

**Distributed Morphology and the Evolution
of the Indo-European Case System**

A thesis submitted

by

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Abstract

In this thesis, I examine the nominal morphology of Proto-Indo-European, Attic Greek, and Hittite in the theoretical framework of Distributed Morphology (DM), a recent theory which departs from traditional conceptions of morphology in a number of ways. In the first three chapters, we will address these three languages one at a time, showing that DM gives us new insight into the synchronic system of these languages and certain dialectal and diachronic shifts within them. I show that DM provides a simple account of the morphological systems we encounter and their interrelationship. In particular, the close relationship between these languages is reflected in their synchronic systems, but they diverge in important respects as well, and I attempt to account for these facts and how they relate to the theory. Certain theoretical issues which bear on the analysis are investigated as well, in particular the scope of impoverishment and the place of extrinsic ordering in morphology.

In chapter 4, we take a closer look at the predictions of DM for morphological change and possible descriptions of diachrony from within the theory, taking examples from the internal histories described in chapters 1-3 as well as the development of Greek and Hittite from Proto-Indo-European. In particular, DM accounts for case syncretism with the devices of impoverishment and underspecification, each of which makes certain predictions about diachronic stability of morphological systems and the kinds of change which should occur. I show that these predictions are borne out to a large degree. Finally, I give a quick overview of a few interactions between the formal system and the

functional motivations for linguistic change which have been implicit in the preceding chapters.

Introduction

0.1. General Introduction: Motivation and Goals

In current generative linguistics, morphology is perhaps the area in which there is the least theoretical agreement. Major schools of thought disagree even on basic questions such as the existence of affixes. For instance, the quite different theories of Lieber (1992) and Halle and Marantz (1993) both hold to the traditional insight that affixes are in some sense independently meaningful pieces, i.e. lexical or Vocabulary items; in contrast, the ‘a-morphous’ approach of Anderson (1992) takes Word Formation Rules to be the basic process underlying morphology, and affixes as epiphenomena. On a number of other basic questions as well, these and other major approaches disagree crucially: whether morphology takes place within the lexicon or in an independent post-syntactic component, for instance, or whether there is “substantive evidence of a purely synchronic kind ... that paradigms are more than mere lists of word-forms” (Carstairs 1987: 29-30).

There are, of course, various reasons for this state of affairs, historical and otherwise, which I do not wish to go into. However, it seems to me that one important factor is the relatively limited data source provided by productive morphology. In phonology or syntax, there is a wide range of combinatory possibilities available for analysis, and the introduction of new forms or the attention of linguists to novel combinations of old forms can disprove theoretical possibilities. In important areas of

morphology, in contrast, there is very little surface data which is not already known: for example, we know that English has two productive verbal suffixes, *-s/-z/-es* and *-t/-d/-ed*, and a limited number of semi-productive suffixes such as *-en*. The creation or borrowing of a new verb will probably not give us any interesting new data: we already know that we will see the suffixes *-s/-z/-es* and *-t/-d/-ed* on the novel form. As a result, it is relatively difficult to test the predictions of a morphological theory directly. Much argumentation must rely instead on theoretical consistency with syntax and phonology, as well as general considerations such as the simplicity and elegance of the theory. This is certainly the case for the method we will pursue in the current work: in most cases, there could be several theoretically viable analyses of a given declension.

The original inspiration for this thesis was the notion that historical change could provide a limited testing ground for theories of morphology, and that it could allow us to choose between different synchronic analyses of a given language. If one theory could reduce the burden of explanation placed on general principles such as analogy or reanalysis by providing specific motivation for certain types of historical change, this fact would suggest, all else being equal, that it is a better theory than its competitors (within a given theory as well as those relying on a different theoretical framework). In particular, I was struck by the historical implications of Halle and Marantz's (1993) Distributed Morphology, hereafter DM. DM proposes a number of devices which make very specific predictions about what types of historical change should be most common, notably underspecification, impoverishment, and feature-based analysis of the conditioning of affixes, on which more below.

This thesis has two interrelated goals. First, I hope to contribute to the theory of DM by providing complete analyses of the nominal morphology of several archaic Indo-European languages and examining the certain theoretical issues in this context. Second, I will explore interactions between the theoretical analysis of these languages' declensions and their histories. I hope to show that diachronic considerations can provide significant and sometimes decisive evidence for a synchronic analysis, and likewise that a theoretical understanding of the synchronic facts can inform our analysis of historical change. However, I will make no effort to be true to the historical facts of the languages *per se* in my synchronic analyses: my overriding concern is to provide a system which language learners could plausibly construct from the surface data to which they are exposed. This process will naturally value the simplicity of the synchronic system and theoretical (UG) requirements over faithfulness to the language's history, and in places the simplest synchronic analyses of the morphological systems analyzed will be strikingly different from their origins.

The thesis is organized as follows: in the remainder of this introduction, I will quickly sketch the basic theoretical assumptions of DM, focusing on those most relevant to my analysis. In chapters 1-3, I will give synchronic analyses of the nominal morphology of Proto-Indo-European (hereafter PIE), Attic Greek, and Hittite, interspersed with analysis of dialectal and historical relations within these languages' declensions and their implications for our synchronic analysis. Chapter 4 outlines some historical implications of the theoretical analyses in chapters 1-3, focusing especially on patterns of case syncretism. For reasons of space, I will not attempt to account for the historical development of these languages' nominal morphology in their entirety; rather, I

will merely attempt to give a representative sample of various types of morphological change and their possible redescription within the DM analyses we have developed.

0.2. Theoretical Assumptions of DM

For more on the content of this section, see especially Halle and Marantz (1993, 1994) and Noyer (1997).

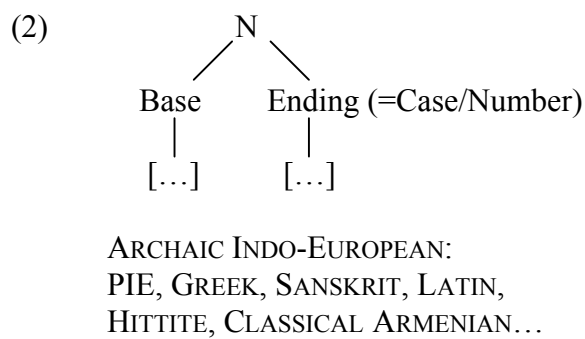
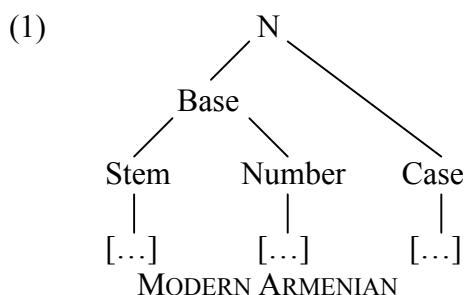
0.2.1. Late Insertion and the Syntactic Structure of Morphology

DM endorses late insertion, in which terminal nodes are given phonological content only after syntactic operations are complete, at a level of representation between Surface Structure and Phonological Form known as Morphological Structure (MS). This claim contrasts with the standard assumption that morphemes are combined in the lexicon and inserted into terminal nodes prior to the syntactic component. Since syntax is the input to morphology, DM makes the highly economical assumption that morphology simply preserves the structures provided by the syntax unless these structures are altered by processes specific to MS: as Embick and Noyer (2001:560) put it, “morphological structure is, unless further movements apply at PF [i.e. MS → D.L.], simply syntactic structure”. Thus DM accounts for Anderson’s (1992: 70) objection that, in many cases, “the one-to-one relation between components of meaning and components of form which is essential to the classical morpheme is violated”, without throwing out Baker’s (1985) attractive proposal that morphology “mirrors” syntax. The syntax-morphology mismatches of which Anderson complains are constrained by the MS-specific processes outlined below. These can alter syntactic structure, sometimes considerably, and the

underlying distinctiveness of terminal nodes can be obscured because of underspecification and impoverishment (section 0.2.3); but Morphological Structure is nonetheless largely identical with syntactic structure.

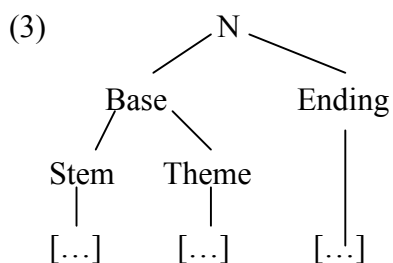
0.2.2. Structure-Changing Operations

Alterations to syntactic structure in the Morphology can take several forms, the most important of which, for our purposes, are fusion and impoverishment. Recall that the terminal nodes manipulated in the syntax and the morphological component contain only features, such as case or number features, but have no phonological content. In certain cases, a language converts two sister nodes into one with the features of both at MS, a process called *fusion*. For instance, we know that Case and Number features are contained in distinct terminal nodes at the end of syntax because of the existence of languages which always have separate exponents for case and number. However, in all the languages we will examine here, the Case and Number nodes provided in the syntax are fused into a single Case-Number node in the Morphology. (1) gives the structure of N in modern Armenian, which has separate case and number endings; (2) is its structure in the archaic Indo-European languages (modulo the addition of the theme node; from Halle and Vaux 1998).



The result of fusion in (2) is that all the features formerly contained in the Case node and the Number node are now under a single Case/Number node, and only one Vocabulary Item (VI) may be inserted in this node.

New terminal nodes may also be introduced at MS to satisfy language-specific requirements. For instance, in the languages we will examine, (2) is further modified by the addition of a Theme node, into which a semantically empty theme vowel is inserted, conditioned by various properties specific to the root such as declension class.



Various other operations are also possible, such as head-to-head movement, morphological merger and fission: see especially Marantz (1988), Halle and Marantz (1993), and Embick and Noyer (2001). On fission, see also below, section 0.2.5.

0.2.3. Vocabulary Insertion and Underspecification

At the stage described in the preceding section, the terminal nodes still have no phonological content. Vocabulary Items (VIs) are inserted into terminal nodes cyclically (from the root outward) at the end of MS by the *subset principle*:

The phonological exponent of a Vocabulary Item is inserted into a terminal morpheme if the item matches all or a subset of the grammatical features specified in the terminal morpheme. Insertion does not take place if the Vocabulary Item contains features not present in the morpheme. Where several Vocabulary Items meet the conditions for insertion, the item matching the greatest number of features specified in the terminal morpheme must be chosen. (Halle and Vaux 1998: 226)

Thus all VIs in the Vocabulary are in competition for insertion into a given terminal node, and the VI with the greatest number of features matching those of the terminal node, but no others, will be inserted. For presentational purposes, VIs are normally given in a list ranked from most highly to least specified, and the process can be seen as proceeding from the top of the list to the bottom. In cases where two VIs make reference to the same number of features, we will impose an extrinsic ordering, a method familiar from phonology.¹

The nature of Vocabulary Insertion gives DM one of its defining characteristics, the ability to express syncretism as a function of underspecification. For example, take the German present tense paradigm in (4) and the Vocabulary Items in (5):

(4)

sag- 'say'	Sg.	Pl.	Inf.
1	sag-e	sag-en	sag-en
2	sag-st	sag-t	
3	sag-t	sag-en	

(5)

- t ⇔ [+2, +pl]
- st ⇔ [+2, -pl]
- e ⇔ [+1, -pl]
- t ⇔ [-pl]
- en ⇔ []

Noyer (1992), Harley (1994), and most recently Harley and Ritter (2002) have investigated the possibility that a 'universal hierarchy of morphosyntactic features' might resolve such cases rather than extrinsic ordering. This may be correct, but the topic is beyond the scope of this paper, and we will follow Halle and Marantz's (1993) use of ordering to resolve otherwise undecidable competition.² A detailed examination of various proposals for case features, such as the one we have adopted and that of Calabrese (1998), is desirable, but beyond the scope of this essay. Such a study would, however, need to rely heavily on patterns of case syncretism and morphological change, as Calabrese (1998) has suggested. I hope that the

The fact that German has the same exponent in the 1 and 3 pl. and the infinitive is a consequence of “retreat to the unmarked case”: since no more specific exponent is available for these nodes, they are filled by the elsewhere morpheme *-en*. In particular, since the infinitive does not have any case or number features, none of the morphemes in (5) could be inserted into a node with the features of the infinitive except *en*. In general, underspecification of this sort is the most economical way to account for syncretism, since it is generated by the structure of the theory with no further devices (cf. Bobaljik 2001).

0.2.4. Impoverishment

Impoverishment is an operation which deletes one or more features from a terminal node in highly specific environments: for instance, $[X] \rightarrow \emptyset / [_, Y, Z]$. In such a case, a terminal node with the content $[X, Y, Z]$ will surface as if it had only the features $[Y, Z]$, even if there is some more specific VI such as “ $A \Leftrightarrow [X, Y, Z]$ ”.

Impoverishment can affect both positive and negative feature values, as well as (as I will suggest) class assignment.

Harris (1994) gives an excellent example of the explanatory power of impoverishment in his account of Spanish clitics. He shows that impoverishment can account in a simple manner for the otherwise bizarre phenomenon of “spurious *se*” in Spanish, in which the clitic cluster /3-dat/^/3-acc/ is realized not as expected **le lo* but as *se lo*. *se* is normally the 3rd person dat./acc. reflexive pronoun in Spanish. However, Harris analyzes *se* as the default 3rd person clitic, which allows him to account for the spurious *se* by simply impoverishing the case features of the dative clitic when it occurs

before an accusative clitic. Similar reasoning will motivate a number of cases of impoverishment in chapters 1-3; in addition, impoverishment rules can motivate certain historical changes such as DUAL \rightarrow PLURAL (as we will see for Greek in chapter 2).

0.2.5. Fission

Another important structure-changing operation which can take place at MS is fission. Fission is unique among such operations in that it occurs during Vocabulary Insertion, rather than before, and that it is conditioned by the particular VI inserted. In normal cases, features of a terminal node which are not matched by the VI inserted are simply ignored thereafter. However, when a morpheme is marked to undergo fission, at the point of its insertion a new sister node is created, into which all features not discharged by the first VI are copied. This node, in turn, undergoes Vocabulary Insertion again. Fission is an extremely important aspect of Indo-European nominal morphology, since it is necessary to account for the appearance of several distinct morphemes where we expect a single fused case/number node. This is an important innovation of DM, since morphemes are treated as undecomposable pieces in most morphological theories. We will see numerous examples of fission in chapters 1-3.

0.2.6. Readjustment

Morphemes are independent pieces in DM, which combine phonologically only through the process of Vocabulary Insertion. In such a theory, we expect *prima facie* that a morpheme should have the same phonological realization in all cases. However,

allomorphy is common in many languages, and DM accounts for most cases of allomorphy with rules of readjustment. These are essentially highly specific phonological rules which apply immediately after Vocabulary Insertion and before the phonology. So, for instance, the English verbs *sold* and *told* consist of the roots *sell* and *tell* plus the past tense suffix */-d/*. The output [sel-d] is then subject to a readjustment rule of the following form (ex. from Halle and Marantz 1993:128):

$$(6) \quad V \rightarrow [+back] \ / \ W \ ___ \ U \ [+past] \\ \quad \quad \quad [+round]$$

where WVU = *sell, tell*

Such readjustment rules play an important role in similar cases of irregular inflection and the residue of PIE ablaut in the archaic Indo-European languages, as we will see.

0.2.7. Persistent Redundancy Rules

Persistent redundancy rules are not a device specific to DM, but play an important role in sketching a DM grammar of some languages. The claim is that if a certain type of information is predictable from another type, it is more economical for a learner to store only one of these and to derive the other online through a rule relating the two. For example, in Greek, declension class is largely predictable from gender: feminine nouns are normally 1st declension (theme *-a-*), and masculine and neuter nouns are normally 2nd declension (theme *-o-*). In the third declension, in contrast, nouns can be of any gender. Thus we can formulate two simple rules of redundancy to account for the patterns of Greek declension class: [+fem] nouns are 1st declension, and all other nouns are 2nd declension. Since these rules cannot override lexically specified declension class, the existence of these rules does not affect third declension nouns, which are specified for

both gender and declension class in the Vocabulary, nor does it rule out the possibility of 1st declension masculine or 2nd declension feminine nouns. Their function is simply to reduce the amount of information which must be memorized by a learner. As Noyer (1998) has suggested, persistent redundancy rules can take effect at any point in the derivation, e.g. if the specified gender or class information of a noun is eliminated by impoverishment. Redundancy rules will be important in several cases of category shifts in Greek, as we will see in chapter 2.

0.2.8. Case Features

An extremely important aspect of the DM approach is that terminal nodes dominate only syntactic, semantic, and/or morphological features. Following Halle and Vaux (1998), we will assume four case features, [oblique], [structural], [superior], and [free], in the following schema:

(8)

	Nom	Acc	Gen	Dat	Loc	Instr	Abl	Erg
Oblique	--	--	+	+	+	+	+	--
Structural	+	+	+	+	--	--	--	+
Superior	+	--	--	+	--	+	+	+
Free	+	--	+	+	--	--	+	--

Halle and Vaux (1998: 225) describe the content of these features as follows:

The feature specification [-oblique] is assigned to nominals that are arguments of the verb; [+oblique] is assigned to nominals that are not arguments of the verb. The feature [-structural] is assigned to nominals on non-structural, semantic grounds; [+structural] is assigned to nominals on the basis of their position in the

syntactic structure, exclusively. The feature [-superior] is assigned to nominals in governed positions in the syntactic structure; [+superior] is assigned to nominals in non-governed positions. [-free] is assigned to nominals with a consistent role in argument structure; [+free] is assigned to nominals whose role in argument structure varies.

Of course, this schema leaves out a number of attested cases, and should not be taken to exclude the possibility that other case features exist. We will have opportunity to reconsider some details of this theory of case features, but will assume that it is by and large correct.²

Chapter One:

The Proto-Indo-European Declension

1.1. Overview of PIE Phonology

PIE has the five vowels /a/, /e/, /i/, /o/, and /u/, each of which can be either long or short. Short /i/ and /u/ alternate with [j] and [w] for reasons of syllabification, and any resonant can function as a syllable nucleus. PIE also has a complex ablaut schema which produces alternations between [e], [o], and \emptyset . It is not clear how to analyze these alternations in terms of synchronic phonology: one possibility is some sort of templatic morphology, but it is difficult to be certain. In any case, these ablauting vowels are normally cited as /e/, and we will hold to this convention. PIE also had three fricatives /h₁/, /h₂/, and /h₃/ whose phonetic values are not precisely known, which had certain coloring and lengthening effects on adjacent sonorants. Most notably, /e/ was colored to [a] when adjacent to /h₂/, and to [o] when adjacent to /h₃/, and a syllabic nucleus was lengthened whenever a laryngeal appeared in the syllable coda. In addition, there were the fricative /s/, the sonorants /m/, /n/, /l/, and /r/, and a range of voiced, voiceless, and voiced aspirate stops: labial, dental, palatal, velar, and labiovelar.

