any complete way what a synchronic grammar of a language was in an abstract, theoretical sense. But using by Optimality Theory, as Keydana does, we now have a means of comparing reduplicative grammars through the examination of constraint rankings.

To achieve this goal, Keydana first sets out to establish the OT constraint grammars of four of the old Indo-European languages in which reduplication is well attested: Gothic, Latin, Greek, and Vedic Sanskrit. He confines his discussion to perfect-tense reduplication, since this is by far the best attested of the several patterns which are reconstructible for Indo-European. Once he has formalized these grammars, he then compares them to draw conclusions about the nature of the perfect-tense reduplicant in Proto-Indo-European. His conclusions are largely conceptually consistent with what will be developed in this thesis; however, the way he reaches these conclusions is troubling.

The biggest problem with his account is the types of constraints he employs to create his grammar, both of the attested languages and the reconstructed proto-language. He does not follow Correspondence Theory, but rather sticks with the outdated, less effective constraints associated with Containment Theory. Instead of the *correspondence* constraints MAX and DEP, he uses PARSE and FILL. It was the imprecise nature of these constraints that ultimately led to their replacement, and this same imprecision significantly hurts Keydana's argumentation. Furthermore, the way he formulates his m*arkedness* and *alignment* constraints are also well outside the norm. All in all, the basic concepts Keydana means to capture with his constraints are usually correct, but the actual employment of constraints and the establishment of a constraint grammar needs to be reworked significantly. This thesis will, independently of Keydana, develop constraints based on Correspondence Theory and the types of constraints found in Kager (2007) to account for the facts in a more coherent and up-to-date manner. Furthermore, since it is concerned only with Greek, it will be able to examine the important issues in much greater depth.

The last work that needs to be mentioned is Fleischhacker (2005), which approaches this problem from a completely different perspective. Fleischhacker's goal is to develop a typology of reduplicative copying patterns based on perceptual similarity. Using a wide variety of evidence, including experimental evidence, Fleischhacker shows that there is a significant difference in the perceptual similarity of various types of cluster simplifications. When comparing correspondences of the type $C_1C_2V \sim C_1V$, the perceptual difference between the pair is significantly greater when C_2 is an obstruent. That is to say, e.g., *pra* sounds much more like *pa* than *sta* sounds like *sa*. Using this knowledge, she accounts for differences in copying patterns by relativizing MAX-BR constraints to the specific type of segment involved. With universal hierarchies driven directly by these perceptual issues, she develops a factorial typology of partial reduplication types that fits quite well with the observed attested patterns.

Fleischhacker (2005: 2) proposes three types of partial reduplication with cluster simplification found cross-linguistically. The first is across-the-board cluster-blind simplification. Languages displaying this type of behavior will reduce any onset cluster in reduplication in a single way. She identifies three options for this sort of simplification: the leftmost consonant is copied (as in Old Irish); the rightmost consonant is copied (as in Nuxalk); or the least sonorous consonant is copied (as in Sanskrit).

The other two patterns of simplification are those which are not blind to cluster type. They show different outcomes for clusters of the type *obstruent + sonorant consonant* (CR) than for all other types of clusters (CC).[14] One of these patterns she calls "sufficient copy," and the other "selective copy." Both types simplify CR-clusters to just C in the reduplicant. Where they differ is their treatment of other clusters. Both ban skipping (i.e. partial copying) for CC-clusters. Sufficient copy languages (which include Gothic) always require copying of some sort, and therefore the full CC-cluster is copied into the reduplicant. Selective copy languages, on the other hand, eschew copying any consonants at all under these circumstances. Fleischhacker's typology predicts this pattern to exist. It is attested, but in just a single language: Ancient Greek.

In Chapter 5, Fleischhacker shows how the employment of these relativized MAX-BR CONSTRAINTS GENERATES the attested patterns. The ranking and tableaux for Ancient Greek are presented and discussed on pp. 148-155. Overall, it is a very appealing approach. The account to be developed below will come at the problem from such a different angle that the two could potentially be seen as complementary. Whereas Fleischhacker uses perceptual considerations, the intricacies of this account will lie mostly in its use of syllabification. I will argue that the variable syllabic affiliation of the onset-initial consonant (due to requirements of syllabification based on the constraints ONSET, NOCODA, and SONORITY SEQUENCE) is what is responsible for the "selective copy" pattern described by Fleischhacker. I will not pretend to speak to the nuts-and-bolts issues related to perception, but I suggest that the importance of equivalence in syllabic

[14] These are usually *obstruent + obstruent clusters*; but, as we will see for Greek, the key difference between the *obstruent + sonorant* cluster and the other cluster types is the sonority profile of the cluster.

position of corresponding elements (Steriade's *onset transfer*), which will be encoded by the use of the constraint STRUCTURAL ROLE, is also a matter of perceptual salience.

1.5. <u>The Outline</u>

As was seen in section 1.1., there is a major distinction between the reduplicative patterns of consonant-initial roots and those of vowel-initial roots. This will shape the progression of the argumentation in this thesis. It will first take up the consonant-initial roots, and then, using the solutions derived therein, extend the analysis to account for the vowel-initial roots as well.

Chapter 2 will begin the examination of the reduplicative patterns of Ancient Greek. It will start with the most basic pattern, which is displayed in the perfect-tense of roots with initial CV- and CRV-sequences. Their pattern of *<u>C</u>e-C(R)V…* reduplication will be motivated through the interaction of the *syllable well-formedness* constraints ONSET, NOCODA, and *COMPLEX, and *alignment* constraints on the different morphemes involved in reduplication. This will be coupled with an argument that the fixed [e] in the reduplicant is an example of morphological fixed segmentism, rather than the more common phonological fixed segmentism.

Chapter 3 will discuss those consonant-initial roots which fail to display a consonant in the reduplicant in their perfect-tense forms. It will be shown that the morphologically fixed /e/ of the reduplicative morpheme gives Greek the license to eschew copying under adverse conditions (the equivalent of Fleischhacker's *selective copy* terminology). These adverse conditions are related directly to syllable structure. The non-copying roots are exactly those where an initial cluster must form itself as heterosyllabic, and it will therefore be the interaction of constraints referencing syllabification and syllabic position that will prevent copying in such cases.

Chapter 4 will examine Greek's reduplicated presents. This non-productive formation displays forms which run counter to the synchronic grammar developed in the previous chapters to account for perfect-tense reduplication. It will be demonstrated that we should not attempt to generate these forms in the synchronic grammar but rather appeal to the grammar of a more archaic language state – one much closer to that of Proto-Indo-European. With minimal adjustment to our constraint ranking, the seemingly exceptional reduplicated presents will be seen as lexicalized archaisms that preserve the regular grammar of an earlier period. Furthermore, this state of affairs will be used to explain a comparable set of exceptions in the perfect tense. The small set of CC-initial roots which display a copying reduplicant contrary to the expected pattern are all roots which have reduplicated presents. Therefore, an appeal to output-output correspondence will be made that demonstrates that these roots were protected from synchronic remodeling because of their connection to reduplicated presents.

Chapter 5 will consider another set of apparent exceptions to the rules laid out in Chapters 1 and 2. A small set of roots which have a CV sequence at the left-edge of their present-tense form show a perfect without copying. It will be shown that the roots displaying this behavior actually begin underlyingly in a geminate consonant, and that the single consonant of the present is the phonologically regular result of simplification of that geminate.

Chapter 6 will begin the examination of the perfect-tense stem-formation patterns of vowel-initial roots. There are three distinct patterns: vowel-lengthening, Attic Reduplication, and the syllabic reduplicant. Vowel-lengthening, the most productive pattern, will be taken up first, and analyzed as an instantiation of vowel coalescence. It will be shown that, despite not displaying any copied segments, this formation is in fact *reduplicated*, insofar as it is created by the addition of the reduplicative morpheme, and that it is the regular output of the synchronic grammar developed for the consonant-initial roots. Once the shape of the reduplicant is motivated, we will discuss the complicated facts of vowel-quality in this vowel-lengthening formation.

Chapter 7 will continue the account of the perfect forms of vowel-initial roots with an examination of the enigmatic pattern of Attic Reduplication. Attic Reduplication, like the reduplicated presents, cannot be generated by the synchronic grammar. However, also like the reduplicated presents, it may be explicable if we push back the creation of the pattern to an earlier language state – in this case, to the time when laryngeals were still present in the language. By appealing to special *markedness* constraints on laryngeals during this period of the language, a valid pre-form for Attic Reduplication can be generated with minimal change to the Pre-Greek rankings developed for the reduplicated presents.

Chapter 8 will look at issues related to aspiration. This will include discussions of the persistence of initial aspiration in certain vowel-initial roots, the aspiration of initial-*r*, and, most significantly, the aspiration alternation in consonant-initial roots traditionally identified as Grassmann's Law. Chapter 9 will provide an overview of the reduplicated aorists. This, like the present, is an unproductive category for reduplication, but there are nonetheless a collection of forms which are clearly reduplicated. The patterns of the reduplicated aorist will directly mirror those of the perfect. Finally, Chapter 10 will briefly review the account developed throughout the rest of the thesis.

1.6. Notes on the symbology and terminology of Optimality Theory

Before proceeding to the analysis, it will be helpful for many to make a quick review of some of the idiosyncrasies of the mechanisms of OT, particularly with respect to the organization and the symbols employed for OT tableaux.[15] The tableaux are meant to model the production and selection of surface forms. The input to the derivation is placed in the upper left-hand corner. Reasonable output candidates are listed down the left-most column. Candidates are generally not listed in any particularly significant order, although the most faithful candidate will usually be given first, and candidates will often be arranged such that significant differences between them may be more easily recognized. Across the top row of the tableau are listed the constraints. When it can be demonstrated that one constraint dominates another, the two constraints are separated by a solid line. When constraints cannot be critically ranked, they are separated by a dotted line. The constraints that will be shown in the tableaux are defined in numbered examples when first introduced. They will typically be abbreviated significantly so as to fit better in the tableaux. A full list of constraint definitions and abbreviations (arranged alphabetically) can be found in the Appendix.

The remainder of the tableau shows the evaluation of constraint violations for each candidate, and the subsequent selection of the optimal form. A violation is indicated by an *asterisk* < * >. (Violations will occasionally be marked instead by the offending segment or feature itself in a few instances where it proves more salient to carry on in this way. These occasions will be noted.) When a violation is fatal, i.e. eliminates a candidate from contention, the * will be followed by an *exclamation mark* < ! >. The cells to the right of the fatal violation are shaded, to re-iterate that violations of the constraints therein are insignificant to the evaluation of the candidate.

Each tableau will also be marked with at least one symbol to the left of a certain candidate. The *pointing finger* < ☞ > indicates that the ranking has chosen the candidate as the winner, and this is the form which actually does surface in the language. The *bomb* < 💣 >

[15] For a far better description and discussion of these technicalities, see Kager (2007).

indicates that the proposed ranking selects the incorrect candidate. The 💣 will necessarily co-occur with a *sad face* < ☹ >, marking the candidate which is the actual form in the language, and indicating that the constraint ranking will need to be revised in order for it to be seen as the correct ranking for the language. In this thesis, I have chosen also to employ the *open hand* < 🖐 > to indicate that a presumed or actual output is not the winner, but is not clearly the loser either – it means that additional consideration of the problem is required.

A few more miscellaneous points of organization need to be noted. Tableaux illustrating perfect-tense forms will have in their heading a pair of forms – the basic present-tense form associated with the root to the left, and the perfect-tense form of the root being examined on the right. This will encompass the majority of tableaux. The remainder primarily deal with present-tense forms on their own. These will often be headed by just the present-tense form, occasionally placed beside the underlying root. In the tableaux themselves, and in the excursus of the candidates of the tableau, the reduplicant will be underlined, and epenthetic segments will generally be superscripted and/or bolded. Syllable boundaries are marked with a *period* < . >, and long vowels are represented with a macron < V̄ > rather than IPA < : > for typographical ease, both inside and outside the tableaux. Subscript numerals are used to index corresponding segments between input and output.

CHAPTER 2

PERFECT-TENSE REDUPLICATION OF CONSONANT-INITIAL ROOTS

Of the several reduplicative types in Ancient Greek, the most common and descriptively straightforward is that which marks the perfect tense of consonant-initial roots which begin with the sequence *consonant* + *sonorant*. Such a sequence can be fulfilled either by *consonant* + *vowel* (CV) or *consonant* + *resonant (i.e. sonorant consonant)* + *vowel* (CRV). Roots of these shapes reduplicate without any major complications, and the primary generalizations regarding the reduplicative patterns of Ancient Greek can be drawn from their behavior. The first observation that can be made is that the reduplicant always precedes the root. Second, the reduplicant (in this type, but not all types, as we will see later) surfaces with a single consonant that corresponds to the initial consonant of the root. This consonant is always followed by the vowel *epsilon* < ε >, which represents [e].[16] Lastly, the reduplicant is not longer than a single syllable. Starting from these basic generalizations, we can begin to assemble our constraint grammar.

2.1. <u>Morpheme alignment</u>

The first piece of the puzzle that needs to be identified is the constraint ranking that ensures the proper positioning of the reduplicant. It is plain to see that, whatever the precise

[16] The majority opinion is that this segment is to be identified as the mid, front, tense vowel [e], rather than the lax vowel [ε]. It will be seen why this is a reasonable conclusion when the vowel system is taken up in more detail in Chapter 6.

nature of the reduplicant (which at this point shall be identified as the morpheme RED), it surfaces as a prefix. This can be captured by employing two simple *alignment* constraints:

(3) Align-RED-L: The left-edge of the reduplicant (RED) should coincide with the left-edge of the prosodic word (PrWd). Assign one violation mark for each segment which intervenes between the left-edge of the PrWd and the left-edge of the RED.[17]

(4) Align-Root-L: The left-edge of the root should coincide with the left-edge of the PrWd. Assign one violation mark for each segment which intervenes between the left-edge of the PrWd and the left-edge of the root.

These two constraints dictate that the root and the reduplicant both want to be situated at the left-edge of the prosodic word. The competition between the two constraints will dictate not only the relative positions of the two morphemes, but ultimately the size of the reduplicant, as well. Since, as we have observed, the reduplicant always precedes the root, we know that the relative ranking of the two alignment constraints must be Align-Red-L » Align-Root-L.[18]

(5) Morpheme alignment: *present* πέμπω [pemp-ō] : *perfect* πέπεμπται [pe-pemp-tai]

/RED[19], pemp, tai/	Align-RED-L	Align-Root-L	Align-Infl-R[20]
☞ a. pe-pemp-tai		p,e	
b. pemp-pe-tai	p!,e,m,p		
c. pemp-tai-pe	p!,e,m,p,t,a,i		p,e

[17] *Alignment* constraints will be evaluated over segments. Evaluation over syllables would likely yield satisfactory results as well, but since the simpler segment-wise evaluation will suffice, this method will be used throughout the thesis.

[18] In the following tableau, violations will be marked using the segments themselves for maximal clarity. This will be replaced by the standard violation mark * in all other tableaux involving alignment constraints.

[19] For the moment, let us take for granted that the proper reduplicant is [pe]. This will be motivated below.

[20] Inflection always surfaces as a suffix, so let us assume an Alignment constraint stating as much. This will have no relevance for the remainder of the thesis.

Since ALIGN-RED-L dominates ALIGN-ROOT-L, any candidate in which the reduplicant is not aligned to the left-edge of the prosodic word will incur a fatal violation, as is the case with candidates (5b) and (5c).

The use of alignment constraints (coupled with the syllable well-formedness constraints to be motivated immediately below) to determine the shape of the reduplicant has the benefit of eliminating the need for a *reduplicative template*. A reduplicative template is an extrinsic stipulation of the shape of a reduplicative construction for which the base will provide material up to the point where the template is satisfied, but no further. In pre-OT accounts, the use of templates could not be avoided, as there was no other mechanism to explain why reduplicants had such predictable, consistent shapes within a language (and cross-linguistically, for that matter). Such a move is thus necessarily employed by pre-OT accounts, both traditional/descriptive and generative, of Ancient Greek reduplication.

Since the reduplicative template is by definition a stipulation, it would be theoretically pleasing if we could find a way to achieve the same goal without it. Because OT allows for the output to be actively shaped by the competition of constraints, eliminating templates now becomes a possibility. The account developed here shows that templatic effects can be generated through the use of independently necessary constraints.[21] Hopefully this will serve as a piece of evidence in favor of moving away from a reliance on templates for reduplication.[22]

(6) CRITICAL RANKING: ALIGN-RED-L » ALIGN-ROOT-L

[21] I admit that the employment of morphological fixed segmentism to be motivated below in some ways mirrors the reduplicative template. Even if this does weaken the argument, reducing the reduplicative template to constraints *plus* the occasional morphologically fixed segment still seems like a step in the right direction.
[22] Hendricks (1999) also employs alignment constraints to help account for the size of the reduplicant.

2.2. The size and shape of the reduplicant

Turning now to the reduplicant itself, the prototypical form can be most clearly identified by examining the pattern of the CV roots. To achieve this proper *CV-CV…* shape, all that is required is to rank the most basic *syllable well-formedness* constraints, ONSET and NOCODA, over MAX-BR, the constraint dictating that all segments present in the base must have a correspondent in the reduplicant.

(7) ONSET: All syllables must have an onset. Assign one violation mark for each syllable which does not have a consonant at the left-edge.

(8) NOCODA: All syllables must not have a coda. Assign one violation mark for each syllable which has a consonant at the right-edge.

(9) MAX-BR: Each segment in the base must have a correspondent in the reduplicant.

The ranking ONSET, NOCODA » MAX-BR ensures that no copying will occur beyond that which creates a maximally unmarked syllable (i.e. with an onset and without a coda). This ranking predicts that the reduplicant of the root √*pemp* will be the CV syllable [pe]:

(10) Motivating the *CV* reduplicant: πέμπω [pemp-] : πέπεμπται [pe-pemp-]

/ RED, pemp- /	ONSET	NOCODA	MAX-BR
a. pemp.-pemp-		**!	
b. pep.-pemp-		**!	*
c. pem.-pemp-		**!	*
☞ d. pe.-pemp-		*	**
e. _e.-pemp-	*	*!	***

Candidate (10e) is suboptimal (and in fact harmonically bounded[23] by (10d)) because it incurs a violation of ONSET without improving on any other constraints. Furthermore, it obtains this ONSET violation by copying one less segment, incurring an additional MAX-BR violation, as well. The more faithful candidates (10a-c) are all eliminated because they incur an additional NOCODA violation (beyond the one which is caused by the coda of the root). Therefore, the candidate with the CV reduplicant, (10d) [pe-pemp-], is the optimal output. This shows that the shape of the reduplicant in Ancient Greek is a classic example of *the emergence of the unmarked* (*TETU*) (McCarthy & Prince, 1994). While marked syllable structure (i.e. closed syllables and – to a lesser extent – onsetless syllables) is allowed throughout the rest of the grammar, reduplication permits only the *most unmarked structure*, since it is not subject to input-output faithfulness.

(11) <u>CRITICAL RANKING</u>: ONSET, NOCODA » MAX-BR

2.3. <u>The nature of the reduplicative vowel</u>

For roots like √*pemp*, the presence of the vowel [e] in the reduplicant looks as if it is simply the result of correspondence and identity with the root vowel. This would imply that the perfect-tense reduplicative morpheme should be defined in the usual way as the completely unspecified /RED/, as was used in the examples above. Under this definition, the vowel in the reduplicant should always match the vowel of the root. For a root like √*lu*, however, this would demand that the reduplicant's vowel surface as [u]. This is not the case. It too surfaces with [e], as seen in λέλυται [le-lu-tai].

[23] One candidate is *harmonically bounded* by another when it incurs all the same violations as the other candidate, and then one or more additional violations. This means that the harmonically bounded candidate will lose under any possible ranking of the constraints.

(12) Accounting for the reduplicative vowel: λύω [lu-] → λέλυται [le-lu-]

/ RED, lu- /	ONSET	NOCODA	MAX-BR	IDENT-BR
☹ a. le.-lu-				*!
💣 b. lu.-lu-				
c. _e.-lu-	*!		*	*
d. _u.-lu-	*!		*	

The universal presence of the [e] in the reduplicant means that this must be a case of "fixed segment reduplication" (Alderete et al., 1999). Alderete et al. identify two different types of fixed segment reduplication: phonological fixed segmentism, which is precisely *the emergence of the unmarked*; or morphological fixed segmentism, where the fixed segment is actually specified in the underlying representation of the reduplicative morpheme. The phonological type is far more common cross-linguistically, and much more widely accepted as a valid type of fixed segmentism. And since we have already seen that the syllable structure of the reduplicant is a case of *TETU*, it would be logical that the quality of the reduplicative vowel might be as well. The fact that it is [e] which emerges as the unmarked is consistent with the phonological properties of the Ancient Greek vowel system. /e/ can be viewed as the vowel which is not positively specified for any of the distinctive features in the system. The phoneme /e/ is [-hi, -low, -back/-round, -long]. Therefore, if we were to postulate a constraint against vowels with positively-specified (i.e. *marked* within the system) feature values, $*V_{[+F]}$,[24] the emergence of [e] as a phonological fixed segment in reduplication could be achieved by the normal *TETU* neutralization ranking of IDENT-IO » $*V_{[+F]}$ » IDENT-BR. That is to say, positively-specified vowel features are tolerated when derived from the input, but not otherwise.

[24] Or a separate constraint for each of the individual feature values: *[+hi], *[+low], *[+back], *[+round], and *[V:].

While this is an appealing solution, there are several factors that must dissuade us from it and point us toward morphological fixed segmentism instead. The best piece of evidence is the presence of [i] as the fixed vowel of present-tense reduplication. It would be impossible to assume that the differing quality of the fixed vowels in the parallel processes could both simultaneously be explained through *TETU*, since the ranking that creates the circumstances for one would apply equally to the other, necessarily yielding the same vowel quality in both.[25] This means that at least one of the vowels must be morphologically fixed, and if that is the case, why not allow both to be morphologically fixed?

Beyond this, we might see another piece of counterevidence in the reflexes of the Proto-Indo-European syllabic resonants. In Greek, the reflexes of the PIE syllabic resonants **r̥, *l̥, *m̥,* and **n̥*[26] each surface with an [a] vowel. The development of the vowel must be seen as epenthesis in Pre-Greek. Since epenthesis is generally subject to many of the same *TETU* restrictions as reduplication (i.e., epenthetic segments will be maximally unmarked), it might be expected that the quality of these epenthetic vowels correspond to the quality of a phonologically fixed vowel in reduplication. Certainly there are additional factors that could affect the quality of these epenthetic [a]'s in this case (e.g. contextual markedness related to the features/quality of the resonants, or diachronic differences in the vowel systems of the language at the points where these developments originate), but this difference should give us pause.

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[25] Sandell (2011) argues that the *i* of the present and the *e* of the perfect can be seen as regular outcomes of the phonology of Proto-Indo-European as governed by morphologically-conditioned ablaut. The *e* is the normal full grade, whereas *i* emerges as an epenthetic repair vowel for zero-grade. If this is the case, then the *morphological* fixed segmentism of Greek can be traced to what was essentially *phonological* fixed segmentism in the earlier period, i.e. morphologization.

[26] The syllabic resonants are (primarily) conditioned allophones of the underlying sonorant consonants which served as nuclei when no adjacent full vowel could do so. These display distinctly different reflexes than the consonantal allophones. See Sihler (1995: 90-98, §93-99) for a discussion of the developments of the PIE syllabic resonants in Greek.

Lastly, support for analyzing the [e] of the reduplicative morpheme as an instance of morphological fixed segmentism, with the vowel specified in the underlying representation, derives from the fact that it will prove very helpful in accounting for consonant-initial roots of the type COV, as well as vowel-initial roots. Furthermore, its morphological status will allow for a principled explanation of why the reduplicative patterns of these types of roots in Greek diverge so significantly from the cognate processes in the other Indo-European languages.

Proceeding under the assumption that the reduplicative vowel is best analyzed as a morphologically fixed segment, the best way to represent the reduplicative morpheme graphically is as /RED*e*/; that is to say, some undefined, unspecified reduplicative string, followed by the fixed segment [e], which is specified in the input (and therefore will be subject to input-output FAITHFULNESS constraints). Using this new definition of the reduplicative morpheme, the vowel of the reduplicant is properly accounted for, but several new candidates must now be considered, and several more constraints must be defined.

(13) MAX-IO: All segments in the input must have a correspondent in the output.

(14) IDENT-IO: All segments in the output with a correspondent in the input must be identical to their input correspondent, and vice versa.

(15) IDENT-BR: All segments in the reduplicant with a correspondent in the base must be identical to their base correspondent, and vice versa.

(16) <u>Motivating the fixed *e* of the reduplicant</u>: λύω [lu-] → λέλυται [<u>l</u>*e*-lu-]

/ RED*e*[27], lu- /	MAX-IO[28]	IDENT-IO	ONSET	NOCODA	IDENT-BR	MAX-BR
☞ a. <u>l</u>*e*.-lu-						*
b. <u>le</u>.-lu	*!				*	
c. <u>l</u>*u*.-lu-		*!				*
d. <u>lu</u>.-lu-	*!					
e. _*e*.-lu-			*!			**
f. <u>lu</u>.*e*.-lu-			*!			

The presence of the fixed /e/ vowel in the input of the reduplicative morpheme brings up the possibility of alternate representations of the same surface string. The candidate pairs (16a) & (16b) and (16c) & (16d) have the same surface phonetic representation. However, in the first candidate of the respective pairs, the vowel in the reduplicant corresponds to the fixed /e/ of the input (indicated with *italicization*); but, in the second candidate, the same surface vowel is rather a *copy*[29] that corresponds with the vowel of the base, the root vowel [u]. (This relationship is indicated by the <u>underlining</u> of the vowel in the reduplicant.) Either representation incurs a specific violation. In (16a) and (16c), the correspondence with the input fixed /e/ means that the vowel of the base has not been copied, causing a violation of MAX-BR. However, by placing this constraint low in the ranking, its violation will not rule out these candidates. The violation for the other candidates in the pairs, (16b) and (16d), is more serious. By copying the root

[27] The surface correspondent of the fixed /e/ of the reduplicative morpheme will be *italicized* in the tableaux throughout. I have chosen to not underline the italicized fixed /e/ to indicate that it is, in some way, different from the rest of the reduplicant. Issues regarding the relation of the fixed /e/ to the RED portion of the reduplicative morpheme will be central to this thesis, and discussed throughout.

[28] The ranking of MAX-IO over ONSET is not directly motivated in these forms. However, we will see on numerous occasions below that deletion is not an allowable repair strategy to fix an ONSET violation, showing that MAX-IO must dominate ONSET.

[29] I will use the word *copy* simply out of convenience and for clarity of intention, not to imply that any discrete copying operation is actually taking place. Basic (monostratal) OT builds its reduplicants strictly through *correspondence* rather than copying or any other sort of derivational process.

vowel, these have deleted the fixed /e/ of the reduplicant, and this brings about a violation of the high-ranked MAX-IO. This violation is fatal.

The next set of candidates to be considered are (16e) [*e*.-lu-] and (16f) [lu.*e*.-lu-]. Both of these remain faithful to the fixed /e/, with respect to both MAX-IO and IDENT-IO. (16e) eschews copying altogether, while (16f) places a full copy beside the fixed /e/. Both are eliminated for their violation of ONSET. Whether fully copying or not copying at all, neither candidate is able to create a well-formed syllable. This demonstrates why, in normal circumstances, partial copying (i.e. onset copying only) is the optimal strategy.[30]

The two choices that remain are (16a) [l*e*.-lu-] and (16c) [l*u*.-lu-]. The two forms are equivalent in their correspondence relationships, with the vowel in the reduplicant coming from the fixed /e/. The difference, of course, is the quality of that vowel in the output. In (16a), the quality remains faithful to the input. In (16c), the quality is not faithful to the input, and, despite having the same quality as the vowel of the base, is not, in fact, actually faithful to the base, since it is not standing in correspondence with it. This makes the change of features completely unnecessary, and this is reflected by the fact that (16c) is harmonically bounded by (16a). Therefore, the optimal candidate (16a) will be selected over (16c) under any ranking.[31]

Since candidate (16f) is ruled out only for its violation of ONSET, we need to also consider another candidate that could alleviate this problem. This will be the candidate which fully copies, but prevents an ONSET violation through the addition of an epenthetic consonant in the reduplicant. This will, of course, yield a violation of a different constraint: DEP-BR.

[30] Roots with more segmental material will have additional viable candidates with respect to syllable structure. This problem will be addressed in Section 2.4.

[31] It is exceedingly difficult to ascertain the absolute rankings of IDENT-IO and IDENT-BR. Notice that the candidates which respectively violate these two constraints are both harmonically bounded, (16b) by (16d) and (16c) by (16a). This means that they could be placed anywhere in the rankings and still yield the same result. Other data presented throughout the thesis will encounter similar problems with respect to the ranking of these constraints. I assume that IDENT-IO » IDENT-BR, because no *back-copying* is ever displayed in the language. But this is not significant to the present argument.

(17) DEP-BR: Every segment in the reduplicant must have a correspondent in the base.

Since the correct form does not display such epenthesis, this constraint must not be fully subordinated within the rankings. Considering only those candidates which are faithful to the fixed /e/ of the reduplicant (as motivated in the previous tableau), we see that DEP-BR will rule out the epenthesis candidates.

(18) Ruling out consonant epenthesis in the reduplicant: λύω [lu-] → λέλυται [l*e*-lu-]

/ RED*e*, lu- /	MAX-IO	ONSET	NOCODA	DEP-BR	MAX-BR
☞ a. l*e*.-lu-					*
b. _*e*.-lu-		*!			**
c. lu.*e*.-lu-		*!			
d. **C***e*.-lu-				*!	**
e. lu.**C***e*.-lu-				*!	

Candidates (18d) and (18e) are the epenthesis candidates respectively equivalent to (18b) and (18c). The epenthesis alleviates the ONSET violation, but incurs a new DEP-BR violation. The full copying candidate (18e) again harmonically bounds the non-copying candidate (18d). The choice then comes down to the actual output (18a) versus the full-copying epenthesis candidate (18e). As long as DEP-BR is fixed above MAX-BR, the correct form is chosen.[32]

(19) CRITICAL RANKING: MAX-IO, ONSET, DEP-BR » MAX-BR

[32] The same outcome can be achieved by using ALIGN-ROOT-L, since the epenthesis candidate has two additional segments intervening between the left-edge of the root and the left-edge of the word. ALIGN-ROOT-L and DEP-BR will generally be conspiring towards the same goal of a minimal reduplicant. This poses a problem in the ranking of these constraints. As long as one of them dominates MAX-BR (and it will be shown that ALIGN-ROOT-L must), the same outcome is obtained.

2.4. The complications of longer roots

Although the morphological fixed segmentism account works without additional consideration for CV roots like √*lu*, it introduces the possibility of other, more problematic candidates for roots with additional material after the nucleus (either a coda or additional syllables), such as √*pemp*. We have observed that the reduplicant is never larger than one syllable.[33] With an empty /RED/ morpheme, this falls out from the fact that the (typical) verbal root is one syllable.[34] But with a complex /RED*e*/ morpheme, the possibility exists for a polysyllabic reduplicant. For CV roots, as just seen, the combination of ONSET and DEP-BR prevents such a polysyllabic reduplicant. However, for a root with a final consonant, the presence of the fixed vowel in the reduplicative morpheme allows for the possibility of an additional syllable in the reduplicant. To avoid this possibility, we need a constraint that can eliminate these candidates. The constraint we need has, in fact, already been introduced – ALIGN-ROOT-L.

Since ALIGN-RED*e*-L dominates ALIGN-ROOT-L, the reduplicant will always precede the root. However, since both are gradient constraints, they are best satisfied when the root is minimally distant from the left-edge of the prosodic word. If we allow ALIGN-ROOT-L to dominate MAX-BR, the way to get the root as close to the left-edge as possible is to have the reduplicant be as small as possible.[35] This need for left-alignment is therefore what ensures the monosyllabic nature of the reduplicant.

[33] Syllabic affiliations of the reduplicant and base are more problematic in several of the more complicated forms, but this statement holds for all basic reduplication patterns.
[34] Once could potentially argue that the inflectional suffixes were part of the base, but this will not ultimately affect the argument being presented.
[35] This is safely assuming some sort of CONTIGUITY constraint preventing the root from intruding inside the reduplicative morpheme.

How ALIGN-ROOT-L is to be ranked with respect to the well-formedness constraints ONSET and NOCODA is difficult to determine with certainty. The only thing which can be definitively stated is that ALIGN-ROOT-L cannot be critically ranked higher than ONSET. If ALIGN-ROOT-L dominated ONSET, then it would be impossible for a reduplicated consonant to ever surface – which is obviously not the correct outcome.

(20) The *wrong* ranking of ALIGN-ROOT-L: πέμπω [pemp-] : πέπεμπται [p*e*-pemp-]

/RED*e*, pemp-/	MAX-IO	ALIGN-RED*e*-L	ALIGN-ROOT-L	ONSET	NOCODA	MAX-BR
☹ a. p*e*.-pemp-			p,e!		*	***
💣 b. _*e*.-pemp-			e	*	*	****
c. pemp-[36]	*!				*	****

On the other hand, if ALIGN-ROOT-L is not critically ranked with ONSET, or if it is dominated by ONSET (as shown immediately below), then the correct output is selected.[37]

[36] This candidate would additionally be problematic in that it has no realization of the reduplicant at all.
[37] Although both options are feasible, I believe the second choice to be preferable. If they are not critically ranked, the final evaluation falls to MAX-BR, which is not active in any other situation:

/RED*e*, pemp-/	ALIGN-RED*e*-L	ALIGN-ROOT-L	ONSET	NOCODA	MAX-BR
a. pem.p*e*.-pemp-		p,e,m,**p!**,e		**	
b. pe.p*e*.-pemp-		p,e,p,**e!**		*	*
c. pe.m*e*.-pemp-		p,e,m,**e!**		*	*
d. pe.*e*.-pemp-		p,e,e	*!	*	**
☞ e. p*e*.-pemp-		p,e		*	***
f. _*e*.-pemp-		e	*	*	****!

However, if ONSET » ALIGN-ROOT-L (as in the tableau presented in the body of the text), then the final evaluation is taken care of by ONSET, which is more consistent with the rest of the system.

(21) <u>The *right* ranking of ALIGN-ROOT-L</u>: πέμπω [pemp-] : πέπεμπται [<u>p</u>*e*-pemp-]

/RED*e*, pemp-/	ALIGN-RED*e*-L	ONSET	NOCODA	ALIGN-ROOT-L	MAX-BR
a. <u>pem.p</u>*e*.-pemp-			**!	p,e,m,p,e	
b. <u>pe.p</u>*e*.-pemp-			*	p,e,p!,e	*
c. <u>pe.m</u>*e*.-pemp-			*	p,e,m!,e	*
d. <u>pe</u>.*e*.-pemp-[38]		*	*!	p,e,e	**
☞ e. <u>p</u>*e*.-pemp-			*	p,e	***
f. _*e*.-pemp-		*	*!	e	****

This shows that, while it is important for the root to be minimally displaced by the reduplicant, it is yet more important for the reduplicant to receive its onset. This will be the common thread running throughout much of the reduplication grammar. And, in COV roots, we will see that this can only be violated when greater forces are brought to bear.

