CONSPIRACY IN HISTORICAL PHONOLOGY

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## DEDICATION

This dissertation is dedicated to my partner, Dennis M. Dillahunt, in gratitude for his patience and support.

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Posthumous thanks to my grandmother Dorothy Crist, who regrettably did not live long enough to see me finish this degree. She gave me and my siblings a book called *The Magic of Words* when I was 7 years old. Despite the promising title, I was disappointed to discover that the book would not teach me how to cast spells on my enemies. However, the book did contain some passages from *Beowulf* in the Old English original. Thus began my fascination with the fact that languages actually *change,* and that our commonplace English language developed bit by bit from something appearing utterly alien and incomprehensible to the average modern speaker.

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Amneris the cat wishes to make the following contribution to this dissertation: “3333 33323q”. Mephisto the cat has no comment.

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## ABSTRACT

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Historical sound change has been modeled in Optimality Theory as a change in the ranking of constraints. In the simplest case, the surface effects of a constraint reranking can be stated in terms of a single traditional rewrite rule. However, there are also rerankings whose corresponding surface effects are diverse and complex, and cannot be stated as a single rule. It is this consequence of OT which I explore in this dissertation, examining conspiracies of historical sound changes in early Greek (the elimination of *j), in West Germanic (the near elimination of voiced fricatives), and in Slavic (the elimination of syllable codas).

**Contents**

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## Conventions

## Abbreviations

| | |
|---|---|
| abl | ablative |
| acc | accusative |
| Bel | Belorussian |
| Bg | Bulgarian |
| BSl | Balto-Slavic |
| CG | compensatory gemination |
| CL | compensatory lengthening |
| Cyp | Cyprian |
| Cz | Czech |
| dat | dative |
| EWS | Early West Saxon |
| GA | Generalized Alignment |
| gen | genitive |
| Gk | Greek |
| Gmc | Germanic |
| Goth | Gothic |
| Hitt | Hittite |
| IE | Indo-European |
| Lat | Latin |
| Latv | Latvian |
| Lesb | Lesbian |
| Lith | Lithuanian |
| LS | Lower Sorbian |
| LWS | Late West Saxon |
| Mac | Macedonian |
| MLG | Middle Low German |
| Myc | Mycenaean |

| | |
|---|---|
| NGmc | North Germanic |
| nom | nominative |
| NWGmc | North West Germanic |
| OCP | Obligatory Contour Principle |
| OCS | Old Church Slavonic |
| OE | Old English |
| OED | Oxford English Dictionary |
| OFris | Old Frisian |
| OHG | Old High German |
| OInd | Old Indic |
| OIr | Old Irish |
| OLFr | Old Low Franconian |
| ON | Old Norse |
| OPr | Old Prussian |
| OS | Old Saxon |
| OT | Optimality Theory |
| PIE | Proto-Indo-European |
| PGmc | Proto-Germanic |
| pl | plural |
| PWGmc | Proto-West-Germanic |
| Russ | Russian |
| SC | Serbo-Croatian |
| sg | singular |
| Skt | Sanskrit |
| SPE | Sound Pattern of English |
| SR | surface representation |
| TA, TB | Tocharian A, Tocharian B |
| Thess | Thessalian |
| Ukr | Ukranian |
| UG | Universal Grammar |
| UR | underlying represenation |
| US | Upper Sorbian |
| WGG | West Germanic Gemination |
| WGmc | West Germanic |
| WS | West Saxon |

The language names Slovak, Slovenian, Slovincian will be spelled out, as will Polish, Polabian. Standard abbreviations for features are used ([cons], [son], etc.). Dates are given using the secular BCE, CE notations.

### Transcription conventions

When speaking within a particular subfield (modern formal phonology vs. one of the branches of Indo-European linguistics), I have followed the transcription conventions of that subfield, at the expense of consistency across fields. This means, for example, that the IPA /a:/∼/a/ will be used in a section concerning modern phonological theory, but the traditional ā∼ă will be used when discussing a PGmc or PIE reconstruction. The problem is one for which there appears to be no satisfactory solution.

Classical Greek words remain written in the Greek alphabet, as do reconstructions dating from Proto-Greek or later, while Linear B words are transcribed into the Roman alphabet, following usual custom.

Slavic words are transcribed into the Roman alphabet, excepting the yer characters ь and ъ. The Slavic category resulting from the merger of PIE *a and *o is transcribed by Shevelov (1965) as *$_{o}$a, but I will follow Schenker (1995) in transcribing it as *ă (or simply *a). The PIE category *ĕ is sometimes written *$_{e}$a, but I will follow Schenker in writing it as *ĕ (or *e). The Slavic reflex of PIE *ē is written with the traditional character ě, known as "yat".

/j/ is generally used throughout for the palatal glide, including in transcriptions of Proto-Germanic and in prehistoric Greek, where it is written by some authors. However, y is used in reconstructed PIE forms, following unanimous conventional practice.

**Note regarding glosses**

I have attempted to supply glosses for all forms cited. In cases where authors have not included a gloss, I have generally supplied a gloss from the standard references. In the interest of avoiding clutter, I have not listed citations for such glosses. Sources consulted include:

| | |
|---|---|
| Greek | Liddell and Scott (1852) |
| | Liddell and Scott (1871) |
| Old English | Clark Hall and Merritt (1962) |
| Gothic | Wright (1910) |
| OHG | Wright (1888) |
| OS | Gallée (1910) |

Any errors in the glosses which I have supplied are my own.

# Chapter 1

# Introduction

> ... There has been some controversy whether such goal-oriented or teleological developments have any historical reality or whether they are not rather figments of the imagination of historical linguists. For one may well ask how, say, the first generation speakers, making the first step in a goal-oriented series of shifts, can possibly know — or control — what further changes will be undertaken by future generations of speakers. ...A first change gives rise to a later response change which in turn may lead to yet other responses. By and large, then, the teleology does not consist in any preconceived 'grand plan' or 'strategy' but evolves through a series of 'tactical decisions', in response to the situation at a given time.
>
> ... however ... [c]ases like these seem to require the assumption that at a certain point the results of various 'tactical decisions' along the way may build up enough 'critical mass' to establish a clear goal for further changes, and from that point onward, all that matters is the accomplishment of that goal, no matter whether this is brought about by an irregular application of otherwise regular sound changes. The very regularity of these conspiracies, however, shows that they are not just figments of linguists' imaginations and that, whatever their explanation, they must be accepted as genuine historical developments.

*Hock, 1991, p. 164-5*

In a model where historical sound change is equated with a change in relative ranking among a set of phonological constraints, a single change in ranking can potentially correspond to multiple traditionally formulated sound changes. The surface results of a single reranking are potentially diverse.

Viewed the other way around, there are many instances of groupings of historical processes which traditional and generative accounts have been obliged to treat as being having no formal connection to one another, even in cases where there is some apparent common thread or trend among those processes (Jakobson, 1929; Kiparsky 1995, p. 642; Hock 1991, p. 164-5). With the appropriate theoretical tools, however, such a trend can be captured formally, and the various individual processes can be formally treated as the outcroppings of a single more general systemic change.

It is this consequence of Optimality Theory (Prince and Smolensky 1993, *et seq.*) which I will explore in this study. Using data from West Germanic, Classical Greek, and early Slavic, I will examine clusters of historical sound changes which have traditionally been analyzed as separate, unconnected processes, but which nevertheless seem to somehow conspire toward some common goal, such as the elimination from a language of a particular contrastive segment or of a particular syllable type. For each of the three historical conspiracies which I will discuss, I will show that the fundamental unity behind the diverse processes making up the conspiracy can be straightforwardly stated in terms of a single constraint whose ranking changes relative to the other constraints in the grammar. The central theme which I will be developing is that Optimality Theory allows us to make formal statements of historical sound change at a level of generality not attainable under any previous theory of phonology.

The remainder of this introduction is divided into four sections. First, I will discuss some general issues concerning the nature of sound changes. Second, I will discuss the specifics of modeling sound change in Optimality Theory. Third, I will briefly discuss some areas in phonological theory where the field has not reached a consensus (feature geometry, mora theory vs. X-slot theory, *etc.*); while my central thesis does not bear crucially on any of these questions, I will make some choices on these matters which I will observe in the following chapters for the sake of consistency. Finally, I will discuss the types of constraints within Optimality Theory which I will be assuming.

## 1.1 Remarks on the nature of sound changes

Under the Neogrammarian conception of sound change, sound changes apply "with a blind and inescapable necessity" (Osthoff 1878, cited in Collinge 1995, p. 205). Sound changes are said to apply without regard to their consequences.

Saussure (1916, discussed in *e.g.* Joseph 1995, Hock 1991) emphasized the distinction between the diachronic and synchronic study of language. Saussure was concerned with the study of a language as it exists at a particular time in the minds of its speakers: specifically, as a system governed by its own internal set of principles ("...a wholly self-contained network of relationships among elements which, as discussed above, have no positive content or value, but only the negative value generated by their differing from one another." [Joseph 1995, p. 238]).

These two ideas — the Neogrammarian conception of sound change as blind to its consequences, and the Saussurean conception of language as a system governed by purely synchronic internal principles — are discussed by Jakobson (1929), who notes that there is a problem in simultaneously accepting both. If we accept that a sound change is blind to its consequences, then it follows that sound changes are events which occur essentially at random in the history of a language (or at least, as Don Ringe p.c. points out, “because of processes external to the grammar, so that a formal analysis must model them as random events”); for if the probability of a particular change depends on internal factors in the language, then the change is not blind to its consequences. The problem, Jakobson says, is that the internal coherence and systematicity of language are not what we would expect if a language at a particular point is history is merely the historical aggregation of the outputs of randomly occurring (albeit exceptionless) changes:

> “La conception néo-grammairienne de l’histoire de la langue équivalait à l’absence de théorie. La théorie d’un processus historique n’est possible qu’à la condition que l’entité qui subit les changements soit considérée comme une structure régie par des lois internes, et non comme un agglomérat fortuit. La doctrine de Saussure sur la langue considérée comme un système établit les prémisses nécessaires pour une théorie de la langue comme fait synchronique, mais elle continue à attribuer à ce système synchronique une origine fortuite, elle continue à envisager la diachronie comme un agglomérat de changements de provenance accidentelle. Une théorie de la diachronie de la langue n’est possible que sous l’aspect du problème des mutations de structure et de la structure des mutations.”[1]

(Jakobson 1929, p. 109)

[1] “The Neogrammarian conception of the history of the language was equivalent to the absence of theory. A theory of a historical process is only possible on the condition that the entity which undergoes the changes is regarded as a structure governed by internal laws, and not as a fortuitous agglomerate. The Saussurean doctrine of treating language as a system establishes the premises necessary for a theory of the language as synchronic fact, but it continues to allot to this synchronic system a fortuitous origin; it continues to consider diachrony as an agglomerate of changes of accidental source. A theory of the diachrony of language is only possible under consideration of the problem of the changes of structure and the structure of the changes.”

Jakobson thus argues that sound change must somehow be required to apply in such a way as to continually renew the orderliness of the system (whatever the mechanism governing this patterning of sound change might be). As evidence for the higher-order organization and apparent goal-directed nature of sound changes, Jakobson discusses at length the Open Syllable Conspiracy of Slavic (which I will discuss in Chapter 4), and notes that numerous rules applying over several centuries had an apparent directionality or goal, in this case that of eliminating syllable codas.

Kiparsky (1995) expands on the point made by Jakobson, noting that "a battery of blind sound changes operating on a language should eventually produce systems whose phonemicization by the standard procedure should violate every universal in the book." To take one instance of the general problem Kiparsky is discussing, it should be a fairly simple exercise to artificially arrange a sequence of sound changes, each attested from the history of some language, which, when applied according to a particular relative chronology, have the cumulative effect on some selected language of eliminating all of the phonological contrasts from that language, leaving all of the entries in the lexicon as *ba-ba-ba-ba*. If sound changes are truly blind to their consequences, such cases should sometimes arise; yet they have never been observed. Clearly, there is something governing phonological change which prevents such cases.

Some have attempted to give a functional explanation to this sort of problem: a sound change is dispreferred if it eliminates crucial contrasts in the system. But this is merely a restatement of the problem, not a hypothesis regarding the mechanism responsible. Similarly, one might argue that "universal grammar" would not permit a system with no contrasts. Like the great majority of modern linguists, I accept that there is an innate, psychologically real universal grammar, but merely invoking UG in this case does not constitute a solution to the problem. What would be needed is some hypothesis regarding the mechanism by which UG would prohibit the particular problematic sequence of the sound changes as arranged in the thought experiment above, while permitting those same sound changes in the various actual languages where they did in fact occur (and from which they were plucked for the purposes of the thought experiment).

To deal with this set of problems, Kiparsky proposes an explanation related to language acquisition (this general sort of approach is not unique to Kiparsky; see *e.g.* Hayes 1996, p. 29). Specifically, he claims that there is a kind of natural selection involved among possible sound changes; there are certain properties of the data confronting the child which have a greater probability of being phonologized by the child than others. There is a great deal of phonetic variation in the language data which the child hears, but the child does not incorporate all of this variation into his or her phonological model of the language; rather, the learner "selectively intervenes in the data, favoring those variants which best conform to the language's system" (p. 655).

Thus, the probability that a particular sound change will occur relates directly to the probability that a particular variant will be acquired into the grammar of the child. The child's biases relate at least in part to the present state of the language being acquired — hence it is no surprise when we observe that deletion is less likely to be accompanied by compensatory lengthening if the language does not already have a length contrast, or that novel geminates tend to be formed through assimilation only in languages which already have geminates (Kiparsky, p. 656). Although Kiparsky does not discuss it in this connection, I would go further and claim that the child's biases are a product not only of pressures within the phonology of the language being acquired, but also of the particular properties of the human articulatory and auditory system (Ohala 1983, Hale and Reiss 1999). The latter assumption has important consequences for the theory of phonology; in short, there might be possible phonologies which are permitted by the universal grammar of the phonology faculty, but which nonetheless never occur, because they are dispreferred by extra-phonological biases related to production and perception. If this conception is correct, then it need not be the case that the phonology faculty is directly concerned with the phonetic naturalness of phonological processes; the tendency for phonological processes to be phonetically natural may be merely the byproduct of the context in which the phonology faculty happens to exist, rather than an inherent property of the phonology faculty itself (Anderson 1981; Hale and Reiss, 1999).

I agree with Kiparsky's general approach, *i.e.* that the selection of those sound changes which actually occur has to do with biases in language acquisition. However, at least one amendment is needed to account for what is known about the way in which sound changes in progress proceed (and the amendment I will discuss is an enlargement of Kiparsky's view rather than a refutation of it). One possible instantiation of Kiparsky's approach is to claim that language change reduces to mere mistransmission of the language from parent to child; under this view, change occurs when the child acquires a grammar which does not perfectly match that of the older generation. If this is the whole story, then in cases where a sound change is in progress in a speech community, we should find only two types of speakers: 1) older speakers who have the earlier grammar, and who emit the older variant 100% of the time; and 2) younger speakers who have the innovative grammar, and who emit the older variant 0% of the time.[2]

This prediction is clearly false. The evidence from modern sociolinguistic investigation of sound changes in progress overwhelmingly supports the conclusion that sound changes involve variation *within speakers* between the original and innovative forms, with each successive generation emitting the innovative form a higher percentage of the time than the preceding one, until the change has gone to completion (see *e.g.* Labov 1994, ch. 3 "Observations in Apparent Time", and ch. 4 "Observations in Real Time"). Clearly, when a child acquires a language, he or she acquires a system in which the points of variation are the same as those in the grammars of the preceding generation of speakers, at least in the normal case:

> "There is little evidence to support the notion of a language-learning faculty isolated from social and historical developments. On the contrary, children appear to focus

[2]Of course, as Don Ringe p.c. points out, it can often happen that there is a considerable overlap between the outputs of the old and new systems.

> sharply on the pattern of social variation, and so reproduce the historically preserved variable patterns” (Labov 1989, p. 96).

It follows that a true phonological reanalysis takes place only at the end of the sound change, when the percentage of the older variant being heard by the child drops below some critical threshhold necessary for its incorporation into the child’s grammatical system.

This is not to say that the mechanism discussed by Kiparsky does not play a crucial role in determining which sound changes will occur, and which will not. The kind of sifting discussed by Kiparsky, I believe, is responsible for the selection of those points of variation which come to be propagated throughout the speech community, and which have a reasonable chance of proceeding to completion, barring some interruption.

### 1.1.1 On the nature of underlying representations during sound change in progress

To make more precise an idea discussed in the previous section, we can distinguish three groups of speakers for any sound change in progress:

1. earlier speakers who emit the original form 100% of the time;
2. speakers who vary between the original and innovative forms;
3. later speakers who emit the innovative form 100% of the time.

There need not be any overlap in lifetimes between those in group 1 and of those in group 3.

A sound change often involves a change to the system of contrasts within the language (Hoenigswald, 1946). For those sound changes where this occurs, I will take it as obvious that speakers in group 1 have the original set of underlying contrasts, and that speakers in group 3 have a set of potentially restructured underlying contrasts. The question I will consider here is the status of the system of contrasts for group 2.

There are at least two possibilities:

- The speakers in group 2 maintain the original set of underlying contrasts, and the original underlying form is sometimes converted to the innovative surface form by variable synchronic processes

- Alternatively, it might be that the speakers in group 2 have a restructured set of underlying contrasts, and the innovative underlying form is sometimes back-converted to the original surface form, again by variable synchronic processes. (I will reject this possibility for reasons having to do with the definitions of sound change and merger, to be discussed below.)

If we allow for both possibilities, then there is a much larger set of possible hypotheses to consider, and we would presumably have to decide one way or the other in each individual case on the basis of economy arguments, *etc.* However, I will assume that speakers in group 2 always have the underlying forms with the original contrasts, because this falls out from the definition of the kind of sound change under consideration, as I will now discuss.

We can distinguish two broad kinds of sound change: some are merely changes in the way a phonological category is phonetically realized, without any changes in the system of phonological contrasts. The second involves phonological merger, possibly merger with zero (Hoenigswald, 1946). In this study, I will be concerned only with the second kind of sound change; this is partly by necessity, because the phonetics of the prehistoric systems I will be considering lie outside the grasp of the comparative method.

By definition, the kind of sound change I am considering involves a loss of contrast. As a matter of conceptual necessity, it follows that when a sound change is in progress, the individuals who vary between the earlier and innovative forms (*i.e.*, the unmerged and merged forms) maintain the same set of underlying contrasts as those of the generation prior to the inception of the sound change. For example, consider a situation where a language originally contrasted /i/ and /e/, but where /e/ is now in the process of merging into /i/. The speakers in group 2 have two categories, one realized as [i] and one realized as [i$\sim$e]; thus, despite the variation in surface realization, these speakers must have the same set of underlying contrasts as the speakers living prior to the inception of the sound change.

For this reason, all of the tableaux in this study will show the original form as the underlying form. I will present pairs of tableaux with the 'before' and 'after' rankings; but it should be understood that the 'after' form represents a ranking variably found for speakers in group 2. The original underlying form presented in the 'after' tableaux might not be the same as the UR for speakers in group 3, because there might no longer be any evidence for the UR as it stood prior to the merger. Speakers in group 3 would not be able to deduce the original UR unless some kind of morphophonemic alternation is left behind after the sound change has gone to completion.

### 1.1.2 Modeling sound change in Optimality Theory

The structured variation in speech is clearly a part of the speaker's competence; but most mainstream theories of phonology for the past half century have been constructed over data from which variation is artificially excluded, *i.e.* the speech of an idealized speaker in a homogeneous language community (Chomsky 1965, p. 3). This approach to the formal modeling of the human language faculty has been extensively criticized (Labov 1972; Guy 1980; Reynolds, 1994, *etc.*). In the words of Labov (1972b, p. 125, cited in Reynolds 1994 p. 26), "We are now in the process of producing a great many well-formed theories with nothing to stand on: beautiful constructions with ugly feet."

Optimality Theory (Prince and Smolensky 1993, *et seq.*) proposes to model the speaker's phonological competence in terms of a set of violable, ranked constraints. Reynolds (1994) reconciles Optimality Theory with the observed variation in phonological outputs by assuming that the relative ranking of constraints for a given speaker at a given time is not necessarily fixed. Variation in outputs corresponds to variation in constraint ranking.

A well-known problem in synchronic analysis which generative approaches have never been able to resolve is the tendency for disparate rules to conspire to maintain some global pattern, *e.g.* various epenthesis and deletion rules to maintain a particular syllable type (Kisseberth, 1970). Perhaps the strongest argument in favor of Optimality Theory is that it resolves this problem by stating the requirements (*e.g.* syllable type) directly rather than concerning itself with individual processes to maintain them (epenthesis, deletion, *etc.*; Prince and Smolensky, 1993).

Sound change has been modeled in Optimality Theory as the reranking of constraints over time (Reynolds, 1994; Zubritskaya, 1994; Anttila, 1997). There is thus a prediction that a change in constraint ranking might make itself felt through a constellation of surface changes which could not necessarily be conflated if historical sound change is modeled as a sequence of ordered rules. This, I argue, is exactly what we find; as languages change, we observe apparent conspiracies of historical processes which cannot be conflated (either because the processes are not of the same type, such as insertion and deletion, or because of problems in the relative chronology). OT offers a promising means for capturing the relevant generalizations.

I will assume the general model of Reynolds (1994), where the variation of sound change in progress is connected with variability in constraint ranking; by extension, a completed sound change is one where the relevant constraints have come to rest in a single ranking. However, my focus is not on the sort of synchronic variation discussed by Reynolds; indeed, the nature of the data under consideration here force an abstraction away from this type of variation. In the following analyses, I will be treating sound changes as abrupt rerankings of constraints. Obviously, this is not intended to be a claim about how sound change works; rather, an abrupt reranking is an unavoidable abstraction which stands for a period of variation which is prehistoric and unrecoverable, but is presumed to have existed, even if we can only observe its end products.

The task of the linguist in describing a historical sound change, then, is to work out two grammars ('before' and 'after') whose sets of constraints are identical, but whose relative ranking of those constraints differs. The 'before' grammar maps the original UR to the original surface form; the 'after' grammar maps the original UR to the innovative surface form. In the case where a constraint gradually rises in ranking over many generations of speakers, giving rise to sound changes which demonstrably have a particular temporal ordering, there will be a series of 'before' and 'after' grammars, with the 'after' grammar of each stage of the change serving as the 'before' grammar of the next.

## 1.2 Some choices in phonological theory

I turn now from the assumptions which are crucial to the analyses in the following chapters, and consider some points which are not crucial for my purposes here. My reason for considering these points is merely to be consistent throughout my analyses; as noted before, I believe that it is possible to make different choices on these points without disrupting the main themes I will be developing.

During the 1980's and early 1990's, the major trend in phonological study was to account for patterns in terms of representations (feature geometry, underspecification, *etc.*). As OT has emerged, some phonologists have backed off from this approach to varying degrees, preferring to account for patterns in terms of constraint ranking (most radically, *e.g.*, Hammond 1995; Golston 1996; cf. less radical departures such as Padgett 1995). There is a fairly wide range of opinion in the field on this question; the approach I will assume here is that representations play an important role in producing the observed patterns.

### 1.2.1 Feature geometry

In the 1980's and early 1990's, the internal structure of segments was a central question for the field of phonology. Numerous views on the matter have been put forward (Clements, 1985; Sagey, 1986, discussed in McCarthy 1988 and in Clements and Hume, 1995; McCarthy 1988; Hume, 1992; Ní Chiosáin and Padgett, 1993; see Clements and Hume 1995 for an overview of the issues).

Most authors assume that features are in some kind of hierarchical arrangement, although it has also been proposed that the relations between features are properly characterized in terms of set membership (Padgett, 1995). Accounts vary considerably on the particular features assumed and the specific relations among those features; the entire question is one on which the field has never come to a satisfactory consensus. This unresolved issue has received little attention in recent years as the field has turned to the particular questions posed by Optimality Theory.

Throughout this text, I will assume the feature geometry put forward by Hume (1992; developed further in Clements and Hume, 1995. My main reason for choosing this particular feature geometry is that it offers a natural statement of some of the palatalization processes which I will be discussing in Chapter 2 (cf. Hong 1997, who makes use of Hume's feature geometry in an OT account of palatalization processes in Korean).

However, none of the analyses which I will put forward rely crucially on this particular feature geometry. For this reason, I will not argue for Clements' and Hume's view over the alternatives, but rather will merely summarize the distinguishing characteristics of Hume's model. For all of the cases I will discuss, I believe that it is possible to substitute some other feature geometry, making relatively minor technical adjustments to the formulation of specific constraints without requiring changes in the relative ranking of constraints or in the general thrust of the argument. Therefore, in cases where the technical formulation of a particular constraint crucially references the feature geometry, I will make it my practice to discuss in general terms what the constraint must accomplish (regardless of the feature geometry one chooses) before going on to formalize the constraint in terms of Hume's geometry.

Likewise, in cases where the details of the feature geometry would serve only to obscure the more general point, I will opt for convenience and clarity rather than technical accuracy. Thus, I will sometimes use such notations as the familiar [-back] rather than $\begin{array}{c}\text{VPlace}\\ | \\ \text{Cor}\end{array}$, making parenthetical note of such deviations. It is true that [-back] has no formal status in

Hume's model, but [-back] has such a broad currency among linguists that I will use it (and other notations of its kind) as a convenient shorthand except where the technical details are important.

The salient properties of Hume's model are as follows:

1. Like Ní Chiosáin and Padgett (1993), but unlike most others (Clements, 1985; Sagey, 1986; McCarthy, 1988), Hume argues for the existence of a VPlace node, where VPlace (when present) is immediately dominated by CPlace (Hume 1992 uses the labels CONS and VOC, respectively, but I will follow Clements and Hume 1995 in using the labels CPlace and VPlace).