1.2. The Declension of Early PIE

The PIE declension can be treated as a synchronic system with considerably better success than its phonology. The language has two declension classes, thematic and athematic. Thematic nouns have a semantically empty theme vowel which appears as *-e-* in the voc. sg. and neuter plural NAV, and *-o-* elsewhere.³ Following the convention of Indo-Europeanists, we will refer to this as the *e/o* class. Athematic nouns include roots with and without a suffix, and can end in a consonant or vowel. The morphophonology of PIE accent and ablaut is far too complex for even a cursory treatment here, and we will abstract away from it as much as possible in order to focus on the case endings proper. We should note, however, that many nouns show stem allomorphy beyond normal ablaut patterns, e.g. the *r/n*-stems, which end in [r] in (singular and sometimes plural) direct cases and [n] elsewhere. Such stem alternations are presumably due to readjustment rules, but I will not attempt to give an exhaustive account of such allomorphy in this essay.

The case endings of early PIE are given in (1). Note that this is a rather idealized picture of the PIE declension which, for reasons of space, does not address certain details and ambiguities of the reconstructed declension.

³ *-e-* does show up from occasionally in other cases: for instance, the thematic instr. sg. *-o-h₁* appears sometimes as *-e-h₁*.

(1)⁴

Examples:	Athematic: e.g. <i>ph₂-ter-</i> ‘father’		Thematic: e.g. <i>wlk^w-e/o-</i> ‘wolf’	
	ATHEMATIC SINGULAR	THEMATIC SINGULAR	ATHEMATIC PLURAL	THEMATIC PLURAL
Voc..	-∅	-e	-es	-o-es
Nom.	-s ⁵	-o-s	-es	-o-es
Acc.	-m	-o-m	-ms	-o-ms
Neuter nom./acc./voc.	-∅	-o-m	-h ₂	-e-h ₂
Dat.	-ei	-o-ei	-b ^h ios	-o-b ^h ios
Abl.	-es	-o-et	-b ^h ios	-o-b ^h ios
Gen.	-es	-o-s	-oHom	-o-oHom
Loc.	-∅	-o-i	-su	-o-su
Instr.	-eh ₁	-o-h ₁	-b ^h i	-o-ois

As we can see in the table, thematic and athematic nouns have the same endings in all cases except the abl. sg., instr. pl., and loc. sg. The gen. sg appears to have different

⁴ Cf. Meier-Brügger (2002), Sihler (1995), Rix (1976), Jasanoff (2004).

⁵ One sees -∅ listed as an athematic nom. sg. ending as well, but this is the product of a synchronic rule deleting -s after a resonant and lengthening a preceding vowel: e.g. /ph₂-ter-s/ ‘father’ → [ph₂-te:r]. In late

endings in the two declensions, but in fact the alternation *-es* ~ *-s* (i.e. in thematic gen. sg. *-o-s*) is a predictable consequence of PIE [e] ~ [o] ~ \emptyset ablaut, and the ending can be reconstructed as a single */-es/*. The same reasoning applies to the instr. sg., which has a single ending */-eh₁/* which appears in the zero-grade *-h₁* in the thematic declension.

For the remainder of section 1.2, we will analyze the declension in (1) on DM principles. This discussion and the rest of chapters 1-3 will make continual reference to the case features from the chart in the Introduction, p. xiv.

1.2.1. Nominative and Genitive Plural

We will begin with the nominative and genitive plural endings. The gen. pl. has the ending *-oHom* in both stem types, which does not occur elsewhere in the PIE declension.⁶ Now, the gen. pl. has the feature complex [+oblique, +structural, -superior, +free, +plural] (recall that case and number nodes have been fused, as described in the Introduction, so that case and number features are listed together). However, a comparison with the features of the other PIE cases reveal that it is not necessary to include the feature [+free] in the VI of *oHom*, since the other four features pick out the gen. pl. uniquely. Thus *oHom* is listed in the Vocabulary as follows:

- (2) *oHom* \Leftrightarrow [+oblique, +structural, -superior, +plural]

The nom. pl. ending *-es* also occurs only here in both declensions. This case can be picked out uniquely by the features [-oblique, +superior, +plural], and so we would expect the VI in (3):

PIE the lengthening of the nom. sg. is generalized as a morphological property of the nom. sg., so that e.g. earlier *pod-s* ‘foot’ becomes *po:d-s* (Meier-Brügger 2002: 198).

⁶ *H* is a cover symbol for “any laryngeal”, which is used in cases such as the gen. pl. ending where we cannot, for phonological reasons, discover which laryngeal was present.

(3) $es \Leftrightarrow [-\text{oblique}, +\text{superior}, +\text{plural}]$

However, another look at (1) suggests a different possibility. The phoneme /s/ occurs as the final element of a large number of PIE case endings: eight athematic and eight thematic cases, with a slightly different distribution in each. If we were to assume that each PIE case ending is a single undecomposable morpheme, we would need 17 different VIs, six of which end in /s/. Furthermore, we would be forced to assume that it is purely accidental that the acc. sg. is *-m* and the plural is *-ms* (we will return to this in the next section).

We can reduce the amount of redundant memorization required by this analysis by assuming instead that PIE has a morpheme *-s* which occurs in a number of different cases. If this is the case, though, its distribution is peculiar: *-s* occurs in singular, plural, oblique and direct cases apparently without discrimination, so that we cannot pick out any features common to every instance. This fact suggests that *-s* is the “default” or “elsewhere” morpheme in PIE, like “spurious *se*” in Harris’ account of Spanish clitics (Introduction, p. xi).⁷ In order to get nom. pl. *-e-s* under this analysis, we must assume that there are two separate morphemes *e* and *s*, and that *e* is marked to undergo fission. Thus we can replace (3) with the VIs in (4):

(4) $e \Leftrightarrow [-\text{oblique}, +\text{superior}, +\text{plural}]$ (fission)
 $s \Leftrightarrow []$

The process of Vocabulary Insertion for the nom. pl. terminal node is diagrammed in (5).

Since we have fission in the nom. pl., the features not discharged by *e* -- i.e. [+structural]

⁷ This suggestion mirrors Halle and Vaux’s (1998) analysis of Latin, where the same *-s* is the default as well. This appears to be true of a number of other Indo-European languages as well, including Greek and Hittite, as we shall see, as well as Latvian, Sanskrit, etc.

and [+free] -- are copied into the empty terminal node created by fission, which then undergoes vocabulary insertion as well.

- (5) [-oblique, +structural, +superior, +free, +plural]
 ↓
 [-e-] + [+structural, +free]
 ↓
 [-e-] + [-s]

Of course, (5) will take place only if there is no VI in the PIE Vocabulary with one or both of the features [+structural, +free] and no more. In fact, as we will see below (section 1.2.4), PIE does have a morpheme *o* whose only feature is [+free], and so we would expect prima facie that the nom. pl. ending should be *-*e-o*. Here another important feature of DM, impoverishment, comes into play. We can prevent the insertion of *o* into the second node by impoverishing the feature [+free] in the nom. pl.:

- (6) [+free] → ∅ / [__, -oblique, +superior, +plural]

Since impoverishment occurs before vocabulary insertion, the feature [+free] will not be present in (5), and the ending will surface correctly as *-e-s*.

1.2.2. Accusative Singular and Plural

The analysis of nom. pl. *-es* as two independent morphemes *-e-* and *-s* developed in the preceding section is crucial to the correct analysis of the acc. sg. *-m* and the acc. pl. *-ms*. It seems reasonable to analyze these endings as containing an accusative ending *m* which is not specified for number. For reasons which will become clear later (section 1.2.8, on the neuter sg. NAV in *-m*), this VI can contain no case features except [-oblique].

- (7) $m \Leftrightarrow [-\text{oblique}]$ (fission / [__, +plural])

Since the morpheme undergoes fission in the plural, and the ending *-m-s* results by a process similar to that in (5). Again, we must verify at the end of our analysis that PIE has no VI with a subset of the remaining features of the accusative plural which appear in its fission node, i.e. [+structural, -free, +plural], so that the default *-s* is correctly inserted. Since it seems likely that the acc. sg. *-m* and the acc. pl. *-ms* are related in this way, the appearance of a clearly independent morpheme *-s* in this ending lends credence to our analysis of *-e-s* as the result of fission.

1.2.3. Singular Oblique Cases (except Locative)

The dat. sg. is *-ei* in both stem types, and the instr. sg. is likewise uniformly *-eh₁*.⁸

These facts suggest the VIs in (8):

- (8) $ei \Leftrightarrow [+oblique, +structural, +superior, -plural]$
 $eh_1 \Leftrightarrow [-structural, +superior, -free, -plural]$

The case of the gen. and abl. sg. is slightly more complex, and the importance of underspecification in accounting for syncretism becomes clear here. The gen. sg. is *-e-s* in the gen. sg. of both stem types, presumably with the same default *-s* that we saw earlier in the nom. and acc. pl. The thematic abl. sg. has a different ending *-et*, but the athematic abl. sg. has the same ending as the gen. sg. of both types, *-e-s*. These facts fall out naturally if *et* is specific to the thematic abl. sg., and the morpheme *-e-* is underspecified with respect to the genitive and ablative sg. This morpheme also undergoes fission, and

⁸ It is generally assumed that the dat. sg. **-ei* is related by ablaut to the zero-grade loc. sg. **-i*, given the close connection between the two cases (e.g. in Hittite, where they have the same exponent, cf. ch. 3). However, there is no principled way to connect the two endings in terms of synchronic phonology of PIE, and the connection must be purely historical (cf. Meier-Brügger 2002: 198-9, Sihler 1995: 253).

It is not necessary to specify that $-b^hi$ is the athematic ending only, since we have already accounted for the thematic instr. pl. in (10).

In order to get the additional morpheme $-os$ in the dative and ablative, we must assume that bh is marked to undergo fission in the dat. and abl. pl., as we anticipated in (11). We also need another VI o which is marked to undergo fission and specified for the single feature shared by the dative and ablative which has not already been discharged by the insertion of b^hi :

(12) $o \Leftrightarrow [+free]$

Since the only feature left in the dat. and abl. pl. is $[_structural]$, which is not matched by any VI in the Vocabulary, the elsewhere morpheme $-s$ will be inserted here; thus we have a tripartite ending $-b^hi-o-s$.⁹

1.2.5. Vocative Plural

So far, we have no account for the PIE vocative, since Halle and Vaux do not suggest a feature set for this case. From their description of the various case features (quoted in the Introduction, p. xi), however, we can infer several features of the vocative. The vocative is not an argument of the verb, and it is a semantic category, so we should expect the features $[+oblique, -structural]$. Furthermore, it occurs in a non-governed position and has no consistent role in argument structure, which suggests the features $[+superior, +free]$. Halle and Vaux, however, assign these features to the ablative, and so we must revise either the ablative or our assumptions about the vocative.

⁹ There is some reason to believe that the instr. pl. ending may have been $-b^hi-s$ rather than simply $-b^hi$. If this is the case, we need only have fission in this case too, and the default $-s$ will be inserted in this case as well.

However, it is relevant that nom./voc. syncretism is extremely common cross-linguistically. Since syncretism is more likely and easier to implement formally when two cases share a number of features, we can infer that the nom. and voc. cases share several features. In addition, the nom., voc., and acc. appear to constitute a natural class, since syncretism of the nom., voc., and/or acc. is also well-attested (as we will see in greater detail later). Therefore it is reasonable to assign the vocative the feature [-oblique], which is shared by the nom. and voc. to the exclusion of all other cases except the ergative (which is nearly absent in Indo-European)¹⁰. Thus we will assign the vocative case the features [-oblique, -structural, +superior, +free] throughout the present work.¹¹

This solution immediately explains the fact that the voc. pl. is *-e-s* like the nom. pl. We argued that the nom. pl. ending *-e-* has the VI reproduced here:

(13) (=3)) $e \Leftrightarrow [-\text{oblique}, +\text{superior}, +\text{plural}]$

We have assumed that the vocative is also [-oblique] and [+superior], and thus the voc. pl. will be *-e-s* as well.

1.2.6. Locative and Vocative Singular

The thematic voc. sg. is *-e*, which is generally assumed to be simply the theme vowel *-e-/o-*, appearing here as *-e-*.¹² Since the athematic voc. sg. is \emptyset , we can plausibly

¹⁰ Except in Hittite, as we will see in chapter 3. If anything, the Hittite ergative supports this claim about the features of the vocative, since the ergative suffix *-ant-* also occurs occasionally in vocatives.

¹¹ However, we may be required to expand somewhat the definition of the feature [oblique] in Halle and Vaux (1998: 225) in order to assign [-oblique] to the vocative: “[t]he feature specification [-oblique] is assigned to nominals that are arguments of the verb”. Since the vocative is not an argument of the verb, we must find some more expansive definition of [oblique] if the vocative is [-oblique]. At present, I have no specific solution to this question.

¹² As often, the conditioning of this [e]~[o] alternation is rather opaque. In this case, since only two cases of the thematic declension normally have the *e*-grade of the thematic vowel (voc. sg. and neuter pl.), it may

infer that the thematic voc. sg. is actually *-e-ø*, which allows us to posit a single ending for the voc. sg. However, *-ø* occurs in the athematic loc. sg. as well. Rather than propose two VIs for these cases which merely happen to be homophonous, we can unite these two as a single morpheme *ø*:

$$(14) \quad \emptyset \Leftrightarrow [-\text{plural}]$$

This VI predicts that any singular case which has no more specific exponent because of the VIs which happen to be available in the language will surface with the ending *-ø*. However, since the vocative is also [-oblique], our prima facie expectation is that the [-oblique] ending *-m* will appear in the vocative. Thus the feature [-oblique] must be deleted by impoverishment in the voc. sg.:

$$(15) \quad [-\text{oblique}] \rightarrow \emptyset / [_, -\text{structural}, -\text{plural}]$$

The thematic loc. sg., however, is *-i*. The simplest way to account for this difference is to suppose that the thematic loc. sg. *-i* is specified for thematic stems only, as in (16):

$$(16) \quad i \Leftrightarrow [+ \text{oblique}, -\text{structural}, -\text{superior}, -\text{plural}] \text{ in the environment } [e/o] + _$$

Because the VI *i* cannot be inserted in [-thematic] stems, the athematic loc. sg. ending is the next available VI, the [-plural] default *-ø*. Thus, the distribution of *i* and *ø* in the loc. and voc. sg. is generated by a combination of underspecification and impoverishment.

1.2.7. Nominative Singular

The nominative singular ending is *-s*. Since we have already argued that there is a default ending *-s*, the most economical analysis is that this nom. sg. is simply this default

in fact be simpler to derive the alternation by readjustment rather than by productive ablaut processes. However, an answer to this question would depend on a generative phonological account of PIE ablaut,

ending. However, appears to conflict with our claim that the VI \emptyset is specified [-plural] and m is [-oblique], since the nom. sg. has both these features, and we would expect one of these to appear in the nom. sg. as well. We can solve this problem by impoverishing the features [-plural, -oblique] in the nom. sg:

$$(17) \quad [-\text{plural}, -\text{oblique}] \rightarrow \emptyset / [_, +\text{structural}, +\text{superior}]$$

This rule will prevent the insertion of [-plural] $-\emptyset$ and [-oblique] $-m$, which will cause the default ending $-s$ to be inserted instead.

1.2.8. Neuter Nominative/Accusative/Vocative

Neuter nouns differ from non-neuters only in the nominative, accusative, and vocative, and the ending of these three cases is always the same in the neuter. For thematic nouns, the neuter sg. ending is $-m$, the same as the acc. sg./pl. ending $-m$. Since we have already suggested that the VI m refers only to the feature [-oblique], and the nom., acc., and voc. are all [-oblique], we already expect $-m$ here unless there is some higher-ranked ending for this case. If we order m above [-plural] \emptyset in the Vocabulary, the thematic neuter sg. NVA will all have the ending $-m$ simply as a result of the underspecification of this morpheme.

However, the athematic neuter sg. $-\emptyset$ requires more machinery. In order to prevent the higher-ranked morpheme $-m$ from being inserted instead, we must posit a rule of impoverishment deleting the feature [-oblique] in the athematic neuter sg. NAV:

$$(18) \quad [-\text{oblique}] \rightarrow \emptyset / [_, -\text{plural}] / [+neuter] + [e/o] + _$$

As a result, the next available exponent, the [-plural] default \emptyset , will be inserted here.

which I am not prepared to give.

In the neuter plural NAV, both declension types have the ending $-h_2$. We can account for this fact with a single VI:

$$(19) \quad h_2 \Leftrightarrow [-\text{oblique}, +\text{plural}] / [+neuter] + ___$$

Here and in chapters 2 and 3 on Greek and Hittite, where the facts are similar, it may seem odd that we use three different strategies (underspecification, impoverishment, and a special neuter plural VI) to account for a single generalization, the fact that the neuter nom., acc., and voc. are always identical. We will refine and expand our explanation of these facts further in chapter 4, section 4.2.1.

1.2.9. Locative Plural

The locative plural ending in both declension types is $-su$.¹³ One way to account for this ending is simply to posit a VI su for this case, as in (20):

$$(20) \quad su \Leftrightarrow [+oblique, -\text{structural}, -\text{superior}, +\text{plural}]$$

This account is relatively straightforward. However, one fact might give us pause: we have already suggested that there is a default morpheme s , and it would be economical to utilize this morpheme if possible by segmenting $-su$ into $-s-u$.

In all cases of fission that we have seen, however, the default $-s$ has appeared external to a more highly specified morpheme. There is some precedent for the opposite order, though: Halle and Vaux (1998) and Halle (1997) analyze the Latin 1st, 2nd, and 5th declension gen. pl. $[-rum]$ as underlying $/-s-um/$, i.e. the normal gen. pl. ending $-um$ plus

¹³ I follow Rix (1976: 140) and Sihler (1995: 253) in assuming that the PIE thematic loc. pl. ending was originally $*-o-su$, and was remodeled to $*-o-isu$ in some dialects of PIE (e.g. Greek $-o-isi$, Sanskrit $-esu$) under the influence of the pronominal paradigm, e.g. $*toi-su$ loc. pl. ‘that’. Sihler claims that this $-o-su$ is the source of the Hittite oblique plural ending $-as$, which we will see in ch. 3, but this is not necessarily correct. This position simplifies our analysis of PIE considerably, although the presence of $*-o-isu$ in late PIE still requires a more complex account (cf. section 1.3 below).

the morpheme *s* (the elsewhere ending in Latin as well) inserted into a fission node which appears closer to the root than the regular gen. pl. ending *um*, and then regularly rhotacized in intervocalic position. The PIE loc. pl. would then be a similar case, with the loc. pl. morpheme *u* and the default *s* we have seen elsewhere.