(22) <u>CRITICAL RANKING</u>: ALIGN-ROOT-L » MAX-BR

2.5. <u>Reduplication of CRV roots</u>

In addition to the CV-initial roots discussed so far, roots which begin with *Consonant + Sonorant Consonant* also display normal reduplication. However, these roots encounter new potential output candidates that could not have been reasonably generated from CV roots. These candidates, as represented in the following tableau, are: those with complex onsets in the reduplicant, (25a) and (25b); those which delete a root consonant to improve syllable structure, (25i); and those which copy a consonant from somewhere other than root-initial position, (25g)

[38] While the elimination mark comes after the NOCODA violation in (d) and (f), notice that it is in fact the ONSET violation which causes it.

and (25h). All these new candidates can be eliminated through the introduction of two more constraints:

(23) ANCHOR-L-BR: When a string of segments in the base stands in correspondence with a string of segments in the reduplicant, the segment at the left-edge of the base must be standing in correspondence with the segment at the left-edge of the reduplicant, and vice versa.

(24) *COMPLEX: All syllable margins must not be complex (i.e. no onset may have more than one segment, and no coda may have more than one segment). Assign one violation mark for each complex syllable margin.

(25) <u>The *Ce* reduplicant in CRV roots</u>: κρίνω [kri-n-] : κέκριμαι [<u>k</u>e-kri-]

/ RED*e*, kri- /	MAX-IO	ANCHOR-L-BR	ONSET	NOCODA	*COMPLEX	MAX-BR
a. <u>kr</u>*e*.-kri-					**!	*
b. <u>kr</u>*e*-k.ri-				*!	*	*
☞ c. <u>k</u>*e*.-kri-					*	**
d. <u>k</u>*e*-k.ri-				*!		*
e. _*e*.-kri-			*!		*	***
f. _*e*-k.ri-			*!	*		***
g. <u>r</u>*e*.-kri-		*!			*	**
h. <u>r</u>*e*-k.ri-		*!		*		**
i. <u>k</u>*e*.-ki-	*!					*

Recalling the data from section 1.1., it is clear that reduplication never surfaces with a complex onset. This was obvious in roots with only one initial consonant. However, in CRV roots, not having a complex onset in the reduplicant would mean that an extra violation of MAX-

BR has occurred. Therefore, an additional constraint that dominates MAX-BR is required. The answer is clearly *COMPLEX, which fits in perfectly with the other *well-formedness* constraints already employed, i.e. another instantiation of *TETU*. Therefore, *COMPLEX eliminates candidate (25a). But, since consonant clusters surface elsewhere, MAX-IO must dominate *COMPLEX. This ranking eliminates the deletion candidate (25i) [k*e*-ki-]. This candidate passes all the well-formedness constraints, and even manages to pass the BR-correspondence constraints. The only constraint it does violate is MAX-IO. But since MAX-IO is undominated, this one violation is enough to eliminate it from contention.

The reduplicants in candidates (25g) and (25h) generally conform to the required unmarked syllable structure, but are suboptimal in a different way. The segment being copied is not the segment at the left-edge of the base, but rather the second consonant of the root's consonant cluster. This is a straightforward violation of the correspondence constraint ANCHOR-L-BR, which requires the left-edge of the reduplicant to correspond to the left-edge of the base. The same constraint can ensure against a root's coda consonants being copied, as well. In the previous example for the root √*pemp*, ANCHOR-L-BR would eliminate a candidate such as [m*e*.-pemp-], since the /m/ of the root is not in root-initial position.

Of the remaining candidates (25c-f), (25e) and (25f) are eliminated because of unnecessary violations of ONSET. In order to select (c) over (d), all that is required is to fix NOCODA over *COMPLEX, eliminating (d) before the complex onset of the root syllable enters into the evaluation.

We should again also consider epenthesis candidates. In the case of √*lu*, we saw that epenthesizing a consonant between the copy of the root vowel and the fixed [e] was ruled out by DEP-BR and/or ALIGN-ROOT-L. With CRV roots, we now have that extra consonant in place.

However, *COMPLEX has prevented both consonants of the root-initial from being copied. If, however, a vowel was epenthesized between them, *COMPLEX would not be violated. We therefore must make sure our ranking can rule out vowel-epenthesis in the reduplicant, as well. Furthermore, we also need to make sure that the root cluster is not broken up by epenthesis either. Just as deletion is never employed to repair a complex onset (MAX-IO » *COMPLEX), epenthesis is never employed to repair a complex onset. This means that DEP-IO must also dominate *COMPLEX.

(26) DEP-IO: Every segment in the output must have a correspondent in the input.[39]

Adding this to our ranking, epenthesis in the root, and epenthesis in the reduplicant can both be ruled out.

(27) Ruling out vowel epenthesis in CRV roots: κρίνω [kri-n-] : κέκριμαι [ke-kri-]

/ RED*e*, kri- /	MAX-IO	DEP-IO	ONSET	NO CODA	*COMPLEX	DEP-BR	ALIGN-ROOT-L	MAX-BR
a. kr*e*.-kri-					**!		***	*
☞ b. k*e*.-kri-					*		**	**
c. _*e*.-kri-			*!		*		*	***
d. k*e*.-ki-	*!						**	*
e. k**V**.r*e*.-kri-					*	*	**!**	*
f. kV.r*e*-k**V**.ri-		*!					****	*

[39] This will not evaluate surface segments in the reduplicant, since they do not derive from the input, but rather the base.

Candidate (27f) is the one ruled out by DEP-IO. Notice that the extra vowel in its reduplicant will not incur a violation of DEP-BR, since it is dependent on the epenthetic vowel of the root. However, the epenthetic vowel in candidate (27e) does not depend on the root, and therefore does incur a violation of DEP-BR, and induces an extra violation of ALIGN-ROOT-L. Either of these is sufficient to rule out the epenthesis candidate.

(28) CRITICAL RANKING: MAX-IO, DEP-IO » NOCODA » *COMPLEX » MAX-BR

2.6. CV and CRV reduplication conclusions

The basic pattern of reduplication seen in the perfect-tense of CV and CRV roots has established the base line for the reduplicative grammar of Ancient Greek. The agreement across all subtypes of these roots in having a *Ce* reduplicant demonstrates that reduplication is shaped by *the emergence of the unmarked* with respect to syllable structure, that *alignment* dictates a minimal reduplicant, and that the vowel of the reduplicant can be best analyzed as morphologically fixed. All these factors will come into play as we examine other root shapes in which other complications arise, and copying does not, in fact, take place.

(29) CONSTRAINT SUMMARY:

ALIGN-RED*e*-L, MAX-IO, DEP-IO, ANCHOR-L-BR »

ONSET, NOCODA »

*COMPLEX »

DEP-BR, ALIGN-ROOT-L »

MAX-BR

CHAPTER 3

THE NON-COPYING BEHAVIOR OF *obstruent* + *obstruent* ROOTS

The reduplicative pattern for the roots examined in Chapter 2 is relatively unremarkable. It follows the cross-linguistically common pattern of partial reduplication shaped by *the emergence of the unmarked* effects. However, we find a very different situation for roots of the type *consonant* + *obstruent* + *vowel* (COV). The difference between these types and the ones discussed in the previous chapter arises from the difference in the specification of the feature [sonorant] in the second segment of the root. In both CV and CRV roots, the second element is [+sonorant], as *sonorants* encompass both resonants and vowels. In COV roots, however, the second element is specified as [-sonorant]. This fact in and of itself is not what determines the distinctive behavior of the two groups, but rather the correlated problems it presents for *sonority.*

3.1. The problem with COV roots

Unlike C(R)V roots, the perfect-tense stem of COV roots surface without a consonant in the reduplicant, instead having only the fixed [e] vowel. For example, the perfect-tense form built from the root /kten/ 'slay' (present tense κτείνω [ktēn-ō]) is ἔκτονα [ektona], rather than an expected [*kektona]. The constraint ranking developed so far cannot properly account for this behavior. Having no reduplicated consonant incurs an additional ONSET violation (and, less importantly, an additional MAX-BR violation) without improving on any other constraint currently being used. The actual form [ek.to.na], candidate (30f), is not only *not* the winner in the following tableau, it is harmonically bounded by (30d), [kek.to.na], which itself loses to candidate (30c) under the current rankings.

(30) Problems with COV roots: κτείνω [ktēn] : ἔκτονα [*e*-kton-]

/ RED*e*, kton, a /	MAX-IO	ANCHOR-L-BR	ONSET	NOCODA	*COMPLEX	MAX-BR
a. kt*e*.-kto.n-a					**!	
b. kt*e*-k.to.n-a				*!	**	
💣 c. k*e*.-kto.n-a					*	*
d. k*e*-k.to.n-a				*!		*
e. _*e*.-kto.n-a			*!		*	**
☹ f. _*e*-k.to.n-a			*!	*		**
g. t*e*-k.to.n-a		*!		*		*
h. k*e*.-ko.n-a	*!					

Since the desired output is harmonically bounded, it is necessary to introduce new constraints. Candidate (30c), [ke.kto.na], can be eliminated by adding SONORITY SEQUENCE (SONSEQ) to the ranking.

(31) SONSEQ: Between any member of a syllable and the syllable peak, only sounds of higher sonority rank are permitted.[40]

If SONORITY SEQUENCE were undominated, however, forms like the present-tense of this verb, κτείνω [ktēn-ō], would be impossible. This can be accounted for by ranking the basic IO-correspondence constraints over SONORITY SEQUENCE:

[40] Definition taken from Byrd (2010: 27). A definition this precise ensures that we can rule out sonority plateaus as well as illicit rises and falls.

(32) <u>The present tense of a COV root</u>: κτείνω [ktē̄n-ō̄]

/ ktē̄n, ō̄ /	MAX-IO	IDENT-IO	DEP-IO	SONSEQ	ONSET	NOCODA	*COMPLEX
☞ a. ktē̄.n-ō̄				*			*
b. e.ktē̄.n-ō̄			*!	*			*
c. ek.tē̄.n-ō̄			*!		*	*	
d. ke.tē̄.n-ō̄			*!				
e. kē̄.n-ō̄	*!						
f. ksē̄.n-ō̄		*!					*

Candidate (32e) is eliminated by MAX, candidate (32f) is eliminated by IDENT,[41] and candidates (32b-d) are eliminated by DEP. The important take-away is that a sequence which would violate SONSEQ if tautosyllabic will never be repaired through deletion or epenthesis. However, as long as we rank SONSEQ over the other *syllable well-formedness* constraint NOCODA, such a sequence can be avoided by syllabifying one of the consonants as a coda. This syllabification strategy will be required when there is a preceding vowel available from the input, since this does not require epenthesis. COV roots will therefore display heterosyllabicity of their initial *consonant* + *consonant* sequence in their perfect-tense forms.

3.2. <u>STRUCTURAL ROLE</u>

SONORITY SEQUENCE gives us a way to prevent a candidate like (30c) [ke.kto.na] from being selected as optimal. However, there is still the problem that our desired output (30f) [ek.to.na] remains harmonically bounded by (30d) [kek.to.na]. We therefore need to add yet

[41] It is likely that IDENT-IO should be broken up into more specific constraints based on specific features, but this is not significant for the current problem. This is the strongest piece of evidence for a relatively high ranking of IDENT.

another constraint. There appear to be two potential solutions. One way to account for these facts is to employ the constraint known as STRUCTURAL ROLE (STROLE).

(33) STRUCTURAL ROLE (STROLE): Two segments standing in correspondence must fill an identical syllabic position (i.e. nucleus, onset, or coda).[42]

This is not a constraint found too commonly in the recent literature. Part of the reason may be as simple as its name, which does it a major disservice. This constraint goes back at least to McCarthy & Prince (1993a: 141). This is the work that lays the foundation for McCarthy & Prince (1995), which is where Correspondence Theory (CT) is formally developed. Since the vocabulary of CT had obviously not yet been developed, there was no naming convention that needed to be followed. This is unfortunate, because STROLE is nothing more than a *correspondence* constraint that dictates IDENTITY between the syllabic positions/roles of segments standing in correspondence.

In CT terms then, the STRUCTURAL ROLE we are dealing with here could better be named IDENT(syllabic position)-BR or some such thing. In order to retain the connection with previous usages of this constraint (however scanty they may be), the name STROLE will nonetheless be employed throughout. However, since STROLE should be considered a constraint family just as any other *correspondence* constraint, we will need to specify along which faithfulness dimension the constraint is being evaluated. Therefore, the exact constraint which is being used is STROLE-BR.

[42] Whether there should be a division among positions within a complex onset or coda is unclear. But the only distinction that will be necessary to effect our outcome is that between onset and coda.

(34) STROLE-BR: A segment in the reduplicant which stands in correspondence with a segment of the base must be in the same syllabic position (i.e. nucleus, onset, or coda) as the base segment, and vice versa.

Since the STROLE constraint type will only be used in this account with respect to the BR-faithfulness dimension, it will continue to be referred to as simply STRUCTURAL ROLE or STROLE (particularly when abbreviated in tableaux). Nonetheless, it is always meant to reference the base-reduplicant relationship

Putting aside the problems with the name, another potential reason why it is not favored in the literature is that it is a correspondence constraint that makes reference to syllabification, a feature which cannot be present in the input. Since syllabification is purely an output phenomenon, this means that STROLE can only apply to correspondence relationships that both reference the output – which obviously excludes the most basic correspondence dimension, input-output faithfulness. However, since we are dealing with the base-reduplicant faithfulness dimension, this constraint can be exercised, as both strings necessarily reference the output, which is defined for syllabification.

In the examples dealt with in Chapter 2, STROLE was always satisfied. Consider forms such as λέλυκα [l*e*.-lu.ka], πέπεμπται [p*e*.-pemp.tai], and κέκριμαι [k*e*.-kri.mai]. In each of these words, the segments which stand in correspondence are the consonant of the reduplicant and the initial consonant of the base/root. In all cases, both segments are syllabified as onsets. This fact is encoded in the grammar as the STROLE constraint.

Since *the emergence of the unmarked* has eliminated all codas from the reduplicant, and since the vowel of the reduplicant is underlyingly specified and therefore not dependent on the vowel of the base, it is in fact only the onset segments which can ever stand in correspondence.[43] The importance of this concept was observed in pre-OT terms by Clements (1985) and Steriade (1988), who use the term *onset transfer*.[44] Ensuring *onset transfer* through STRUCTURAL ROLE and ANCHOR-L-BR is conceptually pleasing, because both of these constraints demand transparency and iconicity with respect to the relationship between the reduplicative base and the reduplicant itself in a number of ways. These constraints dictate that the segments standing in correspondence are both in a prosodically prominent position (i.e. onset). They dictate that the reduplicated consonant (which corresponds to the root-initial consonant) stands in the normal prosodic position for the initial consonant of the root within the paradigm of that root (i.e. onset). And the corresponding segments are in a logically and prosodically parallel position, (i.e. the initial element of their discrete string – which is the onset). If the root-initial consonant were shunted into the coda (a prosodically weaker position) and thus stranded from the rest of the root syllable, the motivation of reduplication, which must be to emphasize the root (yet in the most minimal way possible), is lost; the iconic, transparent relationship between reduplicant and base, and between perfect-tense stem and verbal root, would be gone. Informally put, to Greek speakers, if this relationship would not be maintained, then it was not worth the effort of trying to fill the empty RED portion of the reduplicative morpheme with any material at all.

The general pattern of reduplication in Greek is very common cross-linguistically, and in many ways resembles what we might call the most "unmarked" situation. The reduplicant is aligned to the left, it is monosyllabic, and it bans codas. All these observations come together to support the idea of *onset transfer* as a key factor in reduplication. Whether it is somehow a causal relationship or not, it appears that speakers employing reduplication generally like to have

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[43] The one exception will be the Attic Reduplication forms of vowel-initial roots, to be discussed in Chapter 7.
[44] Fleischhacker (2005) also makes extensive use of this concept.

a matchup between the onset of the reduplicant and the onset of the root.[45] (Equivalent parallelism is likely preferred for codas in the cross-linguistically less common right-aligned reduplication constructions.) *Onset transfer* therefore establishes an iconic link between the two morphological elements, which must be the origin of reduplication to begin with.

Seeing how *onset transfer* and syllabic identity are significant to the normal reduplicative pattern, we can now see why no consonant surfaces in the reduplicant of these COV roots. Any candidate which has an illicit onset cluster will be eliminated by SONORITY SEQUENCE, and any candidate that syllabifies the root-initial consonant as a coda to avoid this problem will fatally violate STRUCTURAL ROLE. The only viable output for such roots is thus the non-copying one. When we introduce these new constraints into the tableau, the proper output is selected.

(35) COV perfects with STROLE and SONSEQ: κτείνω [ktēn] : ἔκτονα [*e*-kton-]

/ RED*e*, kton, a /	MAX-IO	STROLE	ANCHOR-L-BR	SON SEQ	ONSET	NO CODA	*COMPLEX	MAX-BR
a. kt*e*.-kto.n-a				*!*			**	
b. kt*e*-k.to.n-a		*!		*		*	**	
c. k*e*.-kto.n-a				*!			*	*
d. k*e*-k.to.n-a		*!				*		*
e. _*e*.-kto.n-a				*!	*		*	**
☞ f. _*e*-k.to.n-a					*	*		**
g. t*e*-k.to.n-a			*!			*		*
h. k*e*.-ko.n-a	*!							

[45] We have an immediate counterexample in English *fm-* reduplication. See, e.g. Nevins & Vaux (2003). This however is reduplication of a different sort. This is essentially complete reduplication – although also notably with morphological fixed segmentism. Complete reduplication is often thought to make up a compound, as opposed to partial reduplication, which patterns more like an affix. This could lie at the heart of the difference between Sanskrit (and Indo-European) intensive reduplication versus perfect and present reduplication. This could be a potential indication that *onset transfer*, and *syllable transfer* more generally (which is equally called for by STROLE), is more significant in partial reduplication than complete reduplication.

Just as in the last tableau, the deletion candidate (35h) [ke.ko.na] is eliminated by MAX, and candidate (35g) [tek.tona], which takes its consonant from non-base-initial position, is eliminated by ANCHOR. The remainder of the work is done by our two new constraints. Notice that the candidate pairs (35a) & (35b), (35c) & (35d), and (35e) & (35f) differ among themselves only in their syllabification of the root-initial /kt/ cluster. The first of each pair makes the cluster tautosyllabic. Since the cluster consists of two stops, there is a sonority plateau, and thus a violation of SONSEQ. This constraint is high-ranked enough so that just one violation eliminates all of these candidates (i.e. (35a), (35c), and (35e)). Candidates (35a) and (35b) also incur a violation of SONSEQ for the [kt] cluster in the reduplicant.

In the second candidate of each pair, the cluster is heterosyllabic. This avoids any potential issues with SONSEQ, since there is no complex margin to begin with. However, this syllabification now runs up against STROLE. In candidate (35b) and candidate (35d), copying of the base-initial consonant has taken place, and therefore a correspondence relationship between the copied segments and the base segments does exist. Since such a relationship is present, the correspondence constraints must be evaluated. The one that is significant for these outputs is STROLE. In order to avoid a SONSEQ violation, the initial /k/ of the base has been syllabified as a coda. This [k], however, is still in correspondence with the [k] of the reduplicant, which is obviously syllabified as an onset. Since there is now a mismatch in syllabic position between corresponding segments, a violation of STROLE is incurred. If we assume this constraint to be undominated,[46] then this violation will knock out (35b) and (35d).

This leaves us with only the desired output, candidate (35f) [ek.to.na]. This candidate has been able to sneak its way through the constraints by virtue of its lack of a correspondent of any kind in the "reduplicant." Even though it has an onsetless syllable (and one in word-initial

[46] The same result will be achieved with any ranking in which STROLE dominates ONSET.

position, no less) and thus a violation of ONSET, it has managed to pass the more significant syllabification-related constraint SONORITY SEQUENCE, and vacuously satisfy the correspondence constraints STRUCTURAL ROLE and ANCHOR-L-BR.

One more rather strange candidate may deserve discussion. If maintaining identity of syllabic position is the key factor, then what about a candidate which epenthesizes an initial vowel: [**V**k.t*e*-k.to.na]? By epenthesizing a vowel, the entire /kt/ cluster of the root can be copied into the reduplicant while simultaneously avoiding complex margins that violate SONSEQ and maintaining syllabic identity. We might even isolate two candidates with the same surface string: one where the epenthetic **V** belongs to the reduplicant (36b) [<u>**V**k.t</u>*e*-k.to.na], and one where it belongs simply to the prosodic word (36c) [**V**<u>k.te</u>-k.to.na]. While both candidates show clear advantages with regard to our new constraints, they can both be dealt with straightforwardly.

Candidate (36b) violates ANCHOR-L-BR, since there is an element at the left-edge of the reduplicant which does not correspond to the element at the left-edge of the base. (It also violates DEP-BR, but the evaluation is long since done when it reaches that constraint.) Candidate (36c) violates DEP-IO, since the epenthetic vowel in this candidate does not belong to the reduplicant, but rather the prosodic word, and is therefore subject to the input-output faithfulness dimension, rather than the base-reduplicant one. The tableau for the present-tense κτείνω [kteinō] demonstrated that DEP-IO was highly ranked, at least above SONSEQ. Furthermore, both candidates will incur three more violations of ALIGN-ROOT-L than the optimal candidate (36a).[47] We therefore already have the constraints in place to select the right outcome.

[47] Candidate (35c) will actually incur a likely fatal violation of ALIGN-RED*e*-L, since the epenthetic segment does not belong to the reduplicant.

(36) Additional candidates for COV roots: κτείνω [ktēn] : ἔκτονα[*e*-kton-]

/ RED*e*, kton, a /	MAX-IO	DEP-IO	STROLE	ANCHOR-L-BR	SON SEQ	ONSET	NO CODA	MAX-BR
☞ a. _*e*-k.to.n-a						*	*	**
b. **V**k.t*e*-k.to.n-a				*!		*	**	
c. **V**k.t*e*-k.to.n-a		*!				*	**	

3.3. Ramifications of a STRUCTURAL ROLE account

Several issues come out of the account based on STRUCTURAL ROLE.[48] One that is rather positive is how this solution interacts with the notion of REALIZE MORPHEME (Kurisu, 2001). It is rather obvious that a morpheme that contributes any sort of grammatical and/or semantic information should have some identifiable exponent on the surface. With no exponent, there would be no overt clue that the morpheme was present at all. In the present tense and the aorist, reduplication had ceased to have any obvious grammatical or semantic implication by the time of attested Greek. In these categories, reduplication could therefore be lost – either because of adverse forces (such as syllabification, as we have seen) or simply through loss and replacement of an irregular form – on a given form without any major change to the signification of the word. But for the perfect tense, the reduplicative morpheme was a key, productive grammatical signifier of the tense-stem, and could therefore not be completely lost without major ramifications. The key to this whole puzzle is the fixed /e/ of the reduplicative morpheme.

The fixed /e/ allows an exponent of the morpheme to surface without any correspondence relationships occurring. If the [e] was a phonologically fixed segment rather than a morphological one, then the [e] in [ek.to.na] would correspond to the vowel of the base. (It could potentially be identified as epenthetic, but it would still in that case constitute part of the

[48] Many of the same issues will in fact be raised by the alternative account presented below.

reduplicated string, in which case this argument still holds.) While it would pass STROLE, as both correspondents are nuclei, it would run afoul of ANCHOR-L-BR, since the [kt] is still part of the base. It is the fixed /e/ that causes the form of the reduplicant in COV roots in Greek to diverge from the form of such roots in the cognate reduplicative processes in the other ancient Indo-European languages, most notably Sanskrit.

Sanskrit does not have a fixed segment in its reduplicative morphemes (cf., e.g., Steriade (1988)). The vowel of the reduplicant in the Sanskrit perfect can surface as either [a], [i], or [u] – the only three basic vowels of its vowel inventory. Which vowel surfaces depends directly on the vowel of the base (more specifically, the vowel in the zero-grade forms of the base).[49] The reduplicant in the Sanskrit perfect, as in Greek, forbids copying codas and having complex syllable margins. For this reason, it will run into the same problems as Greek does when trying to produce perfect-tense forms for COV roots. However, since there is no fixed vowel to fall back on, it must copy *something* in order to have a surface exponent of the reduplicative morpheme (i.e. satisfy REALIZE MORPHEME). What Sanskrit does is copy the least sonorous consonant of the cluster into reduplicant-initial position, followed by a copy of the base vowel.

(37) <u>COV Perfect-tense reduplicants in Sanskrit</u>

√st^{h}ā ‘stand’ : *perfect* [<u>ta</u>-s.t^{h}au]

√skand ‘leap : *perfect* [<u>ca</u>-s.ka.d-ur][50]

√kṣad ‘divide: *perfect* [<u>ca</u>-k.ṣa.d-ur][51]

[49] The fact that the reduplicative vowel, even in full-grade/o-grade forms, matches the zero-grade vocalism can be explained through output-output faithfulness: IDENT(V)-IO » IDENT(V)-OO$_{\text{ZERO-GRADE}}$ » IDENT(V)-BR. This can easily be seen as a paradigm uniformity effect, since only the active singular does not have zero-grade. Zero-grades in [r̥] reduplicate with [a], presumably because of a *TETU* ranking of a markedness constraint against syllabic consonants.
[50] < c > = IPA [ʧ]. It is the result of palatalization of /k/. Plain velars are not permitted in the reduplicant in Sanskrit. Since the reduplicant vowel derives from PIE **e*, copied velars were palatalized in Proto-Indo-Iranian. This alternation has been essentially morphologized in Sanskrit (which has changed **e* > *a*), possibly by the promotion of a constraint *VELAR into a *TETU* ranking, blocking it from surfacing in reduplication.
[51] < ṣ > = IPA [ʂ] (voiceless retroflex fricative)

All copy strategies would incur some sort of major violation. If only the vowel were copied, there would be violations of ONSET and ANCHOR-L-BR. If the left-most consonant of the base vowel were copied, there would be a violation of STRUCTURAL ROLE (and also CONTIGUITY-BR, although this must not be highly ranked, since Sanskrit, like Greek, has a CV reduplicant for CRV roots).[52] If the right-most consonant of the cluster were copied, ANCHOR would again be violated. Since copying is required, and any copy strategy results in high-ranking violations, Sanskrit has "decided" to choose the reduplicative consonant based on a different means altogether, which is sonority.

Keydana (2006) rightly uses Prince & Smolensky's (1993: 152) *margin hierarchy* to effect this outcome. The *margin hierarchy* states that there is a universal ranking of what segments are preferred at syllable-margins. This hierarchy is based directly on sonority. The least sonorous segments (stops) are the most ideal margin, while the most sonorous segments (vowels) are the worst margin. We can restrict this concept to onsets, because it is well known that minimally sonorous segments are *not* ideal codas. (Nasals are often thought to make the best codas, although, of course, any coda is marked.) Based on the problem at hand, there are four relevant distinctions within the *onset margin hierarchy*, referencing, respectively, vowels (V), resonants/sonorant consonants (R), fricatives (S), and stops (T). The constraints themselves, in their fixed ranking, are as follows:

(38) <u>ONSET MARGIN HIERARCHY CONSTRAINTS</u>: $*_{\sigma}[V$ (= ONSET) » $*_{\sigma}[R$ » $*_{\sigma}[S$ » $*_{\sigma}[T$

---

[52] However, Fleischhacker (2005) convincingly argues that there would be crucial differences between skipping in CR clusters versus other CC clusters.

By placing this ranking fragment (coupled with LINEARITY-BR, in order to avoid copying a more ideal consonant from a root coda), above ANCHOR and STROLE, the reduplicant will be essentially blind to the syllabification and sonority profile of the root segments. The precise ranking of each constraint relative to other significant constraints in Sanskrit is beyond the scope of this paper. It would be interesting to see if the *onset margin hierarchy* interacts at all with syllabification in non-reduplicative contexts.

Such a strategy of sonority-based copying could have been extrapolated by speakers from the treatment of CRV roots, where the reduplicant surfaces as CV. Since phonotactics dictates that the C in such a root has lower sonority than the R, the C, which would have been regularly selected by ANCHOR, is metanalyzed to instead have been selected by the *onset margin hierarchy*.

The relevant point is this: the presence of the fixed /e/ of the reduplicative morpheme gives Greek the luxury, if you will, to be picky about its reduplicants – Fleischhacker's (2005) "selective copy" type. Since it will never run into any problems with REALIZE MORPHEME, if copying would cause too costly a violation, it can eschew copying altogether. But for Sanskrit, when push comes to shove, a less-than-ideal copy will be generated, since otherwise it would incur a violation of REALIZE MORPHEME. This is why we see Sanskrit copying a non-initial root consonant – something that Greek will not do under any circumstances.[53]

A quite ponderous question that the STROLE account raises is how we are to evaluate ANCHOR-L-BR for a form like [ektona]. On the one hand, no correspondence relationship exists, making it hard to conceive how a *correspondence* constraint could be violated. However, we still have a "reduplicative morpheme," insofar as this is what we have been calling /RED*e*/. But does that mean we have a reduplicant? If there are no correspondence relationships between

[53] With the possible exception of Attic Reduplication, which will be discussed below.

segments, could there still be some sort of correspondence between base and reduplicant in general? In which case, could a constraint like ANCHOR, which can make reference to edges and not just segments, still be evaluated without segmental correspondence? That is to say, does ANCHOR work in the way defined above in (23), or does it work more like this:

(39) "If there is a base and a reduplicant/reduplicative morpheme, the segments at the left/right edge **must correspond**."

Under such a definition, it would appear that [ektona] violates ANCHOR, since the [e] could be considered part of the *reduplicant* (even though no copying has occurred), and it does not correspond with the [k]. If this does incur an ANCHOR violation, the optimal candidate would not be chosen. In the case of Attic Reduplication, this stronger definition of ANCHOR could actually yield the desired output. But obviously, that would come at the expense of a large part of the rest of the dataset.

The reason this issue comes up at all is once again the presence of the fixed /e/. Since morphological fixed segmentism in reduplication is relatively rare cross-linguistically (Alderete et al., 1999), one would not normally encounter even the possibility of such a problem. Only when the empty RED string and a morphologically fixed segment are conjoined can such a question about ANCHOR (or at least ANCHOR-BR) be probed. But, as demonstrated here, even with such a situation occurring, it is quite difficult to answer these types of questions. Given, however, that an account based on the normal correspondence definition of ANCHOR-BR seems advantageous, I see no reason to amend it based on the facts of Greek.

(40) CRITICAL RANKING:

MAX-IO, DEP-IO, STROLE, ANCHOR-L-BR » SONSEQ » ONSET, NOCODA

3.4. An alternative to STRUCTURAL ROLE: *alignment*

There is another potential solution for the COV forms, but it poses its own theoretical hurdles. It works in very much the same vein as the STRUCTURAL ROLE account, but relies on ALIGNMENT instead of IDENTITY. The constraint is as follows:

(41) ALIGN (BASE, L; σ, L): The left-edge of the base must coincide with the left-edge of a syllable.

The rationale behind this constraint is similar to the rationale behind ANCHOR-L-BR and STRUCTURAL ROLE. Like these constraints, ALIGN (BASE, L; σ, L) demands a transparency and iconicity with respect to the relationship between the reduplicative base and the reduplicant itself. However, instead of enforcing this through *correspondence*, it enforces it through requirements on the positioning of the base – which is obviously the starting point for any reduplicative process. With ALIGN (BASE, L; σ, L) dictating that the base be situated at the left-edge of a syllable, then any time the root-initial consonant is syllabified as a coda, a violation will be incurred. This will rule out the problematic candidate *[kek.to.na]. However, this constraint would appear to have the unwanted consequence of also eliminating our desired output [ek.to.na], since its /k/ is also syllabified as a coda. But if we, for the moment, assume that this candidate does pass this constraint, the ranking would select it as optimal:

(42) Accounting for COV perfects with ALIGN-BASE-L: κτείνω [ktēn] : ἔκτονα [*e*-kton-]

/ RED*e*, kton, a /	MAX-IO	ALIGN-BASE-L	ANCHOR-L-BR	SON SEQ	ONSET	NO CODA	*COMPLEX	MAX-BR
a. kt*e*.-kto.n-a				*!*			**	
b. kt*e*-k.to.n-a		*!		*		*	**	
c. k*e*.-kto.n-a				*!			*	*
d. k*e*-k.to.n-a		*!				*		*
e. _*e*.-kto.n-a				*!	*		*	**
☞ f. _*e*-k.to.n-a		?			*	*		**
g. t*e*-k.to.n-a		*!	*			*		*
h. k*e*.-ko.n-a	*!							

So the question is: can we develop a rationale that lets us state that [ek.to.na] satisfies ALIGN (BASE, L; σ, L)? I think the answer is yes. There is a major difference between (42d) [kek.to.na] and (42f) [ek.to.na]. In (42d), "copying" has occurred, but in (42f), no "copying" has taken place at all. (We of course still understand "copying" as shorthand for "*correspondence*.") What if we were to say that in order for an element to function as a base, some copying must have occurred? In other words, we would define the reduplicative *base* in the following way:

(43) BASE – a surface string to which some other surface string in the same output (which is not specified in the input) stands in (either full or partial) correspondence

To put this in a slightly less precise (but more easily understandable) manner, we could alternatively say:

(44) BASE – a string from which segmental material is copied through a reduplicative process

Under such a definition, there would actually be **no base** in candidate (42f). Without a base, all constraints which make reference to *base* must be vacuously satisfied. Most significantly, this means that such a candidate would automatically pass ALIGN (BASE, L; σ, L) and ANCHOR-L-BR (and less importantly, it would not incur any MAX-BR violations). In other words, every root has the potential to serve as a *base*, yet it does not become a *base* until material is copied. When copying happens, any constraints involving the *base* become active. Since no copying occurs and the *base* is not activated, (42f) passes the ALIGNMENT constraint, validating the above tableau and the proposed constraint ranking.

This new conception of the base need not be exclusive to the ALIGNMENT account. While it is not necessary to make such statements about the base for the account relying on STRUCTURAL ROLE, it would not seem to contradict that analysis in any way.[54] In fact, this definition of the base should alleviate some of our concerns about ANCHOR-BR voiced above. If the root string in a candidate like [ek.to.na] is not a base to begin with, then the "reduplicative morpheme" is certainly in no danger of being forcibly called a *reduplicant* and by implication necessarily evaluated by ANCHOR-L-BR. The normal definition whereby ANCHOR is only evaluated when a correspondence relationship exists is exactly parallel to this new conception of the base. Since no correspondence relationship exists, *base* cannot be active, just as *reduplicant* cannot be active.