2. While some models distinguish the set of consonant features from the set of vowel features (Clements, 1985; Ní Chiosáin and Padgett, 1993), Hume claims that vowels and consonants are specified by the same articular nodes (Labial, Coronal, Dorsal). In Hume's model, a vowel is specified by features immediately dominated by VPlace, while the primary place of articulation of a consonant is specified by features immediately dominated by CPlace.

3. With regard to secondary consonantal place of articulation, Hume argues that the primary place of articulation is immediately dominated by CPlace, while the secondary place of articulation is immediately dominated by VPlace. Thus, Hume does not make use of a pointer (cf. Sagey, 1986) to designate the primary place of articulation.

Thus, the segments /k/, /j/ (or /i/), /kj/ are represented in Hume's model as pictured in

Figure 1.1.

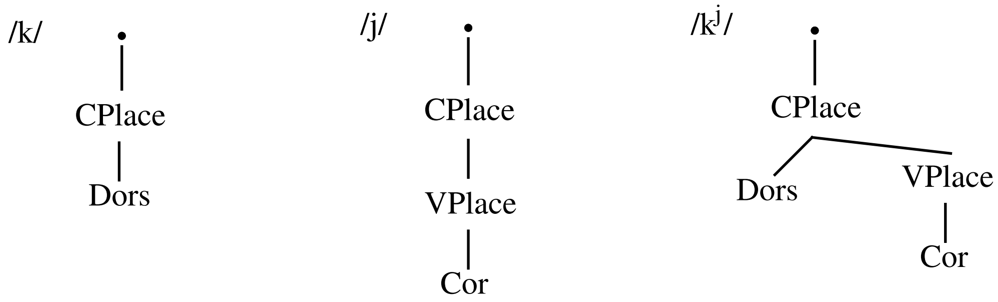


Figure 1.1: Feature geometry of /k/, /j/, /kʲ/

(The representations here do not include all of Hume's geometry, such as [+high] stricture on /j/.)

The major strength to Hume's model is that it allows for a natural account of consonant palatalization processes which are awkward to state in other models. In Sagey's model, for example, /k/ and /i/ are both specified as Dorsal; it is therefore surprising that we find processes of the sort /k/ > č / __i, since /č/ is coronal rather than dorsal. In Hume's model, however, a high front vocoid is specified as Coronal, which makes possible a much more natural statement of the process (Figure 1.2).

A criticism which has been leveled against Hume's model is that it allows for certain types of interactions between consonants and vowels which are extremely rare or unknown. For example, there is an absence of rules such as /su/ fu, where the consonant has taken on the Labial specification of the vowel (Ní Chiosáin and Padgett, 1993. However, Gene Buckley, p.c., notes that consonantal labiality is preserved before the high back vowel in

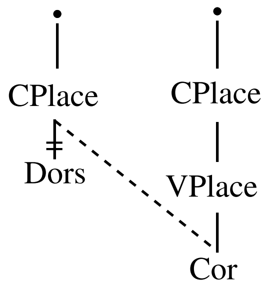


Figure 1.2: Palatalization rule

Japanese, *i.e.* /pu/ → /ɸu/; Shibatani 1990 p. 167). Ní Chiosáin and Padgett's solution involves a feature system where vowels are specified by a different set of features from those used to specify consonants. However, the broad view which I adopt, as mentioned before, is that a phonologically permissible process might be ruled out for phonetic reasons. I suggest that this is the case here.

### 1.2.2 Moras vs. X-slots

A further unresolved issue in phonology relates to the structures which mediate between segments and syllable nodes. The two major views on this question are known as X-slot theory (earlier CV-theory) and mora theory (see *e.g.* Broselow 1995 for a summary of the two views and discussion of their relative strengths and weaknesses). As with feature geometry, I will simply choose one of the alternatives—namely, mora theory—and will adopt it throughout for the sake of consistency, without taking the space to argue for this view.

As with my choices regarding feature geometry, this choice is not crucial to the general discussion of historical phonological conspiracies. I believe that all of the constraints I will posit can be reformulated in terms of X-slot theory without requiring changes in the relative ranking of constraints.

There is more than one version of mora theory. While some variants of mora theory hold that onset consonants are linked to the first mora of the syllable, I will assume a version of the theory in which onset consonants are linked directly to the syllable node (Broselow 1995, p. 188-91). Thus, the shape of the syllable /tam/ in a language where coda nasals are moraic is as shown in Figure 1.3:

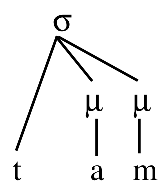


Figure 1.3: Syllable structure

When formally defining constraints, I will repeatedly need to make crucial reference to notions of "short" and "long" for both consonants and vowels. In terms of the traditional branching structure pictured above, a long segment is linked to two prosodic constituents; a short segment is linked to only one. In terms of bracketing theory, a long segment can be defined as one where a mora boundary occurs within the span of the segment; a short segment is one where there is none (cf. Eisner 1999)

### 1.2.3 Moras in underlying representations

It is generally accepted that moras are present in underlying representations in at least those cases where they are necessary to denote contrastive length. In the case where an ungeminated coda consonant projects a mora on the surface, however, this mora is non-contrastive and predictable. Under standard approaches within OT, predictable information is ambiguously specified in the underlying representation. No constraints hold on URs; hence, any regularities in the URs are epiphenomena of the restrictions on the SRs (Smolensky, 1996). Faithfulness constraints cannot reference redundant phonological material, since this material is not guaranteed to be present in the UR.

Under this set of assumptions, compensatory lengthening and compensatory gemination are problematic. When CL or CG occur, a mora "belonging" to a deleted coda consonant comes to be linked to either the preceding or the following segment; but since the deleted consonant is not present on the surface, the syllabification constraints on the surface form cannot reference it, and therefore cannot require the presence of a mora associated with it.

In each instance of CL or CG, it is probably possible to find some fortuitous property of the problem allowing an account which does not require moras to be underlyingly specified for coda consonants. To my mind, this kind of approach fails to directly address what is a very common phenomenon across languages, namely that there is a robust tendency for mora counts to be preserved, regardless of what happens to segmental material.

Sprouse (1997) addresses this problem by assuming that moras are in fact present in the UR ("enriched inputs"), and Steriade (1994) assumes that URs are fully specified (including prosodic structure), except in those cases where the segment or structure in question is subject to surface alternation. While acknowledging the problem posed by and for the notion of the Richness of the Base, I will assume in this dissertation that moras associated with coda consonants are fully specified in URs, and that constraints such as MAXμ can require that these coda moras be parsed, even in cases where the coda segment itself is deleted. However, I will remain agnostic about the underlying specification of other other predictable phonological material (syllable structure, redundant feature specifications etc), and will assume no constraints which require faithfulness to such underlying material (hence I will not assume constraints such as MAX-ONSET, *etc.*).

Thus, I assume that CG and CL involve faithful parsing of a mora in the UR, but it should be acknowledged that this assumption has not been reconciled with the principle of the Richness of the Base. If we accept the standard view that faithfulness constraints cannot reference redundant information in the UR, then it is not clear to me how this special exemption allowing the specification of non-contrastive moras in URs can be stated in a principled way. Nevertheless, the empirical fact of CG and CL remains. Since a sound change in progress involves variation between the original and innovative forms, at least one possibility is that there is some kind of surface-to-surface faithfulness between the old and new surface forms. This kind of explanation would work for all of the cases discussed in this dissertation, but it would not offer an account for cases of synchronic CL and CG (as Gene Buckley, p.c. points out, a truly synchronic case of CL or CG must be evidenced by alternations in the outputs; in such a case, there is the possibility that an allomorph with a moraic coda consonant can influence other surface forms of the same morpheme). In any case, the absence of an immediate explanation for the UR mora exception must be weighed against the observations that CL and CG processes are extremely common, and that a statement of the preservation of mora counts in terms of moras themselves has the merit of directness.

When a coda segment is lost (for whatever reason), the following are possible outcomes for the stranded mora:

- The preceding vowel segment can be linked to the stranded mora (compensatory lengthening)
- The following onset consonant can be linked to the stranded mora (compensatory gemination)
- The stranded mora can be deleted.

At least one instance of each outcome will be discussed in the following chapters.

I assume that the choice between these outcomes is a matter of the relative ranking of the following constraints:

MAXμ: "Don't delete moras." For each mora in the input, there must be a corresponding mora in the output. (Kager 1999 p. 176; Buckley 1998; cf. the PARSEμ of Sherer 1994, p. 11).

*GEMINATE: A consonant is not long (*e.g.* Ham 1998 p. 239 ff).

*LONG-V: A vowel is not long (Sherer 1994, p. 89).

MAXLENGTH: "Don't shorten segments; stay long." For each UR segment $\alpha$ and each SR segment $\beta$, $\alpha\Re\beta$, if $\alpha$ is long, $\beta$ is also long (Cf. the DEPLENGTH constraint of Buckley 1998, which requires that short segments not be lengthened).

A language where *GEMINATE is undominated has no geminates, and a language where *LONG-V is undominated has no long vowels. A language where MAXμ is undominated requires either compensatory lengthening or compensatory gemination in the case where an original coda consonant is deleted. The permutations in ranking of the first three constraints are shown below (the constraint forcing coda consonant deletion is not shown):

| | |
|---|---|
| Loss of coda mora: | *GEMINATE \| *LONG-V $\gg$ MAXμ |
| Compensatory lengthening: | MAXμ \| *GEMINATE $\gg$ *LONG-V |
| Compensatory gemination: | MAXμ \| *LONG-V $\gg$ *GEMINATE |

*GEMINATE and *LONG-V are violated by all instances of surface long segments of the respective type, whether the surface segment reflects an underlyingly long segment or is a lengthening of an underlyingly short segment. Naturally, there are many languages which have a length contrast for both consonants and vowels. In a language of this type, MAXLENGTH dominates both *GEMINATE and *LONG-V, requiring that underlying long segments not be shortened. However, the ranking of *GEMINATE against *LONG-V is still important, because this ranking determines the outcome of a stranded mora, as described above.

## 1.3 Types of constraints

I will assume a superset of the standard constraints discussed in McCarthy and Prince (1995, q.v.), *e.g.* MAX and DEP (replacing earlier PARSE and FILL), IDENT, ANCHOR, UNIFORMITY, *etc.*

I further assume that the following are true of constraints:

1. Constraints can be sensitive not only to segments but to individual features (Zoll, 1996).

2. Constraints can be sensitive to certain positions in the prosodic structure (Beckman, 1998).

3. Primitive constraints can be combined using boolean operators to produce derived constraints (Smolensky, 1995; Crowhurst and Hewitt, 1997).

I discuss each of these assumptions in turn.

### 1.3.1 Constraint sensitivity to segment vs. feature

Under their conventional formulation, the faithfulness constraints MAX and DEP are concerned with segment-to-segment correspondences. Zoll (1996) discusses cases where there is phonological material in the UR which does not necessarily belong to any particular segment, such as the palatal autosegment of Japanese reduplicative mimetics and tone autosegments of tone languages. To account for the faithful parsing of these types of subsegmental material, Zoll distinguishes MAX(seg) from MAX(subseg). The first constraint, MAX(seg), requires the parsing of a segment; this is the conventional sense of MAX (McCarthy and Prince, 1995). The second constraint, MAX(subseg), requires parsing of some non-segmental element.

I will make use of MAX(subseg) in Chapter 2 in connection with a set of palatalization and depalatalization processes in early Greek.

### 1.3.2 Positional faithfulness

Beckman (1998) argues for a category of faithfulness constraints which are violated only if the unfaithfulness between levels occurs in a privileged position. Privileged positions include syllable onsets, root-initial syllables, stressed syllables, *etc.*

Beckman specifically discusses and motivates three varieties of the IDENT constraint:

| Constraint | Only violated in |
|---|---|
| IDENT-ONSET(F) | syllable onsets |
| IDENT-$\sigma_1$(F) | root-intial syllables |
| IDENT-$\acute{\sigma}$ (F) | stressed syllables |

(Beckman, p. 9)

For example, consider the following grammar fragment, which is an instance of the general schema given by Beckman (p. 9):

IDENT-ONSET(voice) $\gg$ *[+voice] $\gg$ IDENT(voice)

The constraint *[+voice] is violated once for each voiced segment. In this grammar, all coda consonants are devoiced, collapsing the voicing distinction in this non-privileged position; IDENT-ONSET(voice) is not violated for non-onset consonants. However, the voicing distinction is maintained for onset consonants.

### 1.3.3 Derived constraints

Following Crowhurst and Hewitt (1997), I assume that primitive constraints can be combined to produce derived constraints. Crowhurst and Hewitt explore joining constraints according to the operators of traditional logic, *i.e.* conjunction, disjunction, and implicature. For Crowhurst and Hewitt, a violation of a constraint (whether primitive or derived) corresponds to the FALSE value of elementary logic.

Thus, the truth table of the AND (conjunction) operator corresponds to the evaluation of a constraint derived by conjunction as follows (p. 8):

| **Constraint A** | **Constraint B** | **Constraint (A $\wedge$ B)** |
|---|---|---|
| satisfied | satisfied | satisfied |
| violated | satisfied | violated |
| satisfied | violated | violated |
| violated | violated | violated |

Crowhurst and Hewitt also allow constraints to be combined by disjunction ($\vee$) and by implicature ($\supset$).[3] As it happens, no occasion arises in the following analyses where I have need to posit a constraint derived by any operator except conjunction (Smolensky 1995; Eisner 1999).

## 1.4 Contents of the following chapters

In Chapter 2, I will discuss a conspiracy which occurred in Greek in the second millennium BCE, in which the glide *j was eliminated from the inventory of the language.

Chapter 3 will cover a conspiracy in West Germanic in which an entire category of contrastive sounds was nearly eliminated: namely, the voiced fricatives. I will also discuss a second conspiracy involving an earlier preference for gemination, and a later preference

[3] There is an error in Crowhurst and Hewitt's truth table for the implicature operator (Crowhurst and Hewitt 1997, conclusion section, #92) In the proposition A $\supset$ B, if A is FALSE, A $\supset$ B is always TRUE regardless of the value of B (not FALSE as Crowhurst and Hewitt state; see *e.g.* Gamut 1991, p. 32; Partee *et al.* 1993, p. 102; Klenk 1983 p. 38).

for the compensatory lengthening of vowels.

In Chapter 4, I will discuss a conspiracy which occurred in early Slavic by which syllable codas were eliminated.

Chapter 5 is a concluding discussion where I will consider two possible objections to general type of analysis under discussion.

# Chapter 2

## The Destruction of *j in Greek

In this chapter, I will discuss a conspiracy of prehistoric rules in ancient Greek whose cumulative effect was to eliminate */j/ as a contrastive segment.

*/j/ originally occurred in a rich set of environments. In prehistoric Greek, */j/ could stand alone as a syllable onset, both word-initially and word-medially (#jV-, -VjV-). Further, prehistoric Greek had a rich set of *Cj clusters; essentially every consonant in the Greek inventory was to be found in this environment. An exception is *βj, for which no secure inherited examples exist (Lejeune 1982, p. 79); I will consider this to be an accidental gap owing to the relative rarity of *b in PIE, and will not discuss it further. One might also count [ŋ] as an exception; this phone occurred only before κ and γ, and was presumably an allophone of ν (/n/), at least originally (Don Ringe p.c. points out that intervocalic /gm/, /gn/ became [gm], [ŋn] at some point). Otherwise, all of the consonants of prehistoric Greek are known to have occurred before */j/.

*/j/ conditioned various consonantal alternations which persisted into classical Greek

after */j/ itself had vanished. An important case is the highly productive verbal suffix *-ye/yo- inherited from Proto-Indo-European (Lejeune, p. 79), which alternated with zero and other affixes within paradigms; thus, the various rules by which */j/ was eliminated gave rise to an assortment of consonantal alternations within verb paradigms which continued into classical Greek. Other suffixes beginning with *-j- produced these consonant alternations in noun and adjective paradigms as well. These alternations are so richly attested that Sommerstein (1973, p. 28-9), working in the framework of SPE, goes so far as to argue that */j/ is still underlyingly present in classical Greek, despite a complete absence of any remaining surface *Cj clusters. This is not the view which I adopt, but the fact that such an analysis can be reasonably considered is an indication of the widespread effects which the */j/-destruction conspiracy had for the morphophonemics of classical Greek.

I will begin with a very brief introduction to the dialects and history of early Greek. I will then detail the facts regarding the various rules eliminating *j. Finally, I will propose a unified analysis of the *j conspiracy in OT.

## 2.1 Brief overview of the external history of Greek

This section is a brief overview of the dialect groupings, dating of documents, and major linguistic events in Greek. The reader who is already familiar with the external history of early Greek can safely skip this section.

At the date of our earliest written records, Greek is already heavily ramified into numerous dialects. Toward the end of the classical period, this great diversity eroded away as the form of Greek known as κοινή, based on the prestige Attic dialect with some borrowings from other dialects, came to be the standard. All of the modern Greek dialects, with one possible exception, derive from κοινή.

The date at which prehistoric Proto-Greek began to diversify into the historically attested dialects is not known. The most widely accepted view is that the latest unity of PIE cannot plausibly have been earlier than the beginning of the fourth millennium BCE (see *e.g.* Mallory, p. 158 ff.); and the earliest written records of Greek (in a clearly differentiated South Greek dialect) date from around the thirteenth century BCE (Mallory, p. 66). The latest unity of Proto-Greek must therefore have been somewhere in this broad period. There is ongoing controversy regarding the dating of the invasion or migration into Greece by the speakers of prehistoric Greek; however, the most widely accepted dating for "the coming of the Greeks" is in the centuries around the beginning of the second millennium BCE (Mallory, p. 71). It is not known whether Greek had already begun to diversify into the later-attested dialect groups at the time of this invasion (or series of invasions).

The earliest records of Greek are written in a syllabary known as Linear B in a South Greek dialect known as Mycenaean. The Linear B documents date from *c.* the thirteenth century BCE. The Linear B writing system collapses many of the distinctions which must have existed in spoken Greek. Nevertheless, Linear B often gives us enough evidence to provide a *terminus ad quem* or *terminus a quo* dating for certain sound changes.

For reasons which have not been conclusively determined, the Mycenaean civilization collapsed around the 12th century BCE. There followed a half-millennium absence of any Greek writing (the "dark age"). The alphabetic writing of Greek began somewhere between 825-750 BCE (Mallory, p. 66).

It is problematic to draw a Stammbaum to represent the Greek dialects, because there have been many innovations which have spread across dialect boundaries, muddying the picture considerably. With this important caveat in mind, the standard view of the relationships among the major Greek dialects can be represented as shown in Figure 2.1 (Risch, 1955; see also Buck, 1955).

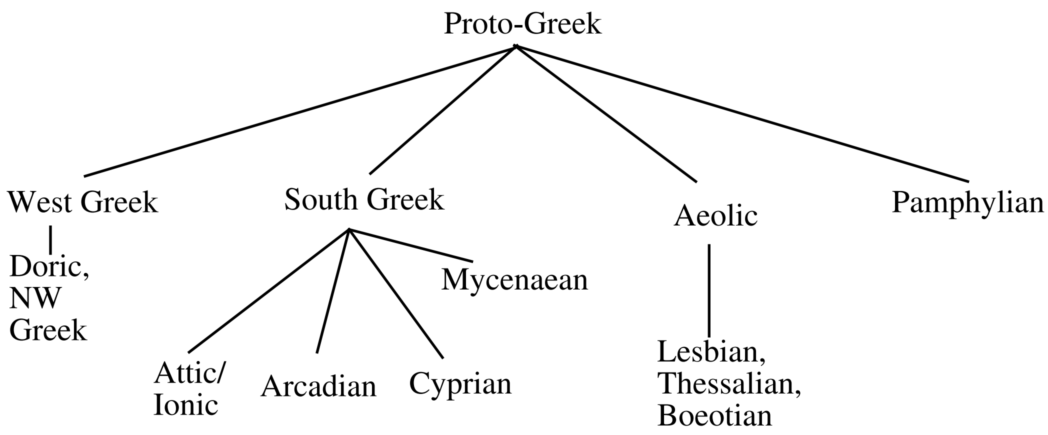


Figure 2.1: Phylogeny of the Greek dialects

Because of various prehistoric population movements, the geographical arrangement of the dialects corresponds very poorly to the structure of this Stammbaum. It is often the case that Greek dialects which are not closely related genetically are nevertheless geographically adjacent, and vice versa. When innovations spread across dialect boundaries, those innovations frequently come to be distributed in groupings of dialects which do not form a proper clade in this tree.

The view which I will adopt is that the *j-conspiracy is an innovation which spread through an already partially differentiated dialect continuum. As I will detail below, the rules of the *j-conspiracy do not operate the same way in all dialects, despite the commonality that *j is uniformly eliminated. In the analysis section, I will show how the differences among dialects can be straightforwardly captured as differences in the ranking of a small number of constraints.

## 2.2 The the *j conspiracy: overview

Following is a list of the rules making up the *j-elimination conspiracy. Each of these rules will be discussed in detail below.

| | | | | |
|---|---|---|---|---|
| 2a. | *-anj- | > | -ain | (metathesis) |
| | *-onj- | > | -oin- | (metathesis) |
| | *-unj- | > | -u:n- | (deletion plus compensatory lengthening) |
| | *-enj- | > | -e:n- | (deletion plus compensatory lengthening) |
| | *-inj- | > | -i:n- | (either metathesis, or deletion plus compensatory lengthening) |

*However,* in Lesbian and Thessalian, the outcome was -VnnV- (compensatory gemination) when the preceding vowel is *u, *e, or *i. After *a and *o, the usual metathesis occurs.

2b. *-rj- (Same developments as *nj: *-arj- > -ajr-, *etc.*)

*mj > *nj (subsequently subject to the same developments as *nj)

2c. *-lj- > -ll- (Gemination)

*However,* in Cyprian, */l/ seems to patterns with */n/ and */r/ (metathesis, *etc.*), although the evidence is very meager.

2d. *p($^h$)j > pt

2e. *t($^h$)j, *k($^h$)j > s, ss, t, tt (the details are very complicated; see below)

*-dj- > -zd- (Most dialects)

*-gj- > -zd- (Most dialects)

2f. *j- > zd-

*Hj- > h- (H = PIE laryngeal)

*sj- > *h- (*s- before V also becomes *h-)

2g. *-j- > ∅ / V__V

*-VwjV- > -VjjV-

*-VsjV- > *VV

*-Vs+jV- > -VjjV-

## 2.3 The *j conspiracy in detail

In this section, I will present the raw facts regarding each rule of the *j-conspiracy. I will save most comments regarding the theory-specific interpretation of these facts for the analysis section further below.

### 2.3.1 *nj

The outcomes for *-nj- are complex, and depend on the preceding vowel. I will first discuss the set of outcomes which were found in Attic and most other dialects (Sommerstein, 1973, p. 27-33; Buck, 1955, p. 65; Lejeune, p. 155):

*-αν-jε/ο > -αινε/ο- (*-anj- > -ain)

*-ον-jε/ο > -οινε/ο- (*-onj- > -oin-)

*-υν-jε/ο > -υνε/ο- (*-unj- > -u:n-)

*-εν-jε/ο > -ενε/ο- (*-enj- > -e:n-)

*-ιν-jε/ο > -ινε/ο- (*-inj- > -i:n-)

The first two rules involve metathesis; when *a or *o precedes a *-nj- cluster, the order of the *n and *j clusters is swapped, giving rise to new instances of the diphthongs αι, οι which were already well established in the Greek inventory (Buck p. 65 uses the word "epenthesis" to describe the process; this is presumably a mistake for "metathesis").

The third rule, where */u/ precedes the cluster, involves the complete deletion of */j/ with compensatory lengthening of */u/. The fourth rule has been analyzed along these same lines, yielding a long epsilon. Somewhat misleadingly, the resulting long vowel is later represented orthographically as <ει>; despite appearances, this spelling represents a long epsilon rather than a ε + ι diphthong.

The fifth rule, where /i/ precedes the cluster, has been analyzed as a further case of compensatory lengthening (*e.g.* Lejeune, p. 155). However, it is also possible that a rule of metathesis has applied, with the */i/ and */j/ segments fusing into a single long segment to avoid a violation of the Obligatory Contour Principle (for general discussion of the OCP and its problems, see Odden 1995, p. 461-464). From the perspective I will adopt below, it does not greatly matter which of these two analyses one adopts, since the particular processes by which a surface form is derived are not of particular interest in OT.

Examples of these rules include:

*κρίνjω > Att. *etc.* κρῑ́ ω 'I separate, divide'
*κτένjω > Att. *etc.* κτείνω 'I kill, slay, slaughter'
*plún-ye-hen > πλῡ́ νε̄ ν 'to be washing' (cf. fut. πλυνε̃ν, aor. πλῦναι < *plún-hai)
*βάνjω > βαίνω 'I go, walk, step'
(Buck, p. 65; Ringe, course handouts)

The outcomes discussed so far are found in all of the Greek dialects except Lesbian and Thessalian. In these dialects, the usual metathesis after *α, *ο occurs, but instead of the compensatory lengthening found in connection with the other vowels, gemination occurs:

*κρίνjω > Lesb. κρίννω, Thess. Lesb. κρέννω
*κτένjω > Lesb. κτέννω (Buck 1955, p. 65)
cf. *ἀγκυρjα - > ἀγκυρρα[ "anchor" (Hamm, p. 16; the '[' indicates a lacuna)
*ὀτρύνj- > ὀτρύνν[ "stir up, rouse, spur on, encourage" (Hamm 1951, p. 16)[1]

Hamm notes that when υ is the vowel preceding *-νj-, there are some sporadic cases of compensatory lengthening of υ (as in Attic and elsewhere) rather than gemination of the sonorant. However, it cannot be ruled out that these forms were introduced into the texts from Homeric Greek. For this reason, I will disregard these cases in my analysis and will assume that gemination is the sole *lautgesetzlich* outcome for *-υρj-, *-υνj- in Lesbian and Thessalian.