It may seem odd for the fission node to appear more closer to the root than the node whose fission caused it to be created, but this process is readily intelligible in DM. Since hierarchical structure is retained throughout the derivation even after vocabulary insertion, it is possible to insert a new node between two nodes which have already been given phonological content (this would, of course, be more problematic in theories in which hierarchical structure is erased after the syntax). However, in DM, there is no reason we cannot simply stipulate that the fission node into which default *s* is inserted appears to the left of dative *i*; in fact, there is reason to believe that the location of the fission node must be stipulated in other cases as well (cf. Halle 1997 on Semitic imperfects), although its placement as a sister node is presumably the default. Thus we can conclude that the loc. pl. *-su* is bipartite, and the morpheme *u* will have the following VI:

- (23) $u \Leftrightarrow [+oblique, -structural, -superior, +plural]$ (fission)

1.2.10. The *ta zdɔ:a trek^hε:* Rule

Greek, Hittite, and Sanskrit share a morphosyntactic peculiarity which can be traced back to PIE, known as the *ta zdɔ:a trek^hε:* rule, which is Greek for “the animals run”. In this sentence, the subject *ta zdɔ:a* is a neuter plural, but the verb *trek^hε:* is singular. The fact that neuter plurals always have singular verbal agreement can be

explained by the history of the PIE neuter plural $-h_2$, which was originally a collective suffix rather than a plural. Thus, for instance, Greek has residual oppositions such as masc. pl. *i-o-i* ‘arrows’ vs. neuter pl. (collective) *i-a* ‘bunch of arrows’, from which the historical origin of this agreement rule is more intelligible. Nevertheless, this rule was synchronically bizarre in the attested Indo-European languages, and perhaps already in PIE.

There are two possible accounts for this agreement pattern. First, we could impoverish the feature [+plural] in verbs when they agree with neuter subjects. However, this would mean increasing the power of impoverishment substantially: up to this point, impoverishment has been conditioned only by features of the same terminal node affected by impoverishment or of other nodes within the noun (i.e. gender and declension class). If impoverishment can be conditioned by syntactic position in this case, however, the locality conditions of impoverishment would have to be substantially weakened, since the feature [+neuter] of the subject NP is in its post-syntactic position at [Spec, IP] at MS, substantially removed from VP.

A better solution is to add a stipulation to the feature-copying process of agreement that the feature [+plural] is not copied onto verbs from neuter subjects. This solution will be reconsidered and refined slightly in chapter 3, section 3.6.

1.2.11. Summary of Early PIE

In our discussion of the early PIE declension, we have proposed the VIs in (25) and the rules of impoverishment in (26):

- (25) $oi \Leftrightarrow [-\text{structural}, +\text{superior}, -\text{free}, +\text{plural}] / [+ \text{thematic}] + __$ (them. instr. pl.)
 $et \Leftrightarrow [-\text{structural}, +\text{superior}, +\text{free}, -\text{plural}] / [+ \text{thematic}] + __$ (them. abl. sg.)

i	⇔ [+oblique, -structural, -superior, -plural] / [+thematic] + __	(them. loc. sg.)
oHom	⇔ [+oblique, +structural, -superior, +plural]	(gen. pl.)
ei	⇔ [+oblique, +structural, +superior, -plural]	(dat. sg.)
u	⇔ [+oblique, -structural, -superior, +plural]	(fission) (loc. pl.)
b ^h i	⇔ [+oblique, +superior, +plural] (fission / [__, +free])	(dat./abl./instr. pl.)
e	⇔ [-oblique, +superior, +plural] (fission)	(nom. pl.)
eh ₁	⇔ [-structural, +superior, -free, -plural]	(instr. sg.)
e	⇔ [+oblique, +free, -plural] (fission)	(gen. sg., ath. abl. sg.)
h ₂	⇔ [-oblique, +plural] / [+neuter] + __	(neuter NVA pl.)
o	⇔ [+free] (fission)	(dat./abl. pl.)
m	⇔ [-oblique] (fission / [__, +plural])	(acc. sg./pl.)
ø	⇔ [-plural] (voc. sg., ath. loc. sg., ath. neuter NVA sg.)	
s	⇔ []	(elsewhere)

- (26) [+free] → ø / [__, -oblique, +superior, +plural]
 [-plural, -oblique] → ø / [__, +structural, +superior]
 [-oblique] → ø / [__, -plural] / [+neuter] + [e/o] + __
 [-oblique] → ø / [__, -structural, -plural]

1.3. Late PIE

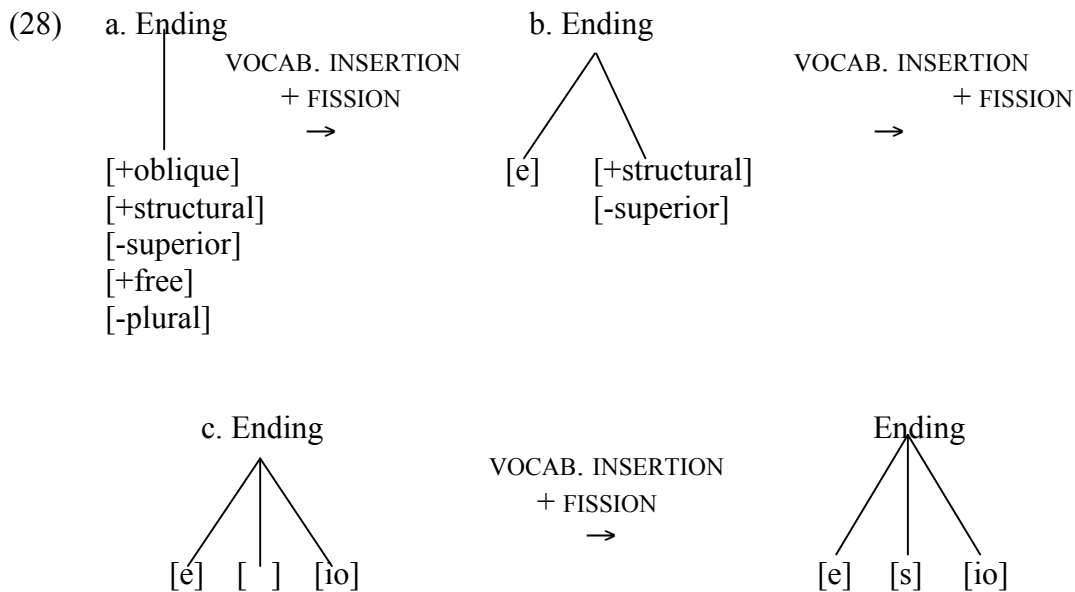
In this section, we will review some important changes which occurred within PIE at a late stage. These should not necessarily be taken as a coherent synchronic system, since each has a slightly different distribution in the Indo-European languages. Rather, the goal is to discuss the formal implementation of these diachronic developments. Three important changes will be emphasized here: the change of the thematic gen. sg. from *-o-s* to *-o-s-io*; the extension of the thematic loc. sg. *-i* to the

athematic nouns; and the change from thematic dat. pl. *-s-u* to *-i-s-u*. Each change shows a different aspect of the interaction of our analysis with historical change.

A notable change between early and late PIE was the extension of the early PIE thematic gen. sg. */-o-e-s/* → *[-o-s]* to *-o-s-io* (Greek *-oio*, Sanskrit *-asya*, Old Latin *-osio*).¹⁴ The apparent solution is to add a new morpheme *io* which is inserted by fission in the thematic gen. sg. to generate this tripartite morpheme.

- (27) $e \Leftrightarrow [+oblique, +free, -plural]$ (fission)
 $io \Leftrightarrow [+structural, -superior]$ in the environment $[e/o] + __$ (fission)
 $s \Leftrightarrow []$

Since the order of morphemes produced by fission can vary, we need only assume that *io* is specific to thematic nouns, so that the athematic gen. sg. remains *-e-s*, while the thematic gen. sg. appears as *e-s-io*. The latter is diagrammed in (28):



¹⁴ The extension *-io* may have originated in the relative/demonstrative pronoun **io-*, used here to disambiguate the thematic nom. and gen. sg. and later resegmented as part of the ending, cf. Meier-Brügger 2002: 200 with references. This and similar historical changes in Greek will be analyzed in more detail in chapter 4.

In the case of athematic *-e-s*, *io* will not be inserted after step (b), and *s* will appear instead, yielding the correct output.

The final change we will consider is a similar issue. In early PIE, the thematic loc. pl. was *-s-u*, but in late PIE it appears as *-isu*, with *-i-* apparently borrowed from the pronominal endings (cf. note 11). The formal implementation of this change is more difficult than in the previous case, however: since we have analyzed *-su* as two morphemes *s* and *u*, the most economical analysis is that the new *i* is the same *-i* which appears in the loc. sg. However, in order to implement this possibility we would need to revise the VIs for *u* and *i* considerably, since they share a number of features in our analysis of early PIE.

One possibility is that *i* was reanalyzed as a simple [+oblique] morpheme in late PIE: since it appears in the singular normally, but in the plural in *-i-s-u*, it would need to be unspecified for number, and it cannot share any features with *u* since it must be inserted into a node produced by the fission of the latter. The features of the loc. pl. other than [-oblique] ([-structural, -superior, -free, +plural]) are sufficient to pick out this case uniquely, and thus this reanalysis would work formally. The new VIs are given in (29):

(29) $u \Leftrightarrow [-\text{structural}, -\text{superior}, -\text{free}, +\text{plural}]$ (fission)

$i \Leftrightarrow [+oblique]$ (fission)

Fission will occur as in (28), except that *u* will fission to the left, and *i* will fission to the right. Since all features of the loc. pl. are discharged by the two morphemes in (29), the default *s* will be inserted in the node created by the fission of *i*, and the result is the tripartite morpheme *-i-s-u*.

However, the athematic loc. pl. remains *-s-u* in late PIE, and we must prevent it from becoming *-i-s-u* as well. I suggest that late PIE also developed a rule of impoverishment deleting the feature [+oblique] in the athematic loc. pl., which prevents the insertion of *i* to the left of *u*, causing *s* to be inserted there instead, and the athematic loc. pl. to remain *-s-u* as it was before the reanalysis in (31). The motivation for the introduction of such a rule is that the introduction of *-i-* into the thematic declension occurred as a result of analogy to pronominal stems ending in *-i-*; no such athematic loc. pl. existed. Rather than introduce a new morpheme *-i* to account for the new thematic loc. pl. ending *-i-s-u*, it was simpler for learners to reanalyze the existing *i* and introduce a new rule of impoverishment.

This reanalysis also suggests a solution to the extension of the thematic loc. sg. ending *-i* to the athematic type, which has formerly had the ending \emptyset . In early PIE, these two endings had the following VIs:

- (30) $i \Leftrightarrow$ [+oblique, -structural, -superior, -plural] in the environment [e/o] + ____
 $\emptyset \Leftrightarrow$ [-plural]

Were it not for our analysis of *-i-s-u* above, we could see the extension of *-i* to the athematic type as a trivial reanalysis of the VI *i*, as in (31):

- (31) $i \Leftrightarrow$ [+oblique, -structural, -superior, -plural]

As a result, *-i* would be the ending of all locative nouns. Since we already have reason to believe that *i* has been reanalyzed as a generic [+oblique] ending, though, this change will occur automatically as a result of the VIs in (29). However, it is not necessary to assume that these two changes were causally linked: indeed, *i* may have been first reanalyzed as in (31), and only later as in (29). Nevertheless, when both

changes have occurred, the simplest analysis will be that the two endings are synchronically connected in this way.

Chapter 2:

The Greek Declension

The dialect of Greek we will focus on is Attic, as spoken in the area around Athens in the 5th and 4th centuries B.C. Attic has the following vowels and diphthongs:

(1)	Short:		Long:		Diphthongs:
	i	u	i:	u:	
			e: ¹⁵	o: ¹⁶	ai, a:i, au, ε:i, ε:u, oi, o:i, ui
	e	o	ε:	ο:	
		a		a:	

In this chapter, we will use the same case features, along with the new feature complex for the vocative which we suggested in chapter 1. Greek has only the five cases nom., acc., voc., dat., and gen., and I have omitted those which do not appear.

(2)

	Nom	Acc	Voc	Gen	Dat
Oblique	--	--	--	+	+
Structural	+	+	--	+	+
Superior	+	--	+	--	+
Free	+	--	+	+	+

¹⁵ Orthographically *ei*.

2.1. Declension Types and Theme Vowels

Greek has three stem types: *a*-stems, *o*-stems, and athematic stems. For the most part, 1st declension *a*-stems are feminine and 2nd declension *o*-stems are either masculine or neuter, while athematic nouns (the third declension) can be of any gender.¹⁷

Masculine is the default gender, which will play a crucial role later. We can formalize these relations with the following redundancy rules:

- (3) a. [] → [-fem, -neuter]
 b. [+fem] → [I]
 c. [] → [II]

As Halle and Vaux (1998: 224) point out, the rules in (3) account for the declension of adjectives: like Latin, Greek has a class of adjectives which select the thematic vowel *o* if the noun they modify is masculine or neuter, but *a*: if the noun is feminine. These are the same thematic vowels that are (by default) selected by nouns of the corresponding gender, by the theme vowel insertion rules in (4).

- (4) *a* / [I] + _____
 o / [II] + _____
 ø / [III] + _____

The redundancy rules in (3) do not override the gender or declension class of a noun if it is listed in the Vocabulary, but merely provide information for nouns which are not specified as to declension class, including most 1st and 2nd declension nouns. 3rd

¹⁶ Orthographically *ou*.

¹⁷ The Greek *a*-stems, like the *a*-stems of Latin and many other Indo-European languages, developed from PIE athematic nouns with a suffix **-e-h₂*, in origin a collective suffix. In PIE, these were inflected like other athematic nouns (cf. Meier-Brügger 2002: 201).

declension nouns and adjectives are specified for declension class, and 3rd declension nouns are also specified for gender. In addition, certain [-fem] nouns also appear as *a*-stems (e.g. *poie:t-a:-s* nom. sg. ‘poet’), and a few *o*-stems are [+fem] (e.g. *ho:d-o-s* fem. ‘road’). For these two types as well, gender and declension class must be listed in the Vocabulary.

In 1st declension nouns, the theme vowel *a* is typically lengthened to *a:* throughout the singular cases. In a small subclass of 1st declension nouns (type I(b)), however, the theme vowel is lengthened only in the gen. and dat. sg. We can account for this divergence by a rule of readjustment which lengthens the theme vowel *a* to *a:* in all singular cases in normal 1st declension nouns, but only in the gen. and dat. sg. in type I(b):

- (5) a. theme vowel /a/ → [a:] / [I(b)] + [-pl., +oblique]
 b. theme vowel /a/ → [a:] / [I] + [-pl]

2.1.1. Theme Vowel Length in the Vocative of 1st Declension Masculine Nouns

With respect to the lengthening of theme vowels in (5), most masculine 1st declension nouns behave like normal 1st declension nouns, with *-a:-* throughout the singular. In a certain subclass of 1st declension nouns, however, the vocative fails to be lengthened. According to Smyth (1920: 52), the voc. sg. *-a* occurs only in (a) nouns with the agentive suffix *-t-*, which surfaces as *-tɛ:s* (← /-t-a:s/), (b) compounds (e.g. *geɔ:-metrɛ:s*, *-a*, ‘surveyor’), and (c) nouns signifying nationalities (e.g. *Perse:s*, *-a*, ‘Persian’). This is hardly a natural class, but condition (a), at least, can be explained as an exception specific to the suffix *-t-*.

Condition (b), on the other hand, reveals an interesting morphological property of Greek. Greek morphology is sensitive to compounds in other areas as well: for instance, while adjectives normally agree with the noun they modify in gender, compound adjectives have masculine agreement even when modifying feminine nouns. So, for example, the adjective *agat^h-ε*: ‘good’ in *gunε: agat^h-ε*: ‘good woman’ has the 1st declension nom. sg. *-ε*: (from /-a:-ø/) as a result of rules (3b) and (4); but the adjective in *gunε: a-tim-o-s* ‘dishonored woman’ (a compound of *tim-* ‘honor’ and the prefix *a-* ‘not’) is 2nd declension masculine. This observation suggests that Greek has a rule of impoverishment which removes the feature [+fem] in compound adjectives only. Once this rule has applied, the redundancy rules 3(a) and 3(c) will convert the adjective to [II, -fem, -neuter], which will cause rule (4) to insert the theme vowel *o* instead of *a*.

Since Greek morphology is sensitive to compound formation elsewhere, it is not surprising that a rule lengthening theme vowels should be sensitive to the presence of a compound noun. Since the other cases do lengthen the theme vowel, the simplest solution is to formulate a rule lengthening the theme vowel only in these cases. Since the nom., acc., gen., and dat. share the feature [+structural], we can formulate the rule as follows:

- (6) theme vowel /a/ → [a] / [I, -fem] + [+structural]
 1. in compounds
 2. in nouns with the suffix *-t-*

We are left with condition (c), nouns signifying a nationality. I see no way to formalize this condition, and so I will leave the question open.

2.2. The Greek Declension

A number of rather complex vowel contractions obscure the underlying segmentation of the Attic Greek endings. These have been the subject of much generative research, e.g. by Steriade (1982) and Noyer (1997b). Rather than recapitulate these analyses, I will simply state the rules informally as they become relevant. For a simple pre-generative exposition of Attic vowel contraction, cf. also Smyth (1920: 19-21).

The most far-reaching phonological peculiarity of Attic is that long /a:/ becomes [ɛ:] in Attic except after an immediately preceding *e*, *i*, or *r*. This rule affects the surface forms of the Attic declension considerably, since most 1st declension nouns have the theme vowel -a:- throughout the singular cases. So, for instance, /p^hug-a:/ ‘flight’ → [p^hug-ɛ:] and /nik-a:/ ‘victory’ → [nik-ɛ:], but /k^hɔ:r-a:/ ‘land’ and /ski-a:/ ‘shadow’ are not affected.¹⁸ We will abstract away from this somewhat troubling rule, however, by representing all 1st declension forms with an underlying /a:/.

¹⁸ This rule has long been a source of puzzlement for several reasons. First, it is not obvious what feature(s) the segments share. A similar problem is posed by the Sanskrit *ruki* rule, as Morris Halle points out to me, and the palatalization of German /x/, which occurs after front vowels and coronal sonorants as described in Halle (2004): *ich* ‘I’, *solch* ‘such’, *manch* ‘several’, and *durch* ‘through’ all have [ç]. This suggests that the conditioning environment for German palatalization is [+sonorant, DACoronal] (the latter is a feature which Halle proposes and defends in his paper as a unary feature of coronal consonants and front vowels). However, this analysis does not apply immediately to Greek: /a:/ does not remain after /l/, which we would expect if the conditioning environment for Greek rule were the same as that of German palatalization. Possibly [l] was not [DACoronal] in Attic Greek, but all phonetic and historical analyses point to [l] rather than [ɭ] (cf. Bubeník 1983: 79).