Furthermore, ALIGN (BASE, L; σ, L) and STRUCTURAL ROLE are themselves not necessarily mutually exclusive. Surely they are almost entirely redundant, and therefore speakers could potentially have difficulty acquiring them as separate constraints. But it would not be impossible for them to exist side by side in the grammar. However, for economy's sake,

[54] The fact, however, that the ALIGNMENT account does **require** such refinements (or even stipulations, if one sees the need to call them that) should favor the STROLE account on the basis of *economy*.

it is best to rely on just one account. Since the STRUCTURAL ROLE account does not require any special definition of the base, and since it relies on *correspondence* rather than *alignment*,[55] I will favor STRUCTURAL ROLE to ALIGN (BASE, L; σ, L).

3.5. Other COV root-shapes

The behavior of non-copying roots was just demonstrated using the root √*kten-*. This represents one of three major types of non-copying root: roots which begin in a *stop* + *stop* cluster (henceforward TT roots). Besides this root, we have in this category also, for example:

(45) TT-roots[56]

Root		Present Tense		Perfect Tense	
kti-	'people, found'	κτίζω	[kti-zd-]	ἔκτισμαι	[ek.ti-s-]
ptis-	'winnow grain, pound'	πτίσσω	[ptis-]	ἔπτισμαι	[ep.tis-]
p^ht^her-	'destroy'	φθείρω	[p^ht^hēr-]	ἔφθορα	[$ep^h.t^h$or-]
p^ht^hi-	'decay, wane'	φθίνω	[p^ht^hi-n-]	ἔφθιμαι	[$ep^h.t^h$i-]

This shows that any root-initial sequence of *stop* + *stop* results in a perfect-stem without a reduplicated consonant.[57] The same behavior will be regularly applicable to another root-shape, *sibilant* + *stop* (ST) roots. These would be expected to follow the same pattern, since this sequence also fails to have the rising sonority required to induce copying.

[55] I take this fact to be a positive. *Alignment* is not quite as universally accepted a constraint type as *correspondence* is. A large part of this is because there are few restrictions on what an alignment constraint can look like. In other words, a common critique of alignment is that it is too powerful. If we were to rely on ALIGN (BASE, L; σ, L), the criticism could be leveled that this an overly-powerful constraint, particularly since it is not typical to use the item BASE in alignment constraints.
[56] Forms in the follow tables are taken from Laar (2000: Ch. 2).
[57] The few exceptions fall into a coherent group. These will be discussed in Chapter 4.

(46) ST-roots

Root		Present Tense		Perfect Tense	
skeda-	'scatter, disperse'	σκεδάννυμι	[skeda(n)-]	ἐσκέδασμαι	[es.keda(s)-]
skep-	'see'	σκέπτομαι	[skep-]	ἔσκεμμαι	[es.kem-]
sper-	'sow'	σπείρω	[spēr-]	ἔσπαρμαι	[es.par-]
spend-	'make a drink offering'	σπένδω	[spend-]	ἔσπεισμαι	[es.pēs-]
stel-	'make ready; send; gather up'	στέλλω	[stel-]	ἔσταλμαι	[es.tal-]
sterg-	'love'	στέργω	[sterg-]	ἔστοργα	[es.torg-]
strep^h-	'turn'	στρέφω	[strep^h-]	ἔστραμμαι	[es.tram-]
sk^{h}id-	'split, cleave'	σχίζω	[sk^{h}izd-]	ἔσχισμαι	[es.k^{h}is-]
zben-[58]	'extinguish'	σβέννῡμι	[zben-]	ἔσβηκα, ἔσβεσμαι	[ez.bɛ̄-], [ez.be(s)-]
zdeug-	'yoke'	ζεύγνῡμι	[zdeug-]	ἔζευγμαι	[ez.deug-]
zdɔ̄s-	'gird'	ζώννυμι	[zdɔ̄n-]	ἔζω(σ)μαι	[ez.dɔ̄(s)-]

One interesting form is the root √*strep^h*-'turn': *present* στρέφω [stre.p^h-ɔ̄] ~ *perfect* ἔστραμμαι [es.tram.-mai]. This root has an initial STR sequence. We have yet to deal with the syllabification of a tri-consonantal string. Steriade (1982) and Byrd (2010) show that this sequence should syllabify as -VS.TRV- in Ancient Greek. However, there is nothing in our ranking that can differentiate that outcome from -VST.RV-. It correctly predicts non-copying, but cannot choose between the two possible syllabifications:

[58] It is unclear whether or not the sigma < σ > in this word represents the normal [s], or rather a [z], which would display expected voicing assimilation before a voiced stop. The two possibilities are essentially equivalent with respect to their sonority profiles.

(47) Accounting for STR- perfects: στρέφω [stre.p^h-ō] ~ ἔστραμμαι [*e*-s.tram.-mai]

/ RED*e*, stram, mai /	ANCHOR-L-BR	STROLE	SON SEQ	ONSET	NO CODA	*COMPLEX	MAX-BR
a. str*e*.-stram.mai			*!*		*	**	**
b. st*e*.stram.mai			*!*		*	**	***
c. s*e*.-stram.mai			*!		*	*	****
d. s*e*-s.tram.mai		*!			**	*	****
e. *e*.-stram.mai			*!	*	*	*	*****
☹ f. *e*-s.tram.mai				*	**	*	*****
☞ g. *e*-st.ram.mai				*	**	*	*****
h. *e*-str.am.mai			*!	**	**	*	*****

Candidate (47d) is knocked out for its violation of STRUCTURAL ROLE. Candidates (47a-c) and (47e) incur a fatal violation of SONORITY SEQUENCE for their *st* onset. But notice that the presence of the *r* in the string does not at all affect that outcome. As it is a resonant following a stop, it does not negatively affect the sonority profile of the cluster, since it is increasing in sonority towards the nucleus. Candidate (47h) also is knocked out for a violation of SONSEQ, but for a different reason. Its offending cluster is not an *st(r)* onset, but rather its *(s)tr* coda. The *tr* sequence that is optimal in an onset is illicit in a coda, precisely for its rising sonority. In this case, it is the *s* which does not negatively affect the sonority profile of the syllable. This candidate is pathological, as it incurs an extra ONSET violation just to create an extra SONSEQ violation. It is harmonically bounded by most of the other candidates shown, including the winners.

The relevant issue, though, is that the desired candidate (47f) [es.tram.mai], ties all the way through with candidate (47g) [est.ram.mai]. This problem can be solved in one of two ways. The first would be to relativize *COMPLEX into *COMPLEX$_{ONSET}$ and *COMPLEX$_{CODA}$. If we allow *COMPLEX$_{CODA}$ to dominate *COMPLEX$_{ONSET}$[59] (while leaving them both in the spot previously designated for simple *COMPLEX), then when a choice between candidates such as (47f) and (47g) is necessary, the candidate with the complex onset will be preferred.

(48) VSTRV syllabification with relativized *COMPLEX

/ CVSTRV /	SON SEQ	ONSET	NO CODA	*COMPLEX$_{CODA}$	*COMPLEX$_{ONSET}$
a. CV.STRV	*				*
☞ b. CVS.TRV			*		*
c. CVST.RV			*	*!	
d. CVSTR.V	*	*	*	*	

An alternative solution is to return to Prince & Smolensky's *margin hierarchy* (1993: 152). We have already seen that this was employed by Keydana (2006) to account for the behavior of COV-type roots in Sanskrit. If we leave *COMPLEX un-relativized, and enter the *onset margin hierarchy* into our rankings anywhere below SONORITY SEQUENCE, it will choose the candidate that has a better onset. Since a *stop* is a better onset than a *resonant/sonorant*, it will select candidate (48/49b), *CVS.TRV*, over candidate (48/49c), *CVST.RV*, not because of any preference for complex onsets or codas, but because of a preference for low sonority onsets.

[59] Since codas are more marked than onsets, one would naturally expect this ranking. However, it seems unlikely such a ranking is universal. Classical Armenian appears to display a ban on complex onsets while allowing complex codas.

(49) <u>VSTRV syllabification with *onset margin hierarchy*</u>

CVSTRV	SONSEQ	ONSET ($*_{\sigma}$[V])	NO CODA	*COMPLEX	$*_{\sigma}$[R	$*_{\sigma}$[S	$*_{\sigma}$[T
a. CV.STRV	*			*		*	
☞ b. CVS.TRV			*	*			*
c. CVST.RV			*	*	*!		
d. CVSTR.V	*	*	*	*			

This solution is ideal because it employs an independently necessary constraint (albeit not independently necessary within Greek). It is also interesting because we can connect it with the fact that ONSET is really nothing more than the topmost constraint in this hierarchy, banning vowels at the left-edge of a syllable. The precise ranking of the other constraints in the onset hierarchy is difficult to determine. We know by virtue of the universality of the *onset margin hierarchy* that they are below ONSET (a.k.a. $*_{\sigma}$[V), but there is no immediately apparent evidence to place them relative to any other constraints in this part of the ranking. It would be interesting to see if critical ranking of these constraints with respect to other constraints could explain any additional problems of Greek phonology, but that is beyond the scope of this paper.

3.6. <u>The problems with TS roots</u>

There is one other type of universally non-copying root: roots which begin in *stop* + *sibilant* (TS). This does not conform to our predictions as closely as we might like. Such a sequence has rising sonority, since a stop is less sonorous than a fricative. We would therefore expect the sequence to syllabify as a complex onset, and thus induce copying, since there would be no STRUCTURAL ROLE violation. But this is not what we get. TS roots clearly form their perfect-stems without copying, showing forms in [*e*-TS…], with the TS sequence apparently heterosyllabic.

(50) TS-roots

Root		Present Tense		Perfect Tense	
kse(s)-	'shave (timber), polish'	ξέω	[kse-]	ἔξεσμαι	[ek.ses-]
psa-	'rub'	ψάω	[psa-]	ἔψηγμαι	[ep.sē(g)-]
pseud-	'lie, speak/play/be false'	ψεύδομαι	[pseud-]	ἔψευσμαι	[ep.seus-]

While TS-roots are not numerous, particularly in the early language, their pattern is clear. When we plug such a root into our rankings, we do not get this outcome. We instead do predict copying:

(51) The *wrong* outcome for TS perfects: ψεύδομαι [pseud-] : ἔψευσμαι [ep.seus-]

/ RED*e*, pseus- /	ANCHOR-L-BR	STROLE	SON SEQ	ONSET	NO CODA	*COMPLEX	MAX-BR
a. ps*e*.-pseus-						**!	***
b. s*e*.-pseus-	*!					*	****
💣 c. p*e*.-pseus-						*	****
d. p*e*-p.seus-		*!			*		****
e. *e*.-pseus-				*!		*	*****
☹ f. *e*-p.seus-				*!	*		*****

Looking at the tableau in (51), we can see why the non-copying candidates are ruled out. Those other candidates in which the *ps* sequence is tautosyllabic do not incur a violation of SONORITY SEQUENCE, which is normally what eliminates such candidates in non-copying roots before the ONSET violation can factor in. Since this root-type (i.e. TS-roots) is also ultimately non-copying, we may want to reconsider whether a *TS* onset actually does pass SONORITY SEQUENCE. We can observe a few other perfect-tense forms that may lead us to slightly altering our definition of SONORITY SEQUENCE, at least for Greek.

The first piece of evidence is the perfect-tense of the word that means ‘come to know’. The Greek root *gnō-* (< PIE **ǵneH_3-*) has perfect ἔγνωκα [e-ŋnō-k-a].[60] (There is also a later (Attic) deverbative from this root γνωρίζω ‘make known, point out’, with a perfect ἐγνώρικα, which clearly shows the same behavior. There do not appear to be any other #*gn-* roots with attested perfects.) The sequence *gn* would be expected to form itself as a rising sonority onset, since *stop* + *nasal* is a subset of general *CR*. However, the non-copying behavior of this root indicates that this is not the case. There is the possibility that a sound change has interfered: *g > ŋ / _N*. (Such a change would be induced by a constraint **gN*: *Don’t have the sequence g + nasal.* Note that this constraint makes no reference to the syllabification of either element.) If this is the case, then the sequence is not *gn* as the orthography would indicate, but rather *ŋn*, as was shown in the phonetic transcriptions above. A *nasal* + *nasal* onset would not have rising sonority, and thus it would violate our established definition of SONORITY SEQUENCE. Assuming that lexicon optimization has occurred and the original /g/ has been regularly replaced by /ŋ/, then the outcome is the expected one.[61]

(52) ἔγνωκα with underlying /ŋ/: γιγνώσκω [g*i*-ŋ.nō-] : ἔγνωκα [*e*-ŋ.nō-k-a]

/ RED*e*, ŋnō- /	STROLE	SONSEQ	ONSET	NOCODA	*COMPLEX	MAX-BR
a. ŋ*e*.-ŋnō-		*!			*	**
b. ŋ*e*-ŋ.nō-	*!			*		**
c. *e*.-ŋnō-		*!	*		*	***
☞ d. *e*-ŋ.nō-			*	*		***

[60] This root has a reduplicated present γιγνώσκω [gi-ŋnō-]. As will be shown in the following chapter, this makes it rather unexpected that the perfect would be non-copying, even if that were the otherwise regular output of the grammar. However, the fact that there is a copying reduplicated present that does not properly conform to the synchronic grammar is an expected consequence of the account that will be developed in the following chapter.

[61] The derivation would work also without such a restructuring, as long as the markedness constraint **gN* remained in the ranking.

The tableau proceeds just like all the others, with copying ruled out because of the necessary violation of either StRole or SonSeq.[62] While this scenario seems likely, if we are to reject the change of *g* to *ŋ*, the problem remains.

Even putting the *gn* forms aside, an additional piece of evidence to consider comes to us from Attic poetry.[63] Steriade (1982) discusses an interesting variation seen in later Attic Greek. Roots that begin in *bl* and *gl* (which constitutes the entire inventory of *voiced stop* + *lateral*, because **dl* is not a permissible sequence in Greek) tend to show both copying and non-copying forms. Of *voiced stop + l (Dl)* roots, seven have attested perfects in Attic.

(53) <u>*Dl* reduplicant variation</u>[64]

Present Tense		Copying Perfect		Non-copying Perfect	
βλαισόομαι	‘be crooked’	βεβλαίσωται	[bebla-]	ἐβλαίσωται	[ebla-]
βλάπτω	‘hinder’	βέβλαφα	[bebla-]	ἔβλαφα	[ebla-]
βλαστάνω	‘sprout’	βεβλάστηκα	[bebla-]	ἐβλάστηκα	[ebla-]
βλασφημέω	‘speak irreverently’	βεβλασφήμηκα	[bebla-]	(not attested)	
βλέπω	‘look’	βέβληφα	[beblɛ̄-]	(not attested)	
γλύφω	‘carve’	γέγλυμμαι	[geglu-]	ἔγλυμμαι	[eglu-]
γλωττίζω	‘kiss lasciviously’	(not attested)		κατ-εγλωττισμένον	[eglɔ̄-]

Steriade rightly attributes the difference between the two types to the difference of syllabification. The copying forms will be those which form the *Dl* cluster tautosyllabically as an onset. The non-copying forms will be the ones which make the cluster heterosyllabic. There are

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[62] It is likely that there is also a constraint banning [ŋ] from word-initial position, just as in English. As this tableau shows, such a constraint is not required to eliminate the copying candidates. However, as will be seen in Chapter 4, the basic constraints are generally not enough to prevent copying perfects from surfacing in roots that have also a reduplicated present. The presence of a constraint against initial [ŋ] might therefore be the reason that this is the sole root with a reduplicated present with an attested perfect that does not show copying.

[63] I would like to thank Donca Steriade (personal communication) and Donald Ringe (personal communication) for bringing the following forms to my attention, and suggesting their connection to the syllabification-based argument presented in this thesis.

[64] Examples taken from Steriade (1982: 207).

two directions from which one can approach this problem. Either the poets are taking advantage of a regularly variable syllabification for these clusters and alternating between forms as the meter requests; conversely, the poets might be imposing such a syllabification so that the meter can be satisfied, even though the language does not organically admit of such syllabification. Whether the forms are artificial or not, the dichotomy still holds – when an initial cluster is tautosyllabic, copying occurs; when it is heterosyllabic, copying does not occur.

If we assume that the poets are simply picking up on organic forms of the contemporary language, then it appears that there must be something in the constraint ranking militating against a *Dl* onset. Steriade incorporates this evidence into a larger statement of the *Minimal Sonority Distance (MSD) requirement* for Attic: "Adjacent tautosyllabic consonants must be at least 4 intervals apart on the sonority scale" (1982: 221). The Attic-specific breakdown of the sonority scale to which she applies this requirement is the following:

(54) *Minimal Sonority Distance (MSD)* for Attic

- *Voiceless stops* – [-sonorant, -continuant, -voice] : *p,t,k* (p^h,t^h,k^h *?)*
- *Voiced stops* – [-sonorant, -continuant, +voice] : *b,d,g*
- *Voiceless fricatives* – [-sonorant, +continuant, -voice] : *s*
- *Voiced fricatives* – [-sonorant, +continuant, +voice] : *z*
- *Nasal* – [+sonorant, -continuant, +voice] : *m,n*
- *Liquids* – [+sonorant, +continuant, +voice] : *l,r*[65]

[65] Steriade (1982: 221). For the final two levels, I have deviated from Steriade's identification of the features. She gives *m,n* as [+sonorant, -continuant, +nasal], and *l,r* as [+sonorant, -continuant, -nasal]. Since the three features she uses for the first four levels are enough to distinguish all six levels (when we identify the liquids as [+cont]), I see no reason to introduce the feature [nasal].

To translate this schematic into the terms used in this thesis so far, any tautosyllabic cluster whose members are not at least four levels apart will incur a SONORITY SEQUENCE violation. Employing Steriade's *MSD* approach will allow us to account for all of the problematic non-copying forms. *TS* clusters are less than four levels apart, and therefore will always be heterosyllabic (save word-initially). The non-copying of ἔγνωκα would be explicable even without resorting to the nasalization analysis, since *voiced stops* and *nasals* are only three levels apart. The variation in Attic might also find an explanation.

It appears that Steriade intends for clusters which are exactly four levels apart to have the potential to be subject to variable satisfaction of the *MSD*. The only pairs of levels that fit the bill are *voiceless stop* + *nasal* (TN) and *voiced stop* + *liquid* (DL). We have already seen the variation in reduplication for the latter (but only in specifically *Dl* clusters, not *Dr*). Steriade also demonstrates that there are certain circumstances where *TN* clusters are subject to similar variation. One could imagine that this is the result of slightly different acquisition of the *Minimal Sonority Distance* requirement by different speakers. Some speakers might internalize the requirement as 'be more than four levels apart,' while others learn it as 'be at least four levels apart,' or the like. The non-variation of *Dr* clusters (i.e. that they always display copying as expected) might piggy-back off this idea, and be explained by saying that some speakers assign *l* and *r* to separate sonority tiers, with *r* being the more sonorous. This would move *r* to five tiers away, making it beyond the scope of variation. If such acquisition issues were peculiar to speakers of Attic, then that would explain the lack of such variation in the other strata of Greek.

It is difficult, however, to conceptualize an elegant way to incorporate such an approach into the Optimality Theory analysis developed here. One could simply add these stipulations into a Greek-specific SONORITY SEQUENCE constraint. If we were to take that route, we might at least try to make it somewhat less stipulative. A generalization can be made that eliminates the need for referencing different levels. If we look at the segments purely in terms of the three features used to identify them, we can see that the combinations that can form licit tautosyllabic clusters differ in a regular way. In order for a segment to intervene between a segment at the syllable edge and the nucleus, it must have a more sonorous value for at least two of the three features. For each of the three features, the positive value is more sonorous than the negative value: [+son] > [-son], [+cont] > [-cont], and [+voice] > [-voice]. The only pair for which this would overgenerate a licit complex margin is *voiceless stop* + *voiced fricative* (TZ). We can allow this to be ruled out separately, since such a sequence is not licensed even heterosyllabically. In other words, the constraint AGREE(voice)-OBS could independently prevent that sequence.

(55) AGREE(voice)-OBS : Adjacent obstruents may not have different values for [voice].

While stating the *MSD* in this way is still stipulative and still relies on counting, at least it references distinctive features rather than somewhat arbitrary classifications.

An alternative, which is also stipulative but in a different way, would simply be to posit constraints against specific onsets. If we are to accept the nasalization account of ἔγνωκα, and minimize the significance of the variation in *Dl* clusters in Attic (after all, it is a late development, and possibly artificial) then all that we are left to contend with is the original problem of our *TS* cluster. So, a constraint $*_{\sigma}$[TS might be enough to do the trick.

(56) *$_{\sigma}$[TS: Do not have a *voiceless stop + fricative* onset.[66]

If we place this above ONSET in our ranking, then it will have the same effect as SONORITY SEQUENCE in motivating heterosyllabicity of these clusters, and thus non-copying for *TS* roots.

In the end, the precise formulation is not terribly significant. If we assume that some reasonable modification of SONORITY SEQUENCE, whether it be based directly on minimum sonority distance or the addition of a separate constraint, is enough to incur a violation in candidates that syllabify *TS* as a complex onset, then the desired outcome will be selected. Let us call this modified constraint SONSEQ'.

(57) Accounting for TS perfects with SONSEQ': ψεύδομαι [pseud-] : ἔψευσμαι [ep.seus-]

/ RED*e*, pseus- /	ANCHOR-L-BR	STROLE	SONSEQ'	ONSET	NO CODA	*COMPLEX	MAX-BR
a. p<u>s</u>*e*.-pseus-			*!*			**	***
b. <u>s</u>*e*.-pseus-	*!					*	****
c. <u>p</u>*e*.-pseus-			*!			*	****
d. <u>p</u>*e*-p.seus-		*!			*		****
e. *e*.-pseus-			*!	*		*	*****
☞ f. *e*-p.seus-				*	*		*****

3.7. Conclusions about the reduplicative patterns of COV roots

In this chapter, it has been demonstrated that the two major reduplication patterns of consonant-initial roots, namely the copying behavior of CRV (*consonant + resonant*) roots versus the non-copying behavior of COV *(consonant + obstruent*) roots, arise out of differences

[66] In the discussion of Attic Reduplication, a similarly constructed constraint will be proposed. It is motivated by the exceptional markedness of one the segments involved. Such a rationale does not seem applicable to this constraint, since neither *p,t,k* nor *s* are particularly marked within the system.

in syllabification, and complications between the base and the reduplicant brought about by these different syllabifications. The driving force behind this distinction is the ranking of three of the *syllable well-formedness* constraints:

(58) RANKING FRAGMENT: SONORITY SEQUENCE » NOCODA » *COMPLEX

The ranking of NOCODA over *COMPLEX has the effect of preferring complex onsets to a *coda + simplex onset* syllabification. However, the yet higher ranking of SONORITY SEQUENCE counteracts this preference when the would-be complex onset does not have rising sonority. In such cases, the *coda + simplex onset* syllabification will be required.

This ranking instigates the divergent treatment of CRV and COV roots. A CR sequence will syllabify as a complex onset, since it will always have rising sonority. But a CO sequence, or in fact any sequence that does not have rising sonority, will have to be heterosyllabic if there is an available vowel preceding. Reduplication provides exactly this environment. The fixed /e/ of the reduplicative morpheme gives the root-initial obstruent in COV roots a syllable to which it can attach as a coda. The initial consonant of a CRV root, however, will not become a coda, since it can form itself as part of a complex onset that has the requisite rising sonority.

The distinctive syllabifications of the two root-shapes induce different evaluations of the base-reduplicant *correspondence* constraints, the most significant being STRUCTURAL ROLE-BR (STROLE) and ANCHOR-L-BR. Since the root-initial consonant of a COV root must syllabify in coda position when the reduplicative morpheme is added, any copying candidate would fatally violate STROLE, as a reduplicated segment would necessarily sit in onset position. Furthermore, any candidate which copied from non-initial position would fatally violate ANCHOR-L-BR.

Therefore, as long as these two constraints, STROLE and ANCHOR-L-BR, dominate ONSET and MAX-BR, the non-copying candidate will be selected for COV roots. On the other hand, since CRV roots will syllabify the CR sequence together in an onset, the left-most consonant can be copied without violating STROLE. This allows copying to be the optimal result. Thus we see that syllable structure drives the alternation in the shape of the reduplicant of consonant-initial roots.[67]

(59) CONSTRAINT SUMMARY:[68]

ALIGN-RED*e*-L, MAX-IO, DEP-IO, STRUCTURAL ROLE-BR, ANCHOR-L-BR »

SONSEQ(ˀ) »

ONSET, NOCODA »

*COMPLEX »

DEP-BR, ALIGN-ROOT-L »

MAX-BR

[67] Another potential solution to the problem solved here by STRUCTURAL ROLE came to me too late for full exposition. We can notice that the copying candidates in these derivations which do satisfy SONORITY SEQUENCE necessarily begin and end their initial syllable with an identical segment, which will always be an obstruent. We might then wonder if it is not STROLE or ALIGNMENT ruling out these candidates, but rather some version of the *OBLIGATORY CONTOUR PRINCIPLE (OCP).*

There does appear to be a dispreference for identical segments on both margins of the same syllable in reduplicated formations across the Indo-European family. (There likewise appears to a dispreference, or even an out-and-out ban, on identical segments within a root among the inventory of roots in Proto-Indo-European.) We can adduce the evidence of the so-called "long vowel perfects/preterites" seen around the family. For example, Sanskrit √pad : *perfect* pēdur (= pa-y.d-ur < *pa-p.d-ur), or Old Irish √gan : *preterite* gḗnair (< *geg.nair). Even Sanskrit √kṣad 'divide: [ca-k.ṣa.d-ur] is free of this problem because of the palatalization of the copied /k/ to [c].

It will be shown in the following chapter that exceptionally-copying COV roots in Greek are generated at an earlier period where the *CC* sequence was tautosyllabic. Therefore, these forms would not serve as counterevidence. Furthermore, a constraint of exactly this type will be proposed regarding laryngeals in order to deal with Attic Reduplication in Chapter 7. This seems a very appealing solution that demands further investigation.

[68] The more speculative constraints are omitted.

CHAPTER 4

PRESENT-TENSE REDUPLICATION AND ITS IMPACT ON THE PERFECT

The situation of reduplication in the present tense is slightly more complex, and paints a somewhat different picture than the reduplication of the perfect tense. Unlike reduplication in the perfect, present-tense reduplication is non-obligatory. Throughout the history of Greek and Indo-European, present-tense reduplication was just one of the many derivational tense-stem forming morphemes/processes. Whereas perfect-tense reduplication (at the very least in Greek and in Sanskrit) was essentially inflectional and obligatory, in the present tense it was used to indicate some sort of aspectual meaning,[69] which should be viewed as more of a derivational process.[70] For this reason, there is no requirement of its presence on any given root. In other words, roots will be free to eschew present-tense reduplication for any reason, be it a problem with its phonological shape or pure chance in historical development. This means we should not make recourse to REALIZE MORPHEME or other such concerns when accounting for the facts of present reduplication.

The phonological shape of the reduplicant of the present tense is very similar to what we see in the perfect. Factoring in certain diachronic developments, the shape is always a *consonant* plus fixed vowel, in this case [i] rather than [e]. This is precisely the shape that we have seen in

[69] What exactly that meaning was is very difficult to determine. It seems as though no coherent meaning can be gleaned from those roots which display it in Greek. See Giannakis (1997) for an examination of the semantics of present-tense reduplication.

[70] The difference I mean to imply here between inflection and derivation is that inflection adds purely grammatical information (in this case *tense*), whereas derivation includes a greater amount of semantic weight (*aspectual* information like *causative, iterative, stative, etc.*, which is not directly tied to tense). The Indo-European verbal derivational markers had virtually all lost their original morpho-semantic force by the time of Greek.

the unmarked cases of perfect-tense reduplication. With the exception of a small, and somewhat cohesive, group of vowel-initial roots, there are no cases where the reduplicative consonant, or the direct remnants of the reduplicative consonant, do not appear. However, this cannot be direct evidence that such forms, i.e. those equivalent to *ektona*, never existed. When present reduplication became unproductive, these forms could have been eliminated, because of their morpho-phonologically marked status, without any negative impact on the verbal system. Nonetheless, the account that will be provided will make it clear that forms that did not copy a root consonant are unlikely to have ever been part of the grammar.

Giannakis (1997) provides an exhaustive list of forms from Homer that display present reduplication. He splits these into five categories:[71] primary athematic verbs, secondary athematic verbs, thematic verbs of the *μίμνω* type, thematic verbs with an initial vowel, and thematic verbs in *-sko-*.

(60) Reduplicated presents in Homer (Giannakis, 1997: 8-9)

Present Tense Forms			Possible reconstructions
Primary Athematic Verbs			
δίδωμι	[di-dɔ̄-mi]	'give'	
ἵημι	[^{h}i-ɛ̄-mi]	'send, throw'	*yi-yē-mi or *Hi-Hyē-mi
ἵστημι	[^{h}i-stɛ̄-mi]	'stand'	*si-stē-mi
κίχημι[72]	[ki-k^{h}ɛ̄-mi]	'come to; reach'	
πίμπλημι	[pi-m-plɛ̄-mi]	'fill'	
τίθημι	[ti-t^{h}ɛ̄-mi]	'place'	

[71] He also surveys "reduplicated presents of the intensive type" (Giannakis 1997: 255-285). Of these, two he classifies as "intensive presents with partial reduplication in *-i-*": λιλαίομαι and τιταίνω. These are consistent with the non-intensive types to be explained here. The remaining, more characteristic intensives have a completely different pattern of reduplication: a CVC reduplicant. The details of the shape of the reduplicant in each of the forms appears largely idiosyncratic. I will not include these in my analysis, as I take them to be completely outside the synchronic reduplicative grammar of Ancient Greek. For an analysis of intensive reduplication in Sanskrit, see Steriade (1988).

[72] There is an alternate present formation with reduplication: κίχανω ~ κίγχανω (Attic only).

Secondary Athematic Verbs[73]			
δίδημι	[di-dɛ̄-mi]	‘bind’	
δίζημι	[di-zdɛ̄-mi]	‘seek out’	*di-dzɛ̄-mi[74]
Thematic verbs of the *μίμνω-type*			
μίμνω	[mi-mn-ɔ̄]	‘(a)wait, stand firm’	
ἴσχω	[i-sk^h-ɔ̄]	‘hold, hold back’	*si-sk^h-ō
ἵζω	[^{h}i-zd-ɔ̄]	‘sit; seat’	*si-sd-ō
πίπτω	[pī̆-pt-ɔ̄]	‘fall’	
γίγνομαι	[gi-ŋn-o-mai]	‘be born; be’	
τίκτω	[ti-kt-ɔ̄]	‘beget’	*ti-tk-ō
νίσσομαι	[ni-ss-o-mai]	‘go’	*ni-ns-o-mai ?
Thematic verbs with Initial Vowel			
ἰάλλω	[i-all-ɔ̄]	‘send forth’	*si-sl̥-yō ?
ἰάπτω	[i-ap-tɔ̄]	‘hurt’	*si-sn̥g^w-yō
ἰαύω	[i-au-ɔ̄]	‘sleep, pass the night’	*H$_2$i-H$_2$w̥s-(y)ō
ἰάχω	[i-ak^h-ɔ̄]	‘cry out, shout’	*wi-wH̥$_2$g^h-ō ?
Thematic verbs in -σκω[75]			
γιγνώσκω	[gi-ŋnɔ̄-skɔ̄]	‘know’	*gi-gn̥H$_3$-sḱō
διδάσκω	[di-da-skɔ̄]	‘teach; learn’	*di-dn̥s-sḱō
ἱλάσκομαι	[^{h}ī-la-sko-mai]	‘propitiate, appease’	*si-slH̥$_2$-sḱo-mai
κικλήσκω	[ki-klɛ̄-skɔ̄]	‘summon, call’	*ki-kl̥H$_1$-sḱō
μιμνήσκω	[mi-mnɛ̄-skɔ̄]	‘remind; remember’	*mi-mn̥H$_2$-sḱō
πιφαύσκω	[pi-p^{h}au-skɔ̄]	‘show; tell’	*b^{h}i-b^{h}H̥$_2$-w-sḱō
τιτύσκομαι	[ti-tu-sko-mai]	‘prepare; try to hit’	*ti-tw̥-sḱō

While several of these forms are difficult to fully account for, the majority can easily be generated with a slight change to the reduplicative grammar developed so far. In the perfect

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[73] Giannakis also includes here ὀνίνημι [oni-nɛ̄-mi] ‘profit, benefit’. This is a very strange looking form among the reduplicated presents. The root derives from PIE **H$_3$neH$_2$*-. This form therefore might be better identified as an Attic Reduplication present. See Ch. 7 for a discussion of Attic Reduplication.

[74] If this derives from a PIE root √**yeH$_2$*-, it must display the development √**yeH$_2$*- > √**dzā*- → *pres *di-dzā-* > *di-zdɛ̄-* in order to explain the *d* in the reduplicant. (If [dz] is a unitary affricate rather than the combination of separate elements [d] and [z], then the reduplicated present to √**dzā*- could potentially have been **dzi-dzā-*. Even if [dz] was a unitary element, it is still possible that it might have been disallowed in the reduplicant by some *TETU* ranking. If it is not unitary, then the [d] is obvious, as *COMPLEX will prevent multiple elements from being copied.)

[75] δειδίσκομαι is listed among these, but it is better seen as an intensive. ἐΐσκω (pf. ἔοικα) is also listed. If this is a reduplicated present, it must have a reduplicant in *-e-*: √**weyk-* → *pres? we-wik-sḱō* > *e.is.kɔ̄*. A reduplicant in *-i-* would yield *#ī-*: *wi-wik-sḱō* > ***i.is.kɔ̄* > ***īs.kɔ̄*. There is a form ἴσκω [is.kɔ̄] with short *-i-*, but this must come from non-reduplicated zero-grade **wik-sḱō*. Since there are no other examples of present reduplication in *-e-*, it seems likely that ἐΐσκω is in some way a secondary formation built from the perfect, which forms the core of this individual verbal system. See Chantraine (1968: 354-5).

tense, we saw that roots with an initial cluster that violates SONORITY SEQUENCE have no copied consonant in their reduplicants, instead surfacing only with the fixed vowel [e]. We attributed this to the fact that the first consonant of these clusters will always syllabify as a coda with the reduplicative vowel, and that the combination of ANCHOR-L-BR and STRUCTURAL ROLE will prevent copying of any root consonant into the reduplicant because of this syllabification. Among the reduplicated presents, we see numerous forms that violate this pattern.