The rules *-υνj- > -ῡ ν-, *-ενj- > -ε̄ ν-, *-ινj- > -ῑ ν- are a part of a larger grouping of rules making up what is known as the First Compensatory Lengthening. The other cases where the First Compensatory Lengthening applied are those where there was a word-medial sonorant either preceded or followed by *h; the *h was deleted and the preceding vowel was lengthened. In Thessalian and Lesbian, however, the undeleted sonorant is geminated, and the preceding vowel is not lengthened (Lejeune, p. 121).

### 2.3.2 *mj

Inherited *μj ([mj]) is rare. The cases where it existed became *νj ([nj]) by an early rule (Lejeune, p. 155). This rule must predate the developments of *νj discussed above, because

[1]The form ὀτρύνν[ is actually ambiguous; because the ending is missing, it cannot be excluded that this is an aorist with *νh. The form ἀγκυρρα[ is unambiguous, however.

original *-αι̯μ -, *-οι̯μ - do not become *-αι̯ν -, *-οι̯ν - (*e.g.* κοι̯μάω 'to lay to rest (zur Ruhe legen)'; Frisk 1960 p. 892).

An example of the *mj > *nj rule, together with the later development of *νj, is as follows:

κοινός 'common, shared in common' < *κονjός < *komyós (from PIE *kom, > Lat. cum, co(n)-; Don Ringe, class handouts, fall 1997; Lejeune, p. 156)
βαίνω 'I go, walk, step' < *βανjω < *g$^w$ m̥- (zero grade of *g$^w$em-)
(Ruijgh, 1961, p. 206; Lejeune p. 155)

### 2.3.3 *rj

*rj clusters had the same outcomes as *nj clusters (Buck, 1955, p. 65; Sommerstein, 1973, p. 27-33). Examples include:

*χαρjω > χαίρω 'I rejoice, am glad'
*μόρjα > μοῖρα 'fate'
*φθέρjω > Att. *etc.* φθείρω, Arc. φθήρω 'I corrupt, spoil'
(Buck, p. 65)

As with *nj, Lesbian geminates the ρ rather than compensatorily lengthening the preceding vowel:

*φθέρjω > Lesb. φθέρρω
(Buck, p. 65)

### 2.3.4 *lj

In nearly all dialects, intervocalic *lj > /ll/ (Sommerstein, p. 30; Buck 1955, p. 65):

> ἄλλος (Lat. alius) 'other'
> στέλλω ( < *στέλjω ) 'I set, place, arrange'

This occurs not only in Lesbian and Thessalian, where gemination is the regular outcome of sonorant + *j clusters, but also in Attic and other dialects, where one would expect metathesis or compensatory lengthening of the preceding vowel, judging from the behavior of other clusters of the kind. *λj > λλ is nearly pan-Greek.

In Cyprian, however, there appears to have been metathesis of the same sort which occurred with *nj, *lj in most dialects (Buck 1955, p. 65):

> αἶλος 'other (Cyp.)' (cf. αλλος)

The form αἶλος, however, is only found in a gloss, not in an inscription. There are at least two other recorded forms where this development is claimed to have occurred (once more in Cyprian and once in Elean), but there are problems with both cases.

### 2.3.5 *p($^h$)j > *πτ

All instances of *pj, *p$^h$j become πτ, both word-initially and word-medially:

> κλέπτει < *klép-ye- 'steal' (cf. Old Lat. clepit, Goth. hlifiþ; Frisk 1960 p. 871)
> σκέπτεται < *skép-ye- <- *spéḱ-ye- 'view, watch' (cf. Lat. cōn-spicit; Frisk, p. 725-6)

πτῆξαι 'duck down jerkily' (< *pjeh$_2$k-; cf. TB pyāktsi; Hackstein, 1992)

Not all instances of πτ in classical Greek derive from *p($^h$)j. Some instances of πτ are inherited directly from PIE:

πί-πτ-ω (<*pt-, zero grade of *pet-) 'I fall, fall down' (Lejeune, p. 69, note 1. The initial syllable is a reduplicant; it is the -πτ- which is of interest here.)

Other instances of πτ result from a rule of metathesis. It is a general requirement in Greek that in any sequence of two stops, the second must be a dental (πτ, κτ, βδ, γδ, φθ, χθ). Earlier sequences not meeting this requirement are brought into line by rules of metathesis including *τπ > πτ, *τκ > κτ; for example:

k$^w$id-pe > τίπτε 'why? why then?', cf. Lat quippe
*tek- > τίκτω 'bring forth, bear', cf. ἔ-τεκ-ον, τόκος
(Lejeune, p. 69)

Further, there are cases where original *p- unexpectedly and sporadically turns up as πτ, with the outcomes for each word differing sporadically from dialect to dialect (for example, πολις 'city' shows up in some dialects as πτολις) (Buck, 1955, p. 61; Lejeune, 1982, p. 39-40). This peculiarity has never been explained.

In cases where πτ does derive from earlier *πj, *φj, the πτ is frequently found in alternation with π or φ within a verb paradigm or derivational set:

| | | | |
|---|---|---|---|
| ἀστράπτω | 'to flash forth, lighten' | ἀστράπη | 'a flash, lightning' |
| κάμπτω | 'to bend, bow' | κάμπη | 'a bend, twist' |
| κλέπτω | 'to steal' | κλαπῆναι | 'stolen' |
| τύπτω | 'to beat, strike, smite, knock' | τύπος | 'a blow' |
| ἅπτω | 'to fasten on, fix' | ἁφή | 'a touch' |
| βάπτω | 'to dip, dye' | βαφή | 'a dipping' |
| κρύπτω | 'to hide, cover, conceal' | κρύφα | 'secretly' |

(Lejeune, p. 79)

With regard to the dating of the rule *p($^h$)j > πτ, it has been observed that the rule has the same outcome in all of the Greek dialects. For this reason, it has been suggested that the rule may have occurred before substantial diversification of the Greek dialects (Lejeune, p. 79).

Unfortunately, the Linear B documents do not provide any clear data to allow us to determine whether *p($^h$)j > πτ had already applied in Mycenaean. There are examples where a πτ cluster is clearly represented (Lejeune, p. 69-70):

| | | |
|---|---|---|
| re-po-to | λεπτός | 'peeled off, husked' |
| pte-we-ra | πτελέϝᾱ | 'elm' |
| di-pte-ra | διφθέρᾱ | 'leather' |
| ra-pte | *ῥαπτήρ | 'stitcher, tailor' (cf. ῥάπτης, an agent noun from ῥάπτω 'stitch') |

(Lejeune, p. 69-80; Hooker 1980, p. 138)

However, in no such case can the Mycenaean πτ cluster be clearly etymologized with earlier *p($^h$)j.

The only argument for *p($^h$)j > πτ in Mycenaean is an indirect one. The Linear B syllabary contains a symbol for the syllable <pte>. This symbol clearly represents /pte/ in Linear B, since it occurs words where the /t/ is old: for example, in the 'tailor' example above, the suffix begins with -t- (Don Ringe, personal communication). However, this is the only symbol in Linear B for which the value in known to consist of stop + stop + vowel. Linear B contains a few symbols for sequences of the form stop + semivowel + vowel (*dwe, dwo, etc.; rja, rjo, tja, etc.*); however, there is no symbol for *<pje>. Lejeune (p. 79, note 5) suggests that the existence of a sign <pte> in Linear B implies the existence of an older sign *<pje>, parallel to the other signs of this type. This is consistent with the fact that pt is uniformly the outcome of *p($^h$)j in all dialects, suggesting an early date for this rule.

### 2.3.6 *t($^h$)j, *k($^h$)j, *dj, *gj

The development of the clusters *t($^h$)j, *k($^h$)j, *dj, *gj is extraordinarily complex, with the outcome depending on the following factors:

- presence or absence of a morphological boundary between the stop and glide
- word-initial or word-medial environment
- length of preceding vowel
- dialect

Despite this complexity, there is one thing which holds true in all cases: every process involves the elimination of a *Cj cluster. The *j of original *t($^h$)j, *k($^h$)j, *dj, *gj clusters is uniformly lost.

The clusters *τj, *θj can be treated together because they always have the same outcome, given a particular dialect and phonological environment (Lejeune, p. 79). The same is true of the pair *κj, *χj. It appears that aspiration does not figure into the outcome of these clusters.

Depending on a variety of factors, the clusters *τj, *θj, *κj, *χj surface as τ, ττ, σ, or σσ:

| | *t($^{h}$)j- | *-t($^{h}$)j- | *-t($^{h}$)+j- | *-k($^{h}$)(+)j- |
|---|---|---|---|---|
| Mycenaean | | -s- | -s- | -z- |
| Arcadian | σ- | -σ- | -σσ-[2] | -σσ- |
| Homeric | σ- | -σσ-[1] ∼ -σ- | -σσ-[2] | -σσ- |
| E. Ionic | σ- | -σ- | -σσ-[2] | -σσ- |
| W. Ionic, Attic | σ- | -σ- | -ττ-[2] | -ττ- |
| Boeotian | σ- | -ττ- | -ττ-[2] | -ττ- |
| Lesb., Thess. | σ- | -σσ- | -σσ-[2] | -σσ- |
| West Greek | σ- | -σσ- | -σσ-[2] | -σσ- |
| Elean, Lak. | σ- | | | -σσ- |
| Cretan | σ- | -ττ-[3] | -ττ-[2,3] | -ττ-[3] |

Notes:

1. When the preceding vowel is long or is a diphthong, single -σ- is found.
2. Following a consonant, however, -σ- is found.
3. In earlier inscriptions, -ζ- is written; in later inscriptions, -θθ- or -τθ- is written.

(Ringe, course handouts, fall 1997; Lejeune, p. 106; Szemerényi, 1966, p. 30)

Examples of these outcomes include:

σέβομαι 'worship, honor' < *tyeg$^{w}$-
σῆμα 'sign, mark, token' < *d$^{h}$y-ā-
Hom. μέσ(σ)ος, Lesb/Thess μεσσος, Att/Ion μέσος 'middle' < *med$^{h}$yo-

Ion. πλάσσω, Att. πλάττω ‘to form, mold’ < *πλαθ-jω
Ion., Thess μέλισσα, Att. μέλιττα ‘bee’
Attic ὅσος, Doric/Lesb/Thess/Elean/Delph ὅσσος ‘as great as; how great’
(Lejeune, p. 62-3, 80, 103-5; Szemerényi, 1966)

It will not be my goal here to give an exhaustive account of all of these developments. What is important is that in all of the cases, *j is eliminated. Following Lejeune (p. 79, 106), I will assume that all of the developments involved palatalization of the consonant preceding *j, giving rise to affricates. Later, either the stop or fricative element of the affricates was lost, depending on dialect.

If we were to judge merely from the evidence of Linear B, we might supose that a merger had occurred between *-t($^{h}$)j- and *-t($^{h}$)+j-, since both are represented with <s>; this <s> contrasts with <z>, which is the outcome of *-k($^{h}$)(+)j-. It is surprising, then, that the later South Greek dialects (Attic, *etc.*) have kept *-t($^{h}$)j-,*-t($^{h}$)+j- separate while merging *-t($^{h}$)+j-, *-k($^{h}$)(+)j-.

One possible explanation for this state of affairs is that Mycenaean has in fact undergone a merger which did not occur in the other South Greek dialects. While Mycenaean closely resembles reconstructed Proto-South Greek, it cannot be directly ancestral to the other South Greek dialects, as evidenced by the apparent absence of the verbal augment in Mycenaean and by various syncretisms in the Mycenaean case system which are incompatible with the case systems of the other South Greek dialects. It is possible, then, that the three categories were still distinguished in Proto-South Greek, and that Mycenaean has merged *-t($^h$)j-,*-t($^h$)+j-, while the other South Greek dialects have merged *-t($^h$)+j-, *-k($^h$)(+)j-.

A second possibility is that *-t($^h$)j-, *-t($^h$)+j- were distinguished in Mycenaean pronunciation, but that the orthography fails to represent the contrast. This would hardly be surprising in light of the numerous other Greek contrasts which the Linear B orthography fails to distinguish. In any case, judging from the orthography, it seems clear that some kind of palatalization had occurred in all three categories (*-t($^h$)j-, *-t($^h$)+j-, *-k($^h$)(+)j-) by Mycenaean times.

Although I accept Lejeune's general view that *-t($^h$)j-, *-t($^h$)+j-, *-k($^h$)(+)j- all became some kind of affricates before developing into the attested segments, I differ in some of the details. Lejeune suggests that *-k($^h$)(+)j- first became *-t($^h$)(+)j-, presumably merging with existing *-t($^h$)+j-, before going on to become an affricate *ts (p. 80). However, if *-k($^h$)(+)j- did merge with existing *-t($^h$)(+)j-, then it is surprising that Linear B represents *-k($^h$)(+)j- with <z>, a spelling which suggests that some kind of affrication or spirantization has already occurred without a merger with *-t($^h$)+j-. The orthographic contrast between <s> and <z> clearly seems to represent a contrast in pronunciation, perhaps realized phonetically as [ts] vs. [č].

In nearly all cases, the the medial clusters ultimately yielded a geminate, with the exception being *-t($^h$)j- (without morpheme boundary) in Arcadian, Ionic, Attic, and sometimes Homeric. Since the relative chronology of the sound changes is unclear, it is difficult to tell whether these outcomes follow fully from regular sound changes, or if there were analogical pressures which resisted or undid certain sound changes in the cases where a morphological boundary was present. For my purposes, the important point is not to account for all of the distressing length and quality differences, but rather to capture the fact that *j was uniformly eliminated through a set of palatalization processes.

Instances of -σσ- for earlier *-k($^h$)(+)j- are sometimes found in Attic. However, the evidence from inscriptions indicates that Attic had ττ from an early date; cases of σσ in Attic are taken to be borrowings from Ionic. In much later κοινή, σσ was found more frequently than ττ (Buck, 1955, p. 69-70), reflecting contact with other dialects.

The development of word-initial *t($^h$)j- into σ- may be early, since the outcome is the same in all dialects. However, it must postdate the change *s- > *h- / V (ἕρπω 'creep, crawl' < *serp-; cf. Lat. serpō, among numerous other examples; Lejeune, p. 92-3). Word initial *σ- before a vowel is never inherited as such from Indo-European into Greek, because *s- always becomes *h- in this environment. Instances of σV- are either later loan words (σήσαμον 'sesame seed', Myc. pl. sa-sa-ma; σήρ 'one of the Seres (an Indian people from whom silk was first bought)', σίδηρος 'iron', *etc.*) or are the *lautgesetzliche* outcomes of *k$^w$j-, *τj-, *θj-, *χj-, and *τϝ- (Lejeune, p. 94).

### 2.3.7 *dj, *gj

The reflex of word-medial *-δj-, *-γj- is ζ in nearly all dialects (Sommerstein, p. 30; Buck 1955, p. 71; Risch, 1955, p. 66). ζ was clearly pronounced as [zd] in classical Attic and Ionic Greek. After the prehistoric palatalization of *-δj-, *-γς-, the resulting segment was probably first pronounced *[dz] before later coming to be pronounced [zd] (Lejeune, p. 80). The reflexes of *-δj-, *-γj- were spelled σδ in Lesbian, which is a natural alternative spelling for [zd] (Buck, p. 71).

In a few dialects, such as Boeotian and Laconian, the outcome of *-δj- and *-γj- is δδ (Szemerényi 1966 p. 36). A reasonable interpretation is that there was a kind of metathesis of continuancy in most dialects, but in the dialects where the outcome is -δδ-, the continuancy is entirely delinked.

Examples of these changes include:

μέ̄ ζων, Ion. μέζων 'greater' (comp. of μέγας 'great')< *meǵ-yōs-
πεζός 'on foot' < *ped-yo-
ἕζομαι 'I seat myself' < *sed-yo- (cf. ἕδος 'seat')
ἅζομαι 'to stand in awe of' < *Hyaǵ-yo- (cf. ἅγιος 'devoted to the gods')
(Buck, p. 71; Lejeune, p. 80)

### 2.3.8 $*k^wj$, $*g^wj$, $*k^{wh}$, $*g^{wh}$

In cases where the original IE labiovelars occurred before *j, the rounding was lost by an early rule which had already gone to completion before Mycenaean times (Lejeune 1982, p.

43, 46, 79). This rule probably occurred before proto-Greek began to separate into dialects, since it is evident in the reflexes of these clusters in all of the dialects of Greek.

Examples include:

πέττει < *pek-ye- < *pek$^{w}$-ye- ‘ripens’ (cf. πεσσω, a non-Attic 1 sg. form cited by Liddell 1852)
Hom. ὄσσα ‘rumor, voice’ < *wok-ya < *wok$^{w}$-ya
ὄσσε ‘eyes (du.)’ < *ok-ye < *ok$^{w}$-ye
νίζω ‘I wash’ < *nig-yō < *nig$^{w}$-yō
(Ringe, course handouts; Lejeune p. 52)

In terms of the *j-conspiracy, the original clusters *k$^{w}$j, *g$^{w}$j, *k$^{wh}$, *g$^{wh}$ can be treated together with the ordinary velars, since it appears that the stops had already become ordinary velars before the rules affecting *-k($^{h}$)j-, *etc.* occurred.

### 2.3.9 Word-initial *j-, *Hj-

The Greek reflexes of word-initial PIE *j- were a considerable problem prior to the 1970’s. In some cases, the outcome is rough breathing, but in other cases, the outcome is ζ- (Buck 1955 p. 52; Lejeune 1982 p. 165-8):

| | |
|---|---|
| ὅς | ‘who (rel. pron.)’ (Skt. yás) |
| ἧπαρ | ‘liver’ (Lat. iecur) |
| ἵεμι | ‘send’ (Lat. iaciō) |
| ζυγόν | ‘yoke’ (Skt. yugám) |
| ζέω | ‘boil’ (Skt. yásati) |
| ζωστός | ‘girded’ (Av. yāstō, Lith. júostas) |

Various solutions to this problem were put forward. One proposal by Nocentini (1972, discussed in Wyatt 1976) is that the words with ζ- are not directly inherited from PIE, but rather are loan words from an unknown IE language, perhaps spoken in Thrace, in which ζ- was the regular outcome of *j-. The words beginning in ζ- are alleged to generally refer to "rural activities", leading to the claim that these are loans from a rural dialect. Wyatt (1976) criticizes this proposal on the obvious grounds that there is no evidence for this dialect other than the problematic words in question; we have no independent record of a language or dialect where IE *j- $>$ ζ-.

Buck (1955, p. 52) makes no attempt to account for the differing outcomes of *j-, apparently considering the ζ outcome to be a sporadic exception to a general rule *j- $>$ *h-. There have been attempts to derive the difference according to sound-law: Wyatt (1976) agrees with the traditional view that there is only one PIE *j, and suggests that the differing outcomes are somehow connected with Grassman's Law (*C$^h$...C$^h$ $>$ *C....C$^h$). It appears to me that such an explanation cannot be correct; among words which do not contain an internal aspirated element, cases of both rough breathing and of ζ- are found (ζυγόν 'yoke' $<$ *yugóm, but ἧπαρ 'liver' $<$ Wyatt's *yék$^w$r̥, for which the modern standard reconstruction is *Hyḗk$^w$r̥).

With the gradual acceptance of the existence of laryngeals in IE, a different account has become possible. In unpublished work, Schindler (1986) proposes that bare word-initial *j- becomes ζ-, but that *Hj- (*i.e.*, a word-initial cluster of a laryngeal followed by *j) becomes rough breathing. Consider the following cases:

ἧπαρ 'liver' < *Hyḗ kʷr̥
ὑσμῑ́ νη 'combat' < *Hyudh-sm-, cf. Lat. iubet 'command' (*'order to fight'), from *Hyudh- 'fight'; cf. Skt. 3pl. yúdhyante
ἧκε '(s)he threw (aor.)' < aor. Hyē-k- < Hyeh$_1$-; cf. Attic pres. ἵησι ← *ἵησι < *īyē- < *Hi-Hyeh$_1$-
ἁγνός 'pure, holy' < *Hyaǵnós 'holy' (cf. Skt yaj- 'to sacrifice', middle perf. 3 sg. ījé < zero grade *Hi-Hiǵ-)
(Schindler, 1986; Ringe, course handouts)

Regarding the chronology of these developments, Lejeune (p. 167-8) notes that the development of ζ appears to have already happened by Mycenaean times:

ze-u-ke-si (dat. pl. of ζεῦγος 'yoke')
ze-so-me-no (fut. med. part. of ζέω 'boil')

At least some of the cases where original *Hj- (with laryngeal) existed are written with <jV-> in Mycenaean, showing that at least the *j- portion of the original cluster had not yet been eliminated:

jo-po-ro-te-ke : (h)ōς προθē κε (h)ōς = sentence connective 'how' or 'as'; προθē κε = 3 sg. aor. of προτίθημι 'set before' without augment; here 'set forth, presented')
jo-i-je-si : (h)ōς (h)ιενσι "(which, how?) they send"
jo-do-so-si : (h)ōς δō σονσι "(which, how) they will give"

However, there are also cases where the *j- is not found:

o-wi-de : (h)ōς ϝιδε

o-de-ka-sa-to : (h)ōς δεξατο
o-di-do-si : (h)ōς διδονσι

Since aspiration is generally not represented in Linear B (Hooker, p. 50), the absence of any initial consonant in this latter group can be taken as an indication that *j- (*[hj-]?) has shifted to *h- in these cases. Lejeune argues on these grounds that the change of *j- to rough breathing must therefore have been in progress during the Mycenaean period.

### 2.3.10 Word-initial *sj-

Lejeune (p. 171) states that there is only one clear instance of inherited word-initial *sj- in Greek:

> ὑμήν 'membrane' < *sjū- (Lat. sūtus ptc. 'sewn', Skt. syūtás 'sewn', syū́ma neut. 'strap, (saddle-)girth, Hitt. sumanz 'cord')

Perhaps the development was *sj- > *hj- > h-, parallel with the development of *Hj-. In any case, our understanding of *sj- in Greek is murky at best.

### 2.3.11 Intervocalic *j

The overall picture regarding intervocalic *-j- in early Greek is complex. Some instances of intervocalic *-j- were directly inherited from PIE. However, new instances of intervocalic *-j- (written -VίV-, and actually representing -jj-, at least before the classical period) sometimes arose from earlier *-wj-, *-sj- and survived into classical Greek. I will discuss in my analysis further below how these new instances of *-j- were permitted to survive, in seeming resistance to the *j-elimination conspiracy.

Original intervocalic *-j- was eliminated prior to the earliest alphabetic writings:

*trej-es > Att. τρεῖς, Cret. τρε-ες (Lat. trēs, Skt. tráy-ah) ‘three’
(Buck 1955 p. 50; Lejeune, p. 87)

Following this change, the resulting hiatus was eliminated through contraction of the vowels.

### 2.3.12 *wj

The current understanding of the outcomes of *-wj- and *-sj- is murky at best. The statements in this section and the next should be taken with caution.

Original *-wj- is generally eliminated by deletion of *w, with the *j ending up as -jj-:

καίω < *κάϝ-jω (*kau) ‘to burn, set on fire’
-είω < -ήϝ-jω (in Elean, a West Greek dialect, this suffix forms denominatives from nouns in -εύς)
fem. adj. γλυκεῖα < *γλυκεϝ-jα ‘sweet’

In cases where the preceding vowel is ι, the outcome is ι.

δῖος < *διϝ-jo-ς (*diw-/*deiw-) ‘divine, godly’

Lejeune characterizes this as lengthening rather than diphthongization, although the outcome in either case would be the same.

In cases where the preceding vowel is already a diphthong ending in ι, the *j leaves no trace:

comparative μείων < *μείϝ-jων 'less, too small'

Lejeune p. 172-3 discusses the situation in Mycenaean regarding *-wj-. It appears that *-wj- had not yet been eliminated in Mycenaean:

di-wi-jo or di-u-jo : δῖος 'divine, godly'

Based on a small set of anomalous cases, Lejeune suggests that all cases of *-wj- had been eliminated prior to the Mycenaean period by a rule *-wj- > *-jj-, but that most cases of the cluster were later restored by analogy. For example, adjectives in *-wjo- and comparatives in *-wjoς could have had the yod restored by analogy with their "doublets" in -ιjo- and -ιjoς-. Don Ringe (p.c.) points out that the isolated form μείϝjων is problematic, since there does not appear to be any related form upon which the -wj- could have been analogically restored.

An additional piece of evidence in the *-wj- puzzle is the personal name Διδαιϝον found in a Corinthian inscription (Kiparsky 1967, p. 620). The first element of this name appears to be *dajwō (< *dawjo ) 'kindle', which appears in later classical Greek as δαίω. According to Kiparsky, *-wj- first underwent metathesis to become *-jw-, which survives in the Corinthian inscription, and then underwent progressive assimilation to become *-jj-.

### 2.3.13 *-sj-

In unpublished work, Nussbaum (1985) discusses word-internal *-sj- clusters in early Greek. The outcome of these clusters depends on whether an original morpheme boundary exists between *s and *j, as illustrated by the following:

> Hom. τέο 'whose' (Lat. cuiu-s, Skt. kásya with analogical k-)
> Hom. ἰδυῖα 'knowing (fem.)' (< wid-ús-ya < *wid-ús-ih$_2$) (Skt. vidúṣī)
> (Ringe, course handouts)

In the first example, there is no morphological boundary, and *-sj- has entirely disappeared. In the second example, a morphological boundary intervenes in *-s+j-, and the cluster comes out as -jj-.

Nussbaum discusses the development of these clusters in the various dialects of Greek. In PIE, the genitive singular ending for thematic nouns was *-osyo (Watkins 1992, §8.6.2; cf. Skt. -asya), where no morphological boundary intervenes between *s and *j. In Lesbian and Thessalian, this ending appears as -οιο; in Attic, it appears as -ου (*i.e.* -ō), and in certain other dialects it appears as -ω (Buck, p. 88). The essence of Nussbaum's analysis is that *-osjo > *-oho- in most dialects; but there was a morphological resegmentation *-os+yo in Lesbian, Thessalian, and also in Mycenaean; in these dialects, *-os+yo > *-ojjo. This analysis entails that the morphological resegmentation happened independently in Mycenaean and in Lesbian/Thessalian, since the three dialects do not form a proper sub-branch of the Greek dialects.