A second troubling fact about the /a:/ → [ɛ:] rule is that, at least at first glance, the conditioning environment (*e*, *i*, or *r*) appears to *block* the application of another rule, rather than condition a rule. Furthermore, the presence of *a:* cannot be explained as a Duke of York gambit, since etymological *ɛ:* remains *ɛ:* after *e*, *i*, and *r*. One proposed solution is that Greek /a:/ was fronted to /æ:/ in Attic, and that two ordered rules applied afterward: first, /æ:/ → [a:] after *e*, *i*, and *r*, and then /æ:/ → [ɛ:] elsewhere (cf. Sihler 1995: 51). This is a plausible interpretation, since [æ:] is a likely intermediate stage between [a:] and [ɛ:]. However we analyze this phonological issue, it is not crucial to my analysis of the Greek declension, and I will abstract away from it by representing 1st declension forms with underlying *a:*.

The theme vowels and case endings of the various Greek declension types are given in (7) as a traditional paradigm. There is no consensus as to the underlying forms of the Greek case endings, and the segmentation and analysis are my own. In several cases the analysis is non-obvious, but I will attempt to justify it below.

(7)

	I	I(b)	I masc.	II masc.	II neut.	III m/f.	III neut.
Exx.:	<i>nik-</i> 'victory'	<i>moir-</i> 'fate'	<i>poiêt-</i> 'poet'	<i>hipp-</i> 'horse'	<i>dôr-</i> 'gift'	<i>t^hêr</i> 'beast'	<i>sômat-</i> 'body', ¹⁹
SINGULAR:							
Voc.	-a:-ø	-a-ø	-a:-ø / -a-ø	-e	-o-n	-ø	-ø
Nom.	-a:-ø	-a-ø	-a:-s	-o-s	-o-n	-s ²⁰	-ø
Acc.	-a:-n	-a-n	-a:-n	-o-n	-o-n	-n	-ø
Dat.	-a:-i	-a:-i	-a:-i	-o:-i	-o:-i	-i	-i
Gen.	-a:-s	-a:-s	-o-o ([o:-])	-o-o ([o:-])	-o-o ([o:-])	-o-s	-o-s
DUAL:							
Nom. Acc. Voc.	-a-e ([a:-])	-a-e ([a:-])	-a-e ([a:-])	-o:-e ([o:-])	-o:-e ([o:-])	-e	-e
Gen. Dat.	-a-in	-a-in	-a-in	-o-in	-o-in	-o-in	-o-in
PLURAL:							
Voc.	-a-i	-a-i	-a-i	-o-i	-a	-e-s	-a

¹⁹ Since word-final stops are deleted in Greek, the nom./voc./acc. sg. /sô:mat-ø/ surfaces as [sô:ma].

²⁰ 3rd declension nouns whose stem ends in a sonorant consonant delete the final -s with compensatory lengthening of the preceding vowel, e.g. /pater-s/ → [patê:r] nom. sg. 'father'. Incidentally, this rule is active and has similar effects in PIE and Latin.

Nom.	-a-i	-a-i	-a-i	-o-i	-a	-e-s	-a
Acc.	-a-n-s ([-a:s])	-a-n-s ([-a:s])	-a-n-s ([-a:s])	-o-n-s ([-o:s])	-a	-n-s	-a
Dat.	-a-i-s	-a-i-s	-a-i-s	-o-i-s	-o-i-s	-s-i	-s-i
Gen.	-a-ɔ:n ([-ɔ:n])	-a-ɔ:n ([-ɔ:n])	-a-ɔ:n ([-ɔ:n])	-o-ɔ:n ([-ɔ:n])	-o-ɔ:n ([-ɔ:n])	-ɔ:n	-ɔ:n

Like PIE and most other IE languages with a case system, Greek fuses case and number terminals: for instance, the gen. sg. has an ending $-o$, which cannot be related phonologically to the gen. pl. $-ɔ:n$, even if we were to assume that $-n$ is an independent morpheme. Thus $-o$ and $-ɔ:n$ reflect both case and number features (although we will see several cases where singular and plural have a single ending the plural is differentiated by a further morpheme, i.e. dat. and acc.).

At first glance, the declension in (7) appears extremely complex. For instance, only one case, the genitive plural, has the same ending in every declension type. Nevertheless, we will see that many morphemes recur throughout the declension in a well-constrained manner, and the system decomposes into a fairly straightforward set of Vocabulary Items, along with a few rules of impoverishment and readjustment.

2.2.1. Default *s* and Singular Default \emptyset

The morpheme *s* appears in a bewildering variety of cases in the Greek declension: nom. sg., gen. sg., nom./voc. pl., dat. pl., and acc. pl. This appears to be the elsewhere ending, as it was in PIE. We also see a number of singular cases with the ending $-\emptyset$, which does not occur in any plural cases, and it seems plausible that \emptyset is a

singular default. Both these assumptions mirror our analysis of PIE *-s* and *-ø* in chapter 1, which show a similar distribution. The necessary VIs are given in (8):

- (8) $\emptyset \Leftrightarrow [-\text{plural}]$
 $s \Leftrightarrow []$

2.2.2. Genitive Plural

The gen. pl. surfaces as *-ɔ:n* in every declension type. The absence of the thematic vowel in the I and II gen. pl. is due to a phonological rule which deletes short vowels before *ɔ:*, as in (9).²¹

- (9) $[-\text{consonantal}, +\text{sonorant}, -\text{high}] \rightarrow \emptyset / _ \text{ɔ:}$

This rule is also seen in the following verb forms (the Greek “contract verbs”):

- (10) $/\text{tima-}\text{ɔ:}/ \rightarrow [\text{tim}\text{ɔ:}]$ ‘I revere’
 $/\text{dɛ:lo-}\text{ɔ:}/ \rightarrow [\text{dɛ:l}\text{ɔ:}]$ ‘I reveal’
 $/\text{p}^{\text{h}}\text{ile-}\text{ɔ:}/ \rightarrow [\text{p}^{\text{h}}\text{il}\text{ɔ:}]$ ‘I love’

The rule applies only to $[-\text{high}]$ vowels, and does not delete the stem-final vowel in e.g. *su-ɔ:n* gen. pl. ‘pigs’. Apparent exceptions such as *pole-ɔ:n* gen. pl. ‘cities’ and *pε:k^he-ɔ:n* gen. pl. ‘forearms’ are due to rule ordering: these roots have a final underlying vowel which is resyllabified as a glide and then deleted intervocally only after (9) has applied:

²¹ The fact that there is an underlying theme vowel in the gen. pl. of the 1st declension is also verified by the circumflex accent of the surface product *-ɔ:n*. Although I have chosen not to represent accents because they are irrelevant to our analysis in most cases, in this case an otherwise unexpected circumflex accent is the trace of a vowel contraction: cf. $/\text{timá-o-men}/ \rightarrow [\text{tim}\text{ɔ:}\sim\text{men}]$ ‘we revere’, with an underlying acute *-a-* but a circumflex *-ɔ:-* on the surface. The 2nd declension gen. pl. is ambiguous, but could be the product of $/\text{-o-}\text{ɔ:n}/$. See Noyer (1997b) for more on Greek accentuation and an overview of the generative literature on the topic.

(11)	/polei-ɔ:n/	/pɛ:k ^h eu-ɔ:n/	/p ^h ile-ɔ:/ ‘I love’
Vowel Contraction (9)	-----	-----	[p ^h ilɔ:]
Syllabification	[polejɔ:n]	[pɛ:k ^h ewɔ:n]	-----
Glide deletion	[poleɔ:n]	[pɛ:k ^h eo:n]	-----
Surface Form	[poleɔ:n]	[pɛ:k ^h eo:n]	[p ^h ilɔ:]

In both /polei-/ and /pɛ:k^heu-/, the underlying stem-final vowel surfaces in the [-oblique] cases, because the vowel /-e-/ is deleted by a rule of readjustment. Thus the nom. sg. forms are *poli-s* and *pɛ:k^hu-s* respectively.

Since ɔ:n appears nowhere else in the declension, it has the VI in (12), which will cause it to be inserted in the gen. pl.

(12) ɔ:n ⇔ [+oblique, -superior, +plural]

2.2.3. Genitive Singular

The 2nd declension gen. sg. [o:] is underlyingly /-o-o/, a fact which is confirmed by other Greek dialects: the ending is *-oio* in Homeric Greek, and it is contracted in Attic after the loss of *-i-* by the rule of intervocalic glide deletion which we saw in (11) above. The 3rd declension gen. sg. *-o-s* can be analyzed as the same *o*, plus the default morpheme *s*. Thus this morpheme is marked to undergo fission in the 3rd declension gen. sg., but not in the 2nd declension. Thus we have the following VI for the gen. sg.:

(13) o ⇔ [+oblique, -superior, -plural] (fission / [III] + __)

However, (13) would predict that the 1st declension gen. sg. ending should be *-a:-o*, which does in fact occur in some dialects. The correct ending in Attic Greek, though,

is the default *s* (i.e. *-a:-s*), which is inserted in the 1st declension gen. sg. as a result of the impoverishment rule in (14):

(14) [-plural] → ∅ / [__, +oblique, -superior] / [I] + __

This rule makes the VI in (13) inapplicable in the 1st declension, as well as that in (8a), since both make reference to the feature [-plural]. Thus neither the gen. sg. ending *o* nor the singular default ∅ is inserted, and the only remaining available morpheme is the default *-s*.

We cannot, however, analyze the 1st declension masculine gen. sg. *-o:* as we did the other gen. sg. endings. *-o:* is the same as the 2nd declension gen. sg., which is unsurprising, as discussed above; but in the 1st declension, it is not the product of the 1st declension theme vowel *a:* plus expected ending *o*, since /a:o/ would probably surface as [ɔ:] in Attic.²² There does not, therefore, seem to be any way to derive *-o:* phonologically from any other plausible candidate, and we must conclude that *-o:* in the 1st declension masculine gen. sg. is the same as its 2nd declension equivalent, viz. /-o-o/.

We can capitalize on the fact that II is the default category for [-fem, -neuter] stems by positing a rule of impoverishment as in (15):

(15) [I] → ∅ / [+oblique, -superior, -plural] / [-fem]

This rule removes the lexically specified category information from the 1st declension masculine gen. sg. Since II is the default category by the persistent redundancy rule (3c), the affected forms will automatically become 2nd declension. As a result, the theme

²² I say ‘probably’ because I cannot actually find any attestations of this vowel sequence in Attic Greek (it would be most likely to occur after *e*, *i*, or *r* because of the rule converting /a:/ to [ɛ:] as discussed above). However, /ao/, at least, surfaces as [ɔ:] as in /tima-o-men/ → [timɔ:men] ‘we revere’. A review of the section on vowel contraction in Smyth’s grammar (1920: 18-21) reveals that *o:* (like its [-back] counterpart *e:*) is only attested as a product of contraction when the first of the two vowels is a short mid vowel, i.e. [e]

vowel will be *o* by rule (4), and the gen. sg. ending *o* will be inserted by (13). Note that (15) must apply before the impoverishment rule (14) which deletes [-plural] in 1st declension nouns, or it would not apply.

2.2.4. Dual

In each declension, the nom., voc., and acc. dual have the same ending, but this ending is different in every declension on the surface: *-a:* in the 1st, *-o:* in the second, and *-e* in the 3rd. Although *-e* appears on the surface only in the 3rd declension form, the most economical analysis is to posit a single ending *-e* for all three declensions. In the 1st declension, the surface form [-a:] could be from underlying /-a-e/, and this would also explain why this ending does not appear as [ε:] as we might expect: the rule converting /a:/ to [ε:] is simply ordered before vowel contraction.²³ The 2nd declension NVA dual *-o:*, however, cannot have merely the *-e* ending seen in the 1st and 3rd declensions, since /o-e/ → [o:] in Greek (e.g. in /e-de:lo-e/ → [edε:lo:] ‘reveal’, 3sg. impft.). The 2nd declension dual NVA *-o:* must be generated instead by an idiosyncratic lengthening and lowering of the theme vowel *-o* by a rule of readjustment. At this point, our most economical option is to assume that the ending *-e* which appears in the other NVA dual cases is present in the 2nd declension as well, since any short vowel is deleted when it appears in hiatus with [o:] (as we will see again later). If *-e* were not underlyingly present, we would need a complicated story to explain the presence of a different ending

or [o]. As far as I know, no one has ever suggested that [-o:] in the gen. sg. of 1st declension masculine nouns is anything but the 2nd declension form, and this seems to be the only possible analysis.

²³ We will see a similar case in our analysis of the acc. pl. [-a:s] (rather than *[-ε:s]) in section 2.2.5.

(presumably it would need to be $-\emptyset$, but this is the [-plural] default!). Thus we can posit a single underspecified VI for these three [-oblique] cases, as in (16):

(16) $e \Leftrightarrow [-\text{oblique}, +\text{plural}, +\text{dual}]$

Like the nom., acc., and voc. dual, the gen. and dat. dual always have the same ending, this time *-in*. Since these cases are all [+oblique], we need only the VI in (19) to account for them:

(17) $in \Leftrightarrow [+oblique, +\text{plural}, +\text{dual}]$

In theory, both (16) and (17) could refer only to the features [\pm -oblique, +dual]. However, this would result in the incorrect insertion of the plural endings in the dual nominative and genitive in certain cases, since the plural VIs would share more features with the dual nom. than the dual endings themselves. We can prevent this from happening by referring to the feature [+dual] as well.. Of course, this requires us to assume some rather intelligent manipulation of the system's combinatorial properties by learners, but this is already a condition of learning a morphological system as complex as that of Greek.

Unexpectedly, however, the 3rd declension gen./dat. dual is the same as the 2nd declension, *-o-in*, with the 2nd declension theme vowel *o*. Like the unexpected I masc. gen. sg. in *-o:*, this is a case of retreat to the unmarked case. Below (section 2.2.8, (33a)) we will show that the feature [+fem] is deleted in 3rd declension nouns after adjectival agreement. As a result of this impoverishment, all 3rd declension nouns will be supplied with the feature [-fem] by redundancy rule (3a). Therefore, we can explain the unexpected 2nd declension form in 3rd declension nouns by simply deleting the category information of 3rd declension oblique duals.

(18) [III] $\rightarrow \emptyset$ / [+oblique, +dual] + __

As a result of (18), these forms will be supplied with the default category II by rule (3c), even when the noun is lexically feminine, and will therefore surface with the theme vowel *o* by (4).

We should note in addition that the dual was moribund in Attic Greek, and was already optional in earlier dialects: for instance, *op^ht^halm-o-i* nom. pl. ‘eyes’ is more common in Homer than the dual *op^ht^halm-ɔ:*. This fact lends credence to our assumption that the dual is [+dual, +plural], since such a state of affairs can be generated simply by assuming that Greek had an optional, context-independent rule of impoverishment deleting the feature [dual]:

(19) [α dual] $\rightarrow \emptyset$ (optional)

When (19) is applied, the dual will have the same feature complex as a plural of the corresponding case. Eventually (19) became obligatory, at which point the dual cases were lost entirely.

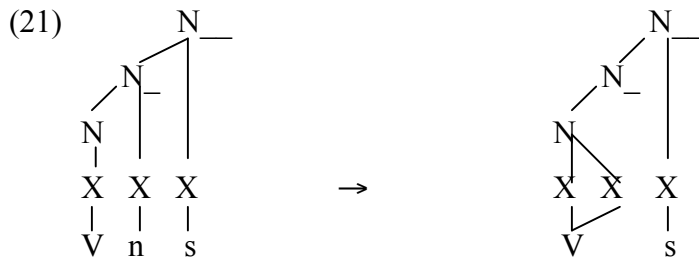
2.2.5. Accusative

The numerous forms of the acc. sg. and pl. are actually phonologically regular products of a single accusative marker *n* which occurs in both singular and plural.

(20) $n \Leftrightarrow [-\text{oblique}]$ (fission / [__, +plural])

This VI accounts for the acc. sg. ending *-n*. There is fission in the plural, and the only morpheme which is available for insertion in the fission node is the default *s*. As a result the acc. pl. ending is *-n-s*.

The surface forms of the 1st and 2nd declension acc. pl., [-a:s] and [-o:s] respectively, are derived phonologically from /-a-n-s/ and /-o-n-s/ respectively as in (21):



This rule is also responsible for the declension of /hen-/ ‘one’:

	UR	Surface Form
nom. sg.	/hen-s/	[he:s]
gen. sg.	/hen-os/	[hen-os]

Note that rule (21) must be ordered after the change of /a:/ to [ɛ:]: otherwise, the acc. pl.

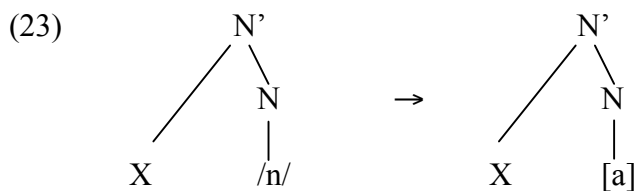
/-a-n-s/ would surface as *[-ɛ:s].

The 3rd declension acc. pl. ending *-as* might give us pause, but it is in fact a reflex of the same acc. pl. /-n-s/. We can see this fact in the alternation of *-a* and *-n* in the 3rd declension acc. sg., which is predictable: *-a* occurs in athematic stems which end in a consonant, e.g. *hr̥e:tor-a* ‘speaker’, and *-n* in stems ending in a vowel, e.g. *poli-n* ‘city’.

This alternation is usually explained in historical terms as a reflex of Indo-European syllabification rules: PIE liquids and nasals became syllabic nuclei between two consonants or between a consonant and a word boundary.

However, the *-n* ~ *-a* alternation in the 3rd decl. acc. sg. *poli-n* vs. *hr̥e:tor-a* suggests that this syllabification rule is still active in Greek. Such alternations are also created by suffixation: e.g. /onomn/ → *onoma* ‘name’, /onomn-iɔ:/ → [onoman-iɔ:] → [onomainô] ‘name (verb)’ (Smyth 1920: 18). The underlying /-n/ in /onomn/ is revealed in the suffixed verb form, where an underlying /onoma-iɔ:/ would surface as [onomaiɔ:].

Thus, I suggest that Greek has a word-level syllabification rule producing these alternations:



Note that, since (23) takes place in the word-level phonology, the final /-n/ in /hr̥e:tor-n/ will be syllabified as [-a] even if the following word begins with a vowel. This is, incidentally, the same environment in which nasals were syllabified in PIE.

Thus, although the *-n* ~ *-a* alternation is usually assumed to be a purely historical phenomenon inherited from PIE by Greek, our morphological system will be greatly simplified if we assume that it is still synchronically active in some cases, and there do not appear to be any compelling counterexamples (cf. Sommerstein 1973). Certainly many cases of Greek *a* from a PIE syllabic nasal did not alternate with *n*, and so were reanalyzed as underlying /a/; however, in the case of the accusative ending *-n*, the presence of such an alternation made the underlying /n/ recoverable.