Each of the *μίμνω* type thematic reduplicated presents (with the possible exception of γίγνομαι) display root shapes with a sequence of consonants that, if tautosyllabic, will violate SONORITY SEQUENCE. This situation comes about because this formation takes zero-grade of the root. In all of these cases, the offending cluster is the result of the root-initial consonant coming into contact with the root-final consonant after the zeroing/syncope of the root vowel. In the perfect tense, such a situation almost never came into play.

In the Proto-Indo-European perfect, there was an ablaut alternation between o-grade in the singular and zero-grade in the plural.[76] In virtually all cases, Greek has leveled one or the other of these grades throughout the paradigm.[77] The majority of perfect-stems are leveled such that they include a proper root-internal vowel. Some do develop a vowel which follows the root consonants (often through vocalization of a root-final laryngeal), but this usually has created a stem-initial cluster that will syllabify as a complex onset rather than *coda +simplex onset*.

The point is that zero-grade formations in the perfect have rarely brought about a situation that will interfere with the unmarked reduplication pattern. This is clearly not the case in the present tense. Nonetheless, however, each reduplicated present of the *μίμνω* type still

[76] This reconstruction is more easily visible outside of Greek, e.g. in Sanskrit and Gothic.
[77] In some cases, mostly for secondary perfect formations in Greek, the e-grade vocalism or other vocalism of the present is carried over into the perfect.

displays a copied consonant in the reduplicant. Our grammar predicts that this will not be the case. In order to explain this seeming exception, we need recourse to diachrony.

Present tense reduplication is unproductive. No new forms of this type could be created in the historical period of Greek. This means that those forms which do display present-tense reduplication must have been lexicalized. As such, they do not need to be derivable by the synchronic reduplicative grammar. Instead, they will represent the facts of the reduplicative grammar at the time when they were created, i.e. up until the point when they were lexicalized. Therefore, if we can systematically account for the differences between these forms and the synchronically regular pattern of the perfect forms with only slight modifications to our reduplicative grammar, we will have evidence of diachronic change vis-à-vis constraint rankings.

4.1. Accounting for the reduplicated presents in Pre-Greek

The problem for reduplication posed by these forms can be solved in one of two ways. The first method relies on syllabification. These forms do not conform to the synchronic reduplicative grammar because we expect them to syllabify their root-initial consonant as a coda, and this would run afoul of STRUCTURAL ROLE, and ultimately induce non-copying. If, however, this consonant did not have to be shunted into the coda, but rather could be syllabified with the second root consonant as a complex onset, then such a violation would not arise.

We have already seen that syllabification is dictated by the interaction of four *syllable well-formedness constraints*, which in the historical period of Ancient Greek have the following ranking:

(61) RANKING IN ANCIENT GREEK: SONORITY SEQUENCE » ONSET, NOCODA » *COMPLEX

What this ranking entails is that a sequence of two consonants will be syllabified as a complex onset unless they do not have rising sonority. In order to get such a sequence of consonants to syllabify as a complex onset, all that is required is to re-rank SONORITY SEQUENCE with respect to NOCODA:

(62) POSSIBLE RANKING IN PRE-GREEK: ONSET, NOCODA » SONORITY SEQUENCE » *COMPLEX[78]

Under this ranking, it is more important to not have a coda than to avoid an onset cluster that does not have rising sonority. This is precisely the situation reconstructed for Proto-Indo-European by Byrd (2010).[79] Steriade (1982) also advocates for this state of affairs in Pre-Greek, largely based on this pattern. If we incorporate this altered ranking into our grammar, we can leave the rest of it, i.e. our ranking of the IO- and BR-correspondence constraints, unchanged, and still properly generate the forms:

(63) Present reduplication with low-ranked SONSEQ: √*men-* : *present* μίμνω [m*i*-mn-ō]

/RED*i*, mn, ō/	DEP-IO	MAX-IO	ST ROLE	ANCHOR-L-BR	ONS	NO CODA	SON SEQ	*COMPLEX	MAX-BR
☞ a. m*i*.-mn-ō							*	*	*
b. m*i*-m.n-ō			*!			*			*
c. *i*.-mn-ō					*!		*	*	**
d. *i*-m.n-ō					*!	*			**
e. mn*i*-.mn-ō							**!	**	
f. n*i*.-mn-ō				*!			*	*	*
g. m*i*.-me.n-ō	*!								**
h. m*i*.-m-ō		*!							

[78] SONORITY SEQUENCE does not necessarily have to dominate *COMPLEX. However, since SONSEQ is essentially a special case of *COMPLEX, it might be expected to universally dominate it. The difference between domination and non-critical ranking of these two constraints will not alter any of the evaluations herein.

[79] He does use the facts of present reduplication in Greek as part of the evidence for this reconstruction, but it is certainly not the only evidence.

In this tableau, we see that our desired output (63a) [mi.mnɔ̄] is correctly selected. The deletion candidate (63h) and the insertion candidate (63g) are ruled out by high-ranked MAX-IO and DEP-IO. Candidate (63f), which copies a non-root-initial consonant is ruled out by ANCHOR-L-BR. Candidate (63b), which syllabifies the root-initial /m/ as a coda but still copies it incurs a fatal violation of STROLE. Notice, however, that even if this violation was removed (i.e. by removing STROLE from that position in the ranking), this candidate would still be eliminated by its NOCODA violation.

The remaining candidates can be distinguished purely through the evaluation of our *syllable well-formedness* constraints. The suboptimal candidate that is most significant is (63d) [im.nɔ̄]. This is the output that our previously-assembled ranking would select (i.e. it is equivalent to [ek.to.na]). In that ranking, the SONORITY SEQUENCE violation incurred by (63a) [mi.mnɔ̄] would have been fatal, and the violations of ONSET and NOCODA that (63d) incurs would be insignificant, since the evaluation would have already selected it as the winner. But now that these constraints dominate SONORITY SEQUENCE, their violations come into play first, and are indeed fatal. Under this ranking, candidate (63d) is now actually worse than candidate (63c), because of its NOCODA violation. But (63c)'s ONSET violation is still enough to eliminate it from contention. The only remaining candidate is (63e), which has copied both root consonants. This is ruled out by SONSEQ and/or *COMPLEX.

One other potential solution relies on STRUCTURAL ROLE. We saw in the tableau in (63) that STROLE's high rank was not actually necessary to select the proper output. If we were to assume that this constraint was lower ranked in the earlier grammar, then we would get the desired surface string without assuming any difference in syllabification (i.e. without lowering SONORITY SEQUENCE).

(64) Present reduplication with low-ranked STROLE: √*men-* : *present* μίμνω [m*i*-mn-ɔ̄]

/RED*i*, mn, ɔ̄/	DEP-IO	MAX-IO	ANCHOR-L-BR	SON SEQ	ONS	NO CODA	ST ROLE	*COMPLEX	MAX-BR
a. m*i*.-mn-ɔ̄				*!				*	*
☞ b. m*i*-m.n-ɔ̄						*	*		*
c. *i*.-mn-ɔ̄				*!	*			*	**
d. *i*-m.n-ɔ̄					*	*!			**
e. mn*i*-.mn-ɔ̄				*!*				**	
f. n*i*.-mn-ɔ̄			*!	*				*	*
g. m*i*.-m**e**.n-ɔ̄	*!								**
h. m*i*.-m-ɔ̄		*!							

In this tableau, the well-formedness constraints (namely SONORITY SEQUENCE) have been left in the same ranking as was generated by the analysis of the perfect. The change in this ranking is that STRUCTURAL ROLE is now much lower ranked, all the way below ONSET and NOCODA. Candidates (64f-g) are eliminated in exactly the same way as in the previous tableau. However, the next candidates to be evaluated are different. With SONSEQ back in its position after the high-ranked correspondence constraints, it is the next constraint to come into play. It will now rule out all those candidates with an illicit cluster, i.e. $_{\sigma}$[mn…]. This eliminates candidate (64e), candidate (64c), and, most interestingly and surprisingly, candidate (64a), the winner in the previous tableau. Since STROLE is now dominated, candidate (64b) is still in the running when these candidates are eliminated. Now it is only left to compete with (64d) [im.nɔ̄]. While the elimination mark for (64d) comes after its NOCODA violation, it is actually its ONSET violation that does it in. Both (64b) and (64d) have violated NOCODA to avoid the SONSEQ problem which has eliminated the other candidates. With this motivated, the choice between

(64b) and (64d) relies on the ranking of ONSET and STROLE. If we assume that ONSET dominates STROLE, as shown in the tableau, then our ranking selects (64b) over (64d).

4.2. Which solution is better?

These two tableaux show that the reduplicated presents in Greek can be explained if we assume that they originate in an earlier period. It further demonstrates that the constraint ranking of this earlier period need only be minimally different from the one constructed based on the productive pattern (i.e. the active synchronic grammar of Ancient Greek). Both solutions need only the re-ranking of a single constraint. In the syllabification account, this is SONORITY SEQUENCE; in the other, it is STROLE. When these constraints are positioned below ONSET and NOCODA, copying is motivated. It is their ranking above these constraints in the synchronic grammar of Ancient Greek that prohibits such copying in active reduplicative formations, i.e. the perfect.

There is nothing about the respective solutions that *a priori* should lead one to prefer one to the other. Both are equally economical. The lower STROLE solution is interesting because it appears that this constraint does not play a major role in determining the reduplicative patterns of the other Indo-European languages. When we reconstruct the reduplicative constraint grammar for Proto-Indo-European, we want it to be able to produce the grammars of the attested languages' reduplicative systems with minimal change (i.e. constraint re-ranking) – this is the equivalent of the principle of the comparative method when applied to constraint grammar reconstruction. If we are to assume that Greek is conservative in its high ranking of STRUCTURAL ROLE, then this would require its demotion (or other constraints' promotion over it) in the majority of other languages. Economy therefore implies that Greek is actually the innovator, and that we should reconstruct Proto-Indo-European with this constraint ranked relatively low. If we further assume that the reduplicated presents are created before the time at which Greek innovates in this way, then we have just described the situation presented as the second solution.

With this as a reasonable possibility, this evidence should not critically factor into a reanalysis of Pre-Greek/Proto-Indo-European syllabification. Steriade's motivation for positing this analysis is driven primarily by the facts of these irregular reduplicants. Byrd's analysis, however, takes many more factors into consideration. Since his account supports the view of syllabification implied by the first solution independently, it appears that it is an economical account as well. As demonstrated by the selection of candidate (64b) in the syllabification tableau, that account is compatible with a low ranking of STROLE, as well. This means that the two solutions are not mutually exclusive. If the comparative evidence[80] shows that it is most economical to rank both SONORITY SEQUENCE and STRUCTURAL ROLE below ONSET and NOCODA in Proto-Indo-European, then there is no reason to assume that Greek has not innovated in both respects, with both constraints having been promoted after the period at which these reduplicated presents were formed.

Furthermore, the almost precise agreement of form between the Greek reduplicated present ἵστημι [^{h}i-stɛ̄-mi] (< **si-stē-mi*) and Latin *sisto* [si-st-ō] implies that these forms may very well go all the way back to Proto-Indo-European (Byrd: 102-4). If this assumption can be maintained (and there seems to be no evidence from Greek that should dissuade us from it), then the constraint ranking that should be reconstructed for PIE is exactly that which generates these

[80] Or, potentially, internal evidence, as will be proposed in the account of Attic Reduplication in Chapter 7.

reduplicated presents.[81] But what this also implies is that perfect forms of COV roots and the like are distinctly innovative. With one or both of SONSEQ and STROLE subordinated, the derivation of the perfect-tense forms of such roots would have proceeded in exactly the same fashion. Let us return to our tableau for κτείνω : ἔκτονα from (35). If we consider the same candidates as before, but employ the constraint ranking developed for Pre-Greek, we will not select ἔκτονα as the output:[82]

(65) The Pre-Greek predictions for COV perfects: κτείνω [ktēn] : ???

/ RED*e*, kton, a /	MAX-IO	ANCHOR-L-BR	ONSET	NO CODA	ST ROLE	SON SEQ	*COMPLEX	MAX-BR
a. kt*e*.-kto.n-a						**!	**	
b. kt*e*-k.to.n-a				*!	*	*	**	
☞ c. k*e*.-kto.n-a						*	*	*
d. k*e*-k.to.n-a				*!	*			*
e. _*e*.-kto.n-a			*!			*	*	**
🖐 f. _*e*-k.to.n-a			*!	*				**
g. t*e*-k.to.n-a		*!		*				*
h. k*e*.-ko.n-a	*!							

What this tells us is that, if the reduplicated presents should be accounted for by an adjusted constraint ranking in Pre-Greek/Proto-Indo-European, then we predict that perfect-tense

81 The major caveat comes in identifying the underlying form of the reduplicative morpheme in Proto-Indo-European. Niepokuj (1997) argues for vowel-copying in all reduplicative categories, denying any phonological or morphological fixed-segmentism. This view is not generally accepted. Sandell (2011) argues more convincingly that the difference in vowel quality between present and perfect reduplication can be traced back to PIE, and that it derives from ablaut considerations. His account essentially amounts to advocating phonological fixed-segmentism (i.e. *TETU*) in both cases. I believe this to be a very strong possibility – although I am partially skeptical of his specific argumentation, as it relies on Morphological Doubling Theory (Inkelas & Zoll, 2005) rather than Correspondence Theory (McCarthy & Prince, 1995).

82 I will show both SONSEQ and STROLE subordinated, but notice that if only SONSEQ were to be subordinated, candidate (c) would still be selected.

reduplication of the same period would have worked in the same way as present reduplication – COV roots would have displayed perfects with a copied consonant in the reduplicant. This prediction is borne out by a small number of irregular perfect-tense forms.

4.3. The copying COV roots and their connection to reduplicated presents

There are essentially three (possibly four) instances of COV-type roots[83] which display a copying perfect. The first example is the perfect-tense form ἕστηκε [he-s.tε̄-] (< *se-$steH_2$-*), which stands beside the present ἵστημι [hi-s.tε̄-] (< *si-$steH_2$-*).[84] The second is the perfect which corresponds to μιμνήσκω [mi-m.nε̄-]: μέμνημαι [me-m.nε̄-]. The third instantiation is actually a set of forms derived from the PIE roots *$petH_2/pteH_2$* and *$petH_1/pteH_1$*, whose individual verbal systems include perfect forms of the shape [pe-pt…].

(66) The perfects of *pt* roots[85]

Present Tense forms	Perfect Tense forms	Reconstructed PIE root	Basic meaning
πετάννυμι, πίτνημι[86]	**πέπταμαι**, πεπέτασμαι	*$petH_2/pteH_2$-*	fly
πέτομαι, ποτέομαι	πέπταμαι,[87] πεπότημαι	*pet-(H_2)-*[88]	fly
πῖπτω, πίτνω	πέπτωκα, **πεπτεώς**, πεπτώς, **πεπτηώς**	*$petH_1/pteH_1$*	fall
πτήσσω	**πεπτηώς**[89]	*$pteH_2$-k-*	scare, crouch

[83] While the *mn* sequence in μιμνήσκω ~ μέμνημαι obviously includes no obstruents, the sonority relationship between the two segments is equivalent, insofar as the two create a sonority plateau. Therefore, *mn* roots would be expected to pattern with COV roots. It just so happens that, except for μέμνημαι and the rest of its perfect paradigm, no perfect forms exist with a root allomorph in initial *mn*, either copying or non-copying.

[84] Given the peculiarities of aspiration in Greek, it cannot definitively be ruled out that the aspiration in the perfect form ἕστηκε is secondary, and that the form is actually a non-copying one, as would be expected. Such aspiration could potentially have been re-introduced "analogically" (i.e. through OO-correspondence) based on the aspiration of the present, which would have come by it honestly. Nonetheless, I think it fair to include it as evidence for this argument.

[85] Forms taken from Laar (2000: 246-8, 253, 259-60). **Bolded** forms are those he takes to be part of the original/reduced individual verbal systems.

[86] Chantraine (1968: 891) takes πίτνημι [pitnε̄mi] to be a nasal-infix present < *$p^ət$-ne-H_2-mi*. The [i], under this very likely account, is therefore epenthetic, not reduplicative – although the two may really be one-and-the-same.

[87] Laar (2000: 247) cites this as occurring only once in Pindar, and that form is questionable. Chantraine (1968: 892) does not include this form in his account of the lemma πέτομαι. Laar, however, cites the more expected πεπότημαι as being attested from Homer on.

[88] Chantraine (ibid.) gives no indication that the laryngeal should not be taken as part of the root.

[89] Chantraine (1968: 948) gives also a perfect ἔπτηκα which is found in later Attic.

There is clearly a great degree of overlap and apparent interplay between all these forms, even amongst those deriving from separate roots. Therefore we must allow for the possibility of contamination. It seems very likely that the primary source of contamination is the reduplicated present πῑ́πτω [pīpt-ō].[90] Chantraine, in discussing the etymology of πέτομαι, agrees, saying: "En grec πῑ́πτω appartient certainement à la même famille" (1968: 892). He comments similarly in regard to πτήσσω (949). Whatever the origins of the various individual verbal systems, it is clear that they are not thoroughly distinct by the period of (Pre-?)Greek.

Allowing for the connection of πῑ́πτω to the other forms in these verbal systems, we see a pattern (albeit based on a very small sample size). In COV roots which include a reduplicated present in their individual verbal systems, the perfect forms display a reduplicated consonant, even though this contradicts the expected outcome. This might lead us to believe that the reduplicated consonant of the present, which survives the constraint re-ranking by lexicalization, protects the reduplicated consonant of the perfect from being removed by synchronic remodeling.

Even though present reduplication is no longer productive in the historical period, it is frequent enough, and similar enough to productive perfect reduplication, that speakers would have easily been able to recognize that the forms were reduplicated, even if they were not synchronically derivable. Therefore, reduplication becomes a natural feature of the individual verbal system. It would be an extremely marked situation for a root to have a present with a reduplicated consonant but a perfect without one.[91] For this reason, interparadigmatic analogy

[90] The long [ī] in πῑ́πτω is somewhat problematic. Giannakis (176) says that this is analogical to ῥῑ́πτω. He also suggests that the form πῑ́πτω is a Greek innovation, based on the fact that a reduplicated present for this verb is not found anywhere else among the Indo-European languages, whereas unreduplicated forms equivalent to πέτομαι are very widely attested. Laar (253), however, does ascribe the form to the *reduced individual verbal system*, meaning that he takes it to be of at least early Pre-Greek origin.

[91] To my knowledge, there is only one: *present* γιγνώσκω [gi-ŋnō-] ~ *perfect* ἔγνωκα [e-ŋnō-].

could step in to protect the perfect from losing its reduplicated consonant. In Optimality Theory terms, this sort of analogy is carried out by output-output (OO) *correspondence* constraints. The constraint motivating the retention of the reduplicated consonant might be stated as follows:

(67) ANCHOR-L-OO$_{\text{REDPRES}}$: The segment at the left-edge of the stem of a reduplicated present of a given root must correspond to the segment at the left-edge of the perfect stem of that root.[92]

I have formulated this constraint to make reference to the stem rather than the reduplicant itself. If we were to reference the reduplicant, we would run into the same conceptual difficulties we have already encountered using ANCHOR-BR. If there is no segment in base-reduplicant correspondence, then there can be no violation of ANCHOR-BR. Likewise, if we referenced just the reduplicant of these forms, a violation of ANCHOR-OO should be avoided if there is no segment in the reduplicant of the perfect. Furthermore, if the present has been lexicalized, speakers might not have complete command of what part of the string is the actual reduplicant, even if they can recognize it as a reduplicated form. Therefore, it seems a better approach to reference the stem, since the word form itself will be easily recognizable as a reduplicated formation, just as the perfect on the whole is also a reduplicated formation.

This constraint should be undominated. With the exception of ἔγνωκα, it is never violated.[93] Notice that for all those reduplicated presents that are not built to COV roots, the

[92] The constraint might alternatively be formulated as an IDENTITY constraint. The specifics of the constraint are not terribly significant.
[93] A potential reason for this can be found if we return to the explanation provided in (51). If the root /g/ was in fact nasalized before the [n], BR-IDENTITY would dictate that, if copying were to take place, the reduplicated segment should be [ŋ]. If we presume that [ŋ] was not permitted in initial position (as in English), then OO-*correspondence* could be overruled by *markedness*. Since the present is lexicalized, almost certainly before the nasalization rule, the copied [g] in γιγνώσκω need not be perfectly identical to its root correspondent, which later nasalizes to [ŋ].

satisfaction of this constraint will be obvious, since the regular reduplicative grammar will produce a form with a reduplicated consonant. Entering this into the synchronically productive rankings (i.e. the one developed for the perfect, not the Pre-Greek one developed for the reduplicated presents), we see that the right string is chosen, but with an unexpected complication.

(68) Exceptional copying in Ancient (*not Pre-*) Greek as OO-Correspondence:

μίμνω [m*i*-mn-] : μέμνημαι [m*e*-mnε̄-]

/RED*e*, mnε̄-/ (base: [mimnε̄-])	ANCHOR-L-OO	DEP-IO	ST ROLE	ANCHOR-L-BR	SON SEQ	ONS	NO CODA	*CMPLX	MAX-BR
☞ a. m*e*.-mnε̄-					*			*	**
✋ b. m*e*-m.nε̄-			*!				*		**
c. *e*.-mnε̄-	*!				*	*		*	***
d. *e*-m.nε̄-	*!					*	*		***
e. mn*e*-.mnε̄-					**!			**	*
f. mn*e*-m.nε̄-			*!		*		*	*	*
g. n*e*.-mnε̄-	*!			*	*			*	**
h. **m***e*-m.nε̄-		*!					*		***

ANCHOR-L-OO correctly eliminates the most problematic candidates, (68c) and (68d). Candidate (68d) [em.nε̄-] is what the basic reduplicative grammar would predict, the lack of copying in COV roots. It also rules out (68g), but that would have lost anyway by ANCHOR-L-BR. The grammar, however, now makes an unforeseen prediction. Because of the presence of STRUCTURAL ROLE near the top of the ranking, those candidates which syllabify the root-initial /m/ as a coda, i.e. candidate (68b) and candidate (68f), incur fatal violations. The elimination of (68f) is unproblematic, but we would have expected candidate (68b) [mem.nε̄-] to be the winner.

This is the candidate which syllabifies the string according to the rules of the synchronic grammar. The goal of ANCHOR-OO was simply to require a reduplicated consonant. But this tableau predicts that the presence of this constraint will actually require anachronistic syllabification as well!

It is difficult to tell whether such forms might actually be syllabified in such a way. One potential test would be scansion in metrical texts. However, any two consonants, even those which are tautosyllabic in an onset, will cause the preceding syllable to be metrically long. Therefore, the scansion in this case will be blind to the distinction between [me.mnɛ̄-] and [mem.nɛ̄-]. But even if we are not to maintain the forms with anachronistic syllabification, the segmental string that this ranking selects is correct. Considering the extremely small portion of the lexicon that this problem affects, it is possible that these perfects could have been lexicalized as well. If ANCHOR-OO was operative as the grammar was changing, these forms could still have been preserved with their unusual syllabification. When the forms were subsequently lexicalized, the reduplicant no longer needed to be synchronically generated – since the output string is identical to the input. But since syllabification is not specified in the input, the forms were then free to gain regular syllabification because base-reduplicant correspondence constraints no longer factored into the derivation. Whether or not lexicalization and/or OO-correspondence is the proper answer, it is clear that the presence of the reduplicated presents must be playing some sort of role in the maintenance of these irregular forms.

4.4. <u>The alternation between ἔκτημαι and κέκτημαι</u>

There seems to be only one perfect form of a COV root which displays a reduplicated consonant without having a reduplicated present. To the present κτάομαι [kta-] 'I acquire', there is vacillation in the perfect between the expected ἔκτημαι [e-k.tε̄-] and the unexpected κέκτημαι [ke-k.tε̄-]. There is no obvious explanation for this situation. One could again resort to lexicalization, although (in this case) this seems little more than a cop out. Another unsubstantiated possibility is dialect differences and dialect borrowing. If one dialect had slightly different rules of syllabification, or there was lag in one dialect to adopt the new syllabification, then such a form might have been maintained and then propagated. If this were the case, though, one would expect more than just a single such form. However, this word does belong to the core of the lexicon, and thus could be more resistant to change than other less significant words. This might have then allowed the archaic formation to be retained, even without connection to a reduplicated present. These are several possibilities, but a better solution is still needed.

4.5. Conclusions about the reduplicated presents

This chapter has demonstrated that, even though the reduplicated presents are not consistently in line with the synchronic grammar that produces the perfect-tense forms, they can be fully explained when recourse is made to an earlier diachronic layer. By positing a grammar in which SONORITY SEQUENCE and/or STRUCTURAL ROLE was less highly-ranked (at least below ONSET), the forms can be generated regularly. As this is an earlier stage, it is necessarily more archaic, and closer to preserving the state of affairs of the proto-language. This finds some degree of confirmation in the extreme formal similarity between Greek ἵστημι (< **si-stē-mi*) and Latin *sisto*. Additional support is found in Byrd (2010), whose constraint ranking for the syllabification of Proto-Indo-European is largely in line with the one developed for Pre-Greek.

Moreover, this same ranking will prove useful in accounting for the pattern of Attic Reduplication in Chapter 7.

By appealing to lexicalization and output-output *correspondence*, the reduplicated presents can also provide a coherent explanation for a small set of COV roots which have copying perfects. Such forms can likewise be generated by the ranking of Pre-Greek necessary for the production of the reduplicated presents. While this account makes a rather unexpected prediction about the syllabification of these forms, the conceptual underpinnings of the solution seem valid.

(69) PROPOSED CONSTRAINT RANKING FOR PRE-GREEK:

ALIGN-RED*e*-L, MAX-IO, DEP-IO, ANCHOR-L-BR »

ONSET, NOCODA »

STROLE, SONSEQ »

*COMPLEX »

DEP-BR, ALIGN-ROOT-L »

MAX-BR

CHAPTER 5

REDUPLICATION AND INITIAL GEMINATES

There is another interesting sub-pattern in the perfect-tense reduplication of consonant-initial roots not yet addressed. It will be entirely consistent with the system developed thus far, once we can understand a few unusual facts. We can start by looking at the verb meaning 'chase.' In its present-tense form, it is σεύω [seu.$^{(w)}$ɔ̄]. Based on our knowledge of the behavior of consonant-initial roots, including *s*-initial roots, we would expect a reduplicant [se-] in the perfect form. This is not what we get. Instead, the perfect stem is [es.su-], as in ἔσσυμαι. This is completely unexpected based on the present-tense forms, which we have always taken to represent the *de facto* root. For this word, however, a different approach must be taken.

5.1. σεύω and palatalization

The answer comes when we consider the diachronic development of this relatively unique word. Our first clue that something could be amiss with this root is simply the fact that it is *s*-initial. By the time of the Classical language, there were many *s*-initial roots, but virtually all of these (save *s + stop roots*) were new additions to the lexicon. This is because, in the period of Pre-Greek, there was a rule whereby /s/ (and also /y/[94]) became /h/.[95] Steriade (1982: 340-50) demonstrates that the environment for this rule can be best described as being when these

[94] The outcome of PIE initial **y* vacillates in Greek between rough breathing /h/ and zeta < ζ > [zd]. Sihler (1995: 187, §191) suggests that the latter outcome may be the result of initial **laryngeal* + *y*, whereas /h/ is the normal outcome of plain initial **y*. This opinion is not shared by all. But if the [zd] outcome can be traced to laryngeals, then Steriade's assertion about the environment for this rule is supported.

[95] The development of this /h/ and its impact on reduplication patterns will be discussed at length in Chapter 8.

segments were syllable-initial – which most conspicuously includes word-initial position. Since we find here an [s] which is in word-initial position, we might suspect that some other issue has intervened.

This is precisely the case. One of the main paths through which /s/ was re-introduced into initial position (and elsewhere) is palatalization.[96] According to Sihler (1995: 562-3), Laar (2000: 267), and Chantraine (1968: 997), the root of σεύω ~ ἔσσυμαι most likely derives from an earlier *$k^{(w)}$*yew-*. In (late-)Pre-Greek, the sequence *consonant* + *y* universally resulted in some sort of palatalized, coalesced segment. These segments were "phonetically long," and the outcomes of all the *stops* + *y* "acquired some degree of assibilation" (Sihler, 1995: 192, §198). The outcome of the *voiceless velar stops* + *y* (and also the voiceless dentals) yielded the long affricate /ʧː/. By the period of attested Greek, all affricates have been de-affricated. The outcome of /ʧː/ differs by dialect, with /tt/ in Attic and Boeotian, and /ss/ in most other dialects (ibid.).[97] This outcome can only stand, however, in medial position. In initial-position, it surfaces as [t] and [s], respectively.[98] This simplification in initial position should not trouble us at all, and will in fact shed light on the odd state of affairs with this root.

Given the relative irregularity and scarcity of these forms, it would not be unreasonable to assume that they are lexicalized exceptions that should not be accounted for synchronically in the first place. However, failing to recognize a restructuring of the underlying form would predict an outcome very different from what we see. When the root was still √*$k^{(w)}$*yew*, the perfect would have been *ke-$k^{(w)}$*yu-*. If we freeze the form at this stage and allow the regular

[96] There are generally said to be two distinct "palatalizations" in the history of Greek. The "first palatalization" affected only the dental stops. The "second palatalization" affected all consonants. The latter will be the one relevant here.
[97] The contrastive outcomes of Attic and Ionic imply that de-affrication is relatively late.
[98] No forms for this root have the /t/ reflexes expected of Attic. If it is attested in Attic, therefore, it is likely as the result of a dialect borrowing.

sound laws relating to palatalization to proceed without interference, the result would be ***ke-ssu-*. Since there is absolutely no trace of such a form, it must be the case that lexical restructuring has taken place. When palatalization occurred, the original underlying segments would have been completely obscured, especially for those cases (such as this one) which did not arise across morpheme boundaries, since these will display absolutely no morphophonemic variation by which they could be synchronically recoverable.[99] This would necessarily lead to restructuring of the lexical entry.

So the question is: what is the new underlying form? Picking it up after the de-affrication, we are presented with two choices:[100] /s-/ or /ss-/. (The /ss/ could alternatively be represented as a moraic consonant /s_{μ}/.[101] This will be examined below.) While it would be simplest in terms of the phonological inventory to posit the /s/ as underlying, the totality of the forms we have make it clear that it should really be /ss/.

5.2. σεύω as an initial double-consonant root

Looking outside of the perfect – where we cannot *a priori* rule out the possibility of the double /ss/ being the result of an interaction with the RED*e* morpheme – we still see the double /ss/ in all forms where the root is preceded by a vowel.[102] In the aorist, when preceded by the augment /e/, there is ἔσσευα [es.seu.$^{(w)}$a]; with a vowel-final preverb, there is ἐπισσεύω [e.pis.seu.$^{(w)}$ɔ̄]; and in compounds with a first member ending in a vowel, there is ὁμοσσυτός 'rushing together' [^{h}o.mos.su.tos]. Furthermore, Steriade also implies that the double < σσ >

[99] The alternation between single and double consonant in the present versus other forms does of course constitute morphophonemic variation, but not relating to either of the original segments.
[100] I will deal with the /s/ variants, since that is the form we are presented with, but the same holds for the Attic /t/ variants.
[101] μ = mora.
[102] The following forms are taken from Steriade (1982: 366).

spelling even occurs when the preceding word is vowel-final, and that, in metrical texts, either spelling has the result of closing the preceding syllable, which is induced only by words with initial clusters. If we were to take the underlying representation of the root to have just /s-/, there would be no way to generate any of these facts. Therefore, it seems fitting to identify the underlying form as /ss-/. This is the route taken by Steriade (1982: 378, fn. 16), as well.

Proceeding from this analysis, the behavior of the perfect-tense form is completely in accord with our reduplicative grammar. The two members of the sequence [ss] are obviously equal in sonority. Therefore, if they are syllabified together in a syllable margin, they will violate SONORITY SEQUENCE, since sonority plateaus incur violations just as falls (in onsets) and rises (in codas) do. High-ranking SONSEQ will therefore force the initial consonants to be heterosyllabic, inducing all the same problems, and thus outcomes, for reduplication as seen earlier with initial-clusters of /kt/, /st/, /ps/, etc.

(70) <u>The perfect of σεύω with underlying double consonant</u>: σεύω [seu-] : ἔσσυμαι [*e*-ssu-]

/ RED*e*, s_1s_2u-, /	MAX-IO	STROLE	ANCHOR-L-BR	SON SEQ	ONSET	NO CODA	*COMPLEX	MAX-BR
a. <u>s</u>$_1$*e*-s_1.s_2u-		*!				*		**
b. <u>s</u>$_2$*e*-s_1.s_2u-			*!			*		**
c. <u>s</u>$_1$*e*.-s_1s_2u-				*!			*	**
d. <u>s</u>*e*.-su-	*!							*
☞ e. *e*-s_1.s_2u					*	*		***
f. *e*.-s_1s_2u-				*!	*		*	***

In this tableau we see the same types of issues arise as in the earlier accounts of the COV roots. Candidate (70d) shows that deletion is not a possible repair strategy, even though it allows maximal satisfaction of all constraints except MAX-IO. Candidates (70c) and (70f) are ruled out because they violate SONORITY SEQUENCE with their tautosyllabic [ss] cluster. The remaining two suboptimal candidates both display a copied [s] in the reduplicant. They differ in their representation only insofar as the reduplicant [s] corresponds to the two different [s] segments of the root. In roots like /kton/, the analogous candidates are not segmentally surface-identical, since the one paralleling (70a) would be [kek.ton-], while the one paralleling (70b) would be [tek.ton-]. Despite their identical segmental structure, both candidates are ruled out in exactly the same way as [kek.ton-] and [tek.ton-] – (70a) by STRUCTURAL ROLE, because the corresponding root segment [s_1] is syllabified as a coda, and (70b) by ANCHOR-L-BR, since the corresponding root segment [s_2] is not at the left-edge of the base. We are therefore left with (70e), which is the candidate that eschews copying and syllabifies the root-initial cluster heterosyllabically. The optimal output is therefore exactly parallel to that for /kton/ → [*e*k.ton].

5.3. <u>The present tense of an underlying double-consonant root</u>

One small piece of business that needs to be cleared up, however, is why the underlying double /ss-/ is absent in non-compounded present-tense forms like σεύω. We have seen that in the present-tense of other COV roots, the underlying cluster surfaces unscathed in the present tense (e.g. /kten/ → κτείνω [**kt**ēnō]). This showed that the violation of SONORITY SEQUENCE was not significant enough to induce a repair through deletion or insertion. Therefore, if we were to try to derive the present-tense form of this root from our current constraint ranking, we would not get the proper result. (The following tableau is a direct recapitulation of the tableau in (32) accounting for the present tense of κτείνω, with the candidates substituting [s] and [s] for [k] and [t].)