The deletion of *-s- in the tautomorphemic cases appears to predate the Mycenaean period, as evidenced by Myc. to-jo = τοῖο (gen. sg. demonstrative; Hooker 1980, p. 60).

(See also Lejeune, p. 171 for an earlier view on *-sj-.)

## 2.4 Relative chronology

The following changes are common to all the Greek dialects, and may date to the Proto-Greek stage or earlier:

*j- > ζ-

*mj > *nj

*p($^h$)j > πτ

*k$^w$($^h$)j, *g$^w$($^h$)j > *k($^h$)j, *g($^h$)j

Based on variation in Mycenaean spelling, it appears that the sound change *j- > h- was in progress during the Mycenaean period. (Lejeune p. 23, 167-8).

The First Compensatory Lengthening (including the whole complex of changes connected with *rj, *nj clusters) must post-date Proto-Greek, since the outcomes differ across dialects. What I will propose in my analysis below is that this is a case of a change spreading across an already differentiated dialect continuum, where Lesbian/Thessalian had already developed a preference for gemination over compensatory lengthening prior to the geographic spread of the *j-elimination conspiracy.

It need not be the case that *-VjV- > *-VV- is crucially ordered with respect to *-w+j-, *-s+j- > *-jj-. Kiparsky (1967) and most subsequent authors take *-w+j-, *-s+j- to have given rise to -jj- rather than the singleton -j-, which has observable consequences for meter since the first of the two syllables should count as heavy. One possibility is that *-VjV- > *-VV- occurred before *-w+j-, *-s+j- > *-jj-, in which case the two rules are temporally in a potentially counterfeeding relationship. However, the other ordering is also possible; a rule *-VjV- > *-VV- would not necessarily affect *-jj-, giving yet another instance of a rule which applies to singleton consonants but not to geminates.

*sV- > *hV- must precede *t($^h$)j- > σ-. It must also precede *k($^h$)j- > σ-, both because the new σ- is not eliminated, and also because *k($^h$)j- gives rise to τ- in some dialects, while *sV- > *hV- appears to be Proto-Greek or earlier.

The formation of the intermediate affricates from coronal and velar stops followed by *j had clearly happened by Mycenaean times, although a more specific dating is difficult. The resolution of these affricates into σ, σσ, τ, ττ must be late, because the outcomes vary greatly across dialects. Even the closely related Attic and Ionic do not agree in their reflexes for these affricates, which speaks to a late date for the elimination of the affricates.

## 2.5 Analysis

### 2.5.1 Overview

Previous analyses of */j/-elimination in Greek (Kiparsky, 1967; Sommerstein, 1973; Ingria, 1980; Steriade, 1982; Wetzels, 1985) have involved multiple rules and have posited various intermediate synchronic levels of representation (or diachronic stages).

Typical of these analyses is that of Sommerstein (p. 31-33; see also p. 39, 49), which I will review in detail. Sommerstein analyzes the elimination of *j in the framework of SPE (Chomsky and Halle, 1968). Sommerstein assumes that *j is still underlyingly present, and posits rules 2.2 through 2.8 as synchronic rules of classical Attic to account for a subset of the *j-conspiracy rules (The feature [±hsp] ("heightened subglottal pressure") distinguishes aspirated and unaspirated voiceless stops; Sommerstein, p. 3. The feature [+WB] indicates a word boundary; p. 5).

$$\begin{bmatrix} -\text{son} \\ -\text{cont} \\ \alpha\text{voice} \end{bmatrix} \begin{bmatrix} -\text{cons} \\ -\text{syl} \\ -\text{back} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{ant} \\ +\text{cor} \end{bmatrix} \begin{bmatrix} +\text{cons} \\ -\text{son} \\ +\text{strid} \\ +\text{ant} \\ +\text{cor} \\ \alpha\text{voice} \end{bmatrix}$$

Figure 2.2: Affrication (*i.e.*, *tj, *kj > *ts; *$t^hj$, *$k^hj$ > *$t^hs$; *dj, *gj > *dz)

$$\begin{bmatrix} -\text{cont} \\ +\text{cor} \end{bmatrix} \rightarrow \emptyset \text{ / [+nas] \_\_[+strid]}$$

Figure 2.3: Release Retiming (*i.e.*, *nts > *ns)

$$\begin{bmatrix} -\text{son} \\ -\text{cont} \\ \alpha\text{voice} \end{bmatrix} \begin{bmatrix} -\text{son} \\ +\text{cont} \end{bmatrix} \rightarrow \begin{bmatrix} \alpha\text{cont} \\ -\text{hsp} \end{bmatrix} \begin{bmatrix} -\text{cont} \\ -\text{hsp} \end{bmatrix}$$

Figure 2.4: Affricate Resolution *i.e.*, ts > tt; dz > zd

The effect of rule 2.8 is *jh > jj; *hj > jj (mirror image; /h/ is considered [-cons]; see p. 3); and *wj > jj. Glide Assimilation would also affect *jw, but Sommerstein states that such clusters are not found. Historically, such clusters did exist (*e.g.* οἷος < οἷϝος); but since Sommerstein is putting forward a *synchronic* analysis of classical Greek, it is fair enough to state that *jw no longer existed in the URs of the language at that time.

Sommerstein posits a further special rule (p. 39) which changes *wj > ww "for which only the present tense formative /y/ is marked plus" (*i.e.*, the rule only applies when the *j is supplied by what was originally the PIE *-ye/o- suffix; Ringe [p.c.] points out that this is historically the result of reanalysis/levelling). As discussed above, the outcomes of *wj are so poorly understood that I will not attempt to respond to Sommerstein's formulation on this point.

Given the state of phonological theory in 1973, this analysis can be judged as a competent analysis of its day. From the modern perspective, there are, of course, a host of

$$\mathrm{y} \rightarrow \begin{bmatrix} +\text{lateral} \\ \alpha\text{features} \end{bmatrix} / \mathrm{V} \begin{bmatrix} +\text{lateral} \\ \alpha\text{features} \end{bmatrix} \text{—}$$

Figure 2.5: Lateralization *i.e.*, lj > ll

$$\overset{1}{\begin{bmatrix} +\text{cons} \\ -\text{cons} \end{bmatrix}} \; \overset{2}{\begin{bmatrix} -\text{cons} \\ -\text{syl} \end{bmatrix}} \rightarrow 2\ 1$$

Figure 2.6: Metathesis *i.e.*, rj > jr; nj > jn.

criticisms which could be made, most of which would reduce to the general criticisms of the SPE framework which occupied the field for much of the 1970's and 1980's. Further, there are various minor details of this analysis where improvement is possible (*e.g.* adjustments would need to be made to account for the outcomes of word-initial *tj-, *$t^h$j-, *kj-, *$k^h$j-).

The chief feature of this analysis which I wish to focus on, however, is that it includes at least four separate rules whose immediate effect is to eliminate *j in positions which would today be described as syllable onsets (Affrication, Lateralization, Metathesis, and Glide Assimilation). Since Sommerstein is only accounting for a subset of the *j-eliminating processes, additional rules would be needed to capture the full conspiracy, even if one allows angled brackets, $\alpha$-notation *etc.*, and an appropriate measure of ingenuity such as that manifest in a rule which conflates ts > tt and dz > zd. The point is that neither the SPE framework, nor any other rule-based model which I am aware of, is capable of capturing the essential unity which I claim exists among the various processes eliminating *j. In

$$\begin{array}{ccccccc} 1 & 2 & 3 & & 1 & & \\ \begin{bmatrix} \text{V} \\ -\text{low} \\ \alpha\text{back} \end{bmatrix} & \begin{bmatrix} -\text{cons} \\ -\text{syl} \\ +\text{high} \\ \alpha\text{back} \end{bmatrix} & \begin{Bmatrix} [+\text{cons}] \\ [+\text{WB}] \end{Bmatrix} & \rightarrow & [+\text{long}] & \emptyset & 3 \end{array}$$

Figure 2.7: Monophthongization *i.e.*, ij > ī; ej > ē; uj > ū

$$\begin{bmatrix} -\text{cons} \\ -\text{syl} \end{bmatrix} \rightarrow \begin{Bmatrix} \begin{bmatrix} +\text{high} \\ -\text{back} \\ \alpha\text{features} \end{bmatrix} & / & \begin{bmatrix} -\text{cons} \\ -\text{syl} \\ +\text{high} \\ -\text{back} \\ \alpha\text{features} \end{bmatrix} & \_\_ \\ \begin{bmatrix} -\text{low} \\ \beta\text{features} \end{bmatrix} & / & \begin{bmatrix} -\text{cons} \\ -\text{syl} \\ -\text{low} \\ \beta\text{features} \end{bmatrix} & \_\_ \end{Bmatrix}$$

Figure 2.8: Glide Assimilation (Mirror image rule)

Sommerstein's framework, it would be just as natural if Greek had a random collection of rules whereby *j is sometimes eliminated, sometimes left alone, and sometimes inserted anew, with no clear overall pattern to the rules or any general trend among their effects. It must be treated as a massive historical accident that processes of so many types chanced to work in concert to entirely eliminate onset *j from Greek.

### 2.5.2 MORAIC[i]

I claim that the entire *j-conspiracy is the product of the rise in ranking of a single constraint prohibiting */j/. I turn now to the formulation of this constraint.

Following generally accepted assumptions, I assume that /i/ and /j/ are specified as [+high, -back]. I assume that /i/ and /j/ are identical in their segmental content, and that the difference between the two is simply a matter of the positioning of this feature bundle in the prosodic structure (Kenstowicz, p. 23).

In classical Greek, the feature bundle [+high, -back] is permitted only when the segment occurs as the nucleus of a syllable (the vowel ι), or as the second element of a diphthong, *i.e.* if the segment is moraic. The constraint can therefore be stated in terms of moraicity:

MORAIC[i]: [+high, -back] $\rightarrow \mu$

> "The feature [+high, -back] implies the presence of a temporally overlapping mora." (Cf. moraic licensing, discussed in Bagemihl 1991.)

There are several aspects of this formulation which should be noted. First, since a segment can be linked to more than one position, MORAIC[i] is not violated in the case where a /j/ segment is linked to two positions, one moraic and one non-moraic (Figure 2.9). In my analysis below, this property of MORAIC[i] will be crucial in distinguishing original intervocalic *-j- (which is deleted, resulting in hiatus) from *-sj- and *-wj- (which give rise to novel intervocalic -jj-).

Leaving this one exception aside, the general effect of MORAIC[i] is to prohibit */j/ when it occurs wholly within an onset. The constraint does not depend on the presence of absence of preceding or following segments in the same onset; in this respect, MORAIC[i] is similar to Steriade's rule of Greek */w/ deletion (1982, p. 118-9), which is formulated

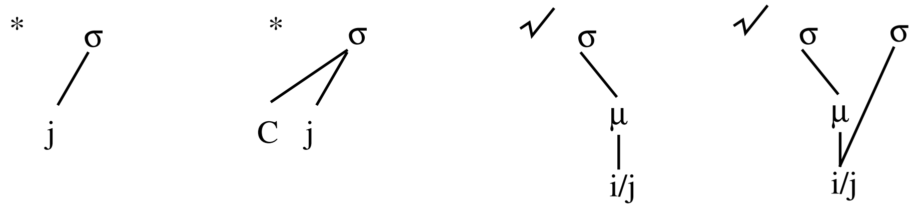


Figure 2.9: Structures violating and not violating MORAIC[i]

not to be sensitive to the particular position within the onset where the */w/ occurs.

As formulated above, MORAIC[i] applies only to /i∼j/. A possible alternative is as follows:

> MORAIC[+high]: “High segments must be moraic.”
>
> [+high] $\rightarrow$ μ

This broader formulation, where the constraint encompasses all high vocoids, predicts that /w/ should be eliminated as well—and indeed it was. Early in the first millenium BCE, the digamma (*/w/) did disappear from Attic and many other dialects (Lejeune 1982, p. 15). Since the elimination of */w/ was substantially later than the elimination of */j/, a possible analysis is that MORAIC[+high] first came to outrank the constraints prohibiting deletion of */j/, and only later came to outrank the constraints prohibiting deletion of */w/ (this implies the existence of faithfulness constraints which are sensitive to particular feature values; see Pulleyblank 1998, and also the discussion below in Chapter 4). Schematically, these stages can be represented as follows:

Stage 1: MAX[w] | MAX[j] $\gg$ MORAIC[+high]
(*w and *j are both parsed intact)
Stage 2: MAX[w] $\gg$ MORAIC[+high] $\gg$ MAX[j]
(*j eliminated; *w remains)
Stage 3:MORAIC[+high] $\gg$ MAX[w] | MAX[j]
(*w eliminated)

A full discussion of the elimination of */w/ is beyond the scope of this chapter. Since I will be focusing on the elimination of */j/ in detail, it is not essential here to assume that there is any formal connection between the elimination of */j/ and of */w/. One can assume the formulation of MORAIC[i] restricted to [-back, +high] segments without affecting the analysis which I will present.

I claim that it is the rise in ranking of MORAIC[i] which is responsible for the elimination of nonmoraic *j in Greek. The remainder of this chapter will explore in detail the interaction of MORAIC[i] with other constraints.

### 2.5.3 Palatalization

The account I will propose here involves palatalization of several of the consonants; there was an intermediate prehistoric stage where several of the Greek consonants could be marked with a secondary palatal place of articulation. This is not a novel claim: Lejeune (1982, p. 79, 106) discusses it in connection with the developments of original *t($^h$)j, *k($^h$)j, *dj, *gj, and Cowgill (1969) puts forward the account which I will assume regarding the developments of *nj, *rj, and *lj.

One point of note is that a secondarily palatalized consonant linked solely as an onset does not violate MORAIC[i], even though some of the features in question are the same as a bare /j/ segment. Assuming that a secondarily palatalized consonant is specified for [Cor] but not for [+high] (Hume 1992, p. 183), the formulation for MORAIC[i] correctly distinguishes /j/ from the palatalized consonants in this manner.

### 2.5.4 Palatalization, Feature Geometry, and OT

As discussed in Chapter 1, I assume the general account of feature geometry put forward by Hume (1992), Clements and Hume (1995). Thus, I assume the following representations, using /l/ as an example (Figure 2.10).

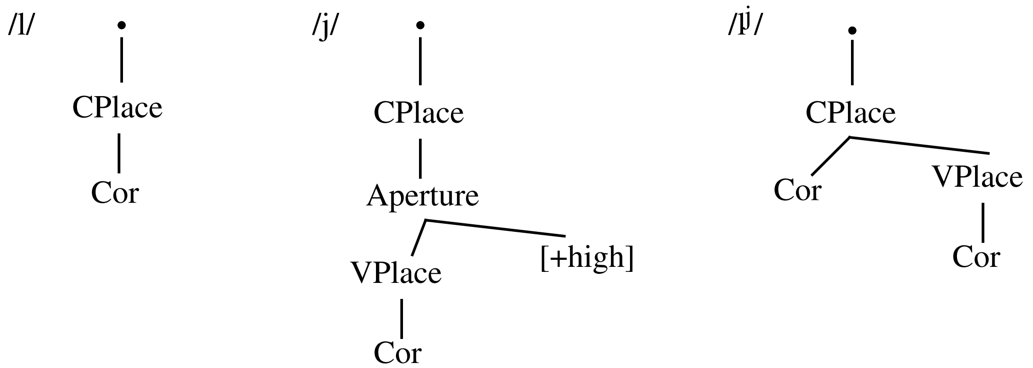


Figure 2.10: Feature geometry of /l/, /j/, /lʲ/

(Cf. Hong 1997, p. 121-123. For clarity, I have omitted some features, such as [lat] and [+cont]).

I have claimed that the rise in ranking of MORAIC[i] forces *j to be eliminated from onset positions. There are at least two possible strategies for satisfying MORAIC[i]: *j could be deleted altogether, or palatalization could occur. The constraint normally taken to disprefer deletion is MAX:

> MAX: Every element of the UR has a correspondent in the SR (McCarthy and Prince, 1995, p. 122).

Since the outcome is palatalization, MORAIC[i] and MAX must both outrank whatever constraint or constraints would prevent palatalization. A standard constraint preventing the coalescence of two underlying segments is UNIFORMITY:

> UNIFORMITY: "No coalescence" No element of the SR has multiple correspondents in the UR (McCarthy and Prince, 1995, p. 123).

However, I will assume that it is not UNIFORMITY which disprefers palatalization in this case (in other words, UNIFORMITY could be ranked below all of the constraints under discussion here; this is consistent with the coalescence of certain vowel sequences at a later date). Rather, it is a markedness constraint prohibiting surface palatalized consonants:

> NO-PAL: A consonant is not specified with $\begin{array}{c}\text{VPlace}\\ | \\ \text{Cor}\end{array}$.

My reason for assuming this constraint is that all of the palatalized consonants eventually became depalatalized. I will discuss below how NO-PAL was involved in depalatalization. Since there is thus an independent need for a constraint dispreferring palatalized consonants, it seems sensible to make use of this same constraint to prevent the initial coalescence of C + j until coalescence is forced by a rise in ranking of MORAIC[i].

Thus, the ranking before and after palatalization is as follows:

Before (*i.e.*, Cj): MAX | NO-PAL $\gg$ MORAIC[i]

After (*i.e.* $C^j$): MORAIC[i] | MAX $\gg$ NO-PAL

These rankings are illustrated in tableaux 2.11 and 2.12, ignoring prosodic issues.

| /nj/ | MAX | NO-PAL | MORAIC[i] |
|---|---|---|---|
| /n/ | *! | | |
| /$n^j$/ | | *! | |
| ☞ /nj/ | | | * |

Figure 2.11: Before palatalization

| /nj/ | MORAIC[i] | MAX | NO-PAL |
|---|---|---|---|
| /n/ | | *! | |
| ☞ /$n^j$/ | | | * |
| /nj/ | *! | | |

Figure 2.12: After palatalization

### 2.5.5 Depalatalization

As discussed in Chapter 1, I assume that when a sound change is in progress, speakers exhibiting surface variation have the original URs but variable ranking of particular constraints. In the case at hand, there was a generation of speakers who sometimes emitted surface palatalized consonants even though they still had /nj/, /rj/, /lj/ in their inputs. For these speakers, it would have been a violation of MAX for palatalization to be altogether lost, because /j/ was still present as a discrete segment in the UR.

However, there was eventually a generation of learners who received only the palatalized consonants as input; and I claim that these speakers internalized the palatalized consonants in their URs. This has the important consequence that it is no longer a violation of MAX for palatalization to be lost (the specific MAX constraint in question is MAX(segment), following Zoll 1996, to be discussed). In the earlier state of affairs, */j/ was an independent segment in the UR, and it was a violation of MAX for *j to be altogether deleted.

There is a potential objection to this general account: given that there was substantial morphologically conditioned alternation arising from original *j, would the learner be led to posit the original *j in the URs? I will assume that this this is not so, because all of the C+j sequences had been eliminated by one means or another. On these grounds, I claim that it was no longer obvious to the language learner that *j had previously been present; at best, the speaker might posit some kind of palatalizing autosegment with a particular morphological function (cf. Mester and Itô, 1989).

More than one analysis of depalatalization is possible, and the choice between these analyses depends on facts which are probably unrecovarable, although some guesses can be made. Notice that if an input contains /$n^j$/, the constraint ranking posited above predicts that depalatalization should automatically occur, with no need for a change in ranking (tableau 2.13). This is because the loss of secondary palatalization is not a violation of MAX (specifically, it is MAX(seg) which is not violated (Zoll 1996).

| /$n^j$/ | MORAIC[i] | MAX(seg) | NO-PAL | MAX(subseg) |
|---|---|---|---|---|
| ☞ /n/ | | | | * |
| /$n^j$/ | | | *! | |
| /nj/ | *! | | | |

Figure 2.13: After depalatalization

So perhaps depalatalization began as soon as learners were no longer positing underlying *j. If there were a substantial period where palatalization remained, however, then there was presumably a faithfulness constraint dispreferring this change in place of articulation of a single segment. I will discuss the formulation of this constraint below.

It is not known how long palatalization persisted. However, a reasonable guess is that at least the developments exemplified by *onj > *$on^jn^j$ > οιν occurred no later than Proto-

Greek, since the outcomes are the identical in all dialects. It is also a reasonable guess that the depalatalization of original *t($^h$)(+)j, *k($^h$)(+)j clusters did not occur until the dialects had diverged, since the outcomes differ considerably across dialects. Thus, it seems that the consonants did not all become depalatalized at the same time. This is not particularly surprising; it is known that languages can prefer palatalization of some consonants over others, as in the case of Japanese mimetic palatalization, where /r/ fails to become palatalized in the formation of Japanese reduplicative mimetics even in environments where it would be expected to do so (Mester and Itô, 1989, p. 270-1).

One way to account for the temporal ordering of depalatalization in Greek is by exploding NO-PAL into a family of constraints, each of which disprefers palatalization for a single consonant or class of consonants. Since palatalization appears to have been eliminated from sonorants before it was eliminated from obstruents, I will assume the following more specific version of NO-PAL in addition to the more general NO-PAL itself:

> NO-PAL-SON: A [+son] segment is not specified with $\begin{array}{c}\text{VPlace}\\ | \\ \text{Cor}\end{array}$ ("Sonorants may not be palatalized").

The sequence of depalatalization rules is predicted by the following three temporal stages:

a. FAITHFULNESS $\gg$ NO-PAL-SON | NO-PAL

b. NO-PAL-SON $\gg$ FAITHFULNESS $\gg$ NO-PAL

c. NO-PAL-SON | NO-PAL ≫ FAITHFULNESS

I turn now to the developments of particular consonants.

### 2.5.6 Sonorants

I discuss here the outcomes of *nj, *rj, and *lj. Following Cowgill's account, I assume that there was an intermediate stage where these sequences became *$n^jn^j$, *$r^jr^j$, and *$l^jl^j$. There is, of course, no way to know whether the segments with these phonological specifications were realized as fully palatal consonants ([ɲ], *etc.*), or whether they were pronounced with a palatal offglide ([$n^j$], *etc.*). If the latter possibility is correct, then I assume that this was a merely phonetic fact; from the perspective of the phonology, the secondary palatalization features were not temporally ordered with respect to to the primary place of articulation.

When *ɑ or *o precedes original *nj, *rj, the result in all dialects is an apparent metathesis. The essence of the account I assume here is that there was a conflict between the rising prohibition on palatalized sonorants versus the requirement that the palatalization features be parsed; this conflict was resolved by moving the palatalization features into their own /i/ segment preceding the original sonorant. Original *nj, *rj before other vowels did not undergo this development; following Warren Cowgill (p.c. to Don Ringe, c. 1980), I assume that there was a prohibition on adding an /i/ segment after a vowel already like /i/ in frontness or height.

For this analysis, I accept the view developed by Zoll (1996) that MAX can be sensitive either to an entire segment, or to some subsegmental unit:

> MAX(subseg): Every subsegment in the UR has a correspondent in the SR (Zoll 1996, p. 62).

The parsing of palatalization features was required by MAX(subseg). Note that this requirement is satisfied if the original palatalized consonant remains palatalized, but it is equally well satisfied if the palatalization features are realized on some other segment, or even within a novel segment of their own. In the case where palatalization comes to be realized in a novel segment, there is a violation of INTEGRITY:

> INTEGRITY: "No Breaking" No element of the UR has multiple correspondents in the SR (McCarthy and Prince, 1995, p. 124).

However, MAX(subseg) requires that the palatalization features be parsed; and NO-PAL-SON requires that sonorants not be palatalized. The ranking during *on$^j$n$^j$ > /oin/ is as follows:

MORAIC[j] $\gg$ MAX(subseg) $\gg$ NO-PAL-SON $\gg$ INTEGRITY

This is illustrated in tableau 2.14.

For this case, it does not matter that MORAIC[j] outranks MAX(subseg), or that MAX(subseg) outranks NO-PAL-SON, but this ranking will be important below.

After vowels other than those which were [-high, +bk], however, it was not permissible for novel /i/ to be inserted. In the case where the preceding vowel is *ʊ, one might appeal

| /on$^j$n$^j$/ | MORAIC[i] | NO-PAL-SON | MAX(subseg) | INTEGRITY |
|---|---|---|---|---|
| on.j | *! | | | * |
| onj.nj | | *! | | |
| on.n | | | *! | |
| ☞ oj.n | | | | * |

Figure 2.14: *on$^j$n$^j$ > /oin/

to the general avoidance of *υι before consonants in all cases where this diphthong would otherwise be expected on morphological grounds, as in certain optatives:

δαινυμι 'give a feast'

δαινῦτο (expect *δαινυιτο) '(have a) feast' (optative mediopassive; occurs in Homer)

πηγνυμι 'become fixed, freeze'

πηγνῦτο 'go stiff' (expect *πηγνυιτο) (optative mediopassive; occurs in Plato's description of Socrates' death)

(Smyth, 1956, p. 207)

Hence, we might suppose that there is an undominated markedness constraint against all cases of */ui/. However, this account will not work when /ɛ/ is the preceding vowel, because /ɛj/ contrasted with /ɛ:/ until a much later merger; for there to be an undominated constraint prohibiting /ɛj/ would incorrectly predict that there should have been no such contrast.

Thus, it appears that there is some kind of restriction preventing novel /ɛj/ diphthongs from arising.