Since Greek nouns with *-a* and *-a-s* in the acc. have stems ending in a consonant, (23) allows us to derive these endings phonologically from underlying /-n/ and /-n-s/, which are the same accusative endings seen in the other declension types.

2.2.6. Dative

The dat. is parallel to the accusative: since we have *-i* in the singular and *-i-s* in the plural, we have only to posit a single morpheme *i* which occurs throughout the dative, and undergoes fission in the plural, as in (24):

$$(24) \quad i \Leftrightarrow [+oblique, +superior] \quad (\text{fission} / [_, +plural])$$

As in the case of the acc. pl., this fission node will be filled with the default *s*, yielding the 1st and 2nd declension dat. pl. *-i-s*.

The 3rd declension dat. sg. *-s-i* is parallel to the PIE loc. pl. *-s-u* discussed in ch. 1, section 1.2.9. There, we saw that in certain cases, the node created by fission appears to the left of the node into which the more highly specified morpheme was inserted. Thus the 3rd declension dat. pl. *-s-i* is in fact the same dative *-i* we have seen elsewhere, with the fission node appearing before the *i* as an idiosyncratic property of fission in this case.

The final complication in our analysis of the dative is the 2nd declension dat. sg. *-o:-i*. The final *-i* is the same as *-i* in the dative of other declensions, but the presence of the vowel *-o:-* (as opposed to, say, [o] or [o:]) is synchronically bizarre. We must assume that, as in the 2nd declension NVA dual *-o:-e*, the theme vowel *-o-* is lengthened and lowered here by a special rule of readjustment.

2.2.7. Nominative and Vocative Plural

In the previous section, we suggested that the dat. ending *-i* is specified [+oblique, +superior]. The I and II nom./voc. pl. ending is also *-i*, and it would be desirable to

collapse these two morphemes if possible. Since the nominative is also [+superior], we can revise (24) as (25):

$$(25) \quad i \Leftrightarrow [+superior]$$

If we accept this solution, we must also explain why *i* does not appear in the nominative singular; I suggest that there is a rule of impoverishment deleting the feature [+structural] in the nom. sg., as in (26):

$$(26) \quad [+structural] \rightarrow \emptyset / [_, -oblique, +superior]$$

The remaining nom./voc. pl. forms are relatively simple to account for. The 3rd declension nom./voc. pl. is evidently *-e-s*, with fission and the default *-s*. Its VI is given in (27):

$$(27) \quad e \Leftrightarrow [-oblique, +superior, +plural] / [III] + _$$

The neuter nom./acc./voc. pl. has the ending *-a*, but the theme vowel *o* does not appear in the 2nd declension. This suggests that the theme vowel is deleted by a phonological readjustment rule in the neuter plural [-oblique] cases, and that *a* has the following VI:

$$(28) \quad a \Leftrightarrow [-oblique, +plural] / [+neuter] + _$$

2.2.8. Nominative and Vocative Singular

The nom. and voc. sg. show a variety of forms, most with either the default singular ending *-ø* or the general default *-s*. One exception is the 2nd declension masc. voc. sg. *-e*. It would be difficult to unify this *-e* with the *-e* in the nom./acc. dual or the 3rd declension nom. pl. *-e-*, and I assume that they are merely homophonous. Thus the II voc. sg. *-e* has the VI in (29):

(29) $e \Leftrightarrow [-\text{oblique}, -\text{structural}, -\text{plural}] / [\text{II}] + ___$

The 2nd declension neuter nom./voc. sg. is the same as the accusative, i.e. *-o-n*, which may seem strange at first glance. Although the morpheme *-n* appears in the acc. sg. and pl. of all declensions, we were careful to give it only the feature [-oblique], since it also occurs in the 2nd declension neuter nom./voc. sg. This is similar to the strategy used by Halle and Vaux (1997) to account for a similar set of facts in Latin: they argue that Latin *m* (the etymological equivalent of Greek *n*) has the feature specification [-oblique, -plural], and that \emptyset and *s* are [-plural] and elsewhere defaults, respectively, just as in Greek. Thus, unless a more highly specified VI intervenes or impoverishment takes place, the nom., voc., and acc. sg. of all declension types are expected to appear as *-m*. It is a simple matter to derive the cases where *-o* or *-s* appears in the Latin [-oblique] cases: simply impoverish the feature [-oblique] to get *-o*, and impoverish [-plural] to get *-s*.²⁴

This analysis is elegant, and the facts of Greek are virtually identical to Latin: both languages have *-m/-n* in the *o*-stem neuter nom., acc., and voc. sg., and the *a*- and *o*-stem acc. sg.; both have *-o* in the *a*-stem nom. sg. and all nom., acc., and voc. neuter sg. forms, and *-s* elsewhere. The Greek case is slightly more complicated, since the morpheme *-n* appears in the acc. pl. as well. We must first ensure that the nom./voc. pl. morphemes are ranked higher in the Vocabulary than *n* and so prevent its insertion in the plural nom. and voc.

In addition, we must modify Halle and Vaux's impoverishment strategy slightly in order to generate the Greek facts: in the singular cases, delete [-oblique] to get the [-

²⁴ The Greek and Latin 1st, 2nd, and 3rd declensions are basically identical in the direct singular cases except that Latin has *-m* where Greek has *-n* (by regular phonological change). Thus when we refer to the layout of the Latin chart in Halle and Vaux's paper, the reader can simply refer to (7), which has virtually the same content in the [-oblique] cases.

plural] default $-\emptyset$, and delete [-oblique, -plural] to get $-s$. For example, in order to account for the 1st declension nom. and voc. sg. ending $-\emptyset$ in this way, we need the rule of impoverishment in (30):

- (30) [-oblique] \rightarrow \emptyset / [I, +fem] + [__, +superior, -plural]

This rule prevents the insertion of *-n*, allowing the singular default *-ø* to be inserted in the 1st declension singular nominative and vocative cases. *-ø* also occurs in the 3rd declension neuter nom./acc./voc.; we can account for this fact by another rule of impoverishment:

- (31) [-oblique] $\rightarrow \emptyset$ / [III, +neuter] + [__, -plural]

Finally, we must explain the presence of *-s* in the nom. sg. of several declension types, since the expected ending is *-ø*. This can be solved by positing a rule of impoverishment deleting the features [-oblique, -plural] in these cases, as in (32).

- (32) [-oblique, -plural] → ∅ / [__, +structural, +superior]
- | | |
|----|------------------|
| | + [I, -fem] |
| OR | + [II] |
| OR | + [III, -neuter] |

Of course, the classes picked out by this rule -- I [-fem], II [-neuter], and III [-neuter] -- are not a natural class, since third declension nouns can be [-fem] or [+fem]. However, third declension feminine nouns are always identical with masculine nouns of the same declension, and so we may be justified in positing a rule which will remove the feature [+fem] in third declension nouns. This would allow us to rewrite (32) with the more natural rules of impoverishment in (33):

- (33) a. [+fem] → ∅ / [III] + __
 b. [-oblique, -plural] → ∅ / [-feminine, -neuter] + [__, +structural, +superior]

After (33a) applies, the feature [-fem] will be automatically inserted in the third declension by the rule of redundancy in (1c), which allows (33b) to apply. The result is

the insertion of the correct ending, the default *-s*. Crucially, the deletion of the feature [+fem] takes place after adjectival agreement, since 3rd declension feminine nouns have feminine agreement. In addition, we have seen independent confirmation of rule (33a) above in section 2.2.4, where we made use of this rule of impoverishment to explain the unexpected appearance of the 2nd declension theme vowel *-o-* in the 3rd declension gen./dat. dual.

2.2.9. Summary

All the Vocabulary Items competing for insertion in the ending node of Greek nouns are listed in (34).

- (34)
- | | | |
|-----|--|-------------------------------------|
| e | ⇔ [-oblique, -structural, -plural] / [II] + __ | |
| in | ⇔ [+oblique, +plural, +dual] | |
| e | ⇔ [-oblique, +plural, +dual] | |
| ɔ:n | ⇔ [+oblique, -superior, +plural] | |
| e | ⇔ [-oblique, +superior, +plural] / [III] + __ | (fission) |
| o | ⇔ [+oblique, -superior, -plural] | (fission / [III] + __) |
| a | ⇔ [-oblique, +plural] / [+neuter] + __ | |
| i | ⇔ [+superior] | (fission / [__, +oblique, +plural]) |
| n | ⇔ [-oblique] | (fission / [__, +plural]) |
| ø | ⇔ [-plural] | |
| s | ⇔ [] | |

In addition, we have proposed the following rules of impoverishment:

- (35)
- | | |
|-----------|---|
| [+fem] | → ø in compound adjectives |
| [-plural] | → ø / [I] + [__, +oblique, -superior] |
| [I] | → ø / [-fem] + [+oblique, -superior, -plural] |
| [III] | → ø / __ + [+oblique, +dual] |

$[\alpha\text{dual}] \rightarrow \emptyset$ (optional)
 $[+\text{structural}] \rightarrow \emptyset / [_, -\text{oblique}, +\text{superior}]$
 $[-\text{oblique}] \rightarrow \emptyset / [\text{I}, +\text{fem}] + [_, +\text{superior}, -\text{plural}]$
 $[-\text{oblique}] \rightarrow \emptyset / [\text{III}, +\text{neuter}] + [_, -\text{plural}]$
 $[+\text{fem}] \rightarrow \emptyset / [\text{III}] + _$
 $[-\text{oblique}, -\text{plural}] \rightarrow \emptyset / [-\text{feminine}, -\text{neuter}] + [_, +\text{structural}, +\text{superior}]$

Perhaps the most troublesome aspect of (34) is the appearance of three homophonous VIs *e*, representing the II voc. sg., the III nom. pl., and the NVA dual. I see no obvious way to collapse these forms: all three contain the feature $[-\text{oblique}]$, but we already have a VI (*n*) with this specification.

Note also that, in several cases, we have made use of extrinsic ordering of VIs which make reference to the same number of features, since e.g. the dual oblique ending *-in* makes reference to the same number of features as the gen. pl. ɔ:n , and we must order the former first in order to ensure that ɔ:n is not inserted in the dual gen. Likewise, the acc. marker *-n* must be ordered after the nom.pl./dative ending *-i*, or the acc. pl. would be *-n-i*, as the reader can verify. As we mentioned in the Introduction, these devices mirror similar strategies in phonology: learners of a morphological or phonological system are able to manipulate the order of application of rules (morphological or phonological) and VIs in order to generate the correct output for their language. We have seen numerous examples of extrinsic ordering of both VIs and impoverishment rules in our analysis of the complex nominal morphology of Greek.

Chapter 3:

The Hittite Declension

3.1. Introduction

Hittite is an Anatolian language which was spoken in Asia Minor in the 2nd millenium B.C. It is attested earliest of any Indo-European language, from the 16th to 13th centuries B.C., but shows many innovations with respect to PIE. Hittite is written in a cuneiform syllabary borrowed from the Akkadians, who in turn borrowed the script from the Sumerians. As a result, Hittite cuneiform is not optimal for representation of the language, and the presence of many Akkadian words and Sumerian logograms in the texts creates certain difficulties. Much of our understanding of Hittite turns on philological questions such as the correct Hittite restoration of Akkadograms or Sumerograms or the exact phonetic value of ambiguous signs. Fortunately, when Hittite scribes used foreign words for inflected nouns, they usually included the Hittite ending as a phonetic complement, since the foreign words did not normally indicate case. Thus we have a reasonably clear picture of Hittite nominal morphology, despite the many difficulties of the writing system. In addition, nearly 100 years of intense philology has resolved many ambiguities, and our understanding of the surface details of the language is now sufficiently clear for a theoretical analysis.

3.2. The Hittite Declension

Hittite has the vowels /a/, /e/, /i/, and /u/, each of which can be long or short. Morphologically, the language has eight cases and four primary stem types: *a*-stems, *i*-stems, *u*-stems, and *ø*-stems. There are also a few (probably 3) neuter *e*-stems and a non-productive class of nouns called the *r/n*-stems, whose stem ends in *r* in [-oblique] cases and in *n* in [+oblique] cases.²⁵ Most Hittite nouns are either *i*- or *a*-stems, but without apparent pattern; therefore, we can assume that each noun is marked for its stem class.

Instead of the masculine/feminine/neuter gender distinction familiar from Greek, Latin, and other Indo-European languages, Hittite distinguishes only common gender and neuter, the former corresponding to the masculine and feminine of other languages.²⁶

r/n-stems can only appear as [+neuter], but the other stem types are normally [-neuter].

Thus we can posit the following redundancy rules:

- (1) a. *r/n* → [+neuter]
- b. [] → [-neuter]

Thus nouns are not marked for gender in the Vocabulary unless they are [+neuter].

The Hittite case endings are laid out in (1). Old and Neo-Hittite represent two attested stages of the language, separated by a few hundred years. Hittite is notable in that its declension is markedly simpler than those of PIE, Latin, or Greek: with only a few exceptions, all stem types have the same endings in every case. Old Hittite retains most of the PIE cases, except that it has merged the PIE dat. and loc. and has added a directive

²⁵ This class can be accounted for by a rule of readjustment converting stem-final [r] to [n] in [+oblique] cases in these forms, and certain nouns of this class have further irregularities in the oblique or plural stem. Otherwise, their declension is normal. For reasons of space, I will not address the various ablauting nouns and other “mixed” declensions, all of which can be accounted for by readjustment rules applying to the oblique and/or plural direct cases.

(‘whither’) case in *a*.²⁷ Several interesting changes occurred between the two stages of the language, particularly the elimination of the inherited gen. pl. *-an* in favor of the ending *-a-s* which occurs in several other plural cases, and the elimination of the directive and instrumental as separate cases.

(2)²⁸

Old Hittite			New Hittite		
	Singular	Plural		Singular	Plural
Voc.	-∅ -e (u-stems only)	-e-s	Voc.	-∅ -e (u-stems only)	-u-s/-e-s
Nom.	-s		Nom.	-s	
Acc.	-n		Acc.	-n	
Neuter Nom./ Voc./Acc.	-∅ -n (<i>a</i> -stems only)	-a -∅ (<i>r/n</i> -stems only)	Neuter Nom./Voc./ Acc.	-∅ -n (<i>a</i> -stems only)	-a -∅ (<i>r/n</i> -stems only)
Dat./Loc.	-i -ya (i-stems only)	-a-s	Dat./Loc. (+Directive)	-i -ya (i-stems only)	-a-s
Directive	-a				
Gen.	-a-s	-an	Gen.	-a-s	
Abl.	-ats		Abl.		

²⁶ The category [+fem] has been lost in Hittite, although it is preserved in several other Anatolian languages (cf. Melchert 1990). Hittite do not reflect the PIE feminine **-eh₂* > **-a:* stems, but rather the PIE thematic *o/e*-stems (since PIE **o* > Hittite *a*).

²⁷ Hittite directive *a* < PIE **-h₂e(i)*, seen in e.g. the Greek adverb *k^ham-ai* ‘to the ground’. This is not normally reconstructed as a PIE case, and we have not included it in our analysis of PIE, although some scholars do believe that it was a full-fledged case ending in PIE.

²⁸ Cf. Friedrich (1960: 43ff), Luraghi (1997: 15-20), Melchert (1995).

Instr.	-it	(+Instr.)	-ats
--------	-----	-----------	------

3.3. Phonology of Theme Vowels

Theme vowels are stable and quite predictable in Hittite. In *a*-stems, the theme vowel is deleted before an ending which begins with a vowel: nom. sg. *ann-a-s* ‘mother’, dat. sg. *ann-i*, acc. pl. *ann-us*. In *i*- and *u*-stems, the theme vowel is never deleted, but a homorganic glide (i.e. *-y-* in *i*-stems, *-w-* in *u*-stems) is inserted before an ending beginning with [a]. This is in fact a general phonological rule of Hittite, and we will see another unrelated example below.

3.4. Old Hittite

We will begin with Old Hittite (OH), presented on the left side of the chart in (2). The prevalence of *s* in a number of cases -- nom. sg. *-s*, gen. sg. *-a-s*, nom/voc. pl. *-e-s*, acc. pl. *-u-s*, dat./loc.(+New Hitt. gen.) pl. *-a-s* -- suggests that *s* is the default morpheme inserted where no other exponent is available, just as in Latin, PIE, and Greek:

(3) $s \Leftrightarrow [\]$

3.4.1. Genitive Plural, Ablative and Instrumental

One striking fact about the OH oblique cases is that both the ablative ending *-ats* and the instrumental *-it* occur in both the singular and the plural. This indicates that these morphemes are not specified for the feature [plural]; thus, *-ats* and *-it* have the following VIs:

(4) $it \Leftrightarrow [+oblique, -structural, +superior, +free]$

ats ⇔ [+oblique, -structural, +superior]²⁹

ats could, but need not, make reference to the feature [-free]. Below, we will see that the abl./instr. syncretism in NH is simpler to explain if it does not.

Another relatively clear case is the gen. pl. *-an*. It occurs only here, and is presumably represented by (4):

(5) *an* ⇔ [+oblique, +structural, -superior, +plural]

3.4.2. Dative-Locative and Directive Singular

It is not immediately clear whether the “dative-locative”, as the case with the ending *-i/-ya* in the singular is usually called, should be analyzed as having the feature content of the dative or of the locative.³⁰ The case seems to serve both functions in (5a-b) (from Luraghi 1997:55, 68):

- (6) a. *ped-i=* *sm-i=* *pat* *ZAG-n-i* 1- *_U* *wah-anzi*
 place-D/L,SG POSS-3PL-D/L,SG (ptc.) right-D/L,SG once turn-3PL
 ‘in their place, they turn once to the right’
- b. *aped-ass=* *a* *tama-i-n* GE_TIN-*a-n* *pi-er*
 that-D/L,PL and other-ACC,SG wine-ACC,SG give-3PL
 ‘and they gave those men another wine’

(‘ptc.’ = untranslatable particle; capital letters are Sumerian; italic capitals are Akkadian.)

²⁹ Hittite *-ats* < Proto-Hittite **-atsi* < Proto-Anatolian **-ati*, seen in the Luvian instr. *-ati*. The reader may wonder why we consider this ending *-ats* rather than *-at-s*, as we will with other cases of final *-s*. This is indeed possible and could be implemented very easily with no effect on the rest of our analysis, and indeed the ending’s historical origin should not be taken to imply that learners could not have resegmented the ending in this way. Nevertheless, I prefer to view *-ats* as a single ending, although I have no synchronically compelling reason to do so.

³⁰ There is a separate dative ending *-ø* in certain neuter nouns, apparently residual from early PIE athematic loc. sg. *-ø*. This ending is not productive, however, and I assume that it is quasi-adverbial, like the locative in Latin and Greek.