(71) <u>The *wrong* account of the present of σεύω:</u> σεύω [seu-]

/sseu-/	MAX-IO	IDENT-IO	DEP-IO	SONSEQ	ONSET	NOCODA	*COMPLEX
💣 a. sseu-				*			*
b. e.sseu-			*!	*			*
c. es.seu-			*!		*	*	
d. se.seu-			*!				
☹ e. seu-	*!						
f. tseu-		*!					*

The solution to this is clear. The difference between the licit *#kt* sequence and the illicit **#ss* sequence is that the latter has two identical segments, whereas the former does not. The *Obligatory Contour Principle* (OCP) addresses exactly this situation. The OCP is a principle/constraint-family that militates against identical adjacent segments and/or features. However, since we don't want it to prohibit the surfacing of our heterosyllabic [-s.s-] sequence in post-vocalic contexts, we need to restrict its operation to the domain of the syllable.[103]

(72) OCP-σ: Do not have identical segments *within a syllable*. Assign one violation mark for each pair of identical segments within a syllable.[104]

Placing this constraint at the top of our ranking, we will motivate a repair strategy for the /ss-/. Returning to our tableau, we see that this will get us most of the way, but still require additional tweaking.

[103] It is more common to apply the OCP over morphological domains than prosodic domains, but not unheard of.
[104] The phrasing *'within a syllable'* should recall the speculative proposal at the end of Chapter 3 which makes use of the OCP to rule out candidates like *[kek.to.na].

(73) <u>The present of σεύω with OCP-σ</u>: σεύω [seu-]

/sseu-/	OCP-σ	MAX-IO	IDENT-IO	DEP-IO	SON SEQ	ONSET	NOCODA	*COMPLEX
a. sseu-	*!				*			*
b. e.sseu-	*!			*	*			*
c. es.seu-				*		*!	*	
☞ d. se.seu-				*				
☹ e. seu-		*						
f. tseu-			*					*!

The OCP has now ruled out the faithful candidate. However, given our current ranking, there is nothing to decide between suboptimal candidate (73d) and the desired candidate (73e). There are a number of easy possibilities, which cannot be decided upon independently from this derivation. The simplest would be to fix DEP-IO above MAX-IO.[105]

Alternatively, we could introduce CONTIGUITY-IO to the ranking. This will prohibit intrusion of any segments (epenthetic or otherwise) into an output string. Since the two [s]'s were contiguous in the input, the internal epenthesis of candidate (73d) is intrusive, and incurs a violation of CONTIG. Since the two candidates reach the end of the evaluation tied, this constraint can be placed anywhere within the ranking and it will still effect the proper outcome.[106] But since CONTIG is essentially preventing a special case of epenthesis (i.e. internal epenthesis instead of external epenthesis), it is more intuitively pleasing to simply rely on DEP-

[105] In the discussion of Attic Reduplication in Chapter 7, it will be adduced that, at a very early stage of the language, possibly Proto-Indo-European itself, MAX-IO must dominate DEP-IO. There is no reason, however, to believe that the rankings could not have switched in the intervening millennia.

[106] Indeed it must be present in the ranking somewhere, since all constraints (at the very least the most basic CORRESPONDENCE constraints) are universal.

IO in this case.[107] Arbitrarily choosing the DEP solution, we see that the proper output is easily selected.

(74) <u>The present of σεύω with DEP » MAX</u>: σεύω [seu-]

/sseu-/	OCP-σ	DEP-IO	MAX-IO	IDENT-IO	SON SEQ	ONSET	NOCODA	*COMPLEX
a. sseu-	*!				*			*
b. se.seu-		*!						
☞ c. seu-			*					

5.4. <u>σεύω as an initial moraic-consonant root</u>

A compelling argument could be made against the details of this account. If the OCP is active, we might expect it to be at work in the lexicon as well as on the surface. This would militate against the presence of an underlying form like /sseu/. The way around this is to replace the double consonant with a moraic consonant /$s_\mu$eu/.[108] Under this analysis, a constraint banning a moraic segment in onset position would induce *splitting* or *breaking* in post-vocalic environments and mora-deletion in word-initial position (and likely in post-consonantal position as well). *Splitting* would incur a violation of INTEGRITY-IO (McCarthy & Prince, 1995: 124), and mora-deletion would incur a violation of MAX-μ-IO. Defining these constraints as follows, they will be enough to generate the necessary output:

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[107] Furthermore, CONTIGUITY could have ramifications on vowel coalescence. Given an input string /$C_1V_2V_3C_4$/ that undergoes vowel coalescence to surface as [$C_1V_{2,3}C_4$], at least two (if not more, depending on how evaluation is carried out) CONTIG violations will be incurred, since C_1 was not underlyingly adjacent to V_3, and C_4 was not underlyingly adjacent to V_2. It is thus preferable to believe CONTIGUITY is (relatively) insignificant in the language. However, it may be worth examining with respect to reduplication and the augment, since one could create candidates that violated CONTIGUITY to improve syllable structure.

[108] It is necessary to posit underlying geminate consonants (represented either as double consonants or moraic consonants) for Greek. There are minimal pairs such as μέλω [me.lō̄] 'I care/think about' versus μέλλω [mel.lō̄] 'I am destined'. The latter derives from **mel-yō*, but the **y* has been lost with compensatory gemination. The origin of the geminate is not synchronically recoverable, and thus must be accounted for in the underlying form.

(75) $*_{\sigma}[(C_0)C_{\mu}$: Consonants in an onset must not have a mora.

(76) INTEGRITY-IO: No segment in the input has multiple correspondents in the output.

(77) MAX-μ-IO: Each mora of the input must have a correspondent in the output.

(78) <u>The perfect of σεύω with underlying moraic-consonant</u>:   σεύω [seu-] : ἔσσυμαι [*e*-ssu-]

/ RED*e*, $\mathbf{s}_{\mu}$u- /	$*_{\sigma}[C_{\mu}$	ST ROLE	ANCHOR-L-BR	MAX-μ-IO	INTEG	SON SEQ	ONSET	NO CODA	MAX-BR
a. <u>s</u>*e*-.$\mathbf{s}_{\mu}$u-	*!								*
b. <u>s</u>*e*-$\mathbf{s}_{\mu}$.u-		*!					*	*	*
c. $\underline{s}^1$*e*-$\mathbf{s}_{\mu}^{1}$.$\mathbf{s}^2$u-		*!			*			*	**
d. $\underline{s}^2$*e*-$\mathbf{s}_{\mu}^{1}$.$\mathbf{s}^2$u-			*!		*			*	**
e. *e*.-$\mathbf{s}_{\mu}$u-	*!						*		**
☞ f. *e*-$\mathbf{s}_{\mu}$.**s**u-					*		*	*	***
g. <u>s</u>*e*.-**s**u-				*!					*
h. *e*.-**s**u-				*!			*		**

The markedness constraint against moraic onsets eliminates the faithful candidates (78a) and (78e). STROLE eliminates candidates (78b) and (78c) for copying their consonant from the new moraic coda, and candidate (78d) is ruled out for copying from non-base-initial position, which the non-moraic [s] is now in because of the *splitting* of the underlying /s_{μ}/. Candidates (78g) and (78h) try to circumvent these problems by deleting the underlying mora, but are ruled out for this reason by MAX-μ. This leaves only one candidate, the desired (78f), which split the underlying /s_{μ}/ but did not copy. MAX-μ must dominate INTEGRITY in order for this derivation to work, since the reverse ranking would knock out (78f) in favor of the mora-deleting (78g). Thus, we see how an underlying single consonant is forced to pattern with the COV roots because of its unusual mora. This solution is also perfectly compatible with the single consonant in the present tense:

(79) <u>The present of σεύω with underlying moraic-consonant</u>: σεύω [seu-] : ἔσσυμαι [*e*-ssu-]

/s_{μ}eu-/	*$_{\sigma}$[C_{μ}	MAX-IO	DEP-IO	MAX-μ-IO	INTEG	SON SEQ	ONSET	NO CODA
a. **s**$_{\mu}$eu-	*!							
☞ b. **s**eu-				*				
c. e**s**$_{\mu}$**.s**eu-			*		*!		*	*
d. eu-		*					*!	

*$_{\sigma}$[C_{μ} will again knock out any candidates with a moraic onset. In this case, the only reasonable such candidate is the faithful one (79a). The remaining candidates all violate one of the three relevant IO-*correspondence* constraints. Even allowing them not to be critically ranked and for the evaluation to be passed to the lower-ranked constraints, the ranking is sufficient to correctly pick the winner. INTEGRITY will rule out (79c), which eliminates the mora problem by splitting the mora off into a coda, being propped up by an epenthetic vowel. ONSET will eliminate the full-fledged deletion candidate (79d), since the total elimination of the /s_{μ}/ would yield suboptimal syllable structure. Of course, the same outcome could be achieved without recourse to the lower ranked constraints if we critically ranked MAX-IO and DEP-IO over MAX-μ-IO. But since we don't need to do so, there is no reason to make that leap.

We have just shown that the unusual behavior of σεύω is due to its unusual underlying form, be it /sseu/ or /s_{μ}eu/. Either account requires the addition of only a few constraints. Since the account based on the OCP uses only that constraint, I will reference that account in the following sections. But note that either account will yield the correct outcomes.

5.5. Other initial geminate roots

There are very few roots that are structurally equivalent to σεύω. Laar (2000: 264) has only one other that derives from *stop* + *glide* coalescence. The lemma given is σάω [sa.ō] 'sift'. Laar (ibid.) and Chantraine (1968: 278)[109] derive this word from **tweH₂*.[110] This word is sparsely attested in the earlier periods, but we have a number of forms from later Attic that show a double *tt*, e.g. the present with preverb δια-ττάω and the perfect ἐ-ττημένος. Thus, this verb clearly must have the same sort of underlying initial geminate as σεύω. Laar (2000: 265-6) identifies σέβω 'worship, feel awe, revere' as coming from **tyeg^w-*. We would expect this to pattern like σεύω and σάω as an underlying initial geminate, yet its perfect is σεσόβηκα. For whatever reason, it has been remodeled as a non-geminate, and patterns with normal single-consonant-initial roots.

One more interesting root is μείρω [mēr-ō] 'divide, share' (Laar, 2000: 214-5),[111] which derives from √**smer-*. Its perfect before the **s* was lost would have been **se-smor-/*se-smr̥-*. The attested forms built to this root show divergent, yet more or less regular, developments across the dialects. There are two formations found in the early language, both appearing in Homer: the Aeolic perfect is ἔμμορα [e-mmor-a], and the Ionic perfect is εἵμαρμαι [^{h}ēmar-mai]. The different treatment of the root in the two dialects follows from the development of medial *-sR-* clusters. In virtually all the Greek dialects, **s* is lost in this position, and some sort of compensatory lengthening results (Sihler, 1995: 216, §227.2). In Aeolic, this lengthening takes the form of gemination of the resonant. Therefore, a sequence **-esmo-* would become *-emmo-*. As was demonstrated for σεύω's perfect ἔσσυμαι [e-ssu-mai], regular sound laws cannot directly account for the perfect form ἔμμορα: Proto-Greek **se-smor-a* > Aeolic ***^{h}e-mmor-a*. While the

[109] Chantraine addresses this under the entry for διαττάω.
[110] The forms would also be compatible with a reconstruction **kyeH₂* or **ḱyeH₂*.
[111] Chantraine (1968: 678-9) uses the mediopassive μείρομαι 'receive as one's portion' as the lemma for this root.

geminated medial [-mm-] is the proper Aeolic outcome, the lack of rough breathing shows that restructuring must have occurred. In Aeolic, therefore, the underlying form of this root must be /mmer/.

This must be different than the route taken for this root in Ionic, which has the perfect form εἵμαρμαι [^{h}ēmar-mai]. In the environments (such as this one) where Aeolic created geminates, Ionic tends instead towards compensatory lengthening of the preceding vowel. Thus, **-emmr̥-* would yield Ionic *-ēmar-*. Exactly the opposite of the Aeolic form, the Ionic can only be explained by saying that the form was lexicalized before the loss of medial **s*. εἵμαρμαι is in fact the outcome of regular sound laws in Ionic: Proto-Greek **se-smr̥-mai* > Ionic ^{h}*ēmar-mai*. The rough breathing and the long vowel cannot be synchronically motivated. The internal morphological constituency of [^{h}ēmar-mai] would have been very difficult for speakers to parse. Therefore, it was left as a lexicalized form. This is different than how Aeolic speakers would have analyzed the geminate formation. That pattern would have been recognizable, based on other roots like σεύω (and the *r*-initial roots to be discussed below), so a synchronically regular form could be produced instead of clinging to a lexicalized irregularity.[112]

The retention of the lexicalized εἵμαρμαι in Ionic would have been supported by several other similar forms. Just as medial **-esm-* yielded Ionic *-ēm-*, medial **-esl-* yielded Ionic *-ēl-*.

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[112] There are later forms which show restructuring in a more typical direction. One of these simply displays an underlying form in initial single /m/: μεμόρηκα [me-mor-ēk-a]. The other is βέβραμμαι [be-bram-mai], which shows an underlying initial /b/. In Greek, a nasal cannot stand before a liquid. Medially, this generally spawns an excrescent homorganic voiced stop. For example, in the word for 'man', the nominative singular is ἀνήρ [anēr], but the genitive singular, which has a zero-grade root allomorph, is ἀνδρός [andros] ← /anr-os/. In initial position, however, the nasal, particularly when it is /m/, denasalizes and surfaces as a voiced stop. This is the case in a word like βλώσκω 'I go/come' < **mlō-skō* < **ml̥H₃-skó*. To this present there are two attested patterns in the perfect: a more archaic μέμβλωκα [me-m.blō-k-a], and a (somewhat) later βέβλωκα [be-blō-k-a]. The former speaks to an earlier period where the initial segment was still underlyingly /m/, and the optimal output of the grammar was a splitting of the nasal into *nasal + voiced stop*. (The [b] is a second correspondent of the underlying /m/ rather than an epethetic segment because of the ranking DEP-IO » INTEGRITY-IO, as was motivated above. In order for this to be the correct analysis, it must be ascribed to the period of the language when STROLE was lower ranked, since the root [m] has been shunted into coda position.) The βέβλωκα form, however, shows a restructuring of the root as /b/-initial, just as βέβραμμαι implied.

This development affected the root √*$sleH_2g^w$- ‘seize, take’. This root has a double-nasal present λαμβάνω [la-m-b-an-ō] ‘I take (hold of)’ and a *-$y^e/_o$- present λάζομαι [lazd-o-mai] ‘I seize’ (< *$sl\mathring{H}_2g^w$-*yo-mai*), both showing the expected initial *l*. While it has a later perfect λελάβηκα [le-lab-ēka] that shows a restructured root with underlying initial /l/, its more archaic perfect is εἴληφα [ē-lēp^h-a].[113] This shows compensatory lengthening in exactly the same way as εἵμαρμαι. The perfect εἴληφα spawned two analogical perfects to structurally similar roots: the present λαγχάνω ‘I obtain (by lot)’ (< √**l(e)ng*^{h}-) has analogical perfect εἴληχα [ē-lēk^h-a] beside normal λέλογχα [le-loŋk^h-a]; and the present λέγω ‘I gather, count; say’ (< **leg*-) has analogical perfect εἴλεγμαι [ē-leŋ-mai] beside normal λέλεγα [le-leg-a]. The presence of forms like this, be they *lautgesetzlich* or analogical, would have supported the retention of εἵμαρμαι.

The perfects of σεύω, σάω, and μείρω are all somewhat idiosyncratic, but nonetheless show that initial geminates created a distinct pattern of reduplication in Ancient Greek. There is, however, a much larger, more coherent set of roots that act in almost exactly the same way. These are *r*-initial roots. It is easy to generate the behavior of *r*-initial roots as geminates by means of the fact that there are no unaspirated initial *r*’s in Greek. This derives from the (somewhat controversial) assertion that Proto-Indo-European had no roots/forms in initial **r* (Lehmann, 1951).[114] All initial [r]’s in Greek are therefore secondary, coming about by the change of initial /s,w/ into aspiration. Most, if not all, roots in Greek that have initial aspirated [^{h}r] in the present derive from forms which originally had one of these two segments before the /r/, i.e. of the shape *#*sr* or *#*wr*. This is borne out in the example roots seen here:

113 The lack of initial rough breathing is likely due to “dissilimation of aspiration” induced by the root-final [p^h] via Grassmann’s Law (see Chapter 8). This would not *lautgesetzlich* affect εἵμαρμαι, because there is no aspirate in the root to trigger the loss of the rough breathing.
114 For the opposite view, see Sihler (1995: 85-8).

(80) Representative *r*-initial roots

PIE root		Present	Perfect	Aorist
**srew-*	‘flow, stream’	ῥέω [^{h}re-]	ἐρρύηκα [e-rru-]	ἐρρύην [e-rru-]
**wr(e)H$_2$g-*	‘break, scatter’	ῥήγνυμι [^{h}rε̄g-]	ἔρρηγμαι [e-rrε̄g-]	ἔρρηξα [e-rrε̄k-]

Since these roots all derive from earlier forms with initial consonant clusters, just as σεύω, σάω, and μείρω did, it is clear why these will pattern in the same way.

5.6. *r*-initial roots as initial geminates

The alternation between double and single consonant exactly parallels the alternation just seen in σεύω. Taking the underlying form of these roots, therefore, to have /rr-/, the perfects will be derived in the same way as in (70). The present will be derived similarly as well, although there are a few minor differences.

(81) The present of *r*-initial roots: ῥήγνυμι [^{h}rε̄g-]

/rrε̄g-/	OCP-σ	DEP-IO	MAX-IO	IDENT-IO	SON SEQ	ONSET	NO CODA	*COMPLEX
a. ^{h}rrε̄g-	*!				*		*	*
b. ^{h}rε̄g-			*				*	
c. e.rrε̄g-	*!	*			*	*	*	*
d. er.rε̄g-		*!				*	**	
e. ^{h}re.rε̄g-		*!					*	
f. drε̄g-				*			*	*!
g. dε̄g-			*	*!			*	
h. ε̄g-			**!			*	*	

Here we see that every candidate which retains both underlying /r/'s incurs a serious violation. If they are tautosyllabic, as in (81a) and (81c), they violate the OCP. If they avoid the OCP violation through epenthesis, they violate DEP-IO, as in (81c-e). Candidates (81b), (81g), and (81h) all get around the OCP problems through deletion. In (81h), both /r/'s have been deleted, thoroughly removing any potential issues with either of the aforementioned constraints. However, the double violation of MAX-IO (in addition to lower-ranked ONSET) eliminates this candidate. (81f)'s MAX violation is not enough to eliminate it, but the MAX violation incurred by (81g), coupled with its violation of IDENT-IO, is enough to be fatal. (81f) is similar to (81g) in that it changes the initial /r/ to a [d]. But this candidate is better because it retains the second /r/ as such, which is now allowed because it has a preceding [d] to prop it up. This cluster passes the OCP and SONORITY SEQUENCE, all by only changing the features of the initial /r/. This leaves us with only (81b) and (81f), both having violated one of the middle-ranked IO-*correspondence* constraints (MAX and IDENT). They tie all the way down until *COMPLEX, where (81f)'s retention of the cluster turns out to be fatal.

One complication should be apparent. In all of the forms where an /r/ is retained in initial position, it is shown with pre-aspiration [^{h}r]. In Greek, all "initial *r*'s" are written with the 'rough breathing' mark. How we are to deal with the alternation between aspiration in the present and non-aspiration in the perfect, either on the initial vowel or on one of the medial [r]'s, is a question that deserves further investigation, but need not be addressed here.

5.7. <u>Conclusions about initial geminates</u>

This chapter has shown that a number of roots which display seemingly aberrant behavior in their perfect-tense forms can actually be straightforwardly explained by critically examining their underlying form. The solution comes from identifying these roots as having an initial consonant which is either double or moraic. This is well-motivated due to the fact that it is invariably brought about through coalescence of two discrete consonants in an earlier period, With the underlying form appropriately altered, the non-copying perfect conforms to the rule, rather than being the exception.

CHAPTER 6

PERFECT-TENSE STEM-FORMATION OF VOWEL-INITIAL ROOTS

The preceding chapters have shown that the reduplicated forms of consonant-initial roots fall into essentially two patterns (copying and non-copying), with the difference between them accounted for straightforwardly by the interaction of syllabification and BR-correspondence. The facts of the vowel-initial roots are somewhat more recalcitrant.

The vowel-initial roots fall into no less than three distinct patterns (and possibly as many as six, depending on how we are to distinguish between them) in their perfect-tense stem formations. The three patterns are: (1) vowel lengthening, where the perfect stem is differentiated from the root only by lengthening of the root-initial vowel – there are certain discrepancies in the quality that the lengthened vowel takes; (2) Attic Reduplication, in which the initial *VC* sequence of the root appears to be copied, with a concomitant lengthening of the root-initial vowel; and (3) what I will refer to as a *syllabic reduplicant* – these forms appear to have a distinct reduplicated syllable filled only by an [e] (which may or may not have attached aspiration) which is in hiatus with the root-initial vowel (the vowel is often the o-grade). If this situation were not complex enough, there is the further issue that forms of multiple patterns very often exist side by side for one and the same root, often even within the same text/author. A brief overview of these patterns can be seen here:[115]

[115] Forms taken from Laar (2000: Ch.2).

(82) Survey of early perfect-tense forms of vowel-initial roots

	Root (Greek < *PIE)		Present Tense		Perfect Tense	
Type 1: Vowel lengthening						
(a) #e : ē	erū < *weru	'protect'	ἔρῡμαι	[erū-]	εἴρῡμαι	[ērū-]
	ʰelk < *selk	'draw, drag'	ἕλκω	[ʰelk-]	εἵλκυσμαι	[ʰēlk-us-][116]
(b) #e : ɛ̄	ʰeps < *sep(s)	'boil'	ἕψω	[ʰeps-]	ἥψημαι	[ʰɛ̄ps][117]
	ʰeu̯r < *wreH$_1$?	'find'	εὕρηκα	[ʰeu̯r-ɛ̄-]	ηὕρηκα	[ʰɛ̄u̯r-ɛ̄-][118]
#a : ɛ̄	ag < *H$_2$eg	'lead'	ἄγω	[ag-]	ἦγμαι	[ɛ̄g-]
	amelg < *H$_2$melg	'milk'	ἀμέλγω	[amelg-]	ἤμελγμαι	[ɛ̄melg-]
#o : ɔ̄	opʰel < *H$_3$bʰel	'owe; be obliged'	ὀφείλω, ὀφέλλω	[opʰēl-],[119] [opʰel-]	ὤφληκα	[ɔ̄pʰlɛ̄-]
	op < *H$_3$ekʷ	'see'	ὄψομαι (fut.)	[op-s-]	ὦμμαι	[ɔ̄m-][120]
	oi̯kʰ < *H$_3$eygʰ	'go away'	οἴχομαι	[oi̯kʰ-]	ᾤχηκα	[ɔ̄$^{(i)}$kʰ-ɛ̄-][121]
Type 2: Attic Reduplication						
(a) VC-roots	ed < *H$_1$ed	'eat'	ἔδω	[ed-]	ἔδηδα	[edɛ̄d-]
	ar < *H$_2$er	'join, fit together'	ἀραρίσκω	[ar-ar-]	ἄρηρα	[arɛ̄r-]
	ol < *H$_3$elH$_1$	'destroy'	ὄλλῡμι	[ol-]	ὄλωλα	[olɔ̄l-]
(b) VCeC-roots	ela(u) < *H$_1$elH$_2$	'drive'	ἐλάω, ἐλαύνω	[ela-], [elau-]	ἐλήλαμαι	[elɛ̄la-]
	akou < *H$_2$kows ?	'hear'	ἀκούω	[akou-]	ἀκηκοα	[akɛ̄ko-]
	oreg < *H$_3$reg	'stretch, reach'	ὀρέγω	[oreg-]	ὀρώρεγμαι	[orɔ̄reg-]
Type 3: Syllabic Reduplicant						
	eik < *weyk	'make like'	ἐίσκω, ἴσκω	[e.i-], [i-]	ἔοικα, ἔικ-	[e.oi̯k-], [e.ik-][122]
	elp < *wel(p)	'hope'	ἔλπομαι	[elp-]	ἔολπα	[e.olp-]
	erg < *werg	'do, make'	ἔρδω[123]	[erd-]	ἔοργα	[e.org-]
	ag < *weH$_2$g	'break'	ἄγνῡμι	[ag-]	ἔᾱγα	[e.āg-]
	ʰal(o) < *welH$_3$	'be taken'	ἁλίσκομαι	[ʰal-]	ἑάλωκα	[ʰe.alɔ̄-]
	ʰor(a) <*(s)wor[124]	'see'	ὁράω	[ʰor(a)-]	ἑόρᾱκα	[ʰe.or(ā)-]
	ōre[125] <*(H$_2$)wers	'make water'	οὐρέω	[ōre-]	ἐούρηκα	[e.ōrɛ̄-]

[116] Form with [ē] from Euripides only. Another form with [e] ἕλκυσμαι is found in Herodotus only (Laar: 141).
[117] Only found in Herodotus (Ibid., 157).
[118] Also forms in [ʰeu̯] (Ibid., 153-4).
[119] Long [ē] is compensatory lengthening from loss of [l], which itself derives from *y*.
[120] [m] is assimilated from /p/. There is an Attic Reduplication form ὄπωπα, which Laar (232) takes to be more original.
[121] Long diphthongs eventually lose their off-glide to become a long monophthong with the quality of the first member of the diphthong. The iota-subscript is a reintroduction of the off-glide into the orthography after its quiescence. There appear to be forms in [oi̯] as well as [ɔ̄i̯] (Ibid., 227-8).
[122] Also εἴξασι [ei̯k.sā.si] (Ibid., 137-8), where the hiatus has been broken by diphthong formation.
[123] From *werg-yō*.
[124] The etymology of this root is difficult to pin down. Certain forms point to *wer/wor*, others to *sor*, and some to *swor*. Many forms could be reasonably derived from more than one of these options. It is possible that multiple roots have converged in this individual verbal system, which is itself partially suppletive with *H$_3$ekʷ- > op- 'see'. See Chantraine (1968: 813-4).
[125] The < οὐ > should be taken as a spurious diphthong [ō] from compensatory lengthening of the lost root *s*.

This survey[126] of forms reflects the amazing variety amongst types of perfect stems found in the early language. This fact alone should lead us to believe that no one grammar could productively create all such vowel-initial forms simultaneously. But this is not necessarily a death blow to our hopes of accounting for these forms. At least part of the problem is that these forms, far more so than those from consonant-initial roots, are subject to massive phonological changes in the late prehistory and early history of Greek. Many scholars believe that Proto-Indo-European had no vowel-initial roots at all. Therefore, all of the vowel-initial roots of Greek are (relatively) new creations.

6.1. The origins of vowel-initial roots in Greek

Vowel-initial roots in Greek come about through two processes. The first is the loss of the Indo-European laryngeals.[127] These were segments in Proto-Indo-European that were universally deleted across the Indo-European daughter languages (with the partial exception of Anatolian), leaving only indirect traces of their existence. Their residue is most commonly seen on the vowels of the daughter languages. This is especially the case in Greek. Vowel-initial roots first enter the language through this loss of the laryngeals in two types. For PIE roots that were of the shape **HeC*, the loss of the laryngeal caused the root-vowel to become root-initial. For example, the Greek root ἄγω 'I lead' /ag-/ derives from PIE *H_2eg.[128] Roots created in this way will still be monosyllabic, as was the root in PIE. The second way laryngeals created

[126] The preceding list is far from exhaustive. For a more complete accounting of early vowel-initial forms, consult Laar (2000: Ch.2) directly.
[127] The most prevalent (although not universally agreed upon) version of the laryngeal theory posits three laryngeals for PIE: *H_1 (the e-coloring or non-coloring laryngeal), *H_2 (the a-coloring laryngeal), and *H_3 (the o-coloring laryngeal). They are generally thought to be some sort of dorsal or pharyngeal fricatives. *H_1 is commonly believed to have been a glottal stop /ʔ/. What will be most significant for our purposes is their sonority profile: they are more sonorous than stops but less sonorous than resonants (a.k.a. sonorant consonants). I will follow the convention of using capital *H* as a cover term for *any laryngeal*. For the development of the laryngeals in Greek, see, e.g., Beekes (1969).
[128] The /a/ of Greek is due to vowel-coloration by the laryngeal.

vowel-initial roots in Greek was through *laryngeal vocalization*.[129] When a laryngeal would otherwise have to be syllabified as the non-final member of a complex onset,[130] its reflex is a short vowel: PIE *$\underset{\circ}{H}_1$ > Greek *e*, PIE *$\underset{\circ}{H}_2$ > Greek *a*, and PIE *$\underset{\circ}{H}_3$ > Greek *o*. Therefore, in roots of the type **HCeC*, the laryngeal vocalizes (in un-prefixed forms) and yields a Greek root of the shape *VCeC*, with the quality of the vowel determined by the laryngeal. Thus, the loss of the laryngeals has created two *new* root shapes in Greek: *VC* and *VCeC*.[131]

More vowel-initial roots are created at later strata, also by the deletion of root-initial segments. In Pre-Greek, /s/ and /y/ are lost in initial position, leaving behind only the "rough breathing" mark, which represents initial aspiration.[132] Later, /w/ is also lost in initial position. It appears to inconsistently result in rough breathing (Sihler, 1995: 183-4, §188).[133] These new vowel-initial roots generally conform to one of the two shapes brought about by laryngeal deletion. However, they do have the potential to create *VRC* roots.[134] This does not appear to be especially prevalent, but we do have the Indo-European root **werg* 'do, make' yielding the Greek present ἔρδω [erd-ɔ̄] (< **werg-yō*) and perfect ἔοργα [e-org-a] (< **we-worg-a*).[135]

While the situation is indeed chaotic (and really more so than is evident from the list in (82)), we can observe some generalizations that may be significant for our account. First, the Attic Reduplication forms are almost exclusively built to PIE laryngeal-initial roots. I find only two counter-examples in Laar (2000). The first is the verb 'keep watch' from PIE **ser*. It has a

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[129] See Byrd (2011) for an analysis of *laryngeal vocalization* as *schwa-epenthesis*. I believe *schwa-epenthesis* to be the proper account, and it will be incorporated into the analysis of Attic Reduplication in the following chapter.
[130] See Byrd (2010) for a more complete analysis of laryngeal syllabification and its reflexes.
[131] Some scholars prefer positing *vowel prothesis* as the origin of at least some members of the latter type (cf. Sihler, 1995: 85-8, §89-91), but this approach suffers seriously in its lack of economy.
[132] Issues related to aspiration will be taken up in full in Chapter 8.
[133] All three segments /s,y,w/ are lost intervocalically as well, with /s/ sometimes resulting in word-initial rough breathing – even if it was not originally in initial-position.
[134] The PIE root shape **HeRC* is incorporated into the more general type **HeC*, and therefore loss of **H* could also create *VRC* roots, although this also is not very common.
[135] See Laar (2000: 146-7).

present ὄρομαι [or-o-mai], and an Attic Reduplication perfect ὄρωρα [orōr-a].[136] This word has clearly been attracted to the verb 'incite' from PIE *H_3er*, which has a present ὄρνῡμι [or-nū-mi] and a perfect ὄρωρα,[137] which is identical to the perfect of 'keep watch.' If its forms were original, we would expect its **s* to yield rough breathing in at least some forms within its individual verbal system. The other exception is the verb 'vomit' from PIE **wemH_1*. Its present is ἐμέω [eme-ō] and its perfect is ἐμημεκα [emēme-k-a].[138] While this does not so closely match any other authentic Attic Reduplication form, its general structure is precisely equivalent to an **HCeC > VCeC* root which has lost its root-final consonant.[139]

The second generalization is that the roots that clearly show a syllabic reduplicant (i.e. have an [e] in hiatus with the root vowel) almost all derive from **w* roots. /w/ was the last of the segments discussed above to delete. In fact, it is maintained in some dialects well into the historical period.[140] Therefore, it is reasonable to believe that these forms were generated with a /w/ still in the underlying form. Whether this /w/ is exceptionally retained in the underlying representation of these forms throughout their history, or the syllabic reduplicant is simply lexicalized in some way, this generalization should be taken into consideration.

Despite these two patterns (Attic Reduplication and syllabic reduplicant), the primary perfect formation for vowel-initial roots is vowel lengthening. In the early period, the frequency of this type does not seem to have been significantly greater than that of the other two (or at least Attic Reduplication – the syllabic reduplicant seems to be a later development). However, over

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[136] Laar (235).
[137] Ibid., 234-5.
[138] Ibid., 142.
[139] It will be shown in Chapter 7 that this latter type is of primary significance for the development of Attic Reduplication.
[140] Sihler (1995: 182, §187): "The letter ϝ (ϝαυ) [= *w*] is of frequent occurrence in inscriptions of most G[reek] dialects except for Attic-Ionic and Lesbian. It disappeared first in consonant clusters, where it is preserved only in the earliest inscriptions of a few dialects; next between vowels; and lastly in initial-position before a vowel, where it survived in some dialects as late as the 2nd century BC, and even to the present day in the isolated relic of Laconian (Lacedaemonian) known as Tsakonian."

time, as more and more vowel-initial roots enter the system, the dominance of the vowel lengthening pattern asserts itself. This is most evident when looking at Classical Attic Greek.

In Classical Attic (the language of Athens in the 5^{th}-4^{th} C. BC), the treatment of vowel-initial roots in the perfect has become much more uniform. There are still remnants of the other patterns (Attic Reduplication, the syllabic reduplicant, and even lengthening with a different outcome – *e*+*e* → *ē*), but these appear to be lexicalized exceptions. The productive pattern is clearly initial-vowel lengthening, with both #*a* and #*e* lengthening to *ɛ̄* <*η*>, and #*o* lengthening to *ɔ̄* <*ω*>. As will be demonstrated, this sort of vowel lengthening is the outcome that is most easily reconcilable with the grammar developed for consonant-initial roots. Therefore, as speakers became more comfortable with having vowel-initial roots in their lexicon, the need to produce forms that more closely mirrored consonant-initial forms lessened, and speakers let the grammar play itself out without additional interference. The exceptional patterns had left their mark (in the form of lexicalized exceptions), but were no longer able to produce new forms.

Since vowel-lengthening is the most productive pattern, this is where we will start our account, first in the early stages of the language and then for Classical Attic. Once this has been completed, we will move on to the other patterns of Attic Reduplication and syllabic reduplicant in the following chapters.

6.2. What about the augment?

Before we begin our examination of vowel-lengthening perfects, one important question should be considered: are these forms actually reduplicated? Attic Reduplication forms clearly display copied segments, but forms with vowel lengthening (and, in some sense, forms with a syllabic reduplicant), surface without any segment which is obviously copied. We have already seen that the COV roots display a perfect-tense stem without a copied segment, and that they can be derived using the reduplicative morpheme (RED*e*). But, in those forms, there is at least an exponent of the reduplicative morpheme that is a *bona fide* segment discretely separate from the root. For vowel lengthening forms, this is not the case.