This is predicted by the following ranking:

MAX(seg) ≫ "NO-/ɛj/" ≫ MAX(subseg)

This is illustrated by the tableaux 2.15 and 2.15. Tableau 2.15 illustrates a failed case of a novel /i/ segment, and tableau 2.16 illustrates preservation of existing /ɛj/ diphthongs.

| /ɛnʲnʲ/ | MORAIC[i] | MAX (seg) | "NO-/ɛj/" | NO-PAL-SON | MAX (subseg) | INTEGRITY |
|---|---|---|---|---|---|---|
| ɛn.j | *! | | | | | * |
| ɛj.n | | | *! | | | * |
| ɛnʲnʲ | | | | *! | | |
| ☞ ɛn.n | | | | | * | |

Figure 2.15: After depalatalization

### 2.5.7 Assumptions regarding Greek syllabification

The syllabification of Greek has been the subject of much discussion (Steriade, 1982; Wetzels, 1985; Woodard, 1997). I will follow Woodard in assuming that the orthographic conventions are not necessarily a reliable indicator of syllabification. I assume here that

| /ɛjn/ | MORAIC[i] | MAX (seg) | “NO-/ɛj/” | NO-PAL-SON | MAX (subseg) | INTEGRITY |
|---|---|---|---|---|---|---|
| ☞ ɛj.n | | | * | | | |
| ɛn.n, ɛː.n | | *! | | | | |

Figure 2.16: Preservation of existing /ɛj/

the mora count of each syllable is preserved over time (with one exception to be discussed below), regardless of the various segmental changes. It is not clear how the facts in Greek regarding compensatory lengthening and gemination can otherwise be explained (see Chapter 1 for discussion of the problems regarding underlying moras and underlying prosodic structure in general).

Thus, from such changes as *αλjος > αλλος, *πλαθjω > πλάσσω, πλάττω, it can be inferred that the original syllabification was *αλ.jος, *πλαθ.jω. This goes against a tendency in some languages to avoid rising sonority across a syllable boundary (see Chapter 4 below); apparently, early Greek had a phonotactic restriction against consonant + *j onsets. It should be noted that many instances of rising sonority across a syllable boundary were removed in the course of the *j conspiracy; this may in fact be one of the phonetic motivations for the conspiracy.

### 2.5.8 The First Compensatory Lengthening

*rj, *nj gave rise to a compensatorily lengthened preceding vowel (except α, ο) in all dialects except Lesbian and Thessalian, where gemination is found. This is a part of a more general family of processes known collectively as the First Compensatory Lengthening. The First Compensatory Lengthening affected vowels preceding the following consonant clusters:

*hm, *hn, *hl, *hr, *hw (< *sC)
*mh, *nh, *rh, *lh, *wh (< *Cs)
*nj, *rj, and possibly *wj (only after *u, *i, *e)

In all of these cases, the *h or *j was eliminated in all dialects. In most dialects, the preceding vowel was compensatorily lengthened. In Lesbian and Thessalian, however, the surviving consonant was geminated without compensatory lengthening of the vowel.

| Prehistoric | Lesb./Thess. | Attic, *etc.* | |
|---|---|---|---|
| *ἔστελσα | ἔστελλα | ἔστειλα | ‘set in order, arrange (aor.)’ |
| *ἔκρινσα | ἔκριννα | ἔκρινα | ‘separate, divide (aor.)’ |
| *σελάσνα | σελάννα | Att. σελήνη (Dor. σελάνα) | ‘moon’ |
| *ἐσμι | ἔμμι | εἰμί, ἠμί | ‘(I) am’ |

(Buck, p. 66-7, 69. As noted above, <ει> spells $\bar{\varepsilon}$.)

Cowgill (1969) notes that gemination is found in Lesbian and Thessalian as the outcome of all of clusters which gave rise to the First Compensatory Lengthening elsewhere, and further notes that gemination was the outcome of *lj in all dialects (except perhaps Cyprian). Cowgill puts forward an account where all of the consonant clusters in question became geminates in the first instance (probably by the Proto-Greek stage). Later, after significant geographic dispersal and dialect diversification, sonorant geminates came to be shortened, with compensatory lengthening of the preceding vowel; however, this innovation did not spread to Lesbian and Thessalian, which were on the far eastern periphery of the Greek-speaking area.

*/$l^jl^j$/ did not undergo these developments. Cowgill claims that this is because */$l^jl^j$/ remained palatalized longer than */$n^jn^j$/ and */$r^jr^j$/. Ordinary */ll/ became degeminated, as in the examples above; but palatalized */$l^jl^j$/ did not. When */$l^jl^j$/ later came to be depalatalized, it remained geminated since the move to eliminate sonorant geminates was no longer in progress.

It should be noted here that there are instances of νν, ρρ in historical Greek. These later geminates arose by certain consonant cluster simplifications after the developments discussed here had gone to completion (Lejeune, p. 124-5).

The analysis so far predicts the depalatalization of all sonorants; an adjustment will be necessary to account for the longer persistance of palatalization on */$l^jl^j$/. Further, the analysis will need to deal with the shortening of sonorant geminates.

### 2.5.9 On the exceptional outcome of *lj

*λ always behaves as expected in Greek, except when *j follows, in which the outcome is uniformly geminate λλ. I will follow Cowgill in assuming that */$l^jl^j$/ remained palatalized well after the other sonorants had become depalatalized and degeminated, and will give an account in these terms of the persistence of this geminate. Rolf Noyer (p.c.) notes that there seems to be a "strange affinity" between /l/ and /j/; exceptional interaction between these segments is found in other languages as well:

> Russian *l'ub-jo-n > /ljublju/ '(I) love' (Schenker 1995, p. 84; Shevelov, 1965, p. 219-220; Rolf Noyer, p.c.)
>
> Lat. fīlium > Italian figlio /fiʎʎo/ 'son'; cf. Proto-Romance blanku > Italian bianco 'white' (Brian McHugh, p.c.; Gene Buckley, p.c.; Hall, 1976, p. 104-5)

The inference to be drawn is that there is some special relationship between *λ and *j which leads to the unexpected outcome of *λj.

I propose that this exceptional outcome of *λj is the result of two constraints, PAL-L and DEP-PAL:

> PAL-L: Every segment specified with [lat] is specified with $\begin{array}{c}\text{VPlace}\\ | \\ \text{Cor}\end{array}$ ("Every /l/ must be palatalized").
>
> DEP-PAL: For every feature $\begin{array}{c}\text{VPlace}\\ | \\ \text{Cor}\end{array}$ in the SR, there is a corresponding feature $\begin{array}{c}\text{VPlace}\\ | \\ \text{Cor}\end{array}$ in the UR ("Don't insert palatalization".)

Although Zoll 1996 does not specifically discuss a DEP-SUBSEG constraint, it is a natural extension of her model; DEP-PAL can be taken as a member of this family of constraints. Note that IDENT-PAL could not be substituted here, since this would incorrectly prevent previously unpalatalized consonants from being palatalized before *j.

PAL-L is violated for all instances of non-palatalized /l/. Thus, if PAL-L were undominated, all surface /l/ would be palatalized in Greek. However, if PAL-L is dominated by DEP-PAL, then /l/ can only be palatalized when the palatalization features associated with /l/ in the SR correspond to features of some segment in the UR. Stated informally, /l/ always 'wants' to be palatalized, but it is not permitted to take its palatalization features from nowhere; it can only receive those features from *j.

Abstracting away from certain complications which will be discussed below, tableaux 2.17 and 2.18 illustrate this analysis. Tableau 2.18 illustrates the failure of *l to be palatalized in the case where there is no earlier *j.

| /aljos/ | MORAIC[i] | DEP-PAL | PAL-L |
|---|---|---|---|
| al.jos | *! | | * |
| aj.los | | | *! |
| ☞ $al^j.l^jos$ | | | |

Figure 2.17: αλλος 'other'

If PAL-L dominates NO-PAL-SON, then */$l^jl^j$/ will remain palatalized even though all other sonorants become depalatalized.

| /pʰulaks/ | MORAIC[i] | DEP-PAL | PAL-L |
|---|---|---|---|
| ☞ pʰu.laks | | | * |
| pʰulʲ.lʲaks | | *! | |

Figure 2.18: φυλαξ 'guard'

### 2.5.10 Degemination

Languages which permit geminates do not necessarily permit gemination of all consonants. For example, Japanese allows gemination of most consonants, but not of /r/.

I have claimed that Greek originally permitted sonorant geminates, but later eliminated them (except for */lʲlʲ/, which persisted longer). I claim that this change corresponds to the rise in ranking of the following constraint:

*SON-GEM: "No sonorant geminates" A [+son] consonant is not long.

Prior to degemination, *SON-GEM is outranked by a constraint prohibiting shortening of geminate segments. As discussed in Chapter 1, this constraint is MAXLENGTH. A fragment of the Greek grammar prior to degemination is as follows:

MAXμ | MAXLENGTH ≫ *SON-GEM

Not shown are *GEMINATE and *LONG-V, which are ranked below MAXLENGTH since Greek generally preserves length both for vowels and for consonants.

An illustration of this ranking, which persists into historical Lesbian/Thessalian, is found in tableau 2.19.

| /krinno:/ | MAXμ | MAXLENGTH | *SON-GEM |
|---|---|---|---|
| krino: | *! | * | |
| kri:no: | | *! | |
| ☞ krinno: | | | * |

Figure 2.19: Before degemination

Degemination of sonorants occurs when *SON-GEM comes to outrank MAXLENGTH:

MAXμ | *SON-GEM ≫ MAXLENGTH

The degemination of (*)κρίννω > κρῖ νω is shown in tableau 2.20.

| /krinno:/ | MAXμ | *SON-GEM | MAXLENGTH |
|---|---|---|---|
| krino: | *! | | * |
| ☞ kri:no: | | | * |
| krinno: | | *! | |

Figure 2.20: After degemination

As for the failure of */$l^jl^j$/ to degeminate, there are at least two possibilities. One is that *SON-GEM is to be formulated so that it is violated only by coronal sonorant geminates. Assuming that */$l^jl^j$/ came to be a fully palatal segment (rather than a merely palatalized one), it would not have violated *SON-GEM and would not have been degminated. Another possibility is that there is a higher ranked constraint requiring secondarily palatalized consonants to be long. I am not aware of parallels in other languages, but it is true that many originally palatalized consonants have long reflexes in historical Greek, and I believe that explanations are available for all of the exceptions.

### 2.5.11 Obstruents

I turn now to the obstruents, beginning with *t($^h$)(+)j, *k($^h$)(+)j. The discussion here will be relatively brief, because most of the facts regarding the palatalization of obstruents fall out from the analysis already developed.

Following Lejeune (p. 79, 106), I assume that these clusters went through as stage as affricates. The specific phonetic value of these affricates is not known, but I will hazard a guess that *k($^h$)(+)j was affricated as [čč] and that *t($^h$)+j was affricated as [$t^st^s$].

Unlike the sonorants, the palatalized affricates were not shortened, because they did not violate *SON-GEM (tableau 2.21).

Further, obstruents did not depalatalize as early as the sonorants did, as evidenced by the fact that the outcomes of the palatalized affricates varies greatly across dialects. As

| V/čč/ | MAXμ | *SON-GEM | MAXLENGTH |
|---|---|---|---|
| V/č/ | *! | | * |
| V:/č/ | | | *! |
| ☞ V/čč/ | | | |

Figure 2.21: Failure of palatalized obstruents to shorten

discussed, the rankings before and after obstruent depalatalization are as follows:

Before: NO-PAL-SON ≫ FAITHFULNESS ≫ NO-PAL

After: NO-PAL-SON | NO-PAL ≫ FAITHFULNESS

Tableau 2.22 shows the failure of obstruents to depalatalize at the same time as the sonorants. Tableau 2.23 shows the later stage where obstruents were depalatalized.

| /čč/ | NO-PAL-SON | FAITHFULNESS | NO-PAL |
|---|---|---|---|
| ☞ /čč/ | | | * |
| ττ, σσ | | *! | |

Figure 2.22: Before obstruent depalatalization

As shown in the tableaux, the intermediate affricates came out as either τ/ττ or σ/σσ. Following Lejeune (1982, p. 106), I assume that this is a matter of either the stop or

| /čč/ | NO-PAL-SON | NO-PAL | FAITHFULNESS |
|---|---|---|---|
| /čč/ | | *! | |
| ☞ ττ, σσ | | | * |

Figure 2.23: After obstruent depalatalization

fricative portion of the affricate being lost. Affricates are generally thought of as contour segments specified both for [-cont] and [+cont] (Broselow 1995, p. 176; Clements and Hume 1995, p. 255-7); deaffrication therefore involved the loss one of these two values. Following Pulleyblank (1998; see Chapter 3 for further discussion), I assume that faithfulness constraints can be sensitive to the specific value (plus or minus) of particular features; hence, the dialects where the outcome was τ/ττ can be analyzed as having [-cont] faithfulness outranking [+cont] faithfulness, with the opposite ranking for those dialects where the outcome was σ/σσ.

Ordinarily, the medial outcome of one of these affricates is a geminate. The major exception is *t($^{h}$)j where there is no morpheme boundary. The most economical account from a historical perspective is that this palatalization predates the others, and the resulting affricate underwent a shortening prior to the other palatalizations. It is possible that the failure of *t($^{h}$)+j (with morpheme boundary) to shorten is due to an analogical restoration and then re-removal of the *j.

### 2.5.12 Other obstruents

*Hj, *sj generally become /h/, leaving aside the cases where a morphological boundary intervened between *s and *j (see above for discussion). I suggest that the preceding consonant became palatalized in both cases, following the ordinary developments discussed above. At some point, there apparently arose a restriction against oral fricatives; I propose that the entire CPlace node was detached in this debuccalization, and that the $\begin{array}{c}\text{VPlace}\\ | \\ \text{Cor}\end{array}$ feature was lost as well.

The following two rules involve the occlusion of *j to a stop or affricate:

*p($^{h}$)j > πτ

*j > ζ / #__

The change of bare *j to a voiced palatal obstruent satisfies both MORAIC[i] and MAX at the expense of unfaithfulness for at least the [±son] feature, as illustrated in tableau 2.24.

| /j/- | MORAIC[i] | MAX | IDENT(son) |
|---|---|---|---|
| j- | !* | | |
| ∅- | | !* | |
| ☞ ζ- | | | * |

Figure 2.24: Occlusion of *j

In the case of $*p(^h)j$, I assume that /p/ is not permitted to be secondarily palatalized in Greek, and that obstruents must be agree in [±voice] with adjacent obstruents. Thus, the development *pj > *pč is predicted; when deaffrication later occurs, the outcome is ππ.

The analysis so far predicts that *j between vowels should become ζ. However, there is no evidence for an intermediate stage where intervocalic *j became an affricate; the segment simply deleted. The account I adopt here is that failure of the predicted development *j > ζ / V__V is due to the general cross-linguistic preference for lenis consonants in the intervocalic environment (see Chapter 3 for discussion). While intervocalic obstruents were not generally lenited between vowels in Greek, the pressure against intervocalic fortis consonants, I claim, was enough to prevent new instances of such consonants from arising.

Stated in terms of OT, there was a constraint prohibiting some appropriate category of fortis consonants in the intervocalic environment. I will simply call this constraint *FORTIS in the absence of any clear evidence about the boundaries of the category in question. *FORTIS was outranked by faithfulness constraints requiring that existing obstruents not be lenited:

IDENT ≫ *FORTIS

*FORTIS outranked MORAIC[i], preventing occlusion of intervocalic *j. A possible strategy would have been to simply delete *j, since no change in quality is possible to satisfy MORAIC[i]. However, intervocalic *j apparently survived longer than other instances of *j (e.g. the segment is represented in Linear B); I claim that this was due to the high ranking of ONSET (tableau 2.25).

| /trejes/ | ONSET | MORAIC[i] |
|---|---|---|
| ☞ tre.jes | | * |
| tre.es | *! | |

Figure 2.25: Before deletion of intervocalic *j

The eventual rise of MORAIC[i] above even ONSET corresponded to the deletion of intervocalic *j, and to the end of the *j conspiracy as well (tableau 2.26).

| /trejes/ | MORAIC[i] | ONSET |
|---|---|---|
| tre.jes | *! | |
| ☞ tre.es | | * |

Figure 2.26: After deletion of intervocalic *j

## 2.6 Conclusion

In this chapter, I showed that it possible to model all of the rules eliminating *j in early Greek in terms of the rise in ranking of a single constraint, MORAIC[i].

# Chapter 3

## The Elimination of Voiced Fricatives in West Germanic

The previous chapter was concerned with the elimination of a single contrastive segment from the inventory of Greek. The present chapter will be concerned with a trend toward the elimination of an entire category of segments: namely, the voiced fricatives of West Germanic. As a secondary issue, I will discuss a shift in West Germanic regarding the resolution of stranded moras from a preference for gemination of consonants to a preference for compensatory lengthening of vowels. I will trace both developments up to historical Old English.

To give a brief overview, the voiced fricatives in Proto-Germanic (other than *z) were in complementary distribution with the voiced stops. In West Germanic, the general trend was for PGmc voiced fricatives to be eliminated. Two of the four voiced fricatives were eliminated altogether during the West Germanic period. As Old English developed, various sound changes occurred which eliminated the remaining voiced fricatives in some environments, with the result that the two voiced fricatives survived only in one highly restricted environment. Before this trend had gone to completion, however, a series of historical rules or changes to the grammar occurred to give rise to a robust new set of voiced fricatives. Unlike the voiced fricatives of Proto-Germanic, the voiced fricatives of Old English are generally found in complementary distribution with the voiceless fricatives.

This chapter will be structured like the preceding one. I will first give a very brief overview of the external history of the language. I will then detail the rules of the conspiracy, and will give an analysis of the conspiracy in terms of Optimality Theory. Since the voiced fricatives are a secondary development in Germanic (unlike *j in Greek, which is inherited directly from PIE), I will include a discussion of the emergence of these segments after the overview of the external history of the language family.

## 3.1 Overview of the external history of West Germanic

This brief section can safely be skipped by the reader who is already familiar with the external history of Germanic.

It is generally agreed that the prehistoric Proto-Germanic language was spoken in what is now Denmark and the area immediately to the south. This language community is identified with the physical remains of the Jastorf culture; even those archaeologists who are most reluctant to draw connections between prehistoric archaeological horizons and particular linguistic entities are comfortable with this identification (Mallory 1989, 84-7). The latest possible date of the unity of the Proto-Germanic speech community was around the beginning of the common era.

Germanic was already diversified into substantially differing languages by the date of the earliest substantial attestations (Gothic in the fourth century; the others several centuries later). Three branches of Germanic are recognized: West, North, and East, with the West and North branches perhaps descending from a Proto-Northwest-Germanic language, as evidenced by certain shared innovations (the set of such shared innovations is admittedly small; it is much smaller than the set of specifically West Germanic innovations). Within West Germanic, it appears not to be possible to draw an orderly Stammbaum to represent the relationships between the various languages and dialects; Ringe, Warnow, and Taylor (2001) report that their attempt to compute a phylogeny of the West Germanic languages "failed spectacularly". This disorderliness is apparently due to the long-term close geographic contact among the dialects.

Nevertheless, the West Germanic dialects can be broadly divided into two groups. Along the North Sea coast was found the Ingvaeonic dialect continuum; this continuum gave rise to Old English, Old Frisian, and (with some complications) Old Saxon. To the south was the large grouping of dialects collectively known as Old High German.

### 3.2 Emergence of voiced fricatives in Proto-Germanic

The voiced fricatives of Proto-Germanic are not original to Proto-Indo-European, with the possible exception that */s/ might have been realized as *[z] before a voiced obstruent

(Watkins, 1992 p. 11; Ringe, 1996 p. 4). Except for *z, the voiced fricatives were in complementary distribution with the voiced stops in Proto-Germanic. These voiced obstruents arose from one of three sources:

1. By Grimm's Law, PIE *bʰ *dʰ *gʰ lost their aspiration and developed fricative allophones in certain environments (Hock 1991, p. 37-42). I deliberately overlook *gʷʰ, whose outcomes in Germanic are problematic and controversial (Seebold, 1967; Watkins 1992, p. 10); this issue is not crucial to the discussion here. I will write the voiced fricative allophones as *β *ð *γ.

2. By Verner's Law, *f *þ *x (from original *p *t *k by Grimm's Law) merged with the voiced stop/fricative series when the preceding syllable nucleus did not originally bear accent prior to the shift of stress to the initial syllable. *s similarly became *z in this environment (Hock 1991, p. 40-41).

3. Original */s/ became */z/ before a voiced obstruent, perhaps continuing the PIE alternation already mentioned. However, the distribution would have changed from that of PIE due to the changes brought about by Grimm's Law: *z might have been retained in *mizdʰó- →*mizdō- 'reward', but would have been lost in *ni[z]dós → *nistaz 'nest'.

Examples of each of these include:

1. Grimm's Law:

*bh: Skr. bhrātar- = Goth. brōþar, OE brōþor
*dh: Gk. θυγάτηρ (θ < *dh) = Goth. daúhtar, OE dohtor
*gh: Skt. haṁsa- (h < *gh) = OHG gans, OE gōs
(Brugmann 1897:705-6)

2. Perhaps the clearest examples of Verner's law are to be found among the strong verbs, due to the shifting stress of PIE:

| Infinitive | Past Participle | |
|---|---|---|
| *snīþan- | *sniðan- | 'cut' |
| *keusan- | *kuzan- | 'choose' |
| *teuhan- | *tuɣan- | 'draw' |

(Campbell 1959, p. 163)

| 3sg. | 3pl. | |
|---|---|---|
| *þarf | *þurβun | 'need' (Don Ringe, p.c.) |

3. Regressive voicing assimilation:

*mizdō- 'reward' (PIE *misdhó-; Watkins 1992, §6.1.6)
*huzdą 'treasure' (PIE *kusdho-; cf. Lat. custōs 'guard', Gk. κύσθος 'vulva')
(Campbell 1959, p. 164)

### 3.3 Distribution of the voiced fricatives

As noted, the voiced stops were in complementary distribution with the voiced fricatives of the corresponding place of articulation in Proto-Germanic (*b∼*β, *d∼*ð, *g∼*ɣ; Moulton, 1954). In most cases, the three phonemes are in agreement with regard to the environments where the stop and fricative allophones are found:

*b, *d, and *g are found:

- following a nasal (whether preceding a vowel, or word finally)
- in geminates, to the extent that these existed in PGmc.

*β, *ð, and *γ are found:

- intervocalically
- word finally following a vowel

Environments where the three phonemes do not agree are:

- Word-initially, the stops */b/ and */d/ are found, but the fricative */γ/ is found.
- Following */l/, the fricatives */β/ and */γ/, are found, but the stop */d/ is found.
- It may be the case that */r/ and */z/ behave as */l/ does regarding the distribution of voiced stops and fricatives, but the evidence is not clear on this point. If this is the case, this environment can be stated more generally as "following a coronal consonant". However, Moulton (1954) claims that */ð/ is the allophone following */r/. Don Ringe (p.c.) states that the evidence from Old Norse supports Moulton's view, but the Gothic evidence does not.

These distributions can be summarized as follows:

| | *b~β | *d~ð | *g~γ |
|---|---|---|---|
| #__ | stop | stop | fricative |
| N | stop | stop | stop |
| Geminate | stop | stop | stop |
| V__V | fricative | fricative | fricative |
| V__# | fricative | fricative | fricative |
| l | fricative | stop | fricative |
| r | fricative? | fricative? | fricative? |
| z | N/A | fricative? | N/A |

(Cf. Baković 1994. The distribution of the voiced stops and fricatives in Spanish is nearly identical to that of Proto-Germanic, with a few minor exceptions to be discussed below.)

At least one generalization emerges from these facts. Notice that the stop allophone is found in geminates and in nasal + stop clusters which are always homorganic. An analysis can be sketched in these terms: if a voiced stop/fricative segment shares its place features with a neighboring segment, the stop allophone is found. Notice also that */d/ is found after */l/, and perhaps after */r/ and */z/ as well, *i.e.*, all of the possible remaining coronal consonants (assuming a coronal articulation for */r/). To avoid an OCP violation in the surface representation, it may be the case that */ld/, */rd/, and */zd/ clusters share a single set of place features just as -NC- clusters and geminates do, in which case nearly all the facts of the PGmc stop/fricative alternation can be captured in a single statement. The only residue requiring a separate stipulation is the presence of stop allophones *[b] and *[d] word-initially.

The requirement that voiced geminates comprise stops and not fricatives appears to persist down into West Germanic; Lass (1994, p. 77) claims that novel */bb/ geminates formed by West Germanic Gemination were stops, not fricatives.

## 3.4 Discussion of */z/

As discussed above, there are two sources of */z/ in Proto-Germanic: Verner's Law and regressive voicing assimilation. Since there are particular issues regarding the status of */z/ as a unit contrasting with */s/, I will discuss */z/ in greater detail here.

Verner's Law has been the subject of various modern analyses (*e.g.* Garrett and Hale 1993; Noyer 1992); for present purposes, it is sufficient to note that Verner's Law changes */s/ to *[z] when the preceding syllabic was originally unstressed, *e.g.*:

> *nasṓ > *nazṓ ( > OHG nara 'relief') (Garrett and Hale)
> *ghaisó- > *gaiza- ( > OE gār 'spear') (Campbell p. 164; OED)

The Verner's Law alternation might have existed allophonically for a period before the stress became fixed on the first syllable in Germanic. The [+voice] of */z/ presumably became contrastively encoded in the lexicon no later than the time of the stress shift, since the conditioning environment was no longer present (*i.e.*, unless one assumes an abstract analysis where the earlier stress was still underlyingly present). In traditional phonemic terms, */z/ became an independent phoneme no later than the stress shift.

The */z/ produced by Verner's Law acquired a somewhat wider distribution through morphological analogy. This is particularly true for noun morphology. A mechanical application of Verner's Law should have produced *-as and *-az as variants of a commonly occurring nominative singular suffix (cf. Gk -ος, *etc.*); but Proto-Germanic appears to have categorically leveled this alternation in favor of *-az.