We may be able to resolve this question by consulting Indo-European languages other than Hittite. Latin and Greek, for example, have a dative case (that is, a case that can be used for the dative function without a preposition), but use PPs with various cases to signal the locative function (except in the limited residual locative cases, used almost exclusively with city names in both languages). Similarly, modern German has a dative but no locative, and many other examples could be adduced. From this evidence, we can conclude that the dative is the cross-linguistically more basic case, and thus we will treat the Hittite dat./loc. as a dative.³¹

The dat./loc. singular appears with two endings, *-i* and *-ya*. *-ya* occurs only in the *i*-stems, and *-i* occurs in all other stem types. However, the similarity between the *i*-stem dat. sg. *-ya* and the directive ending *-a* is too obvious to miss, especially when we recall that Hittite inserts a homorganic glide between a high vowel and a low vowel in hiatus, and that the directive sg. also appears as *-ya* in *i*-stems (section 3.3). Thus we can assume that the *i*-stem dat. sg. ending *-ya* is actually a special use of the directive sg. *a*, and we will return to it when we have discussed the directive. The normal dat. sg. ending *-i* can be assigned the following VI:

- (7) $i \Leftrightarrow [+oblique, +superior, -plural]$ ³²

The directive singular is a more complex problem. Since Hittite is the first language we have seen that has a directive, we have not defined a feature set for it. In terms of mathematical possibilities from the feature chart in chapter 1, we could entertain

³¹ However, as Jay Jasanoff (p.c.) notes, Bengali has a locative case, but no dative, and the dative function is filled by a PP. This fact could be taken to cast our assertion here in doubt, but the evidence at least shows that dative is more basic than locative in general. Even taking Bengali into account, it is remarkable that Hittite uses the same case without a preposition for both dative and locative, for which I know no parallel.

the possibility that the directive shares with the semantically similar locative the features [+oblique, -structural, -superior], but is [+free]. The first three features fit well with Halle and Vaux's description of the various features (quoted in the introduction, p. xiv), but it is not clear why the directive should not "have a consistent role in argument structure" (the definition of [+free]) while the locative does. In fact, the directive's role in argument structure is just as well-defined as the locative's, and both should probably be marked [-free].

This brings up another possibility: our case features may not be sufficient to express the directive case. Although there are, mathematically, 16 possible cases which could be generated by our four features, we should not assume without reason that all 16 possible combinations of these four features will generate attested cases, nor that any particular case should have only the four features in our chart. Rather than tweak the definition of [free] to force the directive to be [-free] (which would probably render it meaningless and might have adverse effects on the feature's applicability to other cases as well), we should consider the possibility that there is a fifth feature. Now, the primary difference between the locative and the directive is that the directive expresses a goal, while the locative expresses a simple position. Likewise, the dative normally expresses the animate goal or beneficiary of an action. The accusative often expresses a goal as well, especially in its common use as an "accusative of direction (goal)" (cf. Kurylowicz 1960: 181-2 for a discussion of this and similar uses of the accusative in Indo-European).

Thus, I propose that we add a feature [goal] expressing this relation. The accusative, dative, and directive are [+goal]; all other cases are [-goal]. Thus the

³² Note that we will have to order this VI after *ats* in the Vocabulary in order to prevent its insertion in the instr. sg. However, certain complications in the formal implementation of the *i*-stem dat. sg. *-ya* make the

directive has the same features as the locative in our chart from the introduction (i.e. [+oblique, -structural, -superior, -free]), as well as the feature [+goal]. If this is correct, the directive singular ending *a* is inserted as a result of the VI in (8), which picks out the directive and dative singular:

(8) $a \Leftrightarrow [+oblique, +goal, -plural]$

Since the dative has already been accounted for in (7), however, *a* will be inserted in the directive only.

Although the creation of a new feature may seem to be a costly device to account for a single case, I think that it is necessary to avoid stretching the meaning of our case features beyond recognition. In addition, the postulation of a second feature shared by the dative and locative solves an otherwise troubling problem. Of the features we have assumed so far, these two cases share only [+oblique], and as a result we would not expect syncretism between these two cases to the exclusion of other [+oblique] cases to be the norm. In fact, however, dative/locative syncretism is relatively common, and we have seen it already in Hittite, and in the history of Greek (the Greek dative reflects the PIE dative and locative, as well as the instrumental) and of Germanic. If these cases shared only the feature [+oblique], we would expect this syncretism to be less common. However, with a new feature [+goal] shared by these cases and no other oblique cases, we can explain this tendency more insightfully.

This analysis also suggests a solution to the question of the *i*-stem dat. sg. $-(y)a$. In order to ensure that the dat. sg. ending *-i* is correctly inserted in the dat. sg., it will be necessary to assume that *i* is ordered before *a* in the Vocabulary: otherwise, we might get *-a* in the dat. and dir. sg, since the features [+oblique, +goal, -plural] are shared by the

assumption of this feature complex unavoidable.

two cases. Now, we can prevent the insertion of *i* in the *i*-stem dat. sg. by an impoverishment rule deleting the feature [+superior] in the dat. sg. of *i*-stems, which will cause the next available morpheme *-a* to be inserted instead.

$$(9) \quad [+superior] \rightarrow \emptyset / [+HI, +BA] + [_, +oblique, +structural]$$

If (9) were not present in Hittite, the *i*-stem dat. sg. would be *-i* as it is in other stem types, and the surface form would simply be *-i*, homophonous with the neuter NVA sg. and [-neuter] voc. sg. forms in *-i-ø*. Thus (9) represents an innovation which may be due to the need to disambiguate these forms. We will explore several clearer cases of disambiguation in section 4.3.1 below.

3.4.3. Remaining Oblique Cases

The gen. sg. and the dat. and dir. pl. all end in *-a-s*. In every case, *-s* appears to be the default ending added to *a* by fission, as we suggested above. Our analysis of these facts will depend on our notion of the role of linguistic cost or simplicity in learning. On the one hand, a learner could assume that it is merely coincidental that the gen. sg. is identical with the dat. and dir. pl., and learn two homophonous morphemes *a*, one for the gen. sg. and one for the dat. and dir. pl. Historically, the homophony of these endings is an accident of phonological change, but since learners of Hittite had no way to know this, we should assume that they would construct the simplest possible system. Having accounted for all the other oblique cases already, we could generate the identity of the gen. sg. and the dat./dir. pl. with a single VI, as in (10):

$$(10) \quad a \Leftrightarrow [+oblique] \qquad \qquad \qquad (\text{fission})$$

However, (13) is not sufficient to generate the neuter plural *-a*, since the [-neuter] nom. and acc. VIs *e* and *u* contain more features and thus are ranked above neuter plural *a* in the Vocabulary. Thus it appears to be necessary to delete the feature [α superior], which occurs in the VIs *e* and *u*, in the neuter nom./acc./voc. :

(14) [α superior] $\rightarrow \emptyset$ / [+neuter] + [__, -oblique, +plural]

In fact, this is not the optimal analysis: in section 4.2.1, we will see an alternate analysis which explains this fact in a less stipulative manner.

However, the *r/n*-stem neuters have the ending *-ø* in the neuter [-oblique] pl. cases. The difference between singular and plural in these nouns is signaled by an accent shift to the final vowel, which lengthened the vowel: e.g. neut. NVA sg. *uddar* ‘thing, word’, pl. *uUdda:r*, or *water* ‘water’, pl. *wiUta:r* (cf. Melchert 1994: 86). This alternation is accounted for by a phonological rule of readjustment shifting the accent in the NVA of these nouns.

The *r/n*-stem neuter plural ending *ø* is also the normal ending of the neuter singular. We can account for these two facts simultaneously with a single VI *ø* underspecified for number, and an impoverishment rule deleting the feature [+plural] in direct cases of the *r/n*-stems, as in (15) and (16):

(15) $\emptyset \Leftrightarrow$ [-oblique]

(16) [+plural] $\rightarrow \emptyset$ / [*r/n*] + [__, -oblique]

Since the VI *a* refers to the feature [+plural], (16) will prevent the insertion of the normal direct neuter pl. ending *-a*, and the next available candidate, *ø*, will be inserted instead. *ø* will also be the neuter sg. ending, as we will see in the next section.

3.4.4. Singular Direct Cases

The voc. sg. appears as *-e* uniquely in the *u*-stems. This is generated by the VI in (17):

$$(17) \quad e \Leftrightarrow [-\text{oblique}, -\text{structural}] / [+HI, +BA]$$

The acc. sg. ending is *-n*, which is the same ending as the neuter direct singular of the *a*-stems. Now, we have supposed that the morpheme \emptyset is specified $[-\text{oblique}]$, and that this \emptyset is the same ending which appears on the neuter pl. of the *r/n*-stems. Ideally, we should also unite this ending with the animate voc. sg. \emptyset . One way to account for this set of facts is to assume that *n* has the VI in (18), and that the impoverishment rules in (19) prevent the insertion of *n* in the neut. sg. of all stem types except the *a*-stems, as well as in the animate voc. sg.:

$$(18) \quad n \Leftrightarrow [-\text{oblique}, -\text{plural}]$$

$$(19) \quad \text{a. } [-\text{plural}] \rightarrow \emptyset / [+neuter] + [-LO] + [_, -\text{oblique}]$$

$$\text{b. } [-\text{plural}] \rightarrow \emptyset / [-neuter] + [_, -\text{oblique}, -\text{structural}]$$

As a result of the VI in (18), we expect the ending *n* in all singular $[-\text{oblique}]$ cases.

However, (19a) removes the feature $[-\text{plural}]$ in all stem types except the *a*-stems, which prevents the insertion of *n* and causes the $[-\text{oblique}]$ ending \emptyset to be inserted instead.

(19b) has the same effect on the $[-\text{neuter}]$ voc. sg.

The final remaining case is the $[-\text{neuter}]$ nom. sg. By removing the features $[-\text{oblique}, -\text{plural}]$ from this case, we can ensure that neither *n* nor \emptyset will be inserted, and that the only remaining option will be the default *s*.

$$(20) \quad [-\text{oblique}, -\text{plural}] \rightarrow \emptyset / [-\text{neuter}] + [_, +\text{superior}]$$

3.4.5. Old Hittite: Summary

A full list of VIs competing for insertion into the case/number nodes of Hittite nouns is given in (21). The language's rules of impoverishment are listed in (22).

- (21) it \Leftrightarrow [+oblique, -structural, +superior, +free]
 an \Leftrightarrow [+oblique, +structural, -superior, +plural]
 ats \Leftrightarrow [+oblique, -structural, +superior]
 e \Leftrightarrow [-oblique, +superior, +plural] (fission)
 u \Leftrightarrow [-oblique, -superior, +plural] (fission)
 i \Leftrightarrow [+oblique, +superior, -plural]
 a \Leftrightarrow [+oblique, +goal, -plural]
 a \Leftrightarrow [-oblique, +plural] / [+neuter] + __
 e \Leftrightarrow [-oblique, -structural] / [+HI, +BA] + __
 n \Leftrightarrow [-oblique, -plural]
 a \Leftrightarrow [+oblique] (fission)
 \emptyset \Leftrightarrow [-oblique]
 s \Leftrightarrow []
- (22) [+superior] \rightarrow \emptyset / [+HI, +BA] + [__, +oblique, +structural]
 [+plural] \rightarrow \emptyset / [r/n] + [__, -oblique]
 [-plural] \rightarrow \emptyset / [+neuter] + [-LO] + [__, -oblique]
 [-plural] \rightarrow \emptyset / [__, -oblique, -structural]
 [α superior] \rightarrow \emptyset / [+neuter] + [__, -oblique, +plural]
 [-oblique, -plural] \rightarrow \emptyset / [-neuter] + [__, +superior]

3.5. Neo-Hittite

Neo-Hittite (NH) nominal morphology is largely the same as its OH ancestor, but several important simplifications have occurred. First, the directive has been lost, and its role has been taken over by the dative. The instrumental has also been lost, its function

subsumed by the ablative. Finally, the gen. pl. ending *-an* has disappeared, and the exponent of the gen. pl. is now the generic oblique plural ending *-a-s*.

The distribution of the directive and dat. sg. endings in OH is the result of the VIs in (23) and the rule of impoverishment in (24):

(23) $i \Leftrightarrow [+oblique, +superior, -plural]$

$a \Leftrightarrow [+oblique, +goal, -plural]$

(24) $[+superior] \rightarrow \emptyset / [+HI, +BA] + [_, +oblique, +structural]$

Between OH and NH, we see a period of increasing optionality in the use of the directive, which began to be expressed by the dative instead. However, as a result of (23), the ending *-a* occurred in *i*-stems in the dative and directive, since the features of the VI *a* are shared by both. This suggests that the optionality was syntactic rather than morphological: that is, during this period nouns with directive semantics were optionally given the case features of the dative before MS, and was treated as a simple dative by the morphology. Eventually, when this was no longer optional, (23) and (24) were unrecoverable because the dative and directive no longer had distinct features, and the VIs in (23) were reanalyzed as in (25):

(25) $a \Leftrightarrow [+oblique, +superior, +plural] / [+HI, -BA] + _$

$i \Leftrightarrow [+oblique, +superior, +plural]$

Of course, this analysis only moves the problem back into the syntax, and does not explain why speakers of Hittite would decide to use the dative with directive function when they had a directive case available. However, it does seem to be correct morphologically, and we will leave the issue here.

The NH merger of ablative and instrumental has a more straightforward morphological explanation. Since the features of the OH morpheme *ats* are a subset of the features of the instrumental ending *-it* (see (4)), we can model this change as a simple loss of the ending *-it*, after which the principle of underspecification ensures that the ablative fills both roles in NH. We could also see the change as the result of a rule of impoverishment deleting the feature [+free] in the instrumental:

(26) [+free] → ∅ / [__, +oblique, -structural, +superior]

After (26) takes effect, a syntactic terminal node with the feature specification of the instrumental will not be able to accommodate the instrumental ending *-it*, and the ablative ending *-ats*, which has a subset of the features of the instrumental as well, will fill this role.

The change from OH gen. pl. *-an* to NH *-a-s* presents the same ambiguity. *-a-s* is the generic [+oblique] ending in OH, appearing in the dative and directive pl. as well as the gen. sg. In NH, it is the exponent of the gen. pl. as well, a fact which can be explained either by the loss of the VI *an* or by impoverishment of [+structural] or [-superior] in the gen. pl. As far as I can see, there is no principled way in any of these cases to decide between these options, since both generate the facts equally well. We might prefer the first account on simplicity grounds, however.

A fourth and somewhat different change between OH and NH is the complete merger of the nom./voc. pl. and the acc. pl. In most stem types, the OH acc. pl. *-u-s* becomes the pl. nom./acc./voc. ending in NH. However, in three cases the OH nom. pl. *-e-s* is used instead: 1) ablauting *u*-stem nouns, i.e. nouns whose stems end in *-au-*, but whose *-a-* is deleted by readjustment in the singular direct cases; 2) stems in *-t-*; and 3)

the relative/interrogative pronoun *kuie:s* ‘who’ (cf. Melchert 1995: 270). In addition, there are scattered and not well-understood instances of nom./acc./voc. pl. *-a-s* and *-i-s* in the NH *i*-stems (ibid., 271). Lacking further evidence, we can only assume that the endings of *kuie:s* and the unpredictable *i*-stem NAV pl. forms are simply memorized variants. Since the nom./acc. merger occurs whether the exponent is *-u-s*, *-e-s*, or something else, it appears to be the result of an impoverishment removing the features which differentiate these cases.

(27) $[\alpha_{\text{superior}}, \alpha_{\text{free}}] \rightarrow \emptyset / [_, -\text{oblique}, +\text{structural}, +\text{plural}]$

NH did not, however, choose one of these endings to serve as the nom./acc. pl. ending; rather, it appears that NH reanalyzed the VIs *-e-* and *-u-* in the wake of (27).

Recall the VIs for nom. pl. *-e-* and acc. pl. *-u-* in OH:

(28) $u \Leftrightarrow [-\text{oblique}, -\text{superior}, +\text{plural}]$ (fission)
 $e \Leftrightarrow [-\text{oblique}, +\text{superior}, +\text{plural}]$ (fission)

After (27) has applied, neither *e* nor *u* can be used for the NAV pl., since the feature [superior] has been deleted. Rather than use the next available VI, the [-oblique] default \emptyset , learners apparently reanalyzed the VIs in (28) as follows:³³

(29) $e \Leftrightarrow [-\text{oblique}, +\text{plural}] / [u _, t _]$ (fission)
 $u \Leftrightarrow [-\text{oblique}, +\text{plural}]$ (fission)

Melchert suggests no explanation for the retention of *-e-s* in *t*-stems, nor do I have one (although perhaps the non-existence of *-u-s* in ergatives in *-ant-* was implicated, cf. below). However, he does offer an explanation for its preservation in the *u*-stems. Hittite has a phonological rule converting [u] to [m] between two vowels if either vowel is [u]:

(30) $/u/ \rightarrow [m] / u _ V \text{ or } V _ u$

As a result, an ablauting *u*-stem such as *assu-* ‘good’ would have an acc. pl. /assau-u-s/ → [assamus]. Melchert suggests that the surface difference between [assam-us] and all other cases, which would end in [w] or [u], was enough to motivate the selection of *assau-es* over *assamus* as the NH nom./acc./voc. pl ending. This explanation is plausible, and indeed morphological change which reduces stem allomorphy is relatively common. Regardless, it is hard to see why else the class of ablauting *u*-stems would be chosen to retain the ending *-e-s*, since even non-ablauting *u*-stems (where the acc. pl. would never be *-m-us*) have *-u-s* in NH.

3.6. Hittite Split Ergativity

An important morphosyntactic feature of Hittite which we have ignored until now is split ergativity. In Hittite, like other Anatolian languages, only animate nouns can function as subjects of intransitive verbs. When an inanimate noun is in this role, it takes the suffix *-ant-* and the animate case endings, as in (26) (from Garrett 1990: 266):

- (31) *nu KUR^{URU}Hatti=ya apa:-s ishan-ant-s arha namma
tsinne[sta]*³⁴

[particle] land Hatti=and that-NOM,SG blood-ERG,SG PV moreover end-PRET3SG

‘and that murder moreover ended the land of Hatti’

Garrett (1990) argues convincingly that Hittite split ergativity arose as an innovation of Proto-Anatolian from the use of archaic abl./instr. ending *-ants* agentively in impersonal constructions (*-ants* is, incidentally, attested a few times in OH as a variant of *-ats*).

³³ Of course, we can only speculate *why* speakers would reanalyze these morphemes rather than use the ending *-ø*. Perhaps the change occurred gradually, and speakers were continually exposed to plurals in *-e-s* and *-u-s*, but misanalyzed them (a situation similar to *r*-hypercorrection in some dialects of English).

However, despite Garrett's hesitation, it is clear that the Hittite ergative functions synchronically as a suffix *-ant-* plus the endings of the common gender: *-s* in the singular and *-e-s* in the plural (e.g. *uttan-ant-e-s* 'words', erg. pl. of *uttar/n-* 'word'). The existence of *-ant-es* in the plural would be inexplicable if original *-ants* had not been resegmented *-ant-s* as a result of its similarity to the animate nom. sg. *-s*.