If we did not have evidence of reduplication from other parts of the perfect system (i.e. consonant-initial roots), there would be no indication at all that a reduplicative morpheme was involved in the creation of these forms. For this reason, it has been proposed, either indirectly (Smyth, 1920: §442; Fleischhacker, 2005: 152) or directly (Steriade, 1982; Haas, 1988; Sihler, 1995: 490), that these forms are *not* brought about by the addition of the reduplicative morpheme, but rather by another element: the *augment*.

The augment is the only inflectional prefix besides reduplication in Ancient Greek. If the augment can be reconstructed for *true blue* Proto-Indo-European (Sihler, 1995: 485), the situation holds for that language state as well. Appearing in Greek, Indo-Iranian, Armenian, and Phrygian (ibid.: 484), this element, reconstructed as *$(H_1)e$, is prefixed to the past tenses in the indicative mood, i.e. the imperfect, the aorist, and the pluperfect.[141] In Greek, it takes two forms: the *syllabic augment* and the *temporal augment* (Smyth, 1920: §428-437; Sihler, 1995: 485-6). The *syllabic augment* is the straightforward outcome of *$(H_1)e$ > Greek *e*. This surfaces on consonant-initial roots, as well as a few vowel-initial roots, all of which derive from earlier non-laryngeal consonant-initial forms. It is called syllabic because it creates a new syllable. The *temporal augment*, on the other hand, does not surface as *e*, but rather as a lengthening of the initial vowel of vowel-initial roots, due to vowel coalescence.

[141] The pluperfect is a secondary development in Greek. The augment is prefixed to the reduplicant. This demonstrates the ranking of ALIGN-AUGMENT-L » ALIGN-RED*e*-L » ALIGN-ROOT-L. The same situation holds for reduplicated aorists of consonant-initial roots.

This is precisely the distribution we see in the perfect tense, with a new syllable (also with *e* but with or without a reduplicated consonant) marking consonant-initial roots (and a small set of vowel-initial roots), but vowel lengthening being the productive pattern for vowel-initial roots. This leads Smyth to say: "In all other cases [i.e. other than C(R)V roots and Attic Reduplication] the reduplication is formed like the augment" (1920: §442). Since the perfect is essentially a past tense in Greek, it would be by no means unreasonable for the augment to have come to mark it, particularly in situations where copying reduplication was not available. But this is an unnecessary stipulation.

The underlying form of the augment, both *syllabic* and *temporal*, is /e/. Compare this to our reduplicative morpheme, /RED*e*/. In situations where copying does not occur (i.e. the RED part of the morpheme yields no material on the surface), the actual exponence will derive solely from the *e*. Therefore, the identity between augmented forms and perfect forms which do not display overt copying is obvious, since both are derived from an input /e/. As long as the constraint ranking can generate non-copying forms for vowel-initial roots (which it can), there is no reason to posit that these forms are marked by a different morpheme than other perfect forms.[142]

[142] As pointed out to me by Jay Jasanoff (personal communication), a question which is unanswerable, with this situation having arisen, is how speakers would have understood the relationship between the augment and these perfect-tense stems. One could imagine a situation where speakers would come to see these perfect forms as being marked by the augment, just as has been suggested, even though that was not the actual means by which they were formed. If this were the case, it might shed light on the development of the semantics of the perfect, as any such conception would necessarily imply a strong sense of *past tense* to be associated with the perfect, as that is what the augment marks. One might further expect, however, if this shift had occurred, that ultimately reduplicated forms would come to be "unreduplicated" and marked instead just by the syllabic augment. Since this did not happen, it seems more likely that such an association of the augment with the perfect never overtook the understanding of the forms as reduplicated, if the connection had ever arisen in the first place. But, of course, with no speakers around to ask, this question cannot truly be answered.

6.3. Perfect-tense stem formation through vowel lengthening

Since it is now clear that perfects formed through vowel lengthening can derive from the addition of the RED*e* morpheme, we can proceed to account for these forms in the same manner as before. To begin, let us consider the perfect forms of the root ἄγω 'I lead' /ag-/. The perfect middle displays the expected outcome with no further ado: ἦγμαι [ēg-]; the perfect active agrees, except that there is an alternation[143] of the root consonant: ἦχα [ēk^h-].[144] The crucial facts to recognize are (1) that the perfect-tense stem has the same number of segments as the root (i.e. there are no additional segments due to the reduplicative affix), and (2) that the only difference between the root and the tense-stem is the length (and quality) of the vowel. In our analysis of the consonant-initial roots, we never encountered a situation where the perfect-tense stem did not have a greater number of segments than the bare root. In order to maintain that these forms are in fact the avatars of the root plus the reduplicative morpheme (RED*e*), it must be the case that these forms display *vowel coalescence*. To evaluate the effects of vowel coalescence, we will need to introduce a number of new constraints. The most important of which is UNIFORMITY.

(83) UNIFORMITY-IO: Segments which are distinct entities in the input cannot correspond to a single segment in the output.

First proposed as such by McCarthy & Prince (1995), UNIFORMITY is just another in the set of *correspondence* constraints. Its ranking relative to the other *correspondence* constraints (namely MAX and DEP) will determine how certain illicit structures are repaired.

[143] This is the so-called *aspirated perfect*.

[144] There are later forms which seem to display Attic Reduplication-like patterns, including ἀγήγοχα [age:gok^{h}a]. This is clearly analogical, likely based on the fact that this root has an Attic Reduplication aorist. We have seen in Chapter 4 that the (lexicalized) presence of copying reduplication in one tense stem can support its occurrence in another. Such is probably the case here.

In this case, the illicit structure is the hiatus which would be brought about by the addition of the fixed /e/ of the reduplicant to a vowel-initial root: /RED*e*.ag-/. Hiatus is militated against by ONSET, which we have already seen play a very significant role in determining the phonological shape of the reduplicant. The presence of ONSET in our constraint ranking will therefore prevent the sequence -*e.a*- from surfacing as such. Our current constraint ranking, with the addition of a relatively low-ranked UNIFORMITY, can straightforwardly eliminate the most obvious candidates.

Let optimal candidate (85h) [ε̄gmai] stand in for all vowel coalescence candidates. The choice of this one over other coalescence candidates will be discussed as we proceed. The only aspect of this that needs mentioning first is that this candidate violates the constraint IDENT-μ-IO.

(84) IDENT-μ-IO: An output vowel must have the same number of moras attached to it as its correspondent in the input, and vice versa.

Since the optimal candidate (85h) has a surface long vowel that corresponds to two input short vowels, it incurs two violations of this constraint. As long as this constraint is dominated by ONSET, its violations will not eliminate our desired output. [145]

[145] The constraints NOCODA and STRUCTURAL ROLE are omitted from the following tableaux. There is a NOCODA violation in each form due to the root [g] being followed by the [m] of the suffix. If the suffix were vowel-initial, e.g. the 1.sg active -*a*, then it would be syllabified as an onset, thus not incurring a NOCODA violation. This also demonstrates why STROLE is being omitted, since it would be violated by the reduplicant [g] in several suboptimal forms simply because of the syllabification of the root [g], as determined by the suffix. The point is moot here, since the optimal form does not copy the /g/ for independent reasons. However, if this were significant, it could be alleviated by an interparadigmatic analogy OO-correspondence constraint maximizing reduplication. That is to say, if copying is motivated in any form, it will surface on every form within the same category. This is essentially equivalent to ANCHOR-L-OO$_{\text{REDPRES}}$, but meant to operate within the perfect. It is quite possible that one and the same constraint could be responsible for all of it, something like a more generalized ANCHOR-L-OO$_{\text{RED}}$.

(85) <u>Perfect-tense stem-formation through vowel-lengthening</u>: ἄγω [ag-ō] : ἦγμαι [ε̄g-mai]

/REDe_1, a$_2$g, mai/	MAX-IO	DEP-IO	ANCHOR-L-BR	ONSET	IDENT-μ-IO	UNIF	ALIGN-ROOT-L	MAX-BR
a. <u>a.g</u>e_1.-a$_2$g.mai				**!			***	
b. <u>a</u>.e_1.-a$_2$g.mai				**!*			**	*
c. e_1.-a$_2$g.mai				**!			*	**
d. <u>g</u>e_1.-a$_2$g.mai			*!	*			**	*
e. <u>g</u>e_1-g.mai	*!						**	
f. <u>g</u>-a$_2$g.mai	*!		*				*	*
g. e_1.-**C**a$_2$g.mai		*!		*			**	**
☞ h. $\bar{\varepsilon}_{1,2}$g.mai				*	**	*		**

Despite its being dominated in the ranking, it is ONSET which is inducing a repair.[146] We see in the faithful candidate (85a), where all input segments are preserved and all root segments are copied, that the internal hiatus causes a violation of ONSET, and this violation is ultimately fatal. (The other violation comes from the word-initial onsetless syllable. This violation is shared with all candidates – including the optimal candidate – that don't impermissibly copy the root [g] into initial position.) ONSET is also responsible for the fatal violations in (85b) and (85c). These candidates copy fewer segments, trading ALIGN violations for MAX-BR violations. But since no consonants are being copied, no improvement is made on the more significant constraint, ONSET.

Candidates (85d-f) all have a reduplicant-initial [g]. (85d) is very similar to (85b), in that it has copied fewer segments. But unlike (85b), it has actually succeeded in improving syllable structure, since the [g] of the reduplicant provides the desired onset. But this comes at the

[146] As discussed in Chapter 2, it is possible based on the forms at hand that ONSET and ALIGN-ROOT-L are not critically ranked. However, when we consider the Attic Reduplication forms, we will see that the critical ranking of ONSET » ALIGN-ROOT-L will prove exceedingly beneficial, albeit for an earlier stage of the language. Therefore, I will continue to show this in the rankings.

expense of ANCHOR-L-BR, which is undominated, and therefore fatally violated. (85e) and (85f) are deletion candidates. They have avoided the ONSET problem by simply deleting one of the vowels which was in hiatus. This violates MAX-IO, which is also undominated and therefore fatal. There are also two other deletion candidates that need mentioning: [$e_1$gmai] and [$a_2$gmai]. These are identical to (85e) and (85f), respectively, minus the copied [g] in the reduplicant. These will incur equal MAX-IO violations, but additionally violate ONSET.[147]

The last suboptimal candidate, (85g), attempts to better satisfy ONSET through epenthesis. As we have seen throughout, this is not an optimal repair strategy. This candidate is ruled out by high-ranked DEP-IO.

What we are left with is the candidate which eschews copying altogether, but still has an output correspondent of both vowels which were underlyingly in hiatus. Hiatus is therefore repaired by *coalescence*. Coalescence is militated against by UNIFORMITY, which is thus violated by this candidate. But, since it has been positioned low in the ranking, it does not enter into the evaluation until all other candidates have been eliminated.

(86) CRITICAL RANKING: MAX-IO, DEP-IO » UNIF
ONSET » IDENT-μ-IO

6.4. Determining the quantity of the coalesced vowel

Having demonstrated that our ranking will straightforwardly repair hiatus with vowel coalescence, it now needs to be shown how the precise nature of the coalesced vowel is determined. The more straightforward feature to account for is the vowel length. What is clearly

[147] They are technically not harmonically bounded by their copying counterparts, since they do improve on ALIGN. [$a_2$gmai] would also incur a violation of REALIZE MORPHEME, since there is no exponent of the reduplicative morpheme.

occurring is maintenance of the moras of the originally separate vowels. In earlier phonological theories, particularly moraic theory,[148] the two vowels would underlyingly be linked to two skeletal slots each bearing a mora. If those two vowels were to coalesce, then the outcome would be a single vowel (i.e. root node / feature matrix) doubly linked to the respective skeletal slots. Although we are not dealing with "slots" *per se*, the concepts are the same. The preservation of underlying moras will be effected in OT Mora by the constraint MAX-μ-IO, as proposed in Chapter 5 and repeated here.

(87) MAX-μ-IO: Each mora of the input must have a correspondent in the output.

This constraint will ensure that every vowel in the input will at least contribute its mora to the output, even if it does not appear as a distinct segment. And since a coalesced vowel is simply the admixture of two underlying vowels, it is unproblematic for them to maintain their moras and create a long vowel as a result.

The more complicated issue is establishing the quality of the coalesced vowel. For the present example, we can defer this problem (to some degree, at least), because of a historical development of the Attic-Ionic dialect of Ancient Greek: *ā* > *ǣ* > *ε̄*.[149] If we posit a constraint banning *ā*, then the only choice for the vowel in this case is *ε̄*.[150] Adding the constraints MAX-μ-IO and **ā* to our ranking, we can properly select *ε̄gmai* as our output.

[148] See McCarthy & Prince "*Prosodic Morphology 1986"* (1996: 56) for an introduction to *Moraic Theory* and a list of sources.
[149] Cf. Sihler (1995: 50-2, §54-6).
[150] The situation is far more complex, and will be addressed systematically below.

(88) Selection of coalesced vowel: ἄγω [ag-ō] : ἦγμαι [ε̄g-mai]

/REDe_1, a_2g, mai/	*ā	MAX-μ-IO	ANCHOR-L-BR	ONSET	IDENT-μ-IO	UNIF	ALIGN-ROOT-L	MAX-BR
a. $a_{1,2}$g.mai		*!		*		*		**
b. $e_{1,2}$g.mai		*!		*		*		**
c. $\bar{a}_{1,2}$g.mai	*!			*	**	*		**
☞ d. $\bar{\varepsilon}_{1,2}$g.mai				*	**	*		**

Candidates (88a) and (88b) are eliminated because they do not maintain all the moras of the input. And candidate (88c) is eliminated for having *ā* as the coalesced vowel, violating **ā.* The important aspect that this tableau should demonstrate is that, based on the ranking of MAX-μ-IO » IDENT-μ-IO, the ideal coalescence candidate for the coalescence of two short vowels will always be a long vowel. This, therefore, is the foundation of the vowel-lengthening pattern.

(89) CRITICAL RANKING: MAX-μ-IO » IDENT-μ-IO

6.5. Ruling out Attic Reduplication

Before further examining vowel quality, there are two more candidates that need to be discussed. These candidates will be ones that display both coalescence and copying. This is the pattern of Attic Reduplication. This pattern is not generated by our ranking. This is ideal for accounting for the vowel-lengthening pattern, but will obviously present a stumbling block for our attempts at explaining Attic Reduplication. But nonetheless, our ranking does rule out such candidates, as seen in the following tableau:

(90) Ruling out Attic Reduplication: ἄγω [ag-ō] : ἦγμαι [$\bar{\varepsilon}$g-mai]

/REDe_1, a_2g, mai/	MAX-μ-IO	ANCHOR-L-BR	ONSET	IDENT-μ-IO	UNIF	ALIGN-ROOT-L	MAX-BR
☞ a. $\bar{\varepsilon}_{1,2}$g.mai			*	**	*		**
b. $\underline{\text{e.g}}\bar{\varepsilon}_{1,2}$g.mai			*	**	*	*!*	
c. $\underline{\bar{\varepsilon}\text{.g}}\bar{\varepsilon}_{1,2}$g.mai			*	**	*	*!*	

In candidates (90b) and (90c), the highly-ranked correspondence constraints are satisfied. These candidates go on to tie the optimal candidate on ONSET, since all have a word-initial vowel. This passes the crucial evaluation to ALIGN-ROOT-L. The presence of the two reduplicated segments in each causes two violations of this constraint. Since the optimal candidate [$\bar{\varepsilon}$gmai] has no reduplicated segments, and has coalesced the fixed /e/ with the root-initial vowel, ALIGN-ROOT-L is perfectly satisfied.[151] This incurs extra violations of MAX-BR; but again, this constraint is freely violated, as it is completely dominated. Thus, the violations of ALIGN in (90b) and (90c) are fatal.

Candidates (90b) and (90c) are differentiated only by the length of the *reduplicated* vowel. In (90b), the shortness of the reduplicated vowel presumably would incur a violation of MAX-μ-BR and/or IDENT-μ-BR. Since (90c) has perfect identity between the corresponding surface vowels, it does not incur violations of these constraints. Without additional constraints, candidate (90b) would therefore be harmonically bounded by (90c). This would be another hurdle for an account of Attic Reduplication, since it is candidate (90b) which reflects the attested pattern. This is just another piece of evidence that Attic Reduplication needs to be explained outside of the synchronic grammar being developed here.

[151] ALIGN-RED*e*-L is also perfectly satisfied, since $\bar{\varepsilon}$ is also the left-most (and only) correspondent of that morpheme.

6.6. Determining the quality of the coalesced vowel

Vowel-lengthening through coalescence has now been motivated as the productive outcome for perfect-stem formation of vowel-initial roots. However, we have yet to address the question of determining the quality of the coalesced vowel. The problem is that there is significant asymmetry in the outcomes, both with respect to the different stages of the language and the different vowels involved. We can see the discrepancies in the survey of vowel-lengthening forms from the table in (82), reproduced here:

(91) The discrepancies of vowel quality in coalescence

Vowel lengthening						
	Root		Present Tense		Perfect Tense	
(a) #e : ē	*erū-*	'protect'	ἔρῡμαι	[erū-]	εἴρῡμαι	[ērū-]
	^{h}elk-	'draw, drag'	ἕλκω	[^{h}elk-]	εἵλκυσμαι	[^{h}ēlk-us-]
(b) #e : ɛ̄	*^{h}eps-*	'boil'	ἕψω	[^{h}eps-]	ἥψημαι	[^{h}ɛ̄ps]
	^{h}eu̯r-	'find'	εὕρηκα	[^{h}eu̯r-ɛ̄-]	ηὕρηκα	[^{h}ɛ̄u̯r-ɛ̄-]
#a : ɛ̄	*ag-*	'lead'	ἄγω	[ag-]	ἦγμαι	[ɛ̄g-]
	amelg-	'milk'	ἀμέλγω	[amelg-]	ἤμελγμαι	[ɛ̄melg-]
#o : ɔ̄	*op^{h}el-*	'owe; be obliged'	ὀφείλω, ὀφέλλω	[op^{h}ēl-],[152] [op^{h}el-]	ὤφληκα	[ɔ̄p^{h}lɛ̄-]
	op-	'see'	ὄψομαι (fut.)	[op-s-]	ὦμμαι	[ɔ̄m-]
	oi̯k^{h}-	'go away'	οἴχομαι	[oi̯k^{h}-]	ᾤχηκα	[ɔ̄$^{(i)}$k^{h}-ɛ̄-]

In the early language, there are very few roots which begin with a high vowel[153] or a long vowel, so our main concerns will be the outcomes of roots with initial non-high short vowels. We see that there are four different short/long alternations between present and perfect: *e ~ ē, e ~ ɛ̄*, *a ~ ɛ̄*, and *o ~ ɔ̄*. There is clearly significant asymmetry between these relationships. To see this better, we will need to take a more thorough look at the vowel inventory of Ancient Greek.

[152] Long [ē] is compensatory lengthening from loss of [l], which itself derives from **y*.
[153] Furthermore, it is often difficult to determine the length of a high vowel with certainty, because the short and long high vowels are not distinguished orthographically.

6.7. The vowel system of Ancient Greek[154]

By the classical period, the phonological inventory of Greek consisted of five short vowels < ι,ε,α,ο,υ > /i,e,a,o,u/, and seven long vowels < ι,ει,η,α,ω,ου,υ > /ī,ē,ɛ̄,ā,ɔ̄,ō,ū/.[155] (Notice that the digraphs < ει > and < ου > can represent two different entities, respectively – the long mid tense vowels [ē,ō] and the diphthongs [eɪ,oʊ]. These two possibilities are referred to respectively as "spurious diphthongs" and "genuine diphthongs.") The vowels can be defined in terms of (at most) five distinctive features.

(92) Distinctive features in the Attic vowel system[156]

Features	Short Vowels					Long Vowels						
	i	e	a	o	u	ī	ē	ɛ̄	ā	ɔ̄	ō	ū
high	+	–	–	–	+	+	–	–	–	–	–	+
low	–	–	+	–	–	–	–	–	+	–	–	–
ATR	+	+	–	+	+	+	+	–	–	–	+	+
round	–	–	–	+	+	–	–	–	–	+	+	+
back	–	–	+	+	+	–	–	–	+	+	+	+

However, according to Sommerstein (1973: 3), and taken up by Haas (1988: 97), the long, lax mid vowels /ɛ̄,ɔ̄/ are better taken as [+low].[157] Such a stance makes [ATR] redundant (i.e. non-contrastive), since all low vowels are [-ATR] and all non-low vowels are [+ATR].

[154] I follow here the traditional views of the Greek vowel system, as given in the sources referenced. One oddity of the traditional view is that the short mid vowels are tense [e,o] rather than lax [ɛ,ɔ]. I think it possibly more plausible that the short vowels were unspecified for tenseness, and had freedom to vary within their region of the vowel space. New examinations of the facts could well paint a picture different than the traditional one, but this is well beyond the scope of this thesis.

[155] In pre-Classical Attic-Ionic, there was also the /ǣ/, which arose from fronting of /ā/. By the Classical period, this had merged with /ɛ̄/. Since the short /a/ never underwent fronting, this series of changes brought about grammatical alternations of the type /a/ ~ /ɛ̄/, which are prevalent in our dataset.

[156] This is the first feature chart given by Haas (1988: 97), but he ultimately adopts Sommerstein's chart, presented in the following table.

[157] Of course, according to the International Phonetic Alphabet, these vowels are not low. Using the precise IPA symbols, the low front vowel would be [æ] or [a], the low back unrounded vowel would be [ɑ], and the low back rounded vowel would be [ɒ]. As we have no speakers available, the precise phonetics are lost to us. Considering how effective the system of Sommerstein and Haas will prove to be, however, in the description of the issues at

(93) Revised Distinctive Features in the Attic vowel system

Features	Short Vowels					Long Vowels						
	i	e	a	o	u	ī	ē	ε̄	ā	ɔ̄	ō	ū
high	+	–	–	–	+	+	–	–	–	–	–	+
low	–	–	+	–	–	–	–	+	+	+	–	–
round	–	–	–	+	+	–	–	–	–	+	+	+
back	–	–	+	+	+	–	–	–	+	+	+	+

Haas later claims that the feature [back] is also non-contrastive, since it largely coincides with [round]. However, for our purposes, retaining [back] as a distinctive feature will ease our analysis, and since we are not relying on *Underspecification Theory* (which Haas makes use of extensively), there is no major impetus to reduce the number of distinctive features. Using these distinctive features, we can now chart the alternations described above.

(94) Feature changes in short/long alternations

Short Vowel			Long Vowel		Changes
[e]	-high, -low, -round, -back	to	[ē]	-high, -low, -round, -back	none
[e]	-high, -low, -round, -back		[ε̄]	-high, **+low**, -round, -back	-low → +low
[a]	-high, +low, -round, +back		[ε̄]	-high, +low, -round, **-back**	+back → -back
[o]	-high, -low, +round, +back		[ɔ̄]	-high, **+low,** +round, +back	-low → +low

hand, I will proceed under the assumption that the vowels commonly identified as /ε̄/ and /ɔ̄/ are (phonologically if not phonetically) [+low].

Among these alternations, only the first, *e* ~ *ē*, is a direct lengthening with no changes in features. The alternations *e* ~ *ɛ̄* and *o* ~ *ɔ̄* are equivalent, with the long vowel differing from the short only in that it has taken on the feature [+low]. The alternation *a* ~ *ɛ̄* is faithful to [low], but is not faithful to [back].

The details of these alternations are thoroughly wrapped up in historical developments. While the alternation *e* ~ *ē* is maximally faithful, and is more common among roots in initial *e* in the early language,[158] the more archaic short ~ long alternations are actually the ones which have the lower vowel. /ɛ̄/ and /ɔ̄/ are the reflexes of the Proto-Indo-European long mid vowels, traditionally written **ē* and **ō*.[159] The Greek higher mid vowels /ē/ and /ō/ are secondary, resulting from compensatory lengthenings and vowel contractions, for the most part within the historical period. The *e* ~ *ɛ̄* and *o* ~ *ɔ̄* alternations are thus thoroughly ingrained in the morphological system by means of ablaut. Existing alternations of these sorts are never leveled to ***e* ~ *ē,* ***o* ~ *ō*. It is only new patterns which can alternate in this way. This is thoroughly compatible, therefore, with this alternation arising in perfect-stem formation of vowel-initial roots, since this is a distinctly new phenomenon.

But the problem is, this pattern is not carried out fully. The new alternation pattern marks #*e*-roots, but never once manifests itself on an #*o*-root. If the quality of the coalesced vowel of the perfect was determined on a purely phonological basis, there is no reason to expect the front and back mid vowels to behave so differently. One possible explanation comes when we consider the entire system, and the one remaining alternation, *a* ~ *ɛ̄*.

[158] #*e*-roots with lengthening perfects are not especially common in the early language. Most take either Attic Reduplication or a syllabic reduplicant. But, of those that do lengthen, *e* ~ *ē* is the regular alternation. ἕψω ~ ἥψημαι is the only counter-example in all of Laar's corpus. The situation will be reversed in the later language.
[159] It is quite possible that these were lax in PIE, and therefore are unchanged in Greek. What may be more likely is that they were simply unspecified for tense/lax, since there was no phonemic distinction.

6.8. $\bar{a}$-fronting in Attic-Ionic

This alternation comes about through what is typically referred to as */ā/-fronting*. As mentioned above, in Attic-Ionic, **ā* develops to *ǣ*. Even though [ā̆] is a rather unmarked segment generally speaking, this is not an unusual change cross-linguistically, and it could potentially be explained in Optimality Theoretic terms using *markedness* constraints like the following:[160]

(95) /ā/-fronting in early Attic-Ionic

/$a_{\mu\mu}$/	*[+low,+back]$_{\mu\mu}$[161]	*[+low,-back]$_{\mu\mu}$	IDENT(back)-IO[162]
a. $a_{\mu\mu}$	*!		
☞ b. $æ_{\mu\mu}$		*	*

This tableau shows that a constraint against long, low, back vowels could induce the sort of fronting we see in the data. When the inherited long front mid vowel **ē* is forced downward by the introduction of the new, secondary /ē/, it encroaches on the territory previously occupied by this fronted *ǣ*. The primary nature of the /ɛ̄/ < **ē* phoneme would have overwhelmed the *ǣ* (which was at this point either an allophone of /ā/ or a marginal phoneme itself), and caused a merger to /ɛ̄/. This meant that any lengthening of underlying /a/ would result in [ɛ̄]. However, the normal lengthening of an underlying /e/ is also [ɛ̄]. From the perspective of the perfect, then, a surface initial [ɛ̄] would be ambiguous with respect to the underlying form of the root.

The development of the alternation *e* ~ *ē* but not ***o* ~ *ō* could therefore be motivated by a desire to avoid ambiguity. In a category where lengthened /a/ coexists with lengthened /e/, the

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[160] Granted, there seems no inherent motivation for these constraints or their ranking, other than their apparent applicability; but it is not uncommon for diachronic changes to lack obvious motivation.
[161] We may want to include [-round] in the constraint, so as not to induce any changes in /ɔ̄/.
[162] The facts of vowel contraction imply that it may be preferable to use a constraint MAX[+F]-IO, which militates against deletion of underlying positively-specified features, to handle this role.

two are differentiated in their lengthened form, respecting the underlying relative height distinction, with /e/ lengthening to the higher mid [ē] and /a/ lengthening to the lower mid [ɛ̄].

6.9. Vowel-lengthening in Classical Attic

The extremely marginal attestation of the alternation *e* ~ *ɛ̄* in the earlier period can now be seen either as an archaism – retaining a state of affairs before the intrusion of the lengthened /a/, or as a precursor of the later trend in which this alternation comes to predominate. As mentioned above, the only instance of this alternation in Laar's corpus is ἕψω ~ ἥψημαι. Since it appears that this root is not at all attested in the very early period, but rather primarily in Herodotus (early 5th C. BC) and Pindar (late 6th or early 5th C. BC) and thereafter, with the only attestation of the perfect coming from Herodotus,[163] the latter case seems much more likely.

ἕψω ~ ἥψημαι is consistent with the pattern of Classical Attic. In this dialect, the alternations *e* ~ *ē* and *e* ~ *ɛ̄* exist side by side. However, it is the latter that is the productive pattern. This can be seen, for example, in the verb ἐθέλω [et^hel-ɔ̄] 'wish, want.' It does not have an attested perfect in the early language. The first attested perfect is in Attic (Chantraine, 1968: 315), and it is ἠθέληκα [ɛ̄t^hel-ɛ̄k-a]. Some *e* ~ *ē* alternations are retained, but these appear to be lexical exceptions.

The change from *e* ~ *ē* towards *e* ~ *ɛ̄* might be instigated by a loss of transparency of the *a* ~ *ɛ̄* alternation. /ā/ is secondarily reintroduced into Attic through a second round of compensatory lengthenings (**ans* > *ās*) and vowel contraction. This would then presumably be the outcome expected by speakers of a straightforward phonological lengthening of /a/. The *a* ~ *ɛ̄* alternation is never leveled in this direction. With this alternation now phonologically opaque, the motivation to keep it separate from the outcome of lengthened /e/ is likely removed,

[163] Laar (2000: 157).

allowing its outcome to become more consistent with the general morpho-phonological alternation of *e* ~ *ε̄*.

6.10. <u>Conclusions about vowel-lengthening in the perfect</u>

The basic pattern of vowel-lengthening in the perfect is easy to motivate and describe within the constraint ranking thus far developed in this thesis, primarily through the introduction of the *correspondence* constraint UNIFORMITY-IO. Ranking this below ONSET will dictate that hiatus *can* be repaired through *coalescence*. Its ranking also below MAX and DEP will dictate that hiatus *will* be resolved through *coalescence*, rather than insertion or deletion. The length of the coalesced vowel is a logical product of coalescence itself, insofar as a coalesced segment should maintain as many characteristics of its input segments as it can. The simplest of these characteristics to maintain is the respective lengths, with two shorts adding up to one long.

The difficult aspect of the vowel-lengthening pattern to explain fully and elegantly is vowel quality. It appears as though the synchronic production of forms is interrupted by diachronic factors, and the phonological and morphological systems are pulling in different directions. It is not at all clear how to integrate all these considerations into an Optimality Theory account. However, since it appears that the entire system is morpho-phonologically driven, it is unclear if the burden should be placed in the phonology at all. An argument could be made that the surfacing of the perfect stem comes to be decided by lexical factors and allomorph selection, rather than on-line phonological creation. Once the long vowel is created, a re-addition of the RED*e* morpheme would induce no change, because trimoric vowels are prohibited. I will leave the question of whether the quality of the coalesced vowel of vowel-initial perfects can be more elegantly explained in an OT framework as an avenue for further research.[164]

[164] The outcomes of vowel-lengthening in the perfect are distinct from those of normal *vowel contraction*, and therefore a wholesale vowel coalescence account that unites the two seems unlikely.

CHAPTER 7

ATTIC REDUPLICATION

In the previous chapter, it was demonstrated that the synchronic grammar of Greek developed throughout this thesis for consonant-initial perfects can most easily be reconciled with the production of lengthened-vowel perfect-stems for vowel-initial roots (albeit with difficulty in accounting for vowel quality). This is ideal, since vowel-lengthening appears to be the dominant pattern, particularly in later stages of the language. This ranking is incapable, however, of directly generating the other major pattern of perfect-stem formation of vowel-initial roots, Attic Reduplication, in which a *#VC-* root displays a perfect in $VC\bar{V}C$-. If we are to explain this as a regular development, we will therefore need to explore the possibilities of earlier grammars, just as we did for the reduplicated presents in Chapter 4. Such a step is validated by the observation that this type of formation is almost exclusively restricted to roots which in early times began with a laryngeal. Such a generalization raises the question: could these forms have been generated at a time when the laryngeals were still present?

I believe the answer is yes. Let our starting point be the grammar of *Pre-Greek* developed for explaining the reduplicated presents in Chapter 4, as this is more archaic than the general grammar employed for all other aspects of this work.

(96) CONSTRAINT RANKING FOR PRE-GREEK:

ALIGN-RED*e*-L, DEP-IO, MAX-IO, ANCHOR-L-BR »
ONSET, NOCODA »
STROLE, SONSEQ »
*COMPLEX »
DEP-BR, ALIGN-ROOT-L »
MAX-BR

As with the analysis of vowel-lengthening, the more significant venture will be to account for the shape of the reduplicant, as issues of vowel quality will be subject to many of the same issues of diachronic interference (especially *ā*-fronting) as in the vowel-lengthening pattern. At present, this ranking will not generate our desired outcome.

(97) Accounting for Attic Reduplication with Pre-Greek rankings:[165] *perfect* ἀγήγερμαι [agε̄ger-]

/RED*e*, ager-/	DEP-IO	MAX-IO	ANCH-L-BR	ONS	NO CODA	SON SEQ	ST ROLE	*CMPLX	ALIGN-ROOT-L	MAX-BR
a. a.g*e*.a.ger-				*					*!**	*
☹ b. a.g*ε̄*.ger-				*					*!*	*
☞ c. *ε̄*.ger-				*						***
d. g*ε̄*.ger-			*!						*	**
e. a.ge.r*ε̄*.ger-				*					*!***	
f. a.gr*ε̄*.ger-				*			*!	*	***	*

As expected, whether the first VC sequence is copied or not, all candidates which do not delete, epenthesize, or improperly anchor will have equal well-formedness violations, namely a single violation of ONSET. This passes the evaluation all the way down to ALIGN-ROOT-L, which

[165] The NOCODA violation has been omitted. It is identical for each candidate.

will always choose the smallest possible exponent of the reduplicative morpheme – i.e. the one which does not copy and has coalesced the fixed /e/. Unless we are to reverse the ranking of ALIGN-ROOT-L and MAX-BR, all other candidates are hopelessly suboptimal. (We obviously do not want to take such a step of reversing these two constraints, since that would ensure full copying in most cases, which is not the output at any stage in the language's visible history or prehistory.) This ONSET problem is thus unavoidable when we have a vowel-initial input. Therefore, we need to continue pushing back the clock, and see if we might have better luck generating our forms with the laryngeals still in place.

7.1. The relationship between laryngeals and Attic Reduplication

Suzuki (1993) is the most comprehensive and theoretically informed account of Attic Reduplication to date. He, as most previous scholars, believes that laryngeals play a key role in the development of this pattern. Citing Beekes (1969), Suzuki states:

> "Based on his detailed philological analysis of the data, Beekes convincingly showed that almost all of the early attested forms involved in AR [Attic Reduplication] originate from **H-*, of which the sequence **HCeC-*, as opposed to **HeC-*, constitutes a majority. Thus, Beekes claimed that the Proto-Indo-European preform **HCeC-* had to do with the origin of AR, while the case involving **HeC-* was an innovation in later times (Beekes 1969: 120f.)" (Suzuki, 1993: 404).