As for the instances of */z/ arising from regressive voicing assimilation, the status of this segment depends on certain assumptions. Prior to Verner's Law, there might well have been no instances of *[z] in the language other than those arising from voicing assimilation; the alternation *[s] $\sim$ *[z] was an entirely ordinary example of predictable allophonic variation. After Verner's Law and the stress shift, however, */z/ must have existed contrastively in underlying representations in at least some positions; and assuming that the language learner chooses the underlying representation which gives the correct surface form with a minimum of computation (cf. lexicon optimization; Prince and Smolensky, 1993), one could claim that *[z] before voiced obstruents was reanalyzed as */z/. One can imagine that there could still be instances of *[z] as allophones of */s/ in the case where a stem-final */s/ was followed by a voiced obstruent in the suffixal morphology; however, to my knowledge, such cases cannot be reconstructed.

The outcome of these processes is that */z/ was firmly established by Proto-Germanic. Because of the peculiarities of its history, however, its distribution was oddly restricted: it did not occur word-initially, for instance. Where it occurred was between vocoids, in codas, and in word-internal onsets after sonorants.

## 3.5 Developments in West Germanic

In West Germanic, *[ð] and *[z] were eliminated. There is a single rule eliminating *[ð] at one stroke. *[z], by contrast, is eliminated by several rules.

### 3.5.1 */ð/ > */d/

During the West Germanic period, all instances of */ð/ became */d/, regardless of environment. As noted above, the *[ð] allophone was found intervocalically, word finally following a vowel, and (if Moulton is correct) following */r/.

Hence, Old English had stops in words such as the following:

| | | |
|---|---|---|
| Medially: | medu | ‘mead’ |
| Finally: | hrēod | ‘hill’ |
| In geminates: | hreddan | ‘rescue’ (<*/hraðjan/) |

Lass (1994, p. 77) appears to be claiming that this rule *ð > *d applied word-initially to give *e.g.* the word-initial stop in OE *dæg* ‘day’. As noted above, however, the *[d] allophone was found word-initially in Proto-Germanic.

In PGmc, there was morphophonemic alternation between */ð/ ∼ */θ/ as a result of Verner’s Law. The WGmc occlusion of */ð / therefore gave rise to fossilized morphophonemic alternations between [d] and [ð] (< *þ) in Old English (Lass, p. 78):

weorþan ‘become (inf.)’ (<þ> = [ð])
wurdon ‘became (pret. pl.)’
snīðan ‘cut (inf.)’
snidon ‘cut (pret. pl.)’

There was also a West Germanic rule *dw (or *ðw) > *ww, which may have eliminated other instances of *[ð] depending on certain assumptions regarding the relative chronology. This rule will be discussed below.

### 3.5.2 Loss of */z/ in West Germanic

*/z/ never survives as such in any of the West Germanic languages. However, its loss did not occur at one time, nor in a manner which can be conflated to a single traditionally formulated historical rule. Rather, this loss involves a cluster of rules. To give a brief overview, there were several rules which deleted */z/ in particular environments and with various consequences; after these sound changes had occurred, a rule of rhotacism merged all remaining instances of */z/ into /r/. Each of these rules will be outlined below.

### 3.5.3 *-z > $\emptyset$ after unstressed V

This rule, which appears to have occurred at the PWGmc stage, had drastic consequences for noun morphology, such as the nominative singular suffix *-Vz (Campbell 1959, p. 166):

| PGmc | Goth | ON | OE | OHG | |
|---|---|---|---|---|---|
| *dagaz | dags | dagr | dæg | tag | 'day' |
| *gastiz | gasts | gestr | giest | gast | 'guest' |
| *sunuz | sunus | sonr | sunu | sunu | 'son' |

*-z occurred in a number of other nominal suffixes in several different noun classes; all of these instances fell to this rule, including the following:

| a-stems | ō-stems | i-stems | u-stems | n-stems | root stems |
|---|---|---|---|---|---|
| nom. sg. | gen. sg. | nom. sg. | nom. sg. | gen. sg. | gen. sg. |
| nom. pl. | (nom. pl.) | gen. sg. | gen. sg. | nom. pl. | nom. pl. |
| | (acc. pl.) | nom. pl. | nom. pl | | |

The ō-stem nominative and accusative plural are problematic in West Germanic (OE -*as,* OS -*os/-as,* Old Netherlandic -*as* ). Stiles (1988, p. 131) discusses these endings, noting that the WGmc pre-form appears to have been *-*ōs,* although the Gothic -*ōs* and ON -*ar* appear to reflect either *-*ōz* or *-*ō̄z* in PGmc. Stiles (p. 139, footnote 18, with references) proposes an account involving analogy with the a-stem genitive singular *-*s*.

### 3.5.4 *zw, *dw (*[ðw]) > *ww

The full inventory of voiced fricatives (*[β], *[ð], *[z], *[γ]) did not occur before */w/ in Proto-Germanic. It appears that the language has never permitted **/bw/ (or **[βw]); this restriction may be inherited from Proto-Indo-European, and there are no known later

Germanic words (*e.g.* loan-words from known languages, or Germanic words of unknown origin) which contain this sequence. */gw/ was permitted in Proto-Indo-European, but Germanic eliminated this sequence, whose reflexes are /w/ or /g/ depending on the language (Seebold, 1967). Thus, *z and *d were the only voiced fricatives still occurring before *w, and the West Germanic rule *zw, *dw (*[ðw]) > *ww can be formulated to apply to all voiced fricatives before */w/.

The rule is very scantily attested, however. The following is an exhaustive list of the words to which this rule is known to have applied:

| Goth | OE | OS | OHG | |
|---|---|---|---|---|
| fidwōr | fēower | fi(u)war | [fior] | 'four' |
| izwis | ēow | iu | iu | 'you [dat. pl.]' |
| izwara | ēower | iuwer | iuwēr | 'your [gen. pl.]' |

The derivation of the word for 'four' has been subject to multiple interpretations; Stiles (1986) summarizes these views and argues for the derivation I am assuming here.

This rule appears not to apply in environments where the stop allophone is found, *e.g.* Goth. *dwalmōn* 'to be foolish,' OE. *dwolma,* OHG. *twalm* 'chaos, bewilderment, stupefaction,' which exhibit the ordinary outcomes of */d/. Instances of */zw/ are extremely rare; a search of the comprehensive online Project Ulfila corpus (DeHerdt and Van Assche, 1998) turns up only one other word with this sequence, namely *ubizwa* 'hall'. The OE word *yfes, efes* 'eaves' is listed as cognate as this word in the OED, but its -s reflects a PGmc */s/ (Don

Ringe, personal communication; it sometimes happens that different branches of Germanic have different Verner's Law variants for the same word; *e.g.* Goth. *auso,* OE. *ēare* 'ear'; see Campbell p. 166); thus this one potential additional example turns out to be of no help.

As will be discussed at length below, West Germanic has a strong tendency to form novel geminates. Note that the rule *zw, *dw (*[ðw]) > *ww also involves gemination. This rule is pan-WGmc, hence probably early, as was West Germanic Gemination (WGG). There appears to be nothing in the relative chronology preventing a claim that this novel *ww is (in part) a product of the same constraint ranking responsible for WGG. I will discuss this idea further below.

### 3.5.5 *z > ∅ / _ i with compensatory lengthening

Consider the following two sets of data:

| | Goth | OHG | OE | OFris | OS | |
|---|---|---|---|---|---|---|
| a. | | | | | | |
| | mizdo | mēta/ miata/ mieta | mēd/ meord | mēde/ mīde/ meide | mēda/ mieda | 'reward' |
| | | lernēn/ lirnēn | leornian | lernēn/ lirnēn | līnōn | 'learn' |
| | huzd | hort | hord | | hord | 'treasure' |
| | razda | rarta | reord | | | 'language, speech' |
| | gazds | gart | gierd (<*gazdi) | | gard | 'sting, switch, goad' |

b.

| | | | | | | |
|---|---|---|---|---|---|---|
| Ingvaeonic | | Non-Ingvaeonic | | | | |
| OE | OS | MLG | OHG | Goth. | PGmc | |
| mē | mī | mi, me | mir | mis | *miz | ‘me (dat.)’ |
| wē | wī, we | wi, we | wī̆r | weis | *wīz | ‘we’ |
| mā | mēr | mēr(e) | mēr | mais | *maiz | ‘more’ |

(OS forms from Gallée (1910); Middle Low German forms from Lübben (1882)).

The loss of original *z in the first set has previously been accounted for with a sporadic rule $*z > \emptyset$ / __*d, *n. In the second set, a northern rule $*z > \emptyset$ / __# is said to have applied in stressed monosyllables.

In Crist (forthcoming), I argue that there is actually a single, *lautgesetzlich* rule at work in Ingvaeonic: namely, $*z > \emptyset \,/\, i \,\_\_]_{\sigma}$, or perhaps $*z > \emptyset \,/\, V_{[\text{-bk}]} \,\_\_]_{\sigma}$. This correctly predicts that deletion should not occur in the PGmc words appearing in Gothic as *huzd* ‘treasure,’ *razda* ‘language, speech,’ and *gazds* ‘sting, switch, goad’. The cases where $*z > \emptyset \,/\, i\_\_]_{\sigma}$ appears to fail to apply can be readily explained in terms of analogical restoration of *z (or perhaps of *r if the restoration happened after rhotacism). In the case of the word for ‘more’, the *z could have been restored by analogy with the adjective *maizan- and with the comparative adjectives, *e.g.* *blindōzan- ‘more blind’; this restoration eventually occurred in Old English as well. In the case of the word for ‘learn’, the *z can have been restored by analogy with *laizijanã ‘teach’; this restoration did not occur in OS. The only word for which difficulty remains is OHG *mēta* ‘reward’; one possible explanation is that

that the rule in question was *lautgesetzlich* within Ingvaeonic but sporadic in the rest of WGmc. Or, perhaps OHG *mēta* is a loan from Ingvaeonic; it is certainly reasonable for a word for 'reward' to spread through trade.

The rule must have occurred prior to Ingvaeonic *ai > *ā, since it applies to *maiz 'more'. This deletion of *z must have applied before rhotacism, since original *r is not deleted in the same environment (*e.g.* OE *hēr* 'here' < *hēr; cf. OFris *hīr*, OS *hēr*, OHG *hiar etc.*). On the lowering of */i/ to */e/ before */z/, see Campbell §123 p. 48.

### 3.5.6 Rhotacism

After all of the previously discussed rules occurred, a rule of rhotacism merged all remaining instances of */z/ into /r/. Rules of this sort are known from other languages, *e.g.* Latin (Hock 1991 p. 82) and some dialects of Greek (Buck 1955 p. 56).

While it is true that rhotacism occurred in both North and West Germanic, it can be shown not to be a shared innovation at the NWGmc stage. As has been noted above, there are some rules which apply only in West Germanic and which are sensitive to the distinction between */z/ and */r/, *e.g.* the rule deleting */z/ with compensatory lengthening in monosyllabic words.

The same is true of North Germanic. The following rule applied in North Germanic:

*ai > ā / __h, r (but not *z)

This produced forms such as OIcel. *sár* 'wound' (< *sairą; cf. OE *sār,* OHG *sēr* );

but the rule did not apply in *meiri* ‘more’ ( < *maizan- ) (Noreen 1904, p. 75). Since this rule applied in North Germanic but not West Germanic, rhotacism must have applied independently in North Germanic.

Further evidence for the relative lateness of rhotacism is seen in runic inscriptions. /r/ and /z/ were represented by separate runes, ᚱ and ᛉ respectively; and there is no confusion between these symbols until centuries after the dispersal of the Germanic peoples. Steblin-Kamenskij (1963) discusses various dates which have been proposed for rhotacism in North Germanic; the earliest date which he lists is the middle of the sixth century.

Some words about this parallel development are in order. One possible explanation is that rhotacism is an innovation which began in either North or West Germanic and then diffused through a dialect continuum. This is plausible, since it is almost certain that there was continual contact among the various North and West Germanic groups through trade. Perhaps a modern parallel is to be found in the change from apical to uvular /r/ which began in French-speaking Paris but is claimed to have spread across language boundaries through northern Germany and into Scandinavia (Trudgill 1974).

Alternatively, perhaps */z/ had already come to be somewhat phonetically rhoticized prior to the breakup of Northwest Germanic (cf. Steblin-Kamenskij 1963, who discusses the possible phonetic progression of the change *z > r, proposing that there was an intermediate stage [ř]). There is at least one early rule where */z/ already patterns like */r/: in Proto-West Germanic, all consonants except */r/ and */z/ were geminated before */j/.

It is very likely that the evidence will never be available to resolve these competing accounts to any level of satisfaction. The important point is that there are several clear pieces of evidence that the phonemic merger of rhotacism cannot be inherited from Proto-Northwest Germanic; it is a development which post-dated the diversification of that branch not only into the North and West branches, but into their respective daughter dialects as well.

In any case, rhotacism produced new instances of /r/ in a wide range of contexts, including the adjectival comparative suffix (OE *blindra* 'more blind' < *blindōzan-); causative weak verbs (OE *nerian* 'to save' < *nazjanã); and assorted other words (*dēor* 'animal', < *deuzą; cf. Goth. *dius* ). Perhaps most striking are the s∼r alternations in certain strong verbs arising from *s∼*z Verner's Law alternations, as in these OE examples:

| Pres. | Pret. Sg. | Pret. Pl. | Past. Part. | |
|---|---|---|---|---|
| cēosan | cēas | curon | coren | 'choose' |
| frēosan | frēas | fruron | froren | 'freeze' |
| lēosan | lēas | luron | loren | 'lose' |
| | wæs | wǣron | | 'was, were' |

See also Campbell (§404 p. 166), Smirnitskij 1990 (∼1946).

### 3.6 On the relative chronology of the West Germanic sound changes

Unfortunately, there is more than one possible relative chronology for the rules discussed here, a fact which potentially complicates an analysis of the disappearance of */z/.

At least this much is certain: rhotacism must have followed the three rules eliminating *z by deletion, because original *r is not deleted in the respective environments. For example, *miz > *me:, but the *r in *hēr 'here' is not deleted. Similarly, the following forms show that *zw > *ww must have occurred before rhotacism, since original *rw did not become *ww:

> Goth arwjō 'in vain'; OHG arwūn
> Goth sparwa, OE spearwa 'sparrow'

The ordering of West Germanic Gemination relative to rhotacism, however, depends on how WGG is formulated.

Under the conventional formulation, West Germanic Gemination (Cj > CCj where the preceding vowel is short) applied to all consonants except *r, whether this *r was original or the result of rhotacism. Under this formulation, WGG is ordered after Rhotacism. Rules which are sensitive to the *z/*r distinction, on the other hand, must be ordered before Rhotacism (Figure 3.1)

The problem with this account is that the rule lowering high vowels appears to apply only in the northern dialects within West Germanic (thus OE *mē* 'to me' [not ***mī* ], but OHG *mir* [not ***mer* ]). Thus, the ordering above places a rule which applies throughout

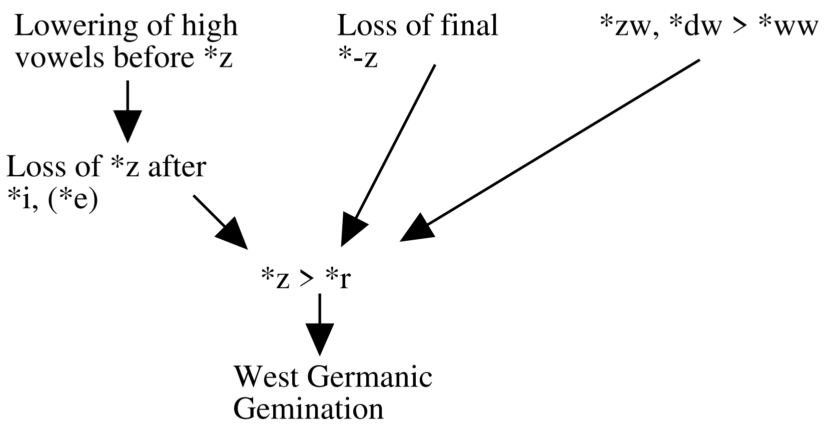


Figure 3.1: A possible relative chronology of WGmc

West Germanic (*i.e.*, WGG) after what looks like a local innovation. There is always the possibility that WGG spread through a dialect continuum after the northern vowel lowering (which, as noted, must be true for rhotacism); but from the standpoint of the comparative method, it would be preferable if WGG could be posited as an innovation for the West Germanic node, with the lowering of high vowels ordered as a subsequent and local innovation.

There is a way that this can be accomplished: WGG can be ordered before Rhotacism, and reformulated to fail not only on *r but on *z as well. This may not be as unnatural a rule as it might seem, if *z was already phonetically taking on a rhotic character, as discussed above. Under this formulation, WGG can apply indeterminately early within West Germanic (Figure 3.2).

WGG is ordered before lowering since the former is taken to be a rule of PWGmc, while the latter is specific to Ingvaeonic, hence later.

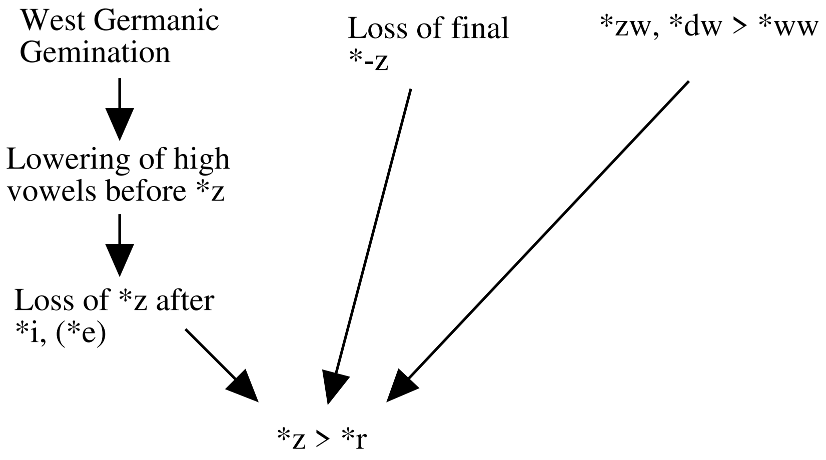


Figure 3.2: Alternative view of the relative chronology of WGmc

Both of these hypotheses regarding the relative chronology of West Germanic are tenable. It may never be possible to make a satisfactory choice between them on empirical grounds. Because its dialects developed in contact, the family does not lend itself to an orderly Stammbaum; there has been too much opportunity for borrowing of lexical items between dialects, dialect mixture, and spread of phonological innovations through dialect continua.

### 3.7 Developments in Old English

After the West Germanic developments already discussed, the voiced fricatives *ð and *z had been eliminated. Only *β and *γ remained, and only in a restricted set of environments: intervocalically, word finally following a vowel, and following */l/ and */r/. *γ was additionally found word-initially.

The concensus view is that /$\gamma$/ was still present in the immediate ancestor of Old English. First, the development of PGmc *$\gamma$ > OE [j] by the rule of palatalization (to be discussed below) is more natural if we assume that [j] developed directly from *[$\gamma$] rather than from an intermediate *[g]. Second, in Modern Dutch, /$\gamma$/ is still to be found today in the environments where pre-OE is predicted to have had it (Lass p. 56); while it cannot be firmly established that /$\gamma$/ has been the pronunciation of this contrastive unit in Dutch continuously since Proto-Germanic, there is nevertheless no counterevidence; and by sheer economy, this is the most likely account.

### 3.7.1 Palatalization: */$\gamma$/ > [j] before front vowels

In prehistoric Old English, velar consonants became fronted before the front vowels (*ǣ̆, *ē̆, *i). The WGmc consonants eventually emerged in Old English as follows:

*k > č

*$\gamma$ > j

*g > ǰ

*sk > š

(Campbell 1959 p. 173; Lass 1994 p. 57)

By other sound changes of Old English, *ā > ǣ(ē) and *au > ēa; these sound changes must have occurred before the palatalization rule, since palatalization occurs before these vowels. Palatalization failed in cases where another consonant intervened between the velar consonant and the front vowel; thus, palatalization has not applied *e.g.* in *climban* ‘climb’.

Since I am concerned here with the loss of voiced fricatives, I will focus on the palatalization of *γ. It is thought that palatalized *γ went through a stage as a voiced palatal fricative before losing its frication to become [j]; Lass (p. 78) states that this loss of frication had ‘probably’ occurred by historical times. In my analysis below, I will not be concerned with the palatalization itself (the analysis for palatalization here is essentially the same as that given for Greek in the preceding chapter; hence there is no great need to repeat it); rather, I will be concerned with the loss of frication, since it is by this change that a voiced fricative is eliminated.

Examples of palatalization of *γ include:

| | | |
|---|---|---|
| Word initial: | ġeard | ‘yard’ |
| | ġēotan | ‘pour’ |
| | ġeorn | ‘eager’ |
| | ġeaf | ‘gave’ |
| | ġīfre | ‘greedy’ |
| | ġift | ‘gift’ |
| Medial: | dæġes | ‘day (gen. sg.)’ |
| | siġe | ‘victory’ |

Palatalization also occurs word-finally following a front vowel (Campbell 1959 p. 174, Lass 1994 p. 57):

| | |
|---|---|
| dæġ | ‘day’ ( < PGmc *dagaz) |
| mǣġ | ‘relative’ |
| bodiġ | ‘body’ ( < *bodeǵ < *bodæǵ < PWGmc *bodag, cf. OHG botah ‘corpse’; Don Ringe, p.c.) |

There are also cases where a palatalized consonant occurs word-finally, but where the palatalization is due to an earlier following *i:

bielġ 'leather bag' < *bealgi < *balgiz (Goth balgs; Don Ringe, p.c.)

### 3.7.2 */γ/ > [g] word initially

In Old English, word-initial *γ- became [g] (Campbell 1959 p. 175; Lass 1994 p. 72). Campbell states that this change occurred "by the end of the OE period" and notes that in late Old English poetry, this /g-/ no longer alliterates from the /j-/ arising from *γ-.

The occlusion of */γ/ occurred *e.g.* in the following words:

| | |
|---|---|
| gōs | 'goose' |
| gōd | 'good' |

### 3.7.3 */β/ > [f], */γ/ > [x] word finally

Unlike PGmc *ð, which became a voiced stop *d in West Germanic word-finally (as in all environments), word-final *β and *γ became voiceless fricatives (Campbell 1959, p. 180; Lass 1994 p. 76).

| | |
|---|---|
| ġenōh | 'enough' (cf. OHG ginuog, ON gnógr) |
| burh | 'city' (cf. Goth. burgs) |
| plōh | 'plow' (cf. OHG pfluog, ON plógr) |

In the earliest OE texts, [x] from *γ is sometimes spelled <g>, but is later spelled <h> more often, suggesting that this change may have still been in progress in the early historical period.

## 3.8 Residue and later developments

After the changes discussed here, the only environment where the WGmc voiced fricatives *β and *γ continued into OE was intervocalically. If the voiced fricatives had been eliminated in this environment, the conspiracy to eliminate this category of segments could be said to have gone to completion; but before it did so, the original voiceless fricatives became voiced intervocalically (Campbell, p. 179; cf. Hayes 1996 p. 10 with references regarding this general type of voicing), giving rise to a new series of voiced fricatives, hence to allophonic alternation between the voiced and voiceless fricatives:

| | |
|---|---|
| wulf | 'wolf (nom.sg.)' (cf. Goth. wulf) |
| wulfas | 'wolves (nom. pl.)' (cf. Goth wulfos) |

(Thanks to Don Ringe for this example. The OE orthography does not represent the voicing of intervocalic [v].)

Original voiced fricatives are permitted to survive in the same intervocalic environment where the new voiced fricatives arose. For example, the medial voiced fricative in Modern English over may well have been continuously pronounced as a voiced fricative from Proto-Germanic all the way down to the present, even if it was reanalyzed by speakers of Old English as belonging to a /f∼v/ phoneme rather than a */β∼b/ phoneme.

As a result of these developments, there is morphophonemic alternation between [b∼v] and [b∼f] in Old English:

| | | |
|---|---|---|
| hebban | ‘to raise’ | ( < *haβjan) |
| hōf | ‘raised (1 and 3 sg. pret.)’ | ( < *ho:β ) |
| habban | ‘to have’ | |
| hafað | ‘has (3sg. pres.)’ | (<f> spells [v] between vowels) |

(It should be noted that *hof* could also be a Verner’s Law variant; this possibility cannot be ruled out.)

## 3.9 Analysis

I claim that the elimination of voiced fricatives which took place between the PGmc and OE periods corresponds to the gradual rise in ranking of a constraint prohibiting voiced fricatives:

*VOICED-FRIC: A [+voice, -son] segment is not [+cont] (“No voiced fricatives”)

There are three aspects of the problem to be considered:

- How to account for the temporal arrangement of the rules eliminating voiced fricatives: “Why aren’t all voiced fricatives eliminated at the same time?”
- How to account for the differing outcomes of the various voiced fricatives (*ð > d, *z > ∅ or r, *etc.*): “Why aren’t all voiced fricatives eliminated the same way?”

- How to account for the differences in the prosodic resolution of a stranded mora in cases where one is produced by the elimination of a voiced fricative? "Why do we sometimes find gemination, and sometimes compensatory lengthening?"

I will consider each of these questions in turn. Since the problem is a complex one, I ask the reader to bear with me as I ignore the second question until after dealing with the first.

### 3.9.1 Temporal sequence of the rules

In this section, I will propose a ranking of constraints to account for the situation in Proto-Germanic, and will then show that certain rerankings of this set of constraints require the elimination of voiced fricatives in various stages.

As discussed above, the fricative allophones of the PGmc voiced stop∼fricative segments were found in all environments, except that 1) the stop allophone is found when the segment is adjacent to a homorganic segment (either in a geminate or in a homorganic cluster such as /mb/, /ld/), and 2) the stop allophones *b- and *d- are found word-initially (unlike word-initial *γ-). This distribution happens to be nearly exactly that of Spanish as discussed by Baković (1994), with the exceptions that PGmc has word-initial *γ- where Spanish has /g-/, and that Spanish does not have geminates. (Baković differs from usual practice by referring to the Spanish lenis allophones as approximants rather than voiced fricatives; Don Ringe p.c. says that this is a matter of variation between dialects. Without questioning the merit of this classification, I will use the term *fricative* for both Spanish and PGmc to avoid having to alternate in my terminology.)