In order to account for the fact that the Hittite neuter ergative has different endings from the animate or neuter nominative, we must assume that it is assigned a different feature set in the syntax as a result of its gender and syntactic position. Referring to the feature chart from the Introduction (p. xi), we can see that Halle and Vaux have already proposed the features [-oblique, +structural, +superior, -free] for the ergative case, and it is presumably [-goal] as well. Recall also the VIs for the [-neuter] nom. sg. and pl. endings:

(32)

	Old Hittite	Neo-Hittite
Nom. Sg. (-s)	[]	[]
Nom. Pl. (OH <i>-e-</i> , NH <i>-e-/-u</i>)	[-oblique, +superior, +plural]	[-oblique, +plural]

All features of the endings *-s* and *-e-s* are also features of the ergative, so that we can generate the endings *-ant-s* and *-ant-e-s* if we assume that the ergative marker *-ant-* is marked to undergo fission, and that its VI does not contain any of the features of the nom.

³⁴ Here I depart from standard transcription practices by rendering [ts] as *ts* rather than *z*, and by ignoring purely graphic vowels: e.g. *-ants* is conventionally transcribed *-anza* or *-anz(a)*.

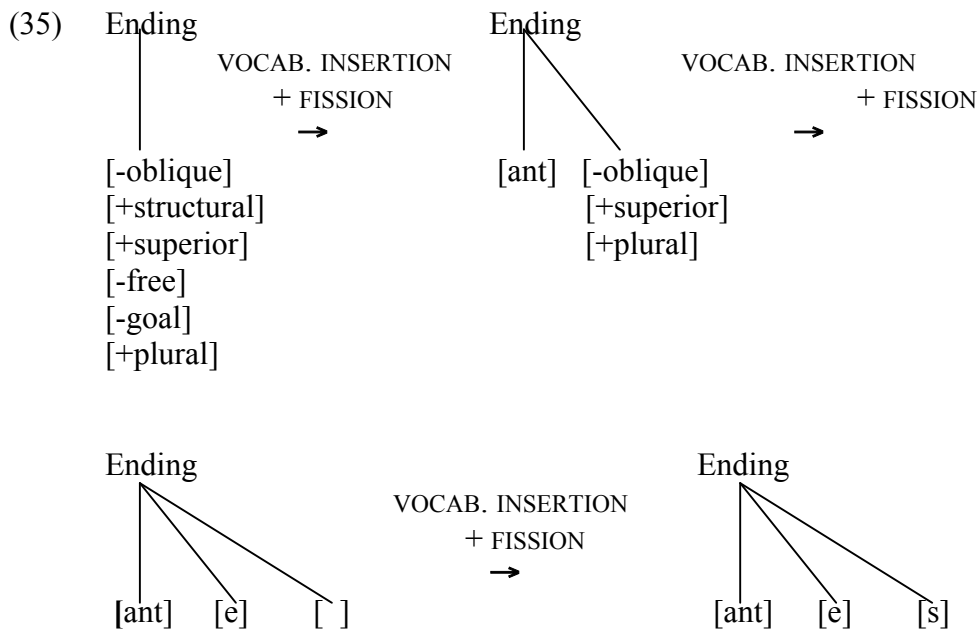
pl. ending.³⁵ The features which remain are [+structural, -free, -goal], and so we can infer that the suffix *-ant-* contains the following features:

- (33) $\text{ant} \Leftrightarrow [+structural, -free, -goal]$ (fission)

The feature [-goal] is crucial here, since if it were not present, the suffix *-ant-* would appear in the accusative as well, which is [+goal]. Furthermore, we must assume that the feature [+neuter] has been impoverished: otherwise, rule (14) would apply, deleting the feature [+superior] and preventing the insertion of *-e-* in this case. Thus Hittite has a rule of impoverishment deleting the feature [+neuter] in ergatives, which is crucially ordered before rule (15):

- (34) $[+neuter] \rightarrow \emptyset / [-oblique, -free] + ___$

Thus the derivation of the ergative plural *-ant-e-s* proceeds as follows:



³⁵ This is not an issue in most analyses of the Hittite ergative, since it is usually treated either as two unitary endings *-ants* and *-antes* which merely happen to resemble the common gender nominative, or as a derivational suffix *-ant-* which makes common gender nouns out of neuter nouns. However, the first analysis has been shown to be untenable above, and the second is impossible in DM because the theory does not acknowledge a distinction between derivational and inflectional morphology.

The same procedure, with minor modifications, will derive the ergative plural in NH, as well as the ergative singular.³⁶ In this way, DM provides a simple account of a Hittite morphosyntactic phenomenon which has long been considered problematic. Since the theory does not distinguish derivational and inflectional morphology, it is not necessary to assume that the ergative marker *-ant-* has any special morphological status.

The Hittite ergative has two other morphological peculiarities. As we saw in the example in (31), the ergative takes non-neuter nominative agreement, *apa:-s* nom. sg. ‘that’ rather than neuter nom. sg. *apa:-n* or ergative agreement such as **apa:-ant-s*, which is attested nowhere. We cannot rely on the rule of impoverishment in (34) to explain this fact, since we would still expect ergative, rather than nominative, agreement here. Therefore we must add a stipulation to the VI *ant* in (33) that it can only be inserted in nouns.

A second peculiarity of the ergative is that it does not participate in the *ta zdɔ:a trek^hε:* rule described in chapter 1, section 1.2.10, according to which verbs with neuter plural subjects have singular agreement. There we suggested that the feature [+plural] is simply not copied to the verb from neuter subjects. One possible explanation for the behavior of Hittite ergatives is that noun-verb agreement takes place after the feature [+neuter] is deleted in ergatives by rule (34), so that ergative plural subjects are not treated as neuters in agreement, and the feature [+plural] is copied to the verb. However, this explanation would allow impoverishment rules to apply either before or after agreement, since we have already seen several cases (agreement with Greek 3rd

³⁶ Note that the impoverishment rule (20) which we proposed to account for the presence of *-s* in the nom. sg. will also delete [-oblique, -plural] in the ergative singular as well, so that *-s* will appear here as well. Note that this rule must apply after (34).

declension nouns, section 2.2.8, and by compound adjectives, section 2.1.1) where impoverishment applies after agreement. A better explanation, it seems to me, is to refine the condition on feature copying which we proposed in chapter 1: rather than preventing copying of [+plural] to the verb from all neuter subjects, it prevents copying only from neuter nominative subjects, and ergatives are not affected.

Chapter 4:

Distributed Morphology and Morphological Change

4.1. Introduction

In this chapter, we will focus on some interactions between the formal systems analyzed in chapters 1-3 and the morphological changes we can observe within and between them. Functional factors such as analogy, reanalysis, and grammar simplification, seen as purely diachronic effects of UG requirements and the process of language acquisition, cannot of course be dispensed with; rather, my claim is that DM provides additional constraints on morphological change and new insight into analogy, case syncretism, and other morphological changes. In addition, DM can provide new insight into questions about the stability or instability of various patterns of syncretism, as we will see in the following section.

4.2. The Role of Impoverishment in Morphological Change

We have already seen a number of case syncretisms within the individual languages analyzed in chapters 1-3 which we explained by impoverishment. However, it is still necessary to give a general account of the role of impoverishment in morphological change, especially the interaction of impoverishment with the formal morphological system of the language and with functional factors motivating morphological change.

We can divide impoverishment-based case syncretism broadly into three types, all of which we have seen examples of in the previous chapters. In the first, impoverishment is the basis for the diachronic stability of a pervasive syncretism. As opposed to underspecification-based syncretism, which is an effect of the availability of morphemes to express a given feature set and can change if the language's Vocabulary changes, the presence of impoverishment makes a syncretism mandatory and diachronically stable. The second diachronic effect of impoverishment is directional change, when a category is lost and entirely subsumed by another category. A third type is overlapping change, when two categories merge into a single category which shows elements of both original categories. The latter two types are distinguished by the relationship between impoverishment and the content of the VIs which express the two categories in the older language.

4.2.1. Stability of Limited Symmetrical Syncretism

An important theoretical aspect of DM is underspecification, the fact that a VI need not have all the features of the terminal node it fills. This fact predicts that case syncretism should be rampant and asymmetrical, as it often is in the languages we have

examined. For example, underspecification was crucial in explaining the syncretism of the PIE athematic abl. sg., athematic gen. sg., and thematic gen. sg. *-e-s*, which excludes the thematic abl. sg. *-et* (section 1.2.3). The VI *et* is simply highly specified for the thematic abl. sg., and *es* is underspecified with respect to the abl. and gen. of both classes. Because the VI with the greatest number of features of a terminal node (but no more) is always inserted, DM provides an insightful account of this symmetrical syncretism in terms of the nature of vocabulary insertion. The same reasoning allowed us to account for the asymmetrical syncretism of the athematic loc. and voc. sg. and thematic voc. sg. in early PIE (1.2.6), the range of oblique cases in Hittite expressed by *-a-s* and its further extension when the directive case was lost (3.4.3), and many other cases of syncretism.

However, we have also seen several cases of syncretism for which underspecification is not a satisfying explanation. In such cases, an opposition which is present in certain categories of a language is systematically absent in other categories. A notable example is the total lack of a contrast between the nominative, accusative, and vocative cases in the neuter of the three languages we have analyzed. These three cases have the same ending regardless of the particular exponent in question: in PIE, we saw thematic neuter NVA sg. *-n*, athematic *-ø*, and plural *-h₂*, and in Greek and Hittite the derivative endings *-n*, *-ø*, and *-a*. If all syncretism were the result of underspecification of individual VIs, we would be forced to conclude that the fact that the neuter nominative, accusative, and vocative are always identical in PIE, Greek, and Hittite is purely accidental, and that all three VIs simply happen to be underspecified for these cases.

In fact, the situation is even worse in our analysis: in section 1.2.2, we took the PIE ending *-n* to be the generic [-oblique] ending, which allowed us to explain its

presence in the thematic [-neuter] acc. sg. as well; but the presence of $-\emptyset$ in the athematic neuter sg. NVA was the result of a rule of impoverishment deleting the feature [-oblique] in these cases, and the neuter plural ending $-h_2$ was due to a third unrelated fact, the presence of a VI h_2 which occurs only in neuter direct plural cases. All of this mirrors Halle and Vaux's (1998) analysis of a similar set of facts in Latin, where essentially the same strategy is employed, differing only in details. We used this strategy in our descriptions of Greek and Hittite morphology as well, again differing only in minor details. However, under this analysis the syncretism of nom., acc., and voc. in these different situations is a consequence of three completely unrelated facts about the language, which merely happen to converge to give us the generalization that these cases are always identical: thus the generalization has no theoretical status.

This analysis does, however, have the significant virtue of generating the correct facts in a relatively simple manner, and we should be hesitant to eliminate it completely. We can see a way out by noticing first that the feature shared by the nominative, accusative, and vocative cases is [-oblique], and that our entire three-part analysis of these facts did not refer to any case features other than [-oblique]. We can explain these facts by supposing that PIE, Greek, and Hittite had a rule of impoverishment deleting all case features except [-oblique] in the neuter nom., acc., and voc., as in (1):

- (1) $[\alpha_{\text{structural}}, \alpha_{\text{superior}}, \alpha_{\text{free}}, \alpha_{\text{goal}}] \rightarrow \emptyset / [+neuter] + [__, -oblique]$

With (1) in place, the neuter nom./voc./acc. syncretism is not only present but also mandatory. This is a more satisfactory analysis of the situation in Greek, Hittite, and PIE in a more satisfactory manner than our explanation so far, since it allows us to express

formally a generalization which we were previously forced to treat as a mere accident, while allowing us to retain the explanation proposed by Halle and Vaux (1998) as well.

Note, however, that the presence of (1) in these languages does not alter the synchronic analysis significantly: we were able to generate the correct output in chapters 1-3 without it, although the presence of (1) does allow us to combine and simplify a few rules of impoverishment. To the extent that we think it is synchronically real, though, we must assume that learners of a morphological system do not merely construct an abstract analysis which derives the surface facts correctly, but also attempt to extract general patterns in the distribution of morphemes which constrain the type of system which can be constructed. Thus rule (1) makes a substantive diachronic prediction, even though it does not directly alter our synchronic analysis: as long as it is active in a language, it should be impossible to introduce distinct forms for the neuter nom., acc., and/or voc. in any declension type, no matter its particular exponent.

This prediction is confirmed by the extraordinary tenacity of this pattern of syncretism in Indo-European. Not only does it exist in PIE, Greek, and Hittite, but in all Indo-European languages with a case system: e.g. Latin, Sanskrit, Anatolian, Germanic, Slavic, and a number of modern Indo-European languages.³⁷ It seems odd that this syncretism would be so tenacious, even when the exponents have changed totally, if there were no underlying rule that is retained even when surface exponents change. In modern German, for instance, the neuter sg. nom./acc. syncretism is marked by the use of the determiner *das* in both cases, rather than by nominal morphology. This development

³⁷ The rule was narrowed to cover only nom. and acc. in Sanskrit, where the neuter sg. vocative is *-a* (e.g. *yug-a* 'o yoke'), matching the corresponding masculine voc. sg., instead of expected *yug-a-m* (Mayrhofer 1972: 39). This change requires only a simple adjustment to (1), i.e. rewriting it as $[\alpha_{\text{superior}}, \alpha_{\text{free}},$

cannot be described as a simple inheritance of the identity of the nominal forms from an earlier stage of the language, which an underspecification analysis would require, since nominal morphology is not at stake in German neuters: rather, the identity of nom. and acc. determiner *das* reflects yet another neuter nom./acc. syncretism, this time in the PIE pronominal endings. At this point, it would seem an incredible coincidence that this should be the case if German had not simply inherited a rule which states that the neuter nom. and acc. must have the same exponent, the same rule that is present throughout the Indo-European languages. These facts point to the presence of (1) already in PIE and its simple inheritance by the daughter languages.³⁸

If this line of reasoning is correct, we should also examine several other persistent syncretisms in Indo-European. In addition to the obvious neuter NVA syncretism, another pattern is prevalent but less often noted: nowhere in the oblique cases do neuters have endings distinct from those of non-neuters of the same declension type. We can see this by comparing the Greek 2nd declension masculine and neuter forms (cf. the chart in section 2.2): the neuter sg. NVA is *-o-n* and the plural is *-a*, but the endings of the masculine and neuter are identical everywhere in the oblique cases, and the same is true in the third declension neuter and non-neuter forms. If we assume that language learners actively attempt to extract patterns of persistent syncretism as we suggested above, it seems reasonable that they would construct a rule of the following form as well:

(2) [+neuter] → ∅ / [+oblique] + ____

α goal] → ∅ / [__, -oblique, -structural] + [+neuter]. This reanalysis is unsurprising, given the low token frequency of neuter vocatives.

³⁸ In Hittite, we must also ensure that rule (1) is ordered after the rule of impoverishment (33) in section 3.6, which deletes the feature [+neuter] in ergatives. If (1) were ordered first, the neuter ergative could not be distinct from the nominative.

This rule captures the generalization that neuters and non-neuters do not have or develop distinct exponents in oblique cases in the Indo-European languages. This generalization affects a large number of distinct surface forms, a fact which makes it unlikely that the mere underspecification of many distinct VIs is responsible.

A third such case is the fact that, although the vocative is clearly a distinct category in the archaic Indo-European languages, the vocative plural is never distinct from the nominative plural in Indo-European. Furthermore, as in the cases above, there can be several different exponents of the nom./voc. pl. in a language, e.g. Greek 1st and 2nd declension *-i* and 3rd declension *-e-s*, but all will display this pattern. Again, we can explain this compulsory syncretism by impoverishing the only feature which separates the two cases:

(3) $[\alpha\text{structural}] \rightarrow \emptyset / [__, -\text{oblique}, +\text{superior}]$

In conclusion, it appears that an important aspect of the diachronic stability of symmetrical syncretism is the presence of impoverishment rules which reduce the number of contrasts which can be expressed by the morphosyntactic features available in the language. Without the presence of such rules, we would expect to see the introduction of distinct forms in at least some of these cases by processes such as analogy or VI loss and compensation by underspecified morphemes. Indeed, such changes and asymmetries are well-attested when syncretism is the result of underspecification, as we have seen in many places in the first three chapters. To the extent that a particular pattern of syncretism is symmetrical throughout a system and diachronically stable, it is likely that a rule of impoverishment is present which actively prohibits asymmetrical change.

In the more common case in which syncretism is asymmetrical or diachronically unstable, we can conclude that it is the result of underspecification.

4.2.2. Directional Syncretism

In cases of directional syncretism, one category of a language is lost entirely and its function is taken over by another category, which is normally less marked than the category it replaces. We have already examined one such case, the gradual loss of the dual which we can observe in the attested period in Greek (section 2.2.4). There, we suggested that the dual has the features [+dual, +plural], and the plural is [-dual, +plural]. In this case, the change was the result of a context-independent rule deleting the feature [α dual], which caused the plural and the dual to have the same feature complex. At first, this rule was optional, so that duals appeared unpredictably as plurals; later, this optional rule came to be employed so often that the dual was lost entirely.³⁹ A similar case is the directional syncretism of abl. and instr. in Hittite, in which the OH instr. *-it* was gradually eliminated in favor of the abl. *-ats*, which serves as the abl./instr. ending in NH (section 3.5).

A crucial component of this type of syncretism is the underspecification of the exponents of the target category for the relevant feature. Theoretically, the VIs which serve as exponents of the Greek plural cases could include the feature [-dual], since all plurals are [-dual]. However, if this were actually the case, the unconditional deletion of the feature [α dual] at MS would fail to create a total merger of the dual and plural, since

³⁹ Compare the similar history of English *wh*, which is optionally voiced to [w] in some dialects and has merged completely with /w/ in many others. The frequency of employment of this optional rule is usually seen as the crucial motivating factor in the merger of *wh* and *w* which has been occurring gradually in English for several hundred years.

a VI with the feature [-dual] would not be able to be inserted in nodes with no specification for [dual]. Likewise, an important element of our analysis of Hittite which allowed us to derive the abl./instr. syncretism was the relative underspecification of the ablative with respect to the instrumental.

As a result, it seems, in cases of directional syncretism we must make the further assumption that every exponent of the target category is not specified for the feature which is impoverished. That this should be true as a matter of contingent fact in many different cases of directional syncretism in different languages seems rather unlikely, especially when the number of distinct VIs involved is high. In the Greek plural cases, for instance, we must assume that all six exponents of plural cases simply happen not to be specified for the feature [dual]. Without this assumption, however, we predict patterns of syncretism which are, as far as I know, unattested: for instance, that, if the genitive plural ending happened to be specified [-dual], the Greek dual should come to be identical with the plural in every case except the genitive, and that the dual genitive would receive some other underspecified ending, e.g. the Greek default *-s*. Since impoverishment affects only terminal nodes and not VIs, this operation cannot help us either.