Thus using **HCeC* roots as his starting point, Suzuki's ultimate solution is to copy the second consonant in **HCeC* roots after the laryngeal is attracted into the reduplicating syllable. This would yield perfect forms in ***C$\bar{V}$CeC* beside presents in *VCeC*. He invokes analogical re-introduction of the root vowel into initial position, so as to create a more iconic relationship with the root. His account follows Beekes in taking Attic Reduplication of **HeC* roots to be analogical to the **HCeC* roots.

Suzuki's account is innovative in that it strongly appeals to syllabification. However, its need to invoke analogy within the **HCeC* type, beyond the more reasonable analogy of **HeC* roots, requires us to continue seeking a better solution. But his starting premise seems valid. We will therefore attempt to develop an account beginning from the **HCeC* roots.

7.2. Ablaut and Attic Reduplication

The following tableaux will show that, with the addition of only a few constraints, our Pre-Greek ranking can generate a viable pre-form for Attic Reduplication, provided we start with a laryngeal in the underlying form. The example root will continue to be ἀγείρω 'gather' *(√ager)*, and we will be seeking to produce its perfect ἀγήγερμαι [a.gē̆.ger-]. This root displays e-grade in its perfect, but other Attic Reduplication forms show the more expected o-grade or zero-grade, having been leveled throughout the perfect paradigm from the singular or plural, respectively.[166] We can see that all three ablaut grades are attested in Attic Reduplication perfects from **HCeC* roots, even with multiple grades attested for certain roots:

[166] I would like to thank Caley Smith (personal communication) for pointing out the deficiency in my exemplar with respect to its ablaut grade.

(98) Ablaut in Attic Reduplication

Root (Greek < *PIE)		Present Tense		Perfect Tense	
o-grade					
*ako(u) < *H_2kow(s)*	'hear'	ἀκούω	[akou-]	ἀκηκοα	[akēko-]
*eleut^h < *H_1lewd^h*	'go, come'	n/a		εἰλήλουθα, ἐλήλουθα	[ēlēlout^h-], [elēlout^h-]
*(en-)eŋk- < *H_1nek*	'bring'	n/a		ἐνήνοχα	[enēnok^h-]
zero-grade					
*ela(u) < *H_1elH_2*	'drive'	ἐλάω, ἐλαύνω	[ela-], [elau-]	ἐλήλαμαι	[elēla-]
*eleut^h- < *H_1lewd^h*	'go, come'	n/a		ἐλήλυθα	[elēlut^h-]
e-grade					
*oreg < *H_3reg*	'stretch, reach'	ὀρέγω	[oreg-]	ὀρώρεγμαι	[orōreg-]
*(en-)eŋk < *H_1nek*	'bring'	n/a		ἐνήνεγμαι	[enēneg-][167]

While the zero-grade is well represented in the Attic Reduplication perfects, it is only present when the root contained a glide or a laryngeal that had the capability to vocalize and serve as a nucleus, thus maintaining the requisite root shape to foster reduplication. The e-grade forms appear secondary and may serve to reintroduce a root vowel in forms that would have had difficulty reduplicating with a zero-grade stem. A detailed examination of the ablaut considerations of these forms is beyond the scope of this thesis.

7.3. Accounting for Attic Reduplication with the laryngeals

Having shown that the e-grade of our example root is non-problematic, we can now proceed to the analysis. The null hypothesis for a root like √*ager-* is that the initial /a/ derives directly from the laryngeal *H_2. With this in mind, let us first see if simply replacing the input

[167] The [g] results from voicing of the underlying voiceless velar stop.

/a/ with /H_2/ (which is a consonant) yields our desired outcome. (We will assume that an underlying /e/ adjacent to H_2 must surface as [a]. This will be discussed further below.)[168]

(99) Attic Reduplication with initial laryngeals[169]

/RED*e*, H_2ger-/	DEP-IO	MAX-IO	ONSET	NO CODA	SON SEQ	ST ROLE	*CMPLX	ALIGN-ROOT-L	MAX-BR
☞ a. H_2*a*.-H_2ger-					*		*	**	**
b. H_2*a*-H_2.ger-				*!		*		**	**
c. H_2g*a*.-H_2ger-					**!		**	***	*
d. H_2g*a*-H_2.ger-				*!	*		*	***	*
e. H_2^a.g*a*.-H_2ger-					*		*	***!*	*
f. H_2^a.g*a*-H_2.ger-				*!		*		****	*
g. H_2a.g*a*.-H_2^a.ger-	*!							****	*
h. H_2ge.r*a*-.H_2ger-					**!		**	****	
i. H_2^a.ge.r*a*-H_2.ger-				*!		*		*****	
j. H_2a.ge.r*a*.-H_2^a.ger-	*!			*				*****	
k. ge-.ger-		*!						**	*
l. *a*.-H_2ger-			*!		*		*	*	****
m. *a*-H_2.ger-			*!	*				*	****

In this case, non-copying candidates, (99l) and (99m), are fatally penalized for their ONSET violation, since now there is a properly anchored consonant to be copied. (99k) is ruled out because of its deletion of the /H_2/, and (99g) and (99j) are eliminated for their root-internal epenthesis. (The reduplicant-internal epenthesis in (99e), (99f) and (99i) will violate DEP-BR not DEP-IO.)[170] SONORITY SEQUENCE rules out those candidates with two illicit clusters, but since

[168] Notice that candidates (a) & (b), (c) & (d), and (e) & (f) form pairs that differ only in the syllabification of the root-initial laryngeal.
[169] As in previous tableaux, I will not mark violations of NOCODA and STROLE induced by the root final /r/, since there will be some forms where this gets syllabified as an onset with a suffix-initial vowel.
[170] This has been omitted in this tableau for reasons of space.

all other candidates are already out of the running, one violation is not fatal. Left only with (99a) and (99e), ALIGN will now select the one with the smaller reduplicant, candidate (99a).

If we take candidate (99a) *H_2aH_2ger- and apply regular sound laws to it (i.e. allow it to develop without synchronic remodeling), the outcome would be:

**H_2aH_2ger- > Proto-Greek †*āger-* > Attic-Ionic †ēger-

These are not the correct forms.[171] When the laryngeals are lost, lengthening does occur, but we do not produce the extra *VC* sequence we are aiming for. We will obviously need to adjust our rankings if we are to reach our goal. But before proceeding, let us consider the outcomes of the remaining candidates, to see which (if any) will yield the desired Attic Reduplication form ἀγήγερμαι [a.gē.ger-mai].

(100) Development of potential Attic Reduplication pre-forms

a. H_2*a*.-H_2ger-	>	Proto-Greek	āger-	>	Attic-Ionic	ēger-
b. H_2*a*-H_2.ger-	>		āger-	>		ēger-
c. H_2g*a*.-H_2ger-	>		(a)gāger-	>		(a)gēger-
d. H_2g*a*-H_2.ger-	>		(a)gāger-	>		(a)gēger-
e. H_2^a.g*a*.-H_2ger-	>		agāger-	>		agēger-
f. H_2^a.g*a*-H_2.ger-	>		agāger-	>		agēger-
g. H_2^a.g*a*.-H_2^a.ger-	>		agāger-	>		agēger-
h. H_2ge.r*a*-.H_2ger-	>		(a)gerāger-	>		(a)gerēger-
i. H_2^a.ge.r*a*-H_2.ger-	>		agerāger-	>		agerēger-
j. H_2^a.ge.r*a*.-H_2^a.ger-	>		agerāger-	>		agerēger-
k. ge-.ger-	>		geger-	>		geger-
l. *a*.-H_2ger-	>		āger-	>		ēger-
m. *a*-H_2.ger-	>		āger-	>		ēger-

[171] A few **HCeC* roots do display this sort of outcome, e.g.: 'milk' **H_2melg-* > *present* ἀμέλγω ~ *perfect* ἤμελγμαι. But, as discussed above, this is not the most common development for this root type.

Clearly, the number of different outputs possible at the period when the laryngeals are still present is thoroughly collapsed when they are lost. To understand the developments, we need only recognize a few sound changes:

(i) $*\breve{V}H > \bar{V} / \_C$ (ii) $*H_2 > a / \{\#,C\}\_C$[172] (iii) $*H > Ø / V\_V$ (iv) $*V.V > \bar{V}$

With the outcomes established, we see that, in order for an account that generates these forms with the laryngeals present to work, we need to come up with a ranking that selects one of the candidates (100e-g).[173]

We have more or less exhausted our inventory of *correspondence* constraints and *alignment* constraints, which leaves us only *markedness* constraints to work with.[174] Any markedness constraint which has not already been well-established in the literature runs the risk of being called *ad hoc*, since it is being posited purely to deal with the problem at hand. We must recognize, therefore, that the solution to be developed immediately below is speculative. But nonetheless, if plausible and useful, such constraints should not be rejected out of hand. With that caveat having being uttered, one constraint which will be useful in winnowing down our candidate list is a markedness constraint which militates against an onset of the shape *laryngeal* + *consonant*:

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[172] This sound law may potentially be incorrect in the framework being developed. Since it will be argued that *laryngeal vocalization* should rather be seen as *schwa epenthesis*, the candidates which do not epenthesize a vowel into the reduplicant following the laryngeal will have no ability to *"vocalize"*. Therefore, those candidates with an initial *H_2g sequence would be ones that wouldn't yield any trace of a *"vocalized laryngeal"*. In the derivations of these candidates, the initial *a* in the Greek forms are parenthesized for this reason. The point is moot, as none of these will be the winners at any point.

[173] Candidates (100c) and (100d), as discussed in the previous note, could potentially yield the desired output, but I believe they should not.

[174] There are also, of course, output-output *correspondence* constraints, but these should be a last resort.

(101) $*_{\sigma}$[HC: Do not have an onset consisting of *laryngeal* + *consonant*.[175] Assign one violation mark for each such cluster.

This is stipulative and *ad hoc*, but, in my estimation, a fair constraint for Pre-Greek.[176] We can see this constraint as the motivation for the "prothetic vowel" which develops as a result of an initial laryngeal in exactly this environment in Greek (as well as Armenian). We need only slightly tweak the current ranking to allow this constraint to cause this development:

(102) Vowel "prothesis": *H_2ger-yō > *ager-yō > agēr-ō*

/H_2ger, yō/	Max-IO	$*_{\sigma}$[HC	Dep-IO
a. H_2geryō		*!	
b. geryō	*!		
c. H_2eryō	*!		
d. eryō	*!*		
☞ e. $H_2{}^a$geryō			*

With the ranking Max-IO » $*_{\sigma}$[HC » Dep-IO, epenthesis is motivated as a repair strategy for syllable-initial clusters of *laryngeal* + *consonant*. However, as long as Dep still dominates all the constraints it has been shown to previously, then fixing the ranking in this way does not pose any complications. What this shows is that the process typically called *laryngeal vocalization* can be better understood as *schwa epenthesis*. This is the argument convincingly advanced in Byrd (2011).

175 *Consonant* will have to include resonant consonants, as there are numerous roots of the shape **HReC*, which is a subset of **HCeC*. In fact, *H_2ger* may be the only instance where the post-laryngeal consonant is actually a stop.
176 Byrd (2010: 61-2) argues against the special markedness of this cluster in Proto-Indo-European. That need not imply that it had not climbed in markedness by the period of Pre-Greek in that branch alone.

When we add *$_\sigma$[HC to the top of our ranking (in accordance with the fragment just motivated), we eliminate a number of problematic candidates, namely those with a *laryngeal* + *consonant* complex onset. This cannot, however, be the whole story.

(103) Attic Reduplication with initial laryngeals and *$_\sigma$[HC:[177]

/RED*e*, H_2ger-/	MAX-IO	*$_\sigma$[HC	DEP-IO	ONSET	NOCODA	SONSEQ	STROLE	*COMPLEX	DEP-BR	ALIGN-ROOT-L	MAX-BR
a. H_2*a*.-H_2ger-		*!				*		*		**	**
💣 b. H_2*a*-H_2.ger-					*		*			**	**
c. H_2g*a*.-H_2ger-		*!*				**		**		***	*
d. H_2g*a*-H_2.ger-		*!			*	*		*		***	*
e. H_2^{a}.g*a*.-H_2ger-		*!				*		*	*	****	*
☹ f. H_2^{a}.g*a*-H_2.ger-					*		*		*	**!**	*
g. H_2a.g*a*.-H_2^{a}.ger-			*!							****	*
h H_2ge.r*a*-.H_2ger-		*!*				**		**		****	
i. H_2^{a}.ge.r*a*-H_2.ger-					*		*		*	**!***	
j. H_2a.ge.r*a*.-H_2^{a}.ger-			*!		*					*****	
k. ge-.ger-	*!									**	*
l. *a*.-H_2ger-		*!		*		*		*		*	****
m. *a*-H_2.ger-				*	*!					*	****

This tableau demonstrates how *$_\sigma$[HC is a special case of *COMPLEX. (SONORITY SEQUENCE is also essentially a special case of *COMPLEX.) Whereas in the derivation without this constraint one violation of SONSEQ turned out *not* to be enough to eliminate the unintended

[177] Constraint names are rotated for reasons of space.

winner, candidate (99/103a), this constraint bans an even more specific type of illicit complex syllable margin: a *laryngeal* + *consonant* onset.

Even though this appears to be a step in the right direction, it has not produced a desired candidate. The introduction of $*_\sigma$[HC has caused new violations that prevent NoCoda from eliminating any candidates. Those candidates which have syllabified the root-initial laryngeal as a coda with the reduplicative morpheme (candidates (103b), (103d), (103f), and (103i)) are now preferable to those which syllabified it as part of a complex onset (candidates (103a), (103c), and (103e)), since that complex onset violates $*_\sigma$[HC, which is of course higher ranked than NoCoda. In other words, $*_\sigma$[HC has reversed which member of the respective pairs is the better candidate. But nonetheless, the ranking still chooses from the first pair, since it is best aligned.

We therefore need to add one more constraint. One possibility is to posit a ban on multiple laryngeals in the same syllable. While this is again stipulative, it also seems to make good sense. Laryngeals are clearly the most marked segments within the system of Proto-Indo-European (Byrd, 2010: 62 n.69), and likewise in the daughter languages up until whatever point they are lost. They are lost so frequently precisely because of the fact that they are so marked. We can therefore see this ban as instead a ban against multiple highly marked segments within the same syllable. Furthermore, if we are to consider the three laryngeals to all be extremely similar with respect to their features, then this ban might actually be a sort of OCP constraint, banning two *similar* highly marked segments within a single domain (i.e. the syllable).[178] With this in mind, I propose the following constraint:

[178] OCP constraints of this type have been proposed earlier, namely as a potential alternative to StRole in Chapter 3, and with respect to initial geminates in Chapter 5. If one would rather not connect this to the OCP, and leave it as a simple *markedness* constraint regarding laryngeals, no harm would be done to the proposal.

(104) OCP-H: Do not have multiple laryngeals in the same syllable. Assign one violation mark for each syllable with multiple laryngeals.[179]

With now both $*_\sigma$[HC and OCP-H in our rankings, any candidate which (1) has a *laryngeal* + *consonant* onset and/or (2) has two laryngeals in the same syllable will be eliminated. The ability of this constraint ranking to rule out both candidate types simultaneously will directly yield our longed-for output.

(105) Attic Reduplication with initial laryngeals, $*_\sigma$[HC, and OCP-H:[180]

/RED*e*, H_2ger-/	$*_\sigma$[HC	OCP-H	DEP-IO	ONSET	NOCODA	SONSEQ	STROLE	*COMPLEX	DEP-BR	ALIGN-ROOT-L	MAX-BR
a. $\underline{H_2}$*a*.-H_2ger-	*!					*		*		**	**
b. $\underline{H_2}$*a*-H_2.ger-		*!			*		*			**	**
c. $\underline{H_2g}$*a*.-H_2ger-	*!*					**		**		***	*
d. $\underline{H_2g}$*a*-H_2.ger-	*!	*			*	*		*		***	*
e. $\underline{H_2^a.g}$*a*.-H_2ger-	*!					*		*	*	****	*
☞ f. $\underline{H_2^a.g}$*a*-H_2.ger-					*		*		*	****	*
g. $\underline{H_2^a.g}$*a*.-H_2^a.ger-			*!						*	****	*
h $\underline{H_2ge.r}$*a*-.H_2ger-	*!*					**		**		****	
i. $\underline{H_2^a.ge.r}$*a*-H_2.ger-					*		*		*	*****!	
j. $\underline{H_2a.ge.r}$*a*.-H_2^a.ger-			*!		*					*****	
l. *a*.-H_2ger-	*!			*		*		*		*	****
m. *a*-H_2.ger-				*	*!					*	****

[179] It probably does no harm to restrict this constraint to prohibiting the same laryngeal, rather than any two laryngeals, in the same syllable.

[180] I omit MAX-IO, and the deletion candidate (k) for reasons of space.

OCP-H has the effect of ruling out those candidates with monosyllabic reduplicants which also syllabify the root-initial laryngeal as a coda. Most significantly, this eliminates our previous winner, candidate (103/105b). Since candidates with monosyllabic reduplicants that syllabify the laryngeal as an onset are eliminated by $*_{\sigma}$[HC, the reduplicant must be polysyllabic![181] Those forms with a disyllabic reduplicant will not violate OCP-H, since their copied laryngeal is now a full syllable removed from the root's laryngeal. Now it is clear why we can get a different pattern on laryngeal roots only. There are special *markedness* constraints – $*_{\sigma}$[HC and OCP-H – that will cause issues in reduplication that non-laryngeal clusters will not.

7.4. Vowel quality in Attic Reduplication

Now that we have established how the shape of Attic Reduplication might have come about, we do need to clarify why we get the vowel quality that we do. All that is necessary is to understand the facts of *laryngeal coloring*. The main residue of the laryngeals in Greek, as in most other Indo-European languages, is that they left their mark on adjacent vowels. An underlying /e/ before or after $*H_2$ surfaced as [a], and as an [o] before or after $*H_3$. $*H_1$ is sometimes called the "non-coloring laryngeal." It does not change the quality of an adjacent underlying vowel. However, in *laryngeal vocalization* environments, it yields Greek *e*, whereas $*H_2$ yields *a*, and $*H_3$ yields *o*. For the latter two, this is obviously the same effect it has on coloring an adjacent /e/. When we follow the view of Byrd (2011) that *laryngeal vocalization* is actually *schwa epenthesis*, all of our facts come together. In the case of schwa epenthesis, the $*H_1$ is actually coloring the schwa, or otherwise unspecified epenthetic vowel, causing it to

[181] The non-copying candidates (l) and (m) are monosyllabic, but ruled out because of their ONSET violation, not one of the laryngeal markedness constraints.

surface as [e]. These generalizations are always true, and therefore they constitute an undominated set of constraints, which I will call *Laryngeal Coloration* (LC):

(106) Laryngeal Coloration (LC):

a. *ə* may not surface adjacent to $*H_1$,$*H_2$ or $*H_3$
b. *e* may not surface adjacent to $*H_2$ or $*H_3$
c. *a* may not surface adjacent to $*H_3$[182]

These constraints will dictate that (a) an epenthetic vowel (schwa) will surface, respectively, as *e,a,o* adjacent to $*H_1$,$*H_2$,$*H_3$, (b) *e* will surface, respectively, as *a,o* adjacent to $*H_2$,$*H_3$, and (c) *a* will surface as *o* adjacent to $*H_3$. By placing the LC constraints at the top of our ranking, we ensure that the presence and influence of laryngeals will be more significant in determining the surface quality of vowels than faithfulness to their input.

This is obviously working in contradistinction to Identity constraints, both Ident-IO and Ident-BR. However, in the optimal form [H_2**a**.g*a*-H_2.ger-], no vowels actually stand in a BR-correspondence relationship. The first vowel is epenthetic, and the second vowel is the fixed /e/ of the reduplicant.[183] Therefore, Ident-BR (at least with respect to vowels) does not come into play. Since the first vowel is epenthetic, it will have no input quality to be faithful to, and will thus takes its quality purely from the adjacent laryngeal without violating any other quality

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[182] It is unclear whether or not we want to include $*H_1$ in this constraint. There are few, if any, underlying /a/'s in PIE. It is not terribly significant for our purposes. Issues relating to the coloration of underlying /o/ are likewise beyond the scope of this thesis.

[183] This was not discussed previously, but this solution is consistent with an analysis that does not employ a morphologically fixed /e/. Phonological fixed segmentism could have been a precursor to morphological fixed segmentism in this case. As discussed in Chapter 2, this could be effected by a constraint $*V_{[+F]}$, banning vowels with positively-specified features. The ranking Ident-IO » $*V_{[+F]}$ » Ident-BR establishes this straightforward *TETU* effect. We can further subordinate this entire ranking fragment to Laryngeal Coloring (LC), because that will control the quality of (most) vowels without regard for their underlying form (i.e. Input-Output Identity).

This set of constraints might even be able to shed light on the lack of coloration of an underlying /o/. This vowel will have the underlying positively-specified feature values [+back] and [+round]. If there is a constraint motivating the maximization of underlying positively-specified feature values (Max[+F]-IO), then its domination of LC would prevent LC from affecting an underlying /o/. Exactly this constraint will be proposed in Chapter 8.

constraints. The fixed /e/, on the other hand, is in an input-output correspondence relationship. Therefore, if it surfaces as anything other than [e], it will violate IDENT-IO. Since this is not what it does, we know that LC » IDENT-IO.

(107) Vowel quality and laryngeal coloration:

/RED*e*, H_2ger-/	LC	IDENT-IO
a. H_2**e**.g*e*-H_2.ger-	*!*	
b. H_2**a**.g*e*-H_2.ger-	*!	
☞ c. H_2**a**.g*a*-H_2.ger-		*
d. H_2**a**.g*a*-H_2.gar-		**!

The first candidate has two [e]'s adjacent to an [H_2], both incurring violations of LC. Candidate (107b) likewise has one fatal violation of LC for its retention of the fixed /e/ as such. Candidate (107c) and (107d) have respected LC by having [a]'s adjacent to all [H_2]'s. Candidate (107c) is preferred to (107d) because (107d) has gone the extra step of changing its root /e/ to [a], not motivated by LC.[184]

7.5. Attic Reduplication of **HeC* roots

This ranking, however, will not generate an Attic Reduplication form for roots of the type **HeC*. The two laryngeal markedness constraints, $*_\sigma$[HC and OCP-H, will not be able to rule out single-consonant copying. This is because the root vowel allows the root-initial laryngeal to syllabify as an onset (avoiding an OCP-H violation), without having to form an HC onset

[184] A candidate like (105d) is meant to show that LC is more significant than BR-IDENTITY, but since that relationship does not actually exist, it does not tell us that for sure. If this were demonstrating an approach without a morphologically fixed segment, then it would tell us that information.

(satisfying *$_\sigma$[HC). Therefore, there is nothing to force double consonant copying. But nonetheless, the ranking does still yield an output that results in vowel-lengthening, which is a well-attested outcome of **HeC* roots.

(108) Attempting to generate Attic Reduplication for **HeC* roots:[185]

/RED*e*, H_2eg-/	*$_\sigma$[HC	OCP-H	DEP-IO	ONSET	NOCODA	SONSEQ	STROLE	*COMPLEX	DEP-BR	ALIGN-ROOT-L	MAX-BR
☞ a. $\underline{H_2}$*a*-.H_2ag-										**	**
b. $\underline{H_2}$*a*-H_2.ag-		*!		*	*		*			**	**
☹ c. $\underline{H_2a.g}$*a*.-H_2ag-										***!*	
☹ d. $\underline{H_2a.g}$*a*-H_2.ag-				*!	*					****	
e. $\underline{H_2g}$*a*.-H_2ag-	*!					*		*		***	*

The winner in this tableau, candidate (106a), is the correct form. It will yield *ēg*-, the vowel-lengthening output attested for this root.[186] Candidate (106c) [$\underline{H_2a.g}$*a*.-H_2ag-] (and also (106d)), however, is a valid pre-form for Attic Reduplication. Such a form would derive as follows: **H_2a.ga.H_2ag-* > **a.ga.a.g-* > *agāg-* > *agēg-*. While Attic Reduplication is not in fact attested for this root,[187] this is the pattern. Notice that this candidate passes all constraints perfectly until it reaches ALIGN-ROOT-L, far down in the ranking. It is significantly more optimal than any other non-winning candidate. We might call this candidate "almost optimal." While this does nothing to change the grammatically correct choice of outputs, it seems reasonable that an "almost optimal" output is a strong candidate for analogy, particularly in a

[185] For reasons of space, I have omitted undominated ANCHOR-L-BR and all improperly anchored candidates.
[186] This does not mean that the attested vowel-lengthening form must derive only from this point in time. As it is the grammatically regular output, there is absolutely no need for it to be lexicalized, or for the allomorph entered into the derivation of its perfect to be changed. Therefore, the synchronic grammar at every point will always produce a vowel-lengthening form from the concatenation of RED*e* with this root.
[187] It is not attested in the perfect. It is, however, attested in the aorist.

language where no other vowel-initial forms exist! The only competing pattern when these forms come into the language by means of the regular grammar is that of Attic Reduplication. Therefore, it is logical that an "almost optimal" candidate in a strange formation might get brought to the surface through connection with a burgeoning pattern in this way.

7.6. Conclusions about Attic Reduplication

So, although not every Attic Reduplication form can be explained (i.e. only **HCeC*, not **HeC*), we have found a regularly-derivable pre-form for the more prominent set. We see that markedness restrictions specific to exactly the **HCeC*-type root induce the completely aberrant pattern. But nonetheless, it is regular with respect to the grammar by which it is produced. When the laryngeals are lost, however, there is absolutely no synchronic motivation within the grammar that would compel copying in vowel-initial roots. This is why these forms just sit there within the system, occasionally attracting new forms analogically, but not creating any new ones by regular development. This means that the forms must have been lexicalized, probably in the period when laryngeals were truly being lost. This would be the only way to preserve the unique structure of these forms, which must have stood out like a sore thumb within the system. Such forms would be recognizable by speakers, and therefore would be likely candidates for lexicalization in situations that threatened to eliminate their characterized status.

(109) <u>PROPOSED CONSTRAINT RANKING FOR PRE-GREEK/LATE-PROTO-INDO-EUROPEAN</u>

ALIGN-RED*e*-L, MAX-IO, ANCHOR-L-BR »

*$_{\sigma}$[HC, OCP-H »

DEP-IO »

ONSET, NOCODA »

STROLE, SONSEQ »

*COMPLEX »

DEP-BR, ALIGN-ROOT-L »

MAX-BR

CHAPTER 8

ISSUES WITH ASPIRATION

For both consonant- and vowel-initial roots, minor complications arise in perfect-tense stem-formation regarding the presence or absence of aspiration. There two places where this is most evident is the behavior "rough breathing" vowel-initial roots and the aspiration alternation known as Grassmann's Law which primarily affects roots with initial aspirated stops.[188]

8.1. Aspiration in Ancient Greek

In Ancient Greek, the environments where aspiration could surface were extremely limited. The only type of aspiration inherited from Proto-Indo-European is the aspiration on *voiceless aspirated stops*, deriving from PIE *voiced aspirated stops*. Aspiration in the stops is realized as an aspirated release. These segments can be underlyingly present anywhere in a word (save word-final position, where all stops are banned), but will only retain their aspiration when they are syllabified in an onset, not in a coda.[189] The only other place where aspiration appears is

[188] As discussed in Chapter 5, aspiration also comes into play with *r*-initial roots. However, this does not seem to strongly bear on reduplication, so it will not be addressed here.

[189] The orthography generally writes a voiceless stop as aspirated before a voiceless aspirated stop (whether the two are a tautosyllabic complex onset or heterosyllabic). While it would be phonetically plausible for such an orthographic representation to actually reflect a cluster with a single aspirated release rather than two successive aspirated consonants, Steriade (1982: 239-41) shows rather convincingly that the first consonant in such a cluster is actually aspirated. But this does not countermand the above description, as the aspiration of the first stop always derives from the second. Thus, aspiration is not licensed in codas.

in word-initial position. This type, referred to as "rough breathing,"[190] will manifest itself as some sort of pre-aspiration of an initial vowel (or [r]).[191]

Unlike the aspiration on stops, the rough breathing aspiration is a Greek innovation. This comes about through sound changes which weaken **s* and **y* in onset position in Proto-Greek (Steriade, 1982: 340-50).[192] Use of *onset* position as the environment for this change requires that it occurred before the change in syllabification between our two language states, i.e. after the grammar of Pre-Greek motivated by present reduplication and Attic Reduplication, but before the attested period characterized by the grammar developed for productive reduplication. This is consistent with the diachronic evidence, so it can and should be maintained.

8.2. <u>The nature of *rough breathing* aspiration</u>

It is difficult to determine the precise nature of the rough breathing type of aspiration, and thus a detailed examination will not be taken up here. However, some salient points need to be mentioned. The primary point of relevance for the topic at hand is the behavior of vowel-initial roots with rough breathing. Take, for example, verbs like ἕλκω [^{h}elk-ɔ̄] 'I draw, drag' or ἁμαρτάνω [^{h}amart-an-ɔ̄] 'I miss the mark.' Their respective perfects are εἵλκυσμαι [^{h}ē̄lk-us-mai] and ἡμάρτηκα [^{h}ɛ̄mart-ɛ̄k-a]. Both display rough breathing in the perfect. Yet, rather than some sort of copying reduplication, they seem to be following the vowel-lengthening pattern of vowel-initial roots.

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[190] "Rough breathing" aspiration, also known by its Latin name *spiritus asper*, is traditionally marked in the orthography with a diacritic: < ἑ > = [^{h}e] or [he]. Thus, the first actual letter is the vowel. The rough breathing mark was a late invention of the scholars of Alexandria in the Hellenistic period. In the original Ionic alphabet, this aspiration was not marked at all (mainly because the dialect it was developed for was a "psilotic" dialect, which had lost this sort of aspiration altogether). In the Attic alphabet, however, which was displaced by the Ionic alphabet, this aspiration was marked by the (capital) letter eta < H >. See Smyth (1920: §9-14) for a more detailed discussion.

[191] According to Steriade (1982: 233), aspiration is contrastive for vowels (in initial position at least), but non-contrastive for /r/. All word-initial [r]'s surface with aspiration.

[192] **w* behaves similarly, although at a later date and less universally.

Their adherence to the vowel-lengthening pattern would seem to point to their being vowel-initial. This would imply that the aspiration is non-segmental, but rather in some way a characteristic of the initial vowel. Under an account where aspiration is directly connected to the initial vowel, the surfacing of rough breathing in the perfect reflects simple IO-*faithfulness*. As demonstrated in Chapter 6, the vowel-lengthening pattern arises through coalescence. We can therefore take the long vowel in a form like εἵλκυσμαι [^{h}ēlk-us-mai] to be the coalesced output correspondent of the *unaspirated* fixed /e/ of the reduplicative morpheme plus the *aspirated* /^{h}e/ of the root. If we assume that the grammar prefers *faithfulness* demanding retention of aspiration over *markedness* militating against aspiration,[193] then the coalesced output will display aspiration.

There are two possible accounts conducive to this type of explanation. One is to identify aspiration as an autosegment. This is the analysis proposed by Steriade (1982: 154). An autosegmental account would speak to the apparent mobility of aspiration, both in environments like this, and certain other developments in the history of Greek where the weakened outcome of medial **s* appears to jump back to word-initial position, despite there being several intervening segments. Another possible explanation would be to identify rough breathing aspiration as a feature of the vowel. This more easily fits in with the picture painted above based directly on faithfulness to the input. The autosegmental account must contend with issues like *linking, anchoring, alignment, etc*., that would serve to complicate the situation significantly. However, it is difficult to say what an aspiration feature for a vowel would be in strict phonetic terms.

[193] This could be effected by a MAXFEATURE type constraint, as argued for by Lombardi (1998), that selects for positively specified feature values, which are essentially *marked* feature values. This sort of explanation appears to account well for the facts of *vowel contraction* in Ancient Greek (although not necessarily the facts of vowel-lengthening in the perfect; but, as discussed in Chapter 6, vowel quality in this category seems to at least in part be morphologically determined).

Despite the apparent conformity of the rough breathing roots to the vowel-lengthening pattern, it is still possible that rough breathing might be segmental, i.e. a phonemic voiceless glottal fricative /h/. After all, the rough breathing type of aspiration always derives from the weakening of a segment. There is strong evidence that the weakened outcome of **s* and **y*, in both initial and medial positions, was a segmental /h/ in earlier periods. De Decker (forthcoming) shows that assuming segmental status of rough breathing aspiration (i.e. identifying it as the phoneme /h/) is useful in accounting for a number of forms in Mycenaean (mostly compounds), and certain aberrations in Homeric scansion. More significantly, Kiparsky (1967) and Steriade (1982: 150-3) show that a segmental /h/ is required for a set of developments yielding compensatory lengthening and/or gemination across the various dialects. These changes are accounted for by positing metathesis of the segmental /h/ with a preceding sonorant consonant, and then subsequent loss of the /h/ with compensatory lengthening (or gemination, which is of course just the re-association of a mora to the adjacent consonant rather than the adjacent vowel).

This reflects the fact that the weakened outcome of **s* and **y*, be it segmental or non-segmental, could not stand in medial position. For this reason, a root-initial /h/ would necessarily be lost when entered into reduplication. Therefore, the lack of a sequence [h*e*.-he-] in the perfect εἵλκυσμαι is completely expected. However, with the loss of the root-initial /h/, the rough breathing no longer has clear motivation. If it is segmental, then it should come about through BR-correspondence. Yet, the ban on medial [h] has removed the segment which it would otherwise correspond with. This obviously presents significant problems. Potential solutions favoring segmental /h/ might include appeals to output-output correspondence or metathesis, or even possibly theoretically more complex and as of yet unsettled concepts like input-reduplicant correspondence or stratal OT. Working out the details of this problem is beyond the scope of this thesis.

8.3. Grassmann's Law

While the questions regarding aspiration have a greater structural impact on the vowel-initial/rough breathing roots with respect to reduplication, one of the most talked about topics in Indo-European linguistics has to do with an aspiration alternation affecting the consonant-initial roots in reduplication. This alternation is known as Grassmann's Law.

When we earlier examined the consonant-initial roots, in all cases of copying roots, the consonant that surfaced in the reduplicant was in every way identical to its correspondent in the base. This is not true when the root-initial consonant is aspirated.