I deal first with the homorganic stop allophones. Baković puts forward an account where these stop allophones fall out naturally from the feature geometry. I agree that it is preferable, where possible, for phonological facts to fall out from representations rather than from purely stipulative constraints. However, there is a potential problem for this analysis which I will discuss below.

While I am assuming the feature geometry of Clements and Hume (1995), Baković adopts the geometry of Steriade (1993), where constriction features are aperture values ($A_0$, $A_{fric}$, $A_{max}$) dominated by place nodes (labial, coronal, dorsal). If adjacent homorganic segments share place features (as the OCP requires), then they must share constriction features as well, since constriction features are dominated by place features. Thus, if the /n/ in /nd/ is specified for full oral closure ($A_0$ in Steriade's geometry), then /d/ is automatically so specified as well. This is the essence of Baković's analysis; */nð/ is not possible unless the two segments have separate place features, presumably in violation of the OCP.

In the feature geometry of Clements and Hume which I am assuming, the feature [cont] is not dominated by the place features; rather, the geometry is as follows, omitting nodes not relevant to the current problem (Figure 3.3).

Using this geometry, an analysis with the same spirit as Baković's can be achieved by adding the stipulation that if adjacent segments share CPlace, they must share the Oral

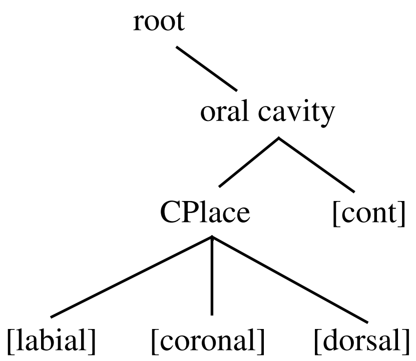


Figure 3.3: Feature geometry of Clements and Hume (1995)

Cavity node as well (at least for Spanish and Proto-Germanic, if not universally).

Regardless of the feature geometry one assumes, there is an issue which needs to be considered. While neither Spanish nor PGmc permits a voiced fricative after a homorganic nasal, both languages permit a voiceless fricative after a homorganic nasal (Castillian *once* /onθe/ ‘eleven’; PGmc *kunþō- > OE cūþe ‘clearly, plainly’). But /nθ/ should be just as ill-formed as /nð/ from the perspective of Baković’s analysis, because [voice] is entirely independent of the place features in both Steriade’s geometry and in that of Clements and Hume. Baković acknowledges this problem, noting that if the Place node dominates both $A_0$ and $A_f$, the prediction is that the nasal should be followed by an affricate (not true in Spanish); but if the $A_0$ is simply not parsed, then there should be a “reduced constriction degree in nasals”. In fairness, it should be noted that nasals delete before /x/ in Proto-Germanic and before other voiceless fricatives in Ingvaeonic; this sort of development is natural if nasals preceding voiceless fricatives are weakened. On the other hand, there are languages such as modern English where there is, to my knowledge and native judgment, no weakening of nasals before homorganic voiceless fricatives. Since a representational account of the absence of voiced fricatives after homorganic nasals is potentially problematic, I will simply assume the following stipulative constraint:

> *V-HOM-FRIC: A voiced consonant is [-cont] if it shares its place features with some other segment.

This constraint is undominated in PGmc, correctly predicting that stop allophones should always be found in homorganic clusters.

I turn next to the word-initial stop allophones *b and *d. Baković assumes that the following constraint is involved in the presence of word-initial stop allophones:

> STRONGONSET: Align (σ, L, [-cont], L) "Every syllable must be left-aligned with an oral closure" (Baković, 1994)

Intervocalic fricatives violate STRONGONSET, but Baković assumes a higher-ranked constraint which prevents intervocalic stops, as I will discuss below. The problem I see for STRONGONSET as formulated is that it makes the wrong predictions for forms cited by Baković such as Spanish [aδβerso] 'adverse'; the [β] is presumably syllabified as an onset, and [b] is predicted for this environment. For this reason, I will assume that it is the following constraint which crucially rules out word-initial stops:

> *INITVFRIC: A word-initial voiced consonant is [-cont].

This constraint is essentially the same as STRONGONSET, except that the environment under consideration is more restricted.

I further assume the following constraints:

NO-b: A segment is not [labial, +voice, +cont].

NO-d, NO-g: (*mutatis mutandis*)

With the set of constraints discussed so far, the distribution of voiced stops and fricatives in PGmc can be analyzed as follows:

*V-HOM-FRIC $\gg$ NO-g $\gg$ *INIT-FRIC $\gg$ NO-b | NO-d $\gg$ *VOICED-FRIC

*V-HOM-FRIC is undominated, correctly capturing the fact that the fricative allophones are never found when adjacent to a homorganic segment. NO-g, NO-b, NO-d outrank *VOICED-FRIC, predicting that the fricative allophones should be found in all other environments, which is essentially true. However, since *INITVFRIC dominates NO-b, NO-d, the stop allophones *b, *d are found word-initially. NO-g dominates *INITVFRIC, correctly predicting that *$\gamma$ is to be found word-initially. (I believe that the special ranking of NO-g above *INITVFRIC is the response by the phonology to an external phonetic pressure, specifically a greater phonetic dispreference for [g] than for [d] or [b]; see Ladefoged 1993, p. 146; Hayes 1996 p. 10; Ohala 1983 p. 195. See also the comments above in section 1.1.1).

This picture is somewhat complex, but this complexity is not an argument against the formal reality of the voiced fricative conspiracy. If the only matter under consideration here were the purely synchronic distribution of the voiced stops and fricatives of PGmc, the grammar one would have to posit would probably not be substantially simpler than the one already shown. By changing the ranking of these constraints, the appropriate WGmc sound changes fall out, as I will now discuss.

In West Germanic, *ð > d. The elimination of *ð in all environments is predicted by the following change in ranking of *VOICED-FRIC (cf. the grammar shown above for PGmc, where *VOICED-FRIC was ranked lowest):

$$\text{*V-HOM-FRIC} \gg \text{NO-g} \gg \text{*INITVFRIC} \gg \text{NO-b} \gg \text{*VOICED-FRIC} \gg \text{NO-d}$$

This partial grammar merely requires that *ð be eliminated one way or another; it does not make a prediction regarding the specific outcome (occlusion to a stop, devoicing, deletion, *etc.*). As noted, I will take up this issue in the second section of the analysis.

In Pre-OE, *β > [f] word-finally. *β existed at this time only in word-final and intervocalic environments. Ignoring for the moment the survival of *β intervocalically, the elimination of word-final *β is predicted by the following rise in ranking of *VOICED-FRIC over NO-b:

$$\text{*V-HOM-FRIC} \gg \text{NO-g} \gg \text{*INITVFRIC} \mid \text{*VOICED-FRIC} \gg \text{NO-b} \mid \text{NO-d}$$

Finally, in late OE, *γ > [g] word-initially, and *γ > [h] word-finally. Once again ignoring the survival of the voiced fricative allophone in the intervocalic environment, the elimination of *γ is predicted by this change from the previous ranking:

*V-HOM-FRIC | *VOICED-FRIC ≫ *INITVFRIC | NO-b | NO-d | NO-g

I return now to the problem that *ð > d intervocalically, but *β, *γ remain voiced fricatives in this one environment as the sole exception to the voiced fricative conspiracy.

[β], [γ] are found intervocalically in Spanish as well. Baković's analysis assumes that the voiced stop∼fricative segments are underlyingly fricatives, and that the insertion of a $A_0$ feature would violate CONTIGUITY. A minor objection is that DEP or IDENT might be more appropriate as the higher-ranked faithfulness constraint (every word-internal DEP violation is trivially a violation of CONTIGUITY, but DEP is the constraint specifically formulated as the general constraint disfavoring insertion). More seriously, it follows from the notion of richness of the base (Smolensky, 1996) that any generalizations which hold true of the lexicon are properly treated as the byproducts of constraint ranking. It would be preferable for the analysis not to make any particular assumptions about the underlying [cont] value (or equivalent) for these voiced obstruent segments.

What I will assume is that the following constraints are involved:

*VbV: A segment is not [labial, +voice, +cont] in the environment VV.

*VdV, *VgV: (*mutatis mutandis*)

(cf. *VkV; Kager 1999 p. 376)

At this point, the set of constraints is becoming large, but there is a certain orderliness. We can imagine a general constraint *VOICED-STOP which prohibits voiced stops in all environments and for all places of articulation. Exploding this constraint along the dimension of place of articulation gives the constraints NO-b, NO-d, NO-g already discussed. *VbV, *VdV, *VgV can be taken as positionally exploded variants of NO-b, NO-d, NO-g (I am aware of no problem with the position in question simply being syllable onsets; see CITE for the notion of positional markedness).

Using the labial variant as an example, consider the following ranking:

NO-b $\gg$ *VOICED-FRIC

In this grammar fragment, the ranking of *VbV is indeterminate; absent other constraints, the outputs will be the same regardless of the ranking of *VbV. This is because NO-b is violated by /b/ in all environments, but *VbV is violated by /b/ only in a specific environment. But consider the following:

*VOICED-FRIC $\gg$ NO-b

Different predictions are made depending on how *VbV is ranked relative to *VOICED-FRIC:

*VOICED-FRIC $\gg$ NO-b | *VbV: Stop allophones in all environments.

*VbV $\gg$ *VOICED-FRIC $\gg$ NO-b: Stop allophones in all environments except intervocalically.

In PGmc, *VOICED-FRIC is ranked below NO-b, NO-d, NO-g; hence, the rankings of *VbV, *VdV, *VgV are entirely indeterminate at this stage. When *VOICED-FRIC rises above NO-d, the ranking of *VdV becomes important; in this case, it happens to be ranked below *VOICED-FRIC, since *ð > *d even intervocalically. When *VOICED-FRIC rises above NO-b and then NO-g, however, *VbV, *VgV outrank *VOICED-FRIC, corresponding to the retention of the fricative allophones in the intervocalic environment.

I have said nothing yet about the outcomes of *z. Since *z has no stop allophone, it behaves somewhat differently from the other voiced fricatives. I will discuss it in its own section further below.

### 3.9.2 Outcomes of the voiced fricatives

In the previous section, I discussed the sequence by which the voiced fricatives were eliminated. I turn now to the specific outcomes in each case.

As noted, PGmc *ð uniformly became *d in West Germanic, leaving aside for the moment the problem of *ðw clusters. The feature being changed is [±cont]. ð does not devoice as *β and *γ sometimes later do; hence at this stage of West Germanic, it less desirable for [±voice] to change than [±cont]. I propose that the following two constraints are involved:

IDENT[cont]: If $\alpha\Re\beta$ and $\alpha$ is [$\gamma$cont], then $\beta$ is [$\gamma$cont].

IDENT[voice]: If $\alpha\Re\beta$ and $\alpha$ is [$\gamma$voice], then $\beta$ is [$\gamma$voice].

(McCarthy and Prince, 1995)

Tableau 3.4 illustrates a fragment of the grammar of Proto-Germanic, in which *ð has not yet been eliminated.

| d | IDENT[voice] | IDENT[cont] | VOICED-FRIC |
|---|---|---|---|
| ☞ ð | | | * |
| d | | *! | |
| θ | *! | | |
| t | *! | * | |

Figure 3.4: Before occlusion of *ð

In West Germanic, however, *VOICED-FRIC has risen above IDENT[cont] in ranking, as shown in tableau 3.5

*γ survives down to Old English, where the situation is different. *γ becomes /g/ word-initially, but becomes /x/ (spelled <h>) word-finally. If we were to judge from the word-final case alone, we could account for this outcome by assuming that IDENT[cont] has come to outrank IDENT[voice] in OE. I suggest that this is so. However, this is clearly not the entire story, because word-initial *γ becomes a voiced stop as did *ð. This kind of asymmetric distribution can be handled in terms of positional faithfulness. I suggest that in Old English, the word-initial outcome /g/ involved a constraint IDENT-ONSET[voice]. To

| d | IDENT[voice] | *VOICED-FRIC | ≫ IDENT[cont] |
|---|---|---|---|
| ð | | *! | |
| ☞ d | | | * |
| θ | *! | | |
| t | *! | | * |

Figure 3.5: After occlusion of *ð

the extent that this constraint was present in the earlier grammar of Proto-West-Germanic, its ranking was indistinguishable from that of IDENT[voice]. Leaving aside some obvious loose ends, the picture in Old English is as shown in tableaux 3.6 and 3.7.

This analysis makes predictions not merely for word-initial and word-final positions in particular, but rather for onsets and codas in general. *γ should become /g/ in all onsets, but it remains /γ/ when intervocalic; below, I will discuss a further constraint *VgV to handle this case. /γ/ remains in syllable codas (*brugdon* ‘they brandished’; *frugnon* ‘they asked’; Don Ringe, p.c.) Another possible outcome, *ŋ, can be ruled out by a highly ranked constraint IDENT[son].

As noted, when *γ becomes palatalized, it loses its frication and becomes a glide /j/. In Old English, the unpalatalized instances of *γ did not become /w/, although they did later do so in Middle English. Briefly, what I assume is that remaining *γ could not become /w/

| *γōs | *VOICED-FRIC | *IDENT-ONSET[voice] | *IDENT[cont] | *IDENT[voice] |
|---|---|---|---|---|
| γōs | *! | | | |
| ☞ gōs | | | * | |
| xōs | | !* | | |
| kōs | | !* | * | * |

Figure 3.6: Word-initial *γ > g

in OE because high back vocoids are required by a highly ranked constraint to be [+rnd], but this outcome was prohibited by highly ranked IDENT[rnd]. A palatal glide is not required to be [+rnd], however, so the voiced palatal fricative resulting from the fronting of *γ is able to lose its frication without violating either constraint. Later, in Middle English, IDENT[rnd] was not ranked so highly, and *γ was able to become /w/.

*β devoiced to /f/ word-finally in Old English. In word-initial position, it was already a stop as early as Proto-Germanic. The analysis already put forward for *γ already makes the correct predictions for *β without any adjustments necessary.

## 3.10 *z

As noted, *z differs from the other voiced fricatives since it has no stop allophone. I treat it here in its own section.

| /sorγ/ | *VOICED-FRIC | IDENT-ONSET[voice] | IDENT[cont] | IDENT[voice] |
|---|---|---|---|---|
| sorγ | *! | | | |
| sorg | | | *! | |
| ☞ sorx | | | | * |
| sork | | | *! | * |

Figure 3.7: Word-final devoicing of *γ

### 3.10.1 Outcomes of *z

There were four rules eliminating *z, the last of which, Rhotacism, eliminated all remaining instances of *z. In the three earlier rules, *z was entirely deleted (sometimes with compensatory gemination or compensatory lengthening), an outcome not found for any of the other voiced fricatives.

The feature crucially distinguishing /z/ from /r/ is [strident] (Kenstowicz 1994 p. 37). At the earlier stage, when *z was resolved by deletion rather than rhotacism, it was permissible for *z to simply not be parsed if this meant that a change in the value of [strident] is avoided. The relevant grammar fragment is shown in tableau 3.8.

When rhotacism later occurs, however, it is more important for the *z segment to be parsed, even if it means that its [strident] value is tampered with, as shown in tableau 3.9.

| /lizno:n/ | *VOICED-FRIC | IDENT[strident] | MAX |
|---|---|---|---|
| lizno:n | *! | | |
| lirno:n | | *! | |
| ☞ li:no:n | | | * |

Figure 3.8: Deletion of *z

| /kuzun/ | *VOICED-FRIC | MAX | IDENT[strident] |
|---|---|---|---|
| kuzun | *! | | |
| ☞ kurun | | | * |
| ku:un | | *! | |

Figure 3.9: Rhotacism

### 3.10.2 Limiting the context of */z/ deletion

Since the loss of */z/ does not occur in all environments at a single stage of West Germanic, the analysis needs to include a mechanism preventing its loss in particular environments. At the stage where rhotacism applies, the only surviving instances of *z are either in onsets (*blindōzan- 'more blind') or in the codas of stressed syllables (which are almost always initial syllables in Germanic).

Since *z is never deleted in onset position and always survives to be rhotacised, I suggest that the following constraint is involved:

ONSET: "Every syllable has an onset."

Onsetless syllables are permitted in Germanic, indicating that DEP ranks above ONSET (This high ranking of DEP is consistent with the overall picture; I can think of few examples of insertion in Germanic, except perhaps for OE *ml > *mbl, *etc.;* Campbell 1959, p. 192 §478). However, there is no violation of DEP in the case where ONSET prevents the deletion of a segment.

In Proto-Germanic, the ranking is as follows:

ONSET | MAX $\gg$ *VOICED-FRIC

In Proto-West-Germanic, *VOICED-FRIC rises in ranking:

ONSET $\gg$ *VOICED-FRIC $\gg$ MAX

This corresponds to the deletion of *z in word-final codas, and of the coda *z in *zw clusters.

Later, *VOICED-FRIC rises above *IDENT[strident], as already discussed, corresponding to the rhotacism of *z in onsets and in codas of stressed syllables. ONSET never comes to be violated.

The only incomplete piece of this picture is that there are certain instances of coda *z which survive past PWGmc. Some of these survivors are later deleted by the rule *z > $\emptyset$ /

i__$]_\sigma$ in Ingvaeonic; others survive to become rhotacized (*gazds, *etc.*). So far as I know, all such survivals occur in stressed syllables (or root-initial syllables, which for Germanic is essentially the same set of syllables); perhaps some kind of account is possible in terms of stress or initial syllable, with the proviso that constraints cannot reference underlying prosodic structure. However, not all cases of coda *z in stressed syllables survive past PWGmc; the PWGmc rule *zw, *ðw > *ww applies to codas in stressed syllables. It is not obvious to me how to model this lack of faithfulness specifically before *w. Further, the Ingvaeonic rule *z > $\emptyset$ / i__$]_\sigma$ involves a similar sort of complication; somehow, *z-deletion is forced after front vowels but prohibited after back vowels (*gazds, *etc.*). I am not aware of any precedent for constraints enforcing faithfulness only in the presence of particular adjacent segments. Specific markedness constraints ruling out /zw/ and /iz/ would detach the problem from the voiced fricative conspiracy, which is not a desirable result from the present perspective. Thus, while the larger picture is fairly clear, there are some problematic details. I notice that in all three cases where *zw, *ðw > *ww is said to have applied, *i or *e is the preceding vowel, which makes me suspect that the correct generalizations are not being fully captured by the rules as currently formulated.

Leaving aside these complications, the larger picture with regard to *z can be captured by means of a positional faithfulness constraint which has already been motivated on other grounds by Beckman.

## 3.11 Compenstory gemination vs. compensatory vowel lengthening

Some of the rules already discussed delete a segment. In the case of *zw, *ðw > *ww, the deletion is accompanied by gemination of the following consonant; but in the case of *z > ∅ / __i, there is compensatory lengthening of the preceding vowel. In this section, I will discuss the general issue of gemination vs. compensatory lengthening in West Germanic, offering an account which encompasses not only the two rules just mentioned, but other cases of gemination and compensatory lengthening as well. In short, there was a shift from an earlier general preference for gemination to a later preference for compensatory lengthening. I will show that this change can be accounted for in terms of a single change in ranking.

The analysis I will put forward has much in common with that of Ham (1998), who offers an OT account of West Germanic Gemination, although I will be considering a larger set of West Germanic rules and will differ with Ham on several specific points. Ham and I arrived independently at similar analyses of WGG. I was not yet aware of Ham's work when I first presented an earlier version of the following analysis in December 1998, but Ham's work had probably already reached print shortly before that time.

### 3.11.1 History of geminates in Germanic

Geminates are robustly attested in Old English and in other West Germanic languages. All of these geminates are secondary developments within Germanic; geminates are unknown in Proto-Indo-European, except in marginal cases such as hypocoristics (Watkins, 1992, p. 13, §6.1.7.5). There is also the case where *t+t sometimes arose at morphological boundaries, but this sequence was phonetically [t$^{s}$t], as evidenced by its various outcomes (Mayrhofer 1986:110-2).

By Proto-Germanic times, a limited set of geminates had developed through assimilation (Lass 1994 p. 25; *e.g.* *fullaz 'full' < PIE *pl̥$h_1$nós; cf. Lith. pìlnas). The resulting set of consonants which could occur as geminates was somewhat limited: /p t k m n l r s/, excluding /f θ x j w/; also, *bb, *dd *gg are rare at best /b∼β, d∼ð, g∼γ/ (Campbell 1959 p. 163; Lass 1994 p. 24) Arguably, /j/ as the second element of a diphthong was sometimes 'geminated' after a short vowel, probably to provide an onset for a following consonant (Campbell 1959, p. 166).

In West Germanic, the occurrence of geminates was greatly broadened, resulting in cases of geminates of every consonant (Lass p. 28). Campbell (p. 167-8) identifies the environments where this occurs:

a. Following short vowels (*i.e.*, in codas) and preceding *-j- (which later deleted), all consonants except *r and *z became geminated:

| PGmc | | OE |
|---|---|---|
| *satjan | > | settan 'set' |
| *saljan | > | sellan 'sell' |
| *framjan | > | fremman 'do' |

(Campbell describes WGG as having applied to all consonants except *r, whether original or from *z. See my remarks above on the relative chronology of the sound changes in West Germanic regarding my slightly different formulation of WGG According to Don Ringe (p.c), the sequence -Cj- occurred only after short vowels, since the *-j- after VVC and CC sequences had already become *-ij- by Sievers' law. ).

b. Before *r and *l, the consonants *p, *t, *k, and *h sporadically geminate after short vowels, *i.e.* in codas (although the conditioning environment is sometimes obscured by later epenthesis):

OE *snottor,* OHG *snottar* 'wise' (cf. ON *snotr,* Goth. *snutrs*)

OE *æppel,* OS *appul* 'apple' (cf. ON *ępli,* and *e.g.* Russ. *jablo-ko*)

c. Campbell (p. 167, footnote) mentions controversial cases of geminates appearing where a prehistoric "thematic" nominal suffix is said to have immediately followed the geminated consonant; hence OE *docga* 'dog', *sugga* 'kind of bird', *crabba* 'crab', *lobbe* 'spider'. Campbell is skeptical of this claim and regards these forms as being of "earlier and diverse origin."

I share Campbell's skepticism; among all the forms mentioned by Campbell in connection with this third category of geminates, there are none for which formation of a novel geminate at the West Germanic stage need be invoked. The word *docga* is not attested outside of OE except as a later loan into other languages. *Crabba* exhibits gemination in its North Germanic cognate (ON *krabbi*), indicating that this geminate must have been present prior to West Germanic (or perhaps, as Don Ringe p.c. points out, that the word is a loan from Old English into Old Norse. Unfortunately, no cognate is attested in Gothic). I have been unable to find cognates for *lobbe;* the OED lists it as being 'of obscure origin'. The OED lists *sugga* as being related to *sūgan* 'to suck', but does not elaborate or offer any cognates which would indicate the stage at which this gemination occurred.

Thus, while the first two types of gemination are solidly established, the third type is dubious at best. I will disregard this type in the analysis below.

### 3.11.2 Analysis of West Germanic Gemination

Previous accounts of WGG (*e.g.* Murray and Vennemann 1983, discussed in Ham 1998) have assumed that WGG is a strategy for repairing a dispreferred rise in sonority across a syllable boundary. This cross-linguistic dispreference for a heterosyllabic rise in sonority has been noted by others (*e.g.* Hong, 1997 p. 75; Rolf Noyer, p.c.). In nearly every case where WGG applies, there is in fact such a rise in sonority. However, Ham (p. 227-8) points out that WGG applies in cases of original *wj:

Gmc. *frawjō- > WGmc. *frawwjō- > OHG frouwe 'lord'

The problem, Ham notes, is that /w/ and /j/ are said to be of equal sonority in all conventional formulations of the sonority hierarchy.

Ham's solution is to claim that gemination before *j is motivated by a dispreference for bare *j as an onset. However, in the case of gemination before *l and *r, Ham stays with the earlier view that the gemination is motivated by an unacceptable heterosyllabic rise in sonority. Ham thus treats WGG as two separately motivated phenomena, even though a rise in sonority exists in all of the *Cj sequences except for the problematic *wj. The alternative is to claim that at least for West Germanic, *w is to be considered less sonorous than *j. We are faced, then, either with a regrettable disjunction in the account of WGG, or else with a reinterpretation of the sonority hierarchy which appears to be otherwise unmotivated. Neither of these two options is particularly attractive.

My main purpose here, however, is not to choose between these two options, but rather to explain why earlier West Germanic settles upon gemination rather than compensatory lengthening, whatever the motivation for the change. Under Ham's approach, there are two markedness constraints involved in WGG; under an approach which assumes that *w is less sonorous than *j, only one markedness constraint is required. Purely for the sake of legibility in the tableaux, I will assume the alternative which requires only one markedness constraint, namely:

> CONTACT: In any string ...$\sigma_X\sigma_Y$, the right edge of $\sigma_X$ is at least as sonorous as the left edge of $\sigma_Y$

(Ham, p. 237; the same constraint is termed SYLLCON by Hong 1997, p. 75).

Given an input where a low-sonority coda is followed by a high-sonority onset, CONTACT is be satisfied by an output where gemination has applied (*e.g.* **fram.jan* > **fram.mjan* ). However, CONTACT would also be satisfied by the candidates ***fra.mjan* or ***fra:mjan*.

Ham's approach to excluding candidates of the form **fra.mjan* is to posit the following constraint:

$\acute{\sigma} = \mu\mu$ : a stressed syllable is bimoraic.