At this point, we must retreat from our theoretical analysis to more general properties of language change and acquisition. It seems likely that learners of a language would not tolerate a strange and asymmetrical system such as the one we have imagined. As soon as the other four dual cases came to be expressed by the plural endings, the genitive dual would be brought into line by analogy, and the offending VI or VIs would simply be reanalyzed accordingly. In addition, it is not clear what motivation a learner of

Greek would have for marking one plural ending [-dual] but not the rest, since this feature is not needed to express any relevant contrast of the language: that is, it is sufficient for [+dual] to contrast with \emptyset rather than [-dual]. Thus the problem we have described turns out to be somewhat artificial, a theoretical possibility which would not arise in a natural language because the process of language learning is constrained by simplicity considerations. Both of these considerations explain why such patterns of syncretism do not arise, even though the formal structure of the system allows for them. As a result, we can explain cases of directional merger by the operation of impoverishment, assuming that the learner will construct a system in which less marked categories are underspecified with respect to the more marked category.

4.2.3. Overlapping Syncretism

A third type of morphological change in which impoverishment is a crucial factor is overlapping syncretism. In such cases, two distinct categories merge into one, and the exponents of the resulting category, although synchronically related, are a mixture of the endings of the two historically distinct categories. A simple example is the merger of nom. and acc. pl. in Neo-Hittite, where the Old Hittite acc. pl. *-u-s* was generalized as the nom./acc. pl. ending except in stems ending in *-u-* or *-t-*, where the nom. pl. *-e-s* was generalized instead (section 3.5). As we suggested there, this change was the result of an impoverishment eliminating the features which differ in these cases, [α superior] and [α free]. However, this impoverishment also prevented the insertion of *-e-s* and *-u-s*, since both referred to the feature [superior]; there was, as a result, an intervening stage of confusion between the two endings, which was resolved by reanalyzing each VI to

eliminate the feature [superior] and assigning it to a certain subset of the available space (3.5, (29)). This is a standard case of overlapping syncretism, which is characterized by an intervening period in which the possible oppositions have been limited by impoverishment, and there is an excess of exponents for the available categories. Eventually this problem is resolved by reanalyzing the exponents into some more intelligible pattern.⁴⁰

The languages we have examined show a number of similar cases, such as the Attic Greek dative, which is the result of two successive stages of overlapping syncretism, first between the PIE dat. and loc. in Proto-Greek, and then between the resulting dat. and instrumental in Attic. Thus the Attic dative endings are derived from three PIE cases: 2nd declension dat. sg. *-o:i* < PIE dat. sg. *-o-ei*, but 3rd declension dat. sg. *-i* < PIE loc. sg. *-i*, and 2nd declension dat. pl. *-o-i-s* < PIE thematic instr. pl. *-o-oi-s*. A detailed analysis of the complex changes leading to the constitution of the Attic dative is not possible in this space, but both stages would be similar to the Hittite case we have examined. In contrast, other dialects of Greek show no reflexes of the PIE instr. pl.: this fact suggests that in these dialects, the second stage, in which the instrumental case was lost, was a directional syncretism (INSTRUMENTAL → DATIVE) rather than an overlapping syncretism as in Attic. The key difference between these two types of syncretism is the relation between impoverishment and the content of the VIs affected. If impoverishment prevents the insertion of all the relevant VIs, and the use of the next available exponent in the Vocabulary would create confusion, the strategy employed is reanalysis of the VIs in

⁴⁰ Perhaps by some extra-grammatical functional principles of diachronic morphology such as those advocated by Natural Morphology (cf. e.g. Wurzel 1989, Rix 1992). It is not necessary in DM to deny the validity of functional approaches to diachronic tendencies, as we have been careful to emphasize; rather, it

a way permitted by impoverishment but still sufficiently expressive, i.e. overlapping syncretism. If only one category is affected, however, directional syncretism results.

4.3. Interaction of Formal and Functional Factors in Morphological Change

Since the early days of generative linguistics, it has been claimed that language learners attempt to construct the simplest possible grammar that can account for the facts of the language (cf. e.g. Halle (1962), Chomsky and Halle (1968)). If true, this suggests that the formal structure of the language and the functional factors which motivate language change should interact in interesting ways, some of which were explored in the papers cited: for example, Halle (1962) argues that dialectal variation in the vowel shift known as Canadian Raising can be explained in terms of rule ordering. Paul Kiparsky, in particular, has explored the historical implications of generative phonology in a number of papers, many of which are collected in Kiparsky (1982). Kiparsky shows that many phonological changes are due to role of the simplicity criterion in language learning: for instance, the relative complexity of bleeding order as opposed to feeding order creates a tendency to simplify the grammar by reordering rules in favor of the latter (Kiparsky 1968). This should not, of course, be taken to imply that a more complex system is not possible, but only that it is diachronically unstable as a result of the simplicity criterion.

In this section, we will examine several Indo-European morphological changes in this spirit. Our goal will be to discern some functional motivations for morphological change which rely crucially on the formal properties of DM.

seems likely that these principles play some role in diachronic change, which is typically underdetermined by theoretical or other facts.

4.3.1. Morphological Dissimilation

In chapters 1 and 2, we saw several strikingly similar morphological changes which required some attention. In section 1.3, we saw the modification of the PIE thematic gen. sg. from early *-o-s* (/o-es/) to later *-o-s-io*. In section 2.2.3, we analyzed the unexpected Greek 1st declension masculine gen. sg. ending *-o-o*, which had apparently been imported from the 2nd declension masculine forms to replace the regular 1st declension ending *-a:-s*. In both cases, the change required some added machinery and created a more complex morphological system overall, so that the simplicity criterion cannot be implicated. It is striking, however, that in both cases the gen. sg. was homophonous with the nom. sg. before the change. In early PIE, the thematic nom. sg. was /o-s/, and the gen. sg., although underlyingly distinct, also surfaced as [o-s]. In Greek, the 1st declension masculine had originally had the same endings as the feminine, i.e. nom. sg. *-a:-*, gen. sg. *-a:-s*. However, the masculine nom. sg. became *-a:-s* apparently by analogy to the 2nd declension masculine nom. sg. *-o-s* (or, as we analyzed it in section 2.2.8, (33b), by extension of a rule of impoverishment to cover all [-fem, -neuter] nom. sg. forms; these two explanations are not necessarily in competition). In any case, after the I masc. nom. sg. had become *-a:-s*, the nom. and gen. sg. were homophonous in Greek, as in PIE.

Another very similar change occurred in several other Greek dialects (e.g. Mycenaean and Aeolic), which responded to the same problem with a different strategy. These dialects have a I masc. gen. sg. in *-a:-o*, created by modifying (4a) (= chapter 2, (14)) to (4b):

- (4) a. [-plural] → ∅ / [I] + [__, +oblique, -superior]

b. [-plural] → ∅ / [I, +fem] + [__, +oblique, -superior]

Rule (4a) prevented the insertion of the normal Greek gen. sg. ending *-o* in all 1st declension nouns; reanalyzed as (4b) in these dialects, it affects only feminine 1st declension nouns, and as a result the masculine gen. sg. is *-a:-o* (since rule (15) from chapter 2, which was responsible for the weird Attic form, is not present in these dialects). This change also served to differentiate the formerly homophonous nom. sg. and gen. sg. in this type. Notably, this innovation was apparently independent of the Attic strategy, in which the I masc. gen. sg. was simply converted to 2nd declension and given the ending *-o-o* by a completely different rule of impoverishment.

In all three cases, the surface identity of the nom. and gen. sg. was apparently perceived as an unacceptable source of ambiguity, since each language responded by modifying the gen. sg. in different ways to eliminate this homophony. This suggests that there may be a diachronic tendency to disambiguate certain cases, although it is not clear from these examples alone exactly what is required for such a situation to be perceived as a problem.

A further reason to conclude that these changes were motivated by the homophony of the nom. and gen. sg. is that both the Attic and the Mycenaean/Aeolic innovations both occurred shortly after the introduction of the ending *-s* in the 1st declension masculine nom. sg., which created the offending state of homophony.⁴¹ The

⁴¹ Cf. Chantraine (1945: 41): “cette innovation [viz. the introduction of the 1st declension masc. gen. sg. in *-o-o*] va de pair avec l’addition du sigma au nominatif”. However, Chantraine concludes that the two changes are due to ‘la même tendance à distinguer le type des féminins’, which cannot be correct *simpliciter*. If there were a general pressure to distinguish I masc. nouns from I fem. nouns, there would be no explanation for the continuing identity of the two paradigms in the other eight cases, nor the productivity of 1st declension masculines. Rather, these two changes go together because the first created the conditions which motivated the second, and the change in the gen. sg. was toward the *-o*-stems because this is the default stem type for masculines.

two changes are distinct and cannot be a shared innovation of the affected dialects, but they seem to have been motivated by the same functional considerations.

It could be objected to this analysis that there is no general diachronic tendency to disambiguate case forms. This is correct, and in fact the general tendency is quite the opposite: at least in the Indo-European languages, syncretism and simplification of the morphological system is extremely common. For instance, no daughter language except Sanskrit retains all eight PIE cases. However, the occurrence of extremely similar disambiguating changes in PIE and twice (independently and due to the introduction of the same ambiguity) in different dialects of Greek suggests that it is specifically the homophony of nom. and gen. that is unstable, rather than homophony in general. More research is needed before a tolerably clear answer can be reached on this question; however, the pattern of syncretism and disambiguation we have seen suggests that there may be certain cases between which syncretism is preferred, and other cases between which syncretism and/or surface homophony is generally avoided. The Greek and PIE data simply suggests that nom./gen. syncretism and/or homophony is strongly disfavored in a language with an otherwise robust distinction between the two cases.

For a start, we can speculate that these tendencies rely on the number of features shared, as Calabrese (1996) has already suggested for diachronic syncretism. More examples of disambiguating change are needed to check this prediction, however. Of course, even if we can spell out its nature more exactly, disambiguation is merely a diachronic tendency, and there will and must be apparent counterexamples: indeed, proto-Greek and early PIE are themselves counterexamples, taken as synchronic systems,

since their nom. sg. and gen. sg. were homophonous before the disambiguation took place.

4.3.2. Redescribing Analogy

Another area in which DM may allow us to explain historical change is analogy. As we have seen, a DM analysis often relies on segmenting endings into smaller units. So, for instance, DM allows us to break down the PIE dat./abl. pl. *-b^hi-o-s* into three morphemes, two of which are shared by other PIE cases. This analysis reduces the burden of redundant memorization which would be required of the language learner if the two endings were unrelated, and allows us to state patterns in the declension which must be assumed to be synchronically unrelated if case endings are taken to be unitary morphemes. This feature of DM also suggests the possibility of accounting for at least some cases of morphological change which change phonological segments within a traditional morpheme: if we can motivate further segmentation of the ending, we may be able to explain the change without reference to analogy.

One example is the Greek 3rd declension dat. pl. ending *-s-i*, which reflects PIE loc. pl. *-s-u*. The difference between these two endings is commonly taken to be the result of analogy: since the dat./loc. sg. was *-i*, the loc. pl. was reanalyzed as *-si* at some point in the history of Greek. We have already argued on independent grounds that the PIE ending *-su* is best taken as two morphemes, *s* and *u* (section 1.2.9), and that the PIE loc. sg. *-i* was reanalyzed as a generic [+superior] morpheme in Greek on the basis of its (historically unrelated) presence in the dat. sg. and nom. pl. (section 2.2.7). Recall that, in late PIE, the loc. sg. ending *-i* was reanalyzed as a [+oblique] marker (section 1.3).

The dat. and loc. cases underwent overlapping merger at some later point in the history of Greek. For the same of argument, let us suppose that, at some stage, Pre-Greek had the following VIs:

- (5) $u \Leftrightarrow [+oblique, +goal, +plural]$
 $i \Leftrightarrow [+superior]$
 $s \Leftrightarrow [\quad]$

This would give us the appropriate endings *-s-u* and *-i*, assuming leftward fission as described in section 1.2.9 for PIE. In fact the correct specification of *i* at this point may have been different, cf. below, but the important point is that it was relatively underspecified.

What is intriguing about the Vocabulary in (5), however, is the ease with which the Attic Greek dative can be derived from it. Instead of relying completely on analogy, we can model the change from *-s-u* to *-s-i* as the loss of the VI *u*. After this has occurred, the VI *i* will fill its place automatically, as long as no more highly specified VI intervenes. The resulting endings are those of Attic Greek as described in chapter 2.

However, this analysis is problematic in light of the Greek dat. pl. *-o-isi* found in early Attic and other Greek dialects. The story would indeed have to be significantly different in these dialects than in Attic, since *-o-isi* is derived from PIE *-o-i-s-u*, whose origin we analyzed in chapter 1, section 1.3. The morpheme *i* which we have appealed to in order to explain the change from *-s-u* to *-s-i* is the same *i* which we argued was present in PIE *-o-i-s-u*. Obviously *i* cannot appear in two positions in *-o-i-s-i*, and so we need a special explanation for the analogy in this case. It looks like these dialects of Greek had two homophonous morphemes *i*, each of which appears in *-o-i-s-i*. In fact, this is highly

plausible, since the Greek nom. pl. ending *-i* was originally distinct from the dat. *-i*, and we may assume that they both appear in *-o-i-s-i*. If this is correct, we can conclude that dat. *i* and nom. pl. *i* were reanalyzed as the same morpheme with the specification [+superior], as we suggested in chapter 2, only in the immediate prehistory of Classical Attic. Up to this point, learners had good reason to suppose that the language had two homophonous VIs *i* -- one [+oblique] and one [+superior] -- and that both occurred in the dat. pl. *-o-i-s-i*. Only after this ending was lost was the reanalysis of the two morphemes possible; but at this point, learners of Attic no longer had any reason to posit two homophonous morphemes *i*, and thus the two formerly distinct VIs were combined in the manner we described in chapter 2.

Another type of change that is often described is analogy has already been addressed above, in chapter 1, section 1.3. The PIE athematic loc. sg. was $-\emptyset$, and the thematic loc. sg. was *-i*; in late PIE, both types had the ending *-i*. This change is usually taken as an effect of analogy, but we suggested there that it was a trivial rewrite of the VI *i*, eliminating the restriction that it could only apply in [+thematic] nouns. In this case, however, it seems clear that the traditional explanation of analogy and our theoretical description are not in competition: even if analogy the correct functional explanation, we still need a plausible theoretical description of the grammars before and after the change. What is perhaps less obvious is that the above reasoning about the history of the Greek dat. pl. can also coexist with an analogical explanation: that is, even if the change was implemented by the loss of the VI *u*, it must have been motivated by some acquisition-related concerns. In this case, analogy is simply another label for grammar simplification. After the loss of *u*, less memorization was required to learn Greek

morphology, and the system was more transparent because of the obvious connection between the dat. sg. and pl. Although there are undoubtedly cases of analogy which cannot analyzed in either of these ways, the structure of DM allows us to reduce some cases of analogy to more basic and well-constrained processes.

Conclusion

A. Theoretical Results

An important motivation for this study has been to give a complete account of the nominal morphology of three important Indo-European languages, and thus to contribute to the understanding of these languages and their interrelationships. I hope to have shown in this way that the surface facts of the language can be reduced to a rule-based framework that interacts with the syntax and phonology in well-defined ways. In addition, the analysis of these languages has suggested several theoretically interesting results. First, in this study we have had repeated need to appeal to extrinsic ordering, both in the Vocabulary and in the order of application of rules of impoverishment. Our use of ordering in the Vocabulary reaffirms Halle and Marantz's (1993) suggestion that the Morphology resembles the phonology in this way, and it is not clear that the examples we have given could be explained by feature geometries of the kind popular in DM theory, although I have not explored this possibility in detail, partly because of the lack of agreement on what feature geometries should consist of.

Furthermore, the need for extrinsic ordering of impoverishment rules is, as far as I am aware, a new development. Nevins (2002) has analyzed some similar cases of "derivational opacity", arguing that they can be accounted for if impoverishment takes place during rather than before vocabulary insertion, allowing the presence of a feature to condition one rule of impoverishment before it is deleted by another rule of impoverishment. However, since extrinsic ordering of impoverishment rules seems to be

independently necessary in Greek and Hittite, our analysis suggests that such cases may be viewed in the same way.

Another significant theoretical issue is raised by our analysis of Greek, in which we used impoverishment to delete the declension class information of a noun in two cases, the 1st declension masculine gen. sg. and the 3rd declension dual oblique ending. In both cases, the nouns appeared with an ending proper to another declension which was the default declension in Greek, i.e. 2nd declension; after class information was impoverished, the noun was converted to the default category by a persistent redundancy rule, yielding the correct surface form. This analysis supports the speculation of Noyer (1998: 283) that cases in which features appear to be inserted can be reduced to “Impoverishment-plus-Insertion”. If “feature insertions occur only through the operation of persistent redundancy rules”, Noyer suggests, “marked values may change to unmarked, but never vice versa” (283). This prediction seems to be borne out by the interactions of redundancy rules and impoverishment in Greek. This is a positive result because impoverishment and redundancy rules are independently motivated devices, and so we can account for cases such as Greek declension class changing without resort to the excessively powerful device of feature insertion.

B. Diachronic

In the course of our analysis of the nominal morphology of Greek, Hittite, and PIE, it became clear that the best analysis of the entire morphological system is not necessarily the obvious analysis when we look at a fragment in isolation. Because of the simplicity criterion, learners will attempt to segment endings into smaller pieces and give

these endings the most general distribution possible that is in keeping with the facts of the language. As a result, historically distinct morphemes are reanalyzed in interesting ways by language learners, and a detailed analysis of the chronological stages of the language allows us to observe how these changes proceed.

In particular, we have seen that syncretism and diachronic changes in patterns of syncretism are due to two basic devices, underspecification and impoverishment. Underspecification tends to create a relatively unstable asymmetrical distribution of a morpheme, and can be affected by the loss of a Vocabulary Item. Impoverishment, on the other hand, is independent of the content of particular VIs, and creates patterns of syncretism which extend beyond particular affixes. The introduction of a rule of impoverishment causes new syncretisms, which can be either directional or overlapping, depending on the content of the VIs which happen to be present.

In addition, the segmentation of case endings into smaller morphemes opens up the possibility of accounting for at least some analogical changes by the other mechanisms we have seen, i.e. underspecification, impoverishment, and VI loss. Finally, we have seen that there is a diachronic tendency on the one hand toward syncretism in cases which share several features, and toward dissimilation of cases in certain circumstances, perhaps because they do not share many features. Our survey of these diachronic effects has been unfortunately brief, and there is a great deal more to be said about them. However, in suggesting some specific analyses of these interactions, I hope to have shown in a broad way that the adoption of an explicit theory such as DM constrains and motivates morphological change in interesting ways, and allows greater

insight into functional factors motivating change and their interaction with the formal structure of the morphology.

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