(110) Aspirated-consonant-initial roots displaying Grassmann's Law

Root		Present Tense		Perfect Tense	
p^{h}eug-	'flee'	φεύγω	[p^{h}eug-]	πέφευγα	[pe-p^{h}eug-]
p^{h}leu-	'abound'	φλέω	[p^{h}le-]	πέφλευσμαι	[pe-p^{h}leu(s)-]
t^{h}u-	'offer by burning; sacrifice'	θύω	[t^{h}u-]	τέθυκα	[te-t^{h}u-]
t^{h}nε̄-	'die, be killed; perish'	θνήσκω	[t^{h}nε̄-]	τέθνηκα	[te-t^{h}nε̄-]
k^{h}ar-	'rejoice at; welcome'	χαίρω	[k^{h}air-]	κεχάρηκα	[ke-k^{h}ar-]
k^{h}ri-	'rub, anoint'	χρίω	[k^{h}ri-]	κέχριμαι	[ke-k^{h}ri-]

This alternation is traditionally ascribed to *Grassmann's Law* (GL), namely the second clause of the law as originally formulated by Grassmann in 1863 (taken (in translation) from Collinge (1985:47)):

“(1) Given a root with a final aspirate and an initial consonant capable of aspiration, and given also that the final element loses aspiration (by some separate sound law), then that feature is retracted to the initial element.

(2) Given two consonant-groups in a word, separated by a vowel and themselves aspirated, and provided that they are within the same root, then one (and normally the first) is deprived of its breath feature.”

The second clause is the more common sense of GL in contemporary usage (Collinge, 1985: 47), and the one more applicable to the issue of reduplication. In other words, it states that, if there are two successive underlying aspirates, one will surface as unaspirated. This is precisely what we see in the reduplicated forms presented in (110). Where we expect to see the copied segment displaying aspiration, it does not. This is presumed to be because it is followed by another aspirated consonant, a pattern seen in non-reduplicative contexts.[194]

While there is some debate about whether GL is a synchronic process at all in Greek (cf. Bubenik, 1973), the deaspiration seen in reduplication has never been questioned. Therefore, Optimality Theory gives a possible alternative explanation. Since the reduplicated consonant is not specified in the input, the difference in aspiration between base and reduplicant could arise as an *emergence of the unmarked* effect. Such a statement removes reduplication from the environment for GL proper, and could allow its merit to be evaluated without interference. (Opponents of GL are often stymied by its apparent presence in reduplicative contexts.)

While it is phonetically difficult to find a feature which would represent aspiration on vowels, no such problem exists for consonants. A voiceless aspirated stop is simply one which has the feature [+spread glottis]. (This is more technical than is necessary for the discussion at hand, so I will simply refer to this feature as [+aspiration] or [+asp]. This also allows for a

[194] For further discussion, see also, e.g., Collinge (1985: 47-60), Lehmann (1967: 109-31), Sihler (1995: 142-4).

potential collapsing of this sort of aspiration with rough breathing aspiration, if rough breathing can in the future be reconciled with the proposed feature-based account.) The reduplicant in Greek has already been shown to have been shaped by *the emergence of the unmarked* with respect to syllable structure and reduplicant size. It is no stretch at all, then, to apply the same concept to aspiration. All that is required is to set up a basic *TETU* neutralization ranking with respect to the feature [aspiration].

(111) IDENT(asp)-IO » *[+asp] » IDENT(asp)-BR[195]

With these constraints now part of the ranking,[196] the unaspirated consonant in the reduplicant is accounted for.

(112) Grassmann's Law in reduplication: φεύγω [p^heug-] : πέφευγα [p*e*-p^heug-]

/ RED*e*, p^heug, a /	ONSET	NOCODA	MAX-BR	IDENT(asp)-IO	*[+asp]	IDENT(asp)-BR
a. p^h*e*.-p^heu.g-a			***		**!	
☞ b. p*e*.-p^heu.g-a			***		*	*
c. *e*.-p^heu.g-a	*!		****		*	
d. p*e*.-peu.g-a			***	*!		

Copying is motivated by the normal means, with candidate (112c) being ruled out for its ONSET violation (which induces an additional unnecessary MAX-BR violation). The choice then comes down purely to what values of aspiration are selected. Candidate (112d) is the *"back-*

[195] The IDENT constraints could alternatively be formulated as MAXFEATURE constraints, in which case the ranking would be: Max[+asp]-IO » *[+asp] » Max[+asp]-BR.
[196] These constraints will not directly interact with any other of the constraints affecting reduplication, so they could be placed anywhere in the ranking, as long as they maintain their relative ranking with each other.

copying" candidate. It attempts to avoid the problem of reduplicant markedness by reducing markedness in the base. This is prevented by IDENT(asp)-IO's ranking above the markedness constraint *[+asp].[197] This leaves only (112b) and (112c), which both retain the root-consonant's [+asp] feature. They differ only in the value of [asp] on the reduplicated consonant. Since the markedness constraint dominates the BR-faithfulness constraint, the extra violation of *[+asp] by the faithful candidate (112a) is fatal, and the *TETU* candidate (112b) is selected.

Similar appeals to markedness concerns for GL in reduplication have previously been made by Lowenstamm (2003: 350-4), and, more closely mirroring the account here, by Keydana (2006). Keydana, although using Optimality Theory, does not (at least directly) connect this to *TETU*. He rather takes the approach of positing an infinite series of constraints each militating against an additional instance of aspiration within a phonological word:

> "– *([sp gl]/PhWd): In einem phonologischen Wort ist das Merkmal
> [spread glottis] nicht lizensiert.
> – *([sp gl], [sp gl]/PhWd): In einem phonologischen Wort sind zwei
> Merkmale [spread glottis] nicht lizensiert.
> – *([sp gl], [sp gl], [sp gl]/PhWd)
> – ... " (Keydana, 2006: 87).

As with a number of his other constraints, this solution relies on counting, something which it is generally believed the phonology is not able to do.[198] Since he is using the earliest

[197] Backcopying also requires IDENT-BR » IDENT-IO. Cf. McCarthy & Prince (1995).
[198] It of course can count categorical violations, but there is nothing to suggest that it should be able to distinguish constraints that themselves distinguish between *n* and *n+1*… violations, including 1 vs. 2.

instantiations of OT as his model,[199] he has PARSE^{SEG} as his primary constraint motivating copying. This inelegantly combines MAX and IDENT (and possibly is intended to encompass both the BR- and IO-faithfulness dimensions). It is possible that Keydana intends this to reflect a *TETU* ranking, but his constraints make it difficult to tell.[200]

His lack of specificity seems to be driven by a (reasonable) desire to retain the connection between GL in reduplication and GL elsewhere. The separation of a constraint militating against one [+asp] segment versus two [+asp] segments does accomplish the goal of dissimilation of aspirates within the word, but, as just mentioned, it does not seem a valid manner to do so. Furthermore, he admits that this account still requires additional constraints to motivate which of the two aspirates will de-aspirate when neither is in the reduplicant, yet he does not venture to provide a suggestion to this effect.

8.4. Grassmann's Law as metanalysis of *TETU* in reduplication

The straightforward feature-based *TETU* account developed above has the benefit of accounting for the largest portion of unequivocal GL examples, i.e. reduplication. It cannot, of course, be directly extended to non-reduplicative contexts. However, it could serve as the source of analogy. One could imagine a circumstance where speakers re-analyzed the de-aspiration, which was originally motivated by *TETU* in reduplication, as simply a normal co-occurrence (i.e. contextual markedness) restriction. The universality of the deaspiration of the first aspirate in such a situation would be the model for the choice of deaspiration in the non-reduplicative contexts. Such a constraint would then eclipse the *TETU* ranking and motivate dissimilation

199 The so-called "Containment Theory" as developed in Prince & Smolensky (1993).
200 He does not appear to make specific mention of *the emergence of the unmarked* in this section of his account.

everywhere. This sort of analogical solution to GL might speak to the inconsistencies associated with its application.

Furthermore, identifying reduplication as the source of an analogical GL could reveal the reason why GL is found in Greek and Sanskrit but nowhere else in the Indo-European language family. Greek and Sanskrit are the only two languages (with the exception of Avestan) where reduplication remains a productive process; everywhere else, even in those languages which retain significant remnants, reduplication has long since stopped producing new forms. Therefore, Greek and Sanskrit would have an abundance of surface forms displaying the $C\ldots C^h\ldots$ (where the *C*'s have identical quality), having been brought about by reduplicative *TETU*, whereas their sister languages would have few if any such patterns, since such occurrences were not common based on the lexical structures of the proto-language.[201] The analogical extension of this pattern could then be made separately in the two languages.

This scenario is obviously pure speculation. It partially removes the burden of accounting for every single supposed GL form from the synchronic phonology, at whatever point it becomes active. This by no means is meant to say that a phonological explanation should not

[201] They will actually not have any alternations represented in exactly this way, since all other languages have lost distinctive aspiration. The only other branches where the PIE *voiced aspirated stops* are kept distinct from the *voiced stops* are Germanic and Armenian (as well as partially in Italic). Everywhere else, any pattern previously represented in this way would no longer be internally distinguished by aspiration, but rather by a voicing distinction, if they have not in fact fallen together completely.

Furthermore, the loss of aspiration renders the *TETU* ranking null and void in these languages. Since it refers specifically to aspiration, and aspiration is no longer specified in the underlying form, the *markedness* and *faithfulness* constraints on aspiration will always be vacuously satisfied, inducing no repairs or inconsistencies. As long as aspiration is lost as a distinctive feature before reduplication becomes unproductive (which would cause the forms to be lexicalized), the newly de-aspirated consonants would be able to achieve complete IDENTITY in copying. Therefore, if we encountered, for example, a Gothic reduplicated preterite of the shape *Dai-D…* (where *D* is a voiced obstruent) – and we in fact may have this with the weak preterite suffix – we do not have to assume that it comes *lautgesetzlich* from a PIE form frozen as $*D^he\text{-}D^h\ldots$, but rather that it was synchronically generated after the underlying PIE $*D^h$ has already become (Pre-)Germanic *D*. Thus, even if the *TETU* ranking is applicable to PIE, we would not expect to see its results anywhere but Greek and Sanskrit.

be sought and cannot be found to this problem.[202] Optimality Theory seems to be the perfect framework in which to tackle this problem. The rampant "exceptions" seem to bespeak the nature of violable constraints. Further examination is definitively warranted and necessary, but beyond the scope of this thesis.

[202] I believe that a phonological explanation can be achieved, possibly even one which ascribes the origins of GL to PIE. As per the previous footnote (fn. 201), application of GL in PIE would essentially be undone in the daughter languages that lose aspiration, provided the alternations had not been lexicalized. Since all of the reduplication forms involving GL, and, more significantly, most of the non-reduplication examples as well, constitute morphophonemic variation, the underlying aspirate would be synchronically recoverable, and therefore remain as such in the underlying form which is inherited into the daughter languages. It would thus be expected that isolated non-paradigmatic forms could show GL effects even in languages without aspiration.

CHAPTER 9

AN OVERVIEW OF AORIST REDUPLICATION

As with the reduplication in the present tense, reduplication in the aorist in Ancient Greek is unproductive, but retains a number of relic forms. These forms fall exclusively into two patterns, both of which are entirely consistent with patterns developed for the perfect.

9.1. Aorist reduplication of consonant-initial roots

The first and slightly more numerous pattern seen among the reduplicated aorists is that of the consonant-initial roots. Just as in the perfect of such roots, these reduplicated aorists show a copying reduplicant of the shape *Ce*. The difference between these forms and reduplicated perfects is that the reduplicant is preceded by the augment [e], which, as discussed in Chapter 6, is a morpheme that productively marks past tenses of the indicative mood. This gives us evidence of the *alignment* constraints that dictate the placement of these morphemes:

(113) CRITICAL RANKING: ALIGN-AUGMENT-L » ALIGN-RED-L » ALIGN-ROOT-L

Many of the reduplicated aorists exist alongside non-reduplicated formations for the same verbal root. This is a situation similar to what was seen for the perfect of vowel-initial roots, where many Attic Reduplication forms were in alternation with the more regular vowel-lengthening forms. The following table shows the attested reduplicated aorists built to consonant-initial roots, as well as the non-reduplicated aorists they coexist with:

(114) The reduplicated aorists of consonant-initial roots[203]

Root		Reduplicated Aorist		Non-Reduplicated Aorist	
da	learn; (aor) teach	δέδαον[204]	[(Ø-)de-da-]	ἐδάην	[e-da-]
kad	deprive; worry	ἐκέκαδον	[e-ke-kad-]	---	
kam	labor, be weary/sick	ἐκέκαμον	[e-ke-kam-]	ἔκμον	[e-km-]
kel	urge, command; call to or upon	ἐκεκλόμην	[e-ke-kl-]	---	
keut^h	hide	ἐκέκυθον	[e-ke-kut^h-]	ἔκυθον	[e-kut^h-]
k^h*ar*	rejoice at; welcome	κεχαρόμην	[(Ø-)ke-k^{h}ar-]	ἐχάρην	[e-k^{h}ar-]
klu	hear	κέκλυθι[205]	[ke-klu-]	κλῦθι, ἔκλυον	[klū-], [e-klu-]
lak	rattle; scream, utter	ἐλελακόμην	[e-le-lak-]	ἔλακον	[e-lak-]
lak^h	obtain (by lot)	ἐλέλαχον	[e-le-lak^h-]	ἔ(λ)λαχον	[e-(l)lak^h-]
lat^h	escape notice, make forget; forget	ἐλέλαθον	[e-le-lat^h-]	ἔλαθον	[e-lat^h-]
map	take hold of, seize	ἐμέμαπον	[e-me-map-]	ἔμαπον	[e-map-]
marp	take hold of, seize	ἐμέμαρπον	[e-me-marp-]	ἔμαρψα	[e-marp-s-]
pal	poise, sway	ἐπέπαλον	[e-pe-pal-]	ἐπάλμην, ἔπηλα	[e-pal-], [e-pɛ̄l-]
par	display, manifest	ἐπέπαρον	[e-pe-par-]	---	
peit^h	persuade; trust	ἐπέπιθον	[e-pe-pit^h-]	ἐπιθόμην	[e-pit^h-]
peut^h	learn (by hearsay)	ἐπεπυθόμην	[e-pe-put^h-]	ἐπυθόμην	[e-put^h-]
p^h*eid*	spare	πεφιδόμην	[(Ø-)pe-p^{h}id-]	ἐφεισάμην	[e-p^{h}eis-]
plɛ̄g	strike, smite	ἐπέπληγον	[e-pe-plɛ̄g-]	ἔπληξα	[e-plēk-s-]
tag	seize	τεταγών[206]	[te-tag-]	---	
tem	find	ἔτετμον	[e-te-tm-]	---	
terp/ *trap*	gladden, amuse; enjoy oneself	ἐτεταρπόμην	[e-te-tarp-]	ἐταρπόμην, ἐτράπην	[e-tarp-], [e-trap-]
teuk$^{(h)}$	make, make ready	ἐτέτυκον	[e-te-tuk-]	ἔτευξα	[e-teuk-s-]
t^h*en/* *p*^{h}*an*[207]	strike; kill	ἐπέφνον	[e-pe-p^{h}n-]	ἔθεινα	[e-t^{h}ēn-]

[203] Forms taken from Laar (2000: Ch. 4).
[204] (Ø-) indicates that the reduplicated form is only attested without the augment. The augment appears to not be fully obligatory in the early stages of the language.
[205] Laar (2000: 190) states that the [ke-] in the apparent reduplicated aorist may be a preverb, and not a reduplicant. This form is attested only as an imperative (-θι [-t^{h}i] is the marker of the 2nd sing. aorist imperative), and therefore the lack of the augment is normal, since the augment only marks the indicative.
[206] This verb is attested only as a reduplicated aorist participle, and lacks the augment accordingly.
[207] The alternation within this individual verbal system is due to the fact that the initial consonant of this root derives from an earlier labiovelar **g*^{wh}*en*. In Greek, the labiovelars generally become labials, as is seen in the reduplicated aorist, but become dentals when followed by a front vowel, which is induced by the apparent *e*-grade in the non-reduplicated aorist ἔθεινα [e-t^{h}ēn-a] < **e-g*^{wh}*en-s-a*.

Looking at the above data, something is strikingly absent. There are no roots of the COV type. Every single reduplicated aorist with a root-initial consonant displays a root allomorph that begins CV or CR, which, of course, are the only root shapes for which the regular synchronic grammar will generate copying. This admits of a rather straightforward explanation.

Notice that the reduplicative vowel of the aorist is always [e]. In the non-copying perfect of the COV roots, the reduplicative morpheme surfaces only as [e], since the RED portion is left unfilled. If we assume that the [e] in the aorist is also morphologically fixed, then the synchronic grammar will induce just such a pattern on COV roots in the aorist, i.e. *e-C.OV…*[208] With no consonant to mark it as obviously reduplicated, such a form would look exactly like a non-reduplicated aorist that was simply marked by the augment, which is also [e]. These forms would then lose their connection with reduplication altogether, and be attracted to the non-reduplicating aorist formations.[209]

This implies that the aorist might have retained its productivity later than the present. We saw that many reduplicated presents are built to COV roots. Their copying behavior can only be explained with recourse to an earlier grammar and subsequent lexicalization. The same grammar would have produced copying forms in the aorist for such roots as well. Since not a single form like this appears to be attested, it must be the case that lexicalization did not occur in the aorist at an equivalent period of development. This may well be due to the similarity of the vowel to that of the perfect, which remains productive and is subject to remodeling when the grammar changes. If reduplicated aorists to consonant-initial roots were still being generated

[208] The same shape will arise for an *obstruent* + *e* +*obstruent*, since the authentic ablaut grade in this category (as demonstrated by the other forms) is the zero-grade.
[209] One might expect such formations to show a long vowel (at least occasionally), if the augment were to coalesce with the fixed /e/ of the reduplicative morpheme. While there are some syllabic augments in [ɛ̄], it does not appear that any of them are built to COV roots (Sihler, 1995: 485-6, §442). However, since, in the early period, neither reduplication nor the augment was fully obligatory in the aorist, it is likely that one or the other could be omitted in the generation of such forms.

synchronically (even if the formation is unproductive and not attracting new lexical items), then the non-copying of COV roots in the aorist is expected. This would then allow their proposed reanalysis as augmented forms, and the subsequent absence of this root shape from the category.

9.2. Aorist reduplication and vowel-initial roots

The behavior of vowel-initial roots in the aorist with respect to reduplication almost entirely parallels what was just discussed for the consonant-initial roots. There are seven forms which are attested with an Attic Reduplication-type pattern in the aorist:

(115) Attic Reduplication aorists[210]

Root		Attic Reduplication Aorist		Non-reduplicated Aorist		Perfect
ag < *H_2eg	lead	ἤγαγον	[ɛ̄gag-]	ἠξάμην	[ɛ̄k-s-]	ἧγμαι
ak^h < *H_2g^h	be troubled	ἤκαχον	[ɛ̄kak^h-]	---		ἀκαχημαι
alek < *H_2lek	ward off	ἤλαλκον	[ɛ̄lalk-]	ἀλεξάμην	[alek-s-]	*not attested*
ap^h < *H_2eb^h ?	cheat, beguile	ἤπαφον	[ɛ̄pap^h-]	---		*not attested*
ar < *H_2er	join, fit together	ἤραρον	[ɛ̄rar-]	ἤρμην, ἦρσα	[ɛ̄r-], [ɛ̄r-s-]	ἄρηρα
eŋk < *H_1nek/H_1enk	bring	ἤνεγκον	[ɛ̄neŋk-]	---		ἐνήνοχα
or < *H_3er	incite, make to rise	ὤρορον	[ɔ̄ror-]	ὤρμην, ὦρσα	[ɔ̄r-], [ɔ̄r-s-]	ὄρωρα

In the Attic Reduplication aorists, the basic pattern of VC copying is upheld. However, the length of the two vowels appears to be reversed from the situation in the perfect. Whereas the perfect had a short initial vowel and a long root vowel, the aorist has a long initial vowel and a short root vowel. The length of the initial vowel can be directly attributed to the coalescence of

[210] Forms taken from Laar (2000: Ch. 4).

the augment with a short vowel in the reduplicant. The shortness of the second vowel, however, defies explanation. In the perfect, the length of the root vowel was motivated by the sound law *$VH > \bar{V}$. The same environment will be found in the output selected for the aorist, and thus we would expect a long vowel in this position. This likely points to these forms being analogical.

It is possible that the shortness of the vowel could be linked, analogically or even directly, to the fact that this is a zero-grade category. An analogical solution might posit that speakers forged a new ablaut relationship between Attic Reduplication perfects and Attic Reduplication aorists. The alternations *ɛ̄* ~ *a,e* and *ɔ̄* ~ *o* as full-grade ~ zero-grade relationships are built into the system as a residual effect of the laryngeals. For example, the 1.sg.pres δίδωμι [di-dō-mi] < **di-deH₃-mi*'I give' is a full-grade form related to zero-grade forms like the verbal adjective δοτός [do-tos] < **dH̥₃-tos* 'given; granted'. If speakers desired to impose a full-grade ~ zero-grade type alternation between perfect and aorist, the laryngeal alternation pattern could be employed. This would result in the reduction of the root-vowel in the aorist. From the perspective of the origin of the form, the point of reduction is incorrect, since it derives from the fixed /e/ of the reduplicant. However, the forms would be so opaque that speakers almost certainly would not recognize it as such.

The appeal to zero-grade might even have the potential to yield proper outcomes from the Pre-Greek rankings. Inputting a zero-grade root allomorph in the aorist, as opposed to a full-grade or o-grade one (or some other sort of secondary allomorph with a full vowel) in the perfect, creates a new set of issues of syllabification in the derivation. A number of the roots have resonants which could vocalize in zero-grade contexts. However, it is difficult to pin down the relative chronology of the reduplicative facts with the developments of the syllabic resonants. This makes it difficult to know if the candidates proposed are diachronically proper with any great degree of confidence. Because of the difficulty in establishing candidates, preliminary investigations have been inconclusive. Since analogy seems likely to have played a role, I will leave the details of this problem as an area for further research.

The identification of only seven reduplicated aorists built to vowel-initial roots is likely somewhat misleading. Just as it was proposed above that the lack of COV reduplicated aorists can be traced to a falling together with the augmented aorist, the lack of vowel-lengthening reduplicated aorists is a red herring. Coalescence is the outcome when the augment is added to vowel-initial roots in the aorist (and the imperfect, for that matter) – this is the so-called *temporal augment*. This will mirror exactly the effects of vowel-lengthening in the perfect, which would necessarily be recapitulated in the derivation of the aorist. Therefore, if roots which became vowel-initial in Greek (i.e. by the loss *H, *s, *y, or *w) originally had reduplicated aorists, they would come to display vowel-lengthening, and thus become identical to an augmented aorist, unless otherwise attracted to the Attic Reduplication pattern.

CHAPTER 10

CONCLUSION

This thesis has demonstrated that an Optimality Theory framework, properly integrated with and informed by the lessons of traditional Indo-European historical linguistics, can thoroughly account for the broad range of patterns of reduplication, and apparent non-reduplication in reduplicative categories, in Ancient Greek. The careful application of *correspondence, alignment,* and *markedness* constraints, coupled with the assertion that the reduplicative morpheme includes a morphologically (not phonologically) fixed vowel, has allowed for the productive reduplication patterns – both those that display copying in the reduplicant and those that do not – to be collapsed into a single grammar. This analysis of the productive synchronic grammar subsequently lays the basis for the explanation of the exceptional, unproductive patterns, chief among which are the reduplicated presents and Attic Reduplication, as lexicalized remnants of the productive grammar of Pre-Greek, which can be formulated as a system minimally different from that of Ancient Greek proper.

Beyond its overall ability to account for the breadth and depth of reduplicated forms, the framework proposed in this thesis has a number of advantages over previous accounts. One major advantage is that the size and the shape of the reduplicant, and its variation in different forms, is explained without appeal to a stipulative reduplicative template. Instead of specifying the structure of the reduplicant as a constraint and allowing it to be satisfied to greater or lesser degrees by its relative ranking in the constraint grammar, this account relies almost exclusively on *alignment* and *syllabification* (namely an *emergence of the unmarked* ban on codas and complex syllable margins in reduplication) to generate these facts. Since these constraints are independently necessary, this sort of explanation is much more economical than one that uses a template. Furthermore, the account of Attic Reduplication requires a reduplicant which ultimately exceeds the size of what would be assumed to be the template, namely RED=CV. While the assertion that the reduplicative morpheme displays morphological fixed segmentism to some degree tempers its advantage over a templatic account (since the fixed vowel is essentially stipulated), it at least removes the burden of this stipulation from the realm of constraints, and locates it instead in the lexicon. That is to say, rather than positing that there must be a type of constraint (i.e. the templatic constraint) which is wholly different from all other types of constraints, it requires only that there is specified material in the underlying form. While reduplicative morphemes are generally thought to be unspecified, all other morphemes obviously have information that is specified in the underlying form. Therefore, the magnitude of the stipulation and its theoretical impact is far less dramatic for morphological fixed segmentism than for reduplicative templates.

An even more significant way in which the account presented in this thesis is an improvement over earlier approaches is that it ascribes the differences in the behavior of consonant-initial roots in reduplication directly to issues of syllabification. Thus, rather than arbitrarily stipulating when the copying of a root-initial consonant will or will not occur, or asserting that wholly different morphemes apply in these different environments, this account incorporates these alternations into a process which is independently necessary for the language at large, since syllabification is a surface feature of all languages.

The significant distinctions can be boiled down to the relative ranking of just three *syllable well-formedness* constraints: NOCODA, *COMPLEX, and SONORITY SEQUENCE. In the productive, synchronic grammar of Ancient Greek, these are ranked as follows (as was presented in (58)):

(116) RANKING FRAGMENT: SONORITY SEQUENCE » NOCODA » *COMPLEX

Although primarily motivated in this thesis through its interaction with reduplication, this ranking is independently verifiable in the remainder of the language, as demonstrated by many of the syllabification-driven phonological processes and diachronic developments examined by Steriade (1982). This ranking dictates that a sequence of two consonants that appear intervocalically will be syllabified as a *complex onset* rather than a *coda* + *simplex onset* (because NOCODA » *COMPLEX) unless that sequence does not have rising sonority, as this would incur a violation of SONORITY SEQUENCE, which is the most significant of the *syllable well-formedness* constraints. The contrasting syllabification of *consonant* + *resonant* (CR) sequences versus *consonant* + *obstruent* (CO) sequences due directly to this ranking lies at the heart of the copying versus non-copying reduplication patterns. By the high ranking of the base-reduplicant *correspondence* constraint STRUCTURAL ROLE-BR, which requires identical syllabic positions for segments standing in BR-correspondence, the rules of syllabification (as effected by the above ranking) induce non-copying for COV roots, since the initial consonant of the root must be syllabified as a coda; yet syllabification presents no interference for copying in CRV roots, as their root-initial consonant can sit in onset position.

A change in syllabification is also the motivation for the exceptionality of the reduplicated presents and the perfects which are associated with them. In these forms, copying occurs for both COV and CRV roots. The equivalent behavior of the two root shapes is indicative of an earlier period of the language where the sequences *CO* and *CR* were treated identically with respect to syllabification. All that is required for the grammar to act in this way is a re-ranking of two of the *syllable well-formedness* constraints.

(117) <u>RANKING FRAGMENT FOR PRE-GREEK</u>: NOCODA » SONORITY SEQUENCE » *COMPLEX

In the grammar of Ancient Greek, the ranking of SONORITY SEQUENCE » NOCODA ensured that a *coda* + *simplex onset* would be preferred to a *complex onset* that violated SONORITY SEQUENCE. With the ranking reversed, not having a coda is the most important aspect of syllabification, and therefore complex onsets will be preferred, regardless of their sonority profile. This, therefore, unites the syllabification of *CO* and *CR* sequences, and provides the requisite conditions for copying for all roots that are consonant-initial.

The ability to account for exceptions by making recourse to an earlier grammar, as demonstrated in this discussion of the changes in syllabification and their impact on reduplication, is another very positive aspect of the account developed in this thesis. This only required the proposal of a constraint ranking which was minimally different from that of the productive synchronic grammar – with a different ranking of just two constraints, SONORITY SEQUENCE and STRUCTURAL ROLE, and the inclusion of two *markedness* constraints which would be invisible to the grammar of Ancient Greek, OCP-H and $*_{\sigma}$[HC. Virtually all of the exceptional patterns of reduplication (present reduplication, Attic Reduplication, even sporadic forms like μέμβλωκα as discussed briefly in Section 5.5) find a solution when framed within the grammar of this language state. The principled explanation of Attic Reduplication is particularly noteworthy. Prior to this, there had been no accounts of this phenomenon that could generate the pattern without either primary appeal to analogy or stipulation of an irregular reduplicant shape for laryngeal roots. While the account developed in this thesis requires secondary analogical spread to **HeC* roots, and probably also to the aorist, it shows that a pre-form that will directly yield the Attic Reduplication pattern can be generated for **HCeC* roots by appealing to *markedness* constraints that specifically target laryngeals. By the inclusion of just two such constraints, the Pre-Greek grammar (which was independently motivated by the pattern of the reduplicated presents) produces the exact form needed to yield Attic Reduplication without making any changes to the procedures of reduplication.

The success of this approach in explaining irregularities shows that diachrony can be a very powerful tool even in synchronic analysis. Careful consideration of the diachronic and comparative facts can provide valuable insight into otherwise difficult problems, including opacity. Hopefully this thesis will promote the use of these underutilized methods in contemporary generative phonological study.

Furthermore, the way in which this thesis attempts to identify different stages of the grammar that reflect different periods of the language can be used towards the goal of reconstruction. While the manner of reconstruction attempted here more closely resembles internal reconstruction, the methodology used in this thesis can equally well be employed for comparative reconstruction. As was first attempted by Keydana (2006), if one can construct the synchronic constraint grammars of related languages, this information can be inputted into what amounts to the comparative method. Unlike traditional comparative reconstruction, the result of this application of the comparative method will not be individual forms, but rather an entire grammar. The reconstructed grammar will be the one which can most economically and reasonably produce the grammars of the attested daughter languages. Attempting internal reconstruction first obviously makes this goal more achievable, since internal reconstruction will shed light on a language state less far removed from that of the parent language. Therefore, in order to successfully engage in comparative reconstruction of grammars, we must first carry out detailed examinations of the daughter languages that thoroughly integrate synchronic and diachronic methods. This thesis has undertaken exactly this for Ancient Greek. The task now will be to do the same for the other daughter languages, so that we might soon be able to paint an unprecedentedly complete picture of Proto-Indo-European as a linguistic system.

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APPENDIX A

INDEX OF CONSTRAINTS

This appendix lists each constraint used throughout the thesis. They are arranged alphabetically. Each entry includes the full name of the constraint, its definition, and any abbreviations used in the tableaux. Constraints whose names begin with non-alphabetic symbols (most frequently an *asterisk* *) are listed by the first alphabetic symbol of their name. Some constraints which were mentioned/proposed only in passing are omitted.

- ALIGN (BASE, L; σ, L): The left-edge of the base must coincide with the left-edge of a syllable.
- ALIGN-RED-L / ALIGN-RED*e*-L: The left-edge of the reduplicant (RED) should coincide with the left-edge of the prosodic word (PRWD). Assign one violation mark for each segment which intervenes between the left-edge of the PRWD and the left-edge of the RED.
- ALIGN-ROOT-L: The left-edge of the root should coincide with the left-edge of the PRWD. Assign one violation mark for each segment which intervenes between the left-edge of the PRWD and the left-edge of the root.
- ANCHOR-L-BR (ANCHOR): When a string of segments in the base stands in correspondence with a string of segments in the reduplicant, the segment at the left-edge of the base must be standing in correspondence with the segment at the left-edge of the reduplicant, and vice versa.

- ANCHOR-L-OO$_{\text{RedPres}}$: The segment at the left-edge of the stem of a reduplicated present of a given root must correspond to the segment at the left-edge of the perfect stem of that root.
- $*_{\sigma}[(C_0)C_{\mu}$ or $*_{\sigma}[C_{\mu}$: Consonants in an onset must not have a mora.
- *COMPLEX (*COMPLX, *CMPLX): All syllable margins must not be complex (i.e. no onset may have more than one segment, and no coda may have more than one segment). Assign one violation for each complex syllable margin.
- DEP-BR: Every segment in the reduplicant must have a correspondent in the base.
- DEP-IO: Every segment in the output must have a correspondent in the input.
- $*_{\sigma}[HC$: Do not have an onset consisting of *laryngeal* + *consonant*. Assign one violation mark for each such cluster.
- IDENT-BR: All segments in the reduplicant with a correspondent in the base must be identical to their base correspondent, and vice versa
- IDENT-IO: All segments in the output with a correspondent in the input must be identical to their input correspondent, and vice versa.
- IDENT-μ-IO: An output vowel must have the same number of moras attached to it as its correspondent in the input, and vice versa
- INTEGRITY-IO (INTEG): No segment in the input has multiple correspondents in the output.
- LARYNGEAL COLORATION (LC):
  a) *ə* may not surface adjacent to $*H_1$,$*H_2$ or $*H_3$
  b) *e* may not surface adjacent to $*H_2$ or $*H_3$
  c) *a* may not surface adjacent to $*H_3$
- MAX-BR: Each segment in the base must have a correspondent in the reduplicant.
- MAX-IO (MAX): All segments in the input must have a correspondent in the output.
- MAX-μ-IO: Each mora of the input must have a correspondent in the output.

- NoCoda: All syllables must not have a coda. Assign one violation mark for each syllable which has a consonant at the right-edge.
- OCP-H: Do not have multiple laryngeals in the same syllable. Assign one violation mark for each syllable with multiple laryngeals.
- OCP-σ: Do not have identical segments *within a syllable*. Assign one violation mark for each pair of identical segments within a syllable.
- Onset (Ons): All syllables must have an onset. Assign one violation mark for each syllable which does not have a consonant at the left-edge.
- Sonority Sequence (SonSeq): Between any member of a syllable and the syllable peak, only sounds of higher sonority rank are permitted
- Structural Role-BR (Structural Role, StRole): A segment in the reduplicant which stands in correspondence with a segment of the base must be in the same syllabic position (i.e. nucleus, onset, or coda) as the base segment, and vice versa.
- *$_\sigma$[TS: Do not have a *voiceless stop + fricative* onset.
- Uniformity-IO (Unif): Segments which are distinct entities in the input cannot correspond to a single segment in the output.

APPENDIX B

FINAL CONSTRAINT RANKINGS

CONSTRAINT RANKING FOR ANCIENT GREEK

ALIGN-AUGMENT-L »

ALIGN-RED*e*-L, MAX-IO, DEP-IO, STRUCTURAL ROLE-BR, ANCHOR-L-BR, MAX-μ-IO »

(INTEGRITY-IO,) SONSEQ$^{(,)}$ »

ONSET, NOCODA »

*COMPLEX, UNIFORMITY-IO, IDENT-μ-IO »

DEP-BR, ALIGN-ROOT-L »

MAX-BR

PROPOSED CONSTRAINT RANKING FOR PRE-GREEK:

ALIGN-RED*e*-L, MAX-IO, ANCHOR-L-BR »

*$_{\sigma}$[HC, OCP-H »

DEP-IO »

ONSET, NOCODA »

STROLE, SONSEQ »

*COMPLEX »

DEP-BR, ALIGN-ROOT-L »

MAX-BR