Thus, Ham claims, there is a preference in West Germanic for stressed syllables to be heavy.

However, as Ham himself notes, the constraint $\acute{\sigma} = \mu\mu$ would incorrectly prefer the SR ***gebban* over **geban* for the UR **geban* 'to give' (p. 251-3). Ham remedies this by introducing an additional constraint FAITH-IO(μ) which prohibits the insertion or deletion of moras. But at this point, Ham need no longer refer to the constraint $\acute{\sigma} = \mu\mu$, since the mora faithfulness constraint will ensure that a formerly closed syllable will remain bimoraic rather than shorten to a single mora. Further, an analysis relying on $\acute{\sigma} = \mu\mu$ fails on empirical grounds; it predicts that WGG should only occur in initial (*i.e.*, stressed) syllables, but this prediction is false:

OHG lōhazzan (reflecting *tt < *tj; cf. Goth lauhatjan 'to lighten')

(OED; Fick, Falk, and Torp 1910; Wright 1910)

Instead of the two constraints $\acute{\sigma} = \mu\mu$ and FAITH-IO(μ), I claim that the following single constraint was involved in maintaining syllable weight in West Germanic (cf. the discussion in Chapter 1, and the facts regarding gemination and vowel lengthening in Greek in Chapter 2):

MAXμ: For each mora in the input, there is a corresponding mora in the output.

MAXμ is not concerned with the distinction between gemination and compensatory lengthening; it merely requires that the mora in question be preserved. CONTACT and MAXμ would both be satisfied by a candidate in which the original coda mora is parsed, but is linked to the preceding vowel, thus lengthening it (***fra:.mjan*). This case would be ruled out by a surface constraint *LONG-V:

*LONG-V: No vowel segment is linked to more than one mora (Sherer 1994, p. 89).

Note that *LONG-V is violated for *all* instances of surface long vowels, even those corresponding to underlying long vowels. Since West Germanic has contrastive vowel length, there must be a more highly ranked constraint requiring that underlying long segments be parsed as such. This constraint might be termed MAXLENGTH (cf. the DEPLENGTH constraint discussed in Buckley 1998). Since *LONG-V is outranked by MAXLENGTH in Germanic, the only cases where *LONG-V will crucially distinguish the optimal candidate are those where a novel long vowel could potentially be created.

One further point which remains to be explained is why WGG did not apply at an earlier stage of the language. Presumably, the requirement that sonority not rise across syllable boundaries was originally outranked by another constraint prohibiting the formation of novel geminates, much in the manner just discussed regarding the formation of novel long vowels:

> *GEMINATE: A single consonantal segment is not associated with two contiguous prosodic positions. (Ham p. 239 ff. refers to this constraint as NO-GEMINATES)

The entire picture regarding WGG can now be drawn. Leaving aside MAXLENGTH, the constraint ranking in Proto-Germanic (prior to WGG) should have been as shown in tableau 3.10.

| /framjan/ | MAXμ | MAXLENGTH | *LONG-V | *GEMINATE | CONTACT |
|---|---|---|---|---|---|
| ☞ fram.jan | | | | | * |
| fram.mjan | | | | *! | |
| fra:.mjan | | | *! | | |
| fra.mjan | *! | | | | |

Figure 3.10: Before West Germanic Gemination

WGG resulted from the reranking illustrated in tableau 3.11.

| /fram.jan/ | MAXμ | MAXLENGTH | *LONG-V | CONTACT | *GEMINATE |
|---|---|---|---|---|---|
| fram.jan | | | | *! | |
| ☞ fram.mjan | | | | | * |
| fra:.mjan | | | *! | | |
| fra.mjan | *! | | | | |

Figure 3.11: After West Germanic Gemination

### 3.11.3 Compensatory Lengthening

In this section, I will discuss various compensatory lengthening processes applying in the prehistory of OE following the WGmc period. I will argue that these processes can be collectively accounted for by a later reranking of the constraints MAXμ, *LONG-V, and *GEMINATE, which were discussed in the previous section.

One instance of compensatory lengthening occurred in Ingvaeonic, where nasals were deleted before voiceless fricatives (Campbell, 1958 p. 47):

| OHG | OE | |
|---|---|---|
| gans | gōs | 'goose' |
| fimf | fīf | 'five' |
| mund | mūþ | 'mouth' |
| ander | ōþer | 'other, second' |
| unser | ūser (= ūre) | 'our' |

Later in the history of OE, a further group of compensatory lengthenings took place (Hogg, 1992 p. 173-6). Hogg first discusses compensatory lengthening resulting from deletion of /h/ (/x/) in three environments:

1. Intervocalically:

| | | |
|---|---|---|
| *sihið | > *sī-ið | ‘he sees’ |
| *feohes | > *fēo-es | ‘property (gen. sg.) |

While Hogg cites this as an instance of compensatory lengthening, it is not clear that the long vowels do not merely result from the contraction of two vowels (thanks to Don Ringe, p.c. for pointing this out). The instances of compensatory lengthening which follow do not suffer from this ambiguity.

2. Following a vowel and preceding a voiced consonant:

| | | |
|---|---|---|
| *gesiehne | > gesīene, gesȳne | ‘visible’ |
| *stiehli | > stȳle | ‘steel’ |
| *yhmest | > ȳmest | ‘highest’ (an alternative form of yfemest; cf. Goth. aúhumists) |

3. Following a liquid and preceding a vowel:

| | | |
|---|---|---|
| *feorhes | > fēores | ‘life’ |
| *wealhes | > *wēales | ‘foreigner’ |

Hogg notes (p. 174) that there is variation in this third environment: in all dialects, it appears that there is alternation between lengthened and unlengthened variants. However, Don Ringe (p.c.) points out that this could be the result of subsequent changes.

A further case where compensatory lengthening applied is in the deletion of /j/ before a dental consonant (Hogg, p. 175). This deletion is found most commonly in West Saxon, and it occurs late enough that the unchanged forms are attested in the earlier texts; *e.g.* EWS þ*egn,* LWS þ*ēn* 'thane'. While this deletion is less common in other dialects, compensatory lengthening is found in those cases where it does occur, *e.g.* Northumbrian *ongǣn* 'against,' for which *ongægn* is the more frequently occurring variant.

### 3.11.4 Analysis of Compensatory Lengthening

Hogg (p. 175-6) discusses earlier views on the chronology of compensatory lengthening in Old English, noting that older references sometimes give unneccessarily complex accounts resulting from a failure to understand compensatory lengthening in terms of syllable structure. While Hogg is not speaking from a specifically OT perspective, he describes the chronology of compensatory lengthening in terms which lend themselves to an OT analysis: "compensatory lengthening is purely automatic and therefore takes place whenever the opportunity arises."

Stated in terms of OT, there appears to be a requirement that all underlying moras be parsed (see Chapter 1), as was true for WGG discussed above, and which can again be captured in an OT analysis by the high ranking of MAXμ. In the case of CL, however, novel long vowels are formed. Note that for many of the input forms to which deletion and CL applied (*onþer, *gesiehne, *feorhes), MAXμ would have been satisfied by outcomes where gemination rather than compensatory lengthening occurred (**oþþer, **gesienne, **feorres). These incorrect outcomes are those predicted by the constraint ranking assumed for WGG, *i.e.* MAXμ | MAXLENGTH | *LONG-V > *GEMINATE. Indeed, among all the rules where compensatory lengthening occurs, it appears that the only cases where gemination is not available as an alternative are 1) when a segment was deleted intervocalically, leaving no consonant to be geminated (*feohes > *fēo-es), and arguably, 2) when the deleted segment was a member of a word-final coda, in which case the language might disprefer the formation of a word-final geminate (*fimf > OE *fīf*).

To summarize, in every case where CL and gemination were both potential resolutions for a stranded mora, Ingvaeonic and OE uniformly choose CL over gemination, in contradistinction to the situation in West Germanic. These facts can be straightforwardly analyzed as a reranking of constraints occurring as West Germanic developed into Ingvaeonic, with the resulting ranking persisting in OE into the historical period (tableau 3.12).

| /gesieh.ne/ | *hC | MAXμ | MAXLENGTH | *GEMINATE | *LONG-V |
|---|---|---|---|---|---|
| gesieh.ne | *! | | | | |
| gesie.ne | | *! | | | |
| gesien.ne | | | | *! | |
| ☞ gesīe.ne | | | | | * |

Figure 3.12: Compensatory lengthening

The toy constraint *hC is taken to stand for whatever set of markedness constraints are responsible for the failure of /h/ to be parsed following a vowel and preceding a voiced consonant; the specific formulation of these constraints is not important to the point at hand.

### 3.11.5 Application to other rules

As was discussed earlier, West Germanic tends to resolve stranded moras through gemination, while Ingvaeonic has shifted to resolution through compensatory lengthening. Gemination is the product of the West Germanic ranking MAXμ | MAXLENGTH ≫ *LONG-V ≫ *GEMINATE, while compensatory lengthening is the product of the Ingvaeonic/OE ranking MAXμ | MAXLENGTH ≫ *GEMINATE ≫ *LONG-V.

The */z/-deletion rules of West Germanic sometimes result in gemination, and sometimes in compensatory lengthening. The rule changing *zw, *ðw > *ww produced a geminate. At what can be reasonably taken to be a later date (as discussed above), the rule *z > ∅ / i__]$_\sigma$ involved compensatory lengthening. Schematically, these two changes can be pictured as in tableaux 3.13 and 3.14. (I assume that the final /n/ in *lizno:n is extrametrical; this point is not important here.)

This set of facts is accounted for by the constraints and rankings already posited to account for WGG and the later rules involving compensatory lengthening, with no need for further amplification. In West Germanic, gemination of *w in *izwar > *iwwar is correctly selected as the optimal candidate (Figure 3.15). Not pictured are the markedness constraints responsible for the historical delinking of the *z segment from its coda mora,

| /izwar/ | MAXμ | *LONG-V | *GEMINATE |
|---|---|---|---|
| iwar | *! | | |
| i:war | | *! | |
| ☞ iwwar | | | * |

Figure 3.13: West Germanic *zw > *ww

| /lizno:n/ | MAXμ | *GEMINATE | *LONG-V |
|---|---|---|---|
| lino:n | *! | | |
| ☞ li:no:n | | | * |
| linno:n | | *! | |

Figure 3.14: Ingvaeonic *iz > *i: (or *ez > *e:)

and the faithfulness constraints preventing earlier delinking.

However, by Ingvaeonic times, this constraint ranking had changed to MAXμ | MAXLENGTH | *GEMINATE ≫ *LONG-V (Figure 3.16)


Figure 3.15: *izwar > *iwwar


Figure 3.16: *liznōn > *līnōn

## 3.12 Conclusion

In this chapter, I showed that the conspiracy involving the loss of voiced fricatives in the period between West Germanic and Old English could be captured formally in terms of the rise in ranking of a single constraint, *VOICED-FRIC. As a secondary issue, I showed that the shift in strategy within West Germanic from gemination to compensatory lengthening could be accounted for in terms of a single change in constraint ranking.

# Chapter 4

## The Slavic Open Syllable Conspiracy

In the previous two chapters, I have discussed conspiracies in which a contrastive segment or category of segments has been eliminated from the inventory of a language. In this chapter, I will discuss a different type of conspiracy: namely, one which results in a change in the set of permissible syllable structures.

Between the beginning of the common era and the tenth century, Slavic underwent a series of sound changes whose cumulative effect was essentially to eliminate syllable codas. This tendency is known as the *law of open syllables* (Schenker 1995, p. 82) or the *open syllable conspiracy* (Hock 1991, p. 165).

The specific interpretation of the conspiracy has been a matter of controversy, with views ranging from denial of any connection between the various developments of the conspiracy (Shevelov 1965, p. 203) to the claim that there is a formal unity among the processes (Bethin, 1998).

In some of the earliest work in OT, Prince and Smolensky (1993, ch. 6) discuss the

Jakobsonian taxonomy of syllable types, and show that the set of types observed in human languages corresponds to the possible permutations in ranking of the constraints ONSET, -COD, PARSE, and FILL (ONSET, NOCODA, MAX, and DEP in contemporary terms, which I will use henceforth). A language in which NOCODA is ranked lowest permits optional syllable codas; but if NOCODA outranks MAX or DEP, codas will be eliminated by deletion of the consonant or by epenthesis of a following syllable nucleus, respectively. If historical phonological change corresponds to a reranking of constraints, it should be possible to observe cases where earlier codas come to be systematically eliminated as NOCODA rises in ranking above MAX and/or DEP. I claim that the Slavic Open Syllable conspiracy is exactly such a case.

At least two authors have previously observed that the open syllable conspiracy can be given a unified account in Optimality Theory. Crosswhite (UCLA/Rochester) proposed an OT analysis of the conspiracy in an unpublished class paper which I have unfortunately been unable to obtain. Bethin (1998) gives a very detailed discussion of the Rising Sonority conspiracy in terms of fairly recent phonological theory. Although Bethin does not develop an OT analysis in detail, she repeatedly makes mention of OT and states the essentials of what an OT analysis would involve—namely, the enforcement of the NOCODA constraint. I agree that this is the correct approach to the problem, and in this chapter, I will develop an analysis of the conspiracy in detail along these lines.

There is also a tendency in Slavic for previously onsetless syllables to acquire onsets;

this tendency would probably qualify for analysis as a conspiracy in its own right, presumably corresponding to the rise in ranking of ONSET, but I will not take up this issue here. It should be noted, however, that some of the rules I will examine, such as certain rules of metathesis, have the double merit of eliminating a coda and creating an onset.

## 4.1 Brief overview of the external history of Slavic

The Slavic family does not lend itself to the construction of an orderly Stammbaum. At best, we can distinguish three dialect continua (cf. Schenker 1995 p. 68):

West Slavic:

Polish, Kashubian, Slovincian, Polabian (Lechitic sub-group)

Czech, Slovak

Upper Sorbian, Lower Sorbian

South Slavic:

(Old Church Slavonic)

Slovene, Serbo-Croatian, Macedonian, Bulgarian

East Slavic:

Russian, Belorussian, Ukrainian

Even this very general classification is problematic, however, because Czech and Slovak sometimes pattern with South Slavic. Czech and Slovak probably once formed a continuum with the early South Slavic dialects before becoming geographically separated by the spread of Germanic and the invasion of the Magyars.

As with any linguistic branching, no precise date can be assigned to the final unity of so-called Common Slavic. Shevelov (1965, p. 2) states that "[Common Slavic] as such ceased to exist by the seventh century", but Schenker (p. 69) claims that "[a]t the time of the Moravian mission (863), and perhaps for two or three generations beyond it, one may still speak of a Slavic linguistic unity." The Magyar invasion at the end of the ninth century divided the Slavic-speaking territory (Strayer and Gatzke 1984, p. 190), geographically isolating West Slavic from South Slavic.

### 4.2 A note on the Slavic vowels

Authors vary in their transcription of the Slavic vowels, and there are certain conventions not used outside of Slavic studies. I will briefly mention here a few points of interest regarding the Slavic vowels.

The vowel transcribed as <ě> is known as jat'. This vowel continued PIE *ē and was still long in Slavic. Shevelov (p. 164) claims that this vowel was backed to an /aː/ pronunciation, but this is unlikely to be so, since the vowel remained front in several languages (R. e, P. e/a, but Ukr. i, SC e/(i)je/i, Cz. ě/í; Ron Kim, p.c.; Don Ringe, p.c.)

Some authors, including Shevelov, make use of the notations */$_{o}$a/ and */$_{e}$a/ to indicate categories whose phonetic realization had changed. */$_{o}$a/ is the vowel resulting from the merger of PIE *a, *o (Shevelov, p. 150ff.). This vowel was originally pronounced [ă] in Pre-Proto-Slavic, but later came to be pronounced as /ŏ/ by Proto-Slavic (Schenker p. 81). I will follow Schenker in writing this vowel as <ă> (or <a>). Similarly, the vowel which Shevelov writes as */$_{e}$a/ continues PIE *ĕ; Shevelov claims that this vowel was backed, but there appears to be no evidence to support this view.

A major feature of the Slavic vowel system was the pair of vowels known as "jers" and written ь and ъ (Shevelov, p. 432-465; Schenker p. 97 ff). These vowels developed from earlier *ĭ and *ŭ, although there were a few environments in which these earlier vowels did not develop into jers. According to Shevelov, the jers had a more centralized pronunciation than the original vowels. The jers did not survive long in Slavic (although they did survive into OCS), but they had far-reaching effects on Slavic phonology. Eventually, the jers came to be eliminated in weak position ("the fall of the jers," as this development is known in the literature. Rolf Noyer p.c. points out that this term must be taken to mean the deletion of certain jers on the surface, since it is often claimed that the jers are underlyingly present in at least some of the later Slavic languages). The result was the reintroduction of syllables with codas, at which point the open syllable conspiracy can be said to have come to an end.

### 4.3 The open syllable conspiracy: overview

Following are the major developments of Slavic resulting in the loss of a coda. I will take the open syllable conspiracy to comprise the set of rules listed here.

Deletion of word-final nasals after short vowels
Deletion of word-final *-t, *-d
Deletion of first consonant in stop + fricative, stop + stop clusters
Deletion of final *s, *x
Monophthongization of *Vj, *Vw diphthongs
  *ai > ě
  *ei > ī
  *au > ū2
  *eu > jū2
Deletion of nasal codas
Elimination of *tl, *dl clusters (East, South Slavic only)
Metathesis in ORC sequences
Metathesis or pleophony in CORC sequences
Developments in CuRC, CiRC sequences

## 4.4 The open syllable conspiracy in detail

### 4.4.1 Loss of word-final nasals after short vowels

There were two separate rules in Slavic by which nasals in coda position were deleted. The earlier of these, which I discuss here, involved word-final nasals after short vowels. The nasal feature of the nasal consonant was simply lost in these cases (Shevelov p. 225). In the second, later change, which I will discuss below, all remaining coda nasals were deleted, but the nasal feature was transferred to the preceding vowel.

Shevelov (p. 224) lists the following examples of the earlier change:

*sūnum > *sūnu > OCS synъ 'son (acc. sg.)'
*vilkom > *vilkum > *vilku > OCS vlьkъ

Shevelov (1965, p. 224) claims that word-final nasals were lost substantially earlier than the word-final stops.

With regard to the relative chronology of this rule, Shevelov notes that it must precede the deletion of word-final *-s, since the nasal in *-ns, *-ms is protected by the *-s and is not deleted by this rule.

Shevelov further suggests that the loss of final nasals precedes the merger of IE *a and *o into a single vowel *a. Shevelov states that *o > *u before final nasals, and argues that "a vowel with a much broader aperture (*i.e.* *a) hardly could have yielded *u." But this is hardly convincing; nasals often affect vowel height, and I am aware of nothing to exclude the possibility that the merged *a/*o vowel already had a raised allophone *[o] before nasals. The kind of evidence which would be needed to support Shevelov's chronology are instances of original PIE *a which did not end up as *u before word-final nasals; but Don Ringe (p.c.) notes that such cases should not exist, due to the structure of the PIE inflectional morphology; Ron Kim (p.c.) agrees, noting that there are no examples of PIE *-am. The merger of *a/*o in Slavic belongs to the very earliest stratum of post-PIE rules; it may be a shared innovation with Baltic. Absent evidence to the contrary, my guess would be that the loss of word-final nasals is a later rule.

Strangely, word-final nasals were not deleted by this rule when the preceding vowel was long; in such cases, the outcomes are the same as in those of word-internal nasal codas, *i.e.* the preceding vowel is nasalized (*nogāN > OCS nogǫ 'foot'). It is reasonable to surmise that the nasals surviving in this position underwent the later change, which involved transfer of the nasal feature to the preceding vowel. This exception is odd, since one would expect superheavy syllables to be most highly dispreferred; I will discuss this problem below.

### 4.4.2 Loss of final *t, *d (beginning of Christian era)

It is an accident of Indo-European morphology that *-t and *-d were the only word-final stops in PIE, at least in non-root syllables (Shevelov p. 226; Don Ringe, p.c.). These stops were deleted in Slavic:

> OCS vlьk-a 'wolf (gen. sg.)' < *-ād < PIE *-e-$h_2$ed (cf. Skt. vṛ̥́kād, Lith vil̃ko < *-ā̃ d)
>
> OCS to 'that' < *tód
>
> OCS pade '(s)he fell (aor 3 sg)' < *-et
>
> OCS padǫ 'they fell (aor 3 pl)' < *-n̥t

(Thanks to Ron Kim, p.c. for the PIE ending *-e-$h_2$ed.)

In terms of the relative chronology of this change, Shevelov claims that the word-final stops were lost after the loss of word-final nasals (see section above).

Shevelov claims that there was a development *-est > -e (3 sg aor) showing that word-final stops were lost before word-final *-s was lost (p. 227) Don Ringe (p.c.) and Ron Kim (p.c.) point out that this is a highly debatable claim at best; the sigmatic aorist was normally thematized in Slavic, and there is no reason to assume that the original form of sigmatic aorist survived to such a late date. Unfortunately, there are no other instances of inherited *-st which might tell us something about the relative chronology of the two rules. Schenker (1995, p. 82) groups the loss of *-t, *-d, *-s as a single change.

In terms of the absolute dating of this sound change, Shevelov (p. 227) claims that the Gothic word *ūt* 'outside' is borrowed into Slavic as the prefix vy- (< *ū-); suggesting that the loss of final *-t dates from the first few centuries of the common era. However, Ron Kim (p.c.) points out that there is no reason that this cannot simply be an inherited form, and Don Ringe (p.c.) is similarly skeptical.

Shevelov (p. 226) notes that final stops were lost in Baltic as well, but states that there is no evidence that it was a shared innovation between Baltic and Slavic. If the dating considerations just discussed are correct, then it is impossible for this development to be a shared inheritance; it must be a parallel innovation.

### 4.4.3 Internal consonant cluster simplification

In word-internal consonant clusters where a stop was followed by consonant the first of the two consonants deletes. The following consonant could be a stop, fricative, or nasal; developments differed if the following segment was a glide, and a stop + liquid was apparently syllabified as a complex onset, since deletion does not occur in this case. Examples include:

| Proto-BSl | OCS | | | |
|---|---|---|---|---|
| *pŏktŏs | potъ | 'sweat' | cf. OCS | pekǫ 'I bake' |
| *dōdmĭ | damь | 'I will give' | | dadętъ 'they will give' |
| *sŭpnŏs | sъnъ | 'sleep' | | sъpati 'to sleep' |
| *grĕbtēj | greti | 'to bury' | | grebetъ 'he buries' |
| *māzslŏ | maslo | 'oil' | | mazati 'to spread' |
| *ŏbwīdētēj | obiděti | 'to offend' | | viděti 'to see' |
| *nŏktĭs | noštь | 'night' | cf. Lat. | nox, noctis 'night' |
| *ptrŭjŏs | (ChSl) stryi | 'paternal uncle' | | pater 'father' |

(Schenker 1995, p. 82)

Shevelov (p. 202) provides the following summary of the changes which occurred:

| Coda consonant | Onset consonant | Outcome |
|---|---|---|
| p, t, k | s | s (or x, if k precedes???) |
| t, d | k, g | k, g |
| k | t | t |
| p | t | t (st) |
| b, p | (m), n | (m), n |
| t, d | m, n | m, n |
| v | r, l | r, l (word-initially) |
| b | v | b |

(Shevelov 1965, p. 202)

Notice that in all cases, the original onset consonant is the one which survives, except in the case where *b precedes *v. However, *v actually represents [w] in OCS (it later became [v] in most of the daughter languages; it was probably still underlyingly /w/, however, as evidenced *e.g.* by the fact that it does not trigger voicing assimilation in Russian as do the other voiced fricatives; Rolf Noyer, p.c.). It appears that while Slavic generally prefers to retain the onset consonants, it puts a higher priority on retaining [+cons] segments, even if doing so requires choosing a coda consonant over an onset.

As Shevelov (1965, p. 203) reports, it is sometimes claimed that consonant cluster simplification eliminated all internal clusters except for those which were also permitted to occur in word-initial position. Shevelov points out that this is not strictly true: the clusters /skl/, /zg/, and /zd/ occur only word-internally:

> skl: istęsklъ 'grown thin'
> zg: probrězgъ 'dawn'
> zd: mьzda 'reward'

However, Shevelov acknowledges that the absence of these clusters in word-initial position could merely be accidental, or could represent gaps in the evidence. I will assume that it is merely an accident of history, rather than a restriction in the grammar of Proto-Slavic, that word-initial /skl/, /zg/, and /zd/ never happened to arise.

Viewed from the perspective of modern syllable theory, this outcome is not disturbing. The generalization is that syllable codas come to be prohibited. In any language which permits complex onsets but prohibits codas, there will be a general tendency for the sets of attested initial and internal consonant clusters to be roughly the same; but there may well be historical reasons why the two sets are not perfectly identical (a mismatch between initial and medial onsets is not uncommon; *e.g.* Parks 1976, p. 28-30 discusses such cases in Pawnee).

### 4.4.4 Loss of final *s, *x (6th century)

Word-final *-s and *-x were deleted (Shevelov, p. 227):

Loss of *-s:

| | |
|---|---|
| *slav-eses (nom sg) | > slovese |
| *gen-ās (gen sg) | > ženy |
| *sūn-aues (nom pl) | > synove 'son' |
| *vilk-aNs (acc pl) | > vlьky 'wolf' |

Loss of *-x:

| | |
|---|---|
| *sūn-ux (nom sg) | > synъ |
| *nakt-ix (nom sg) | > noštь |
| *svekr-ūx (nom sg) | > svekry |
| *sūn-aux (gen sg) | > synu |
| *vilk-amux (dat pl) | > vlьkomъ |
| *ved-aix (2 sg opt) | > vedi (2 sg. imperative) |

The *-x had originally arisen from *-s by the RUKI rule (Shevelov p. 125), which was common to Balto-Slavic and Indo-Iranian, hence very old. Ron Kim (p.c.) points out that some or all of the examples of *-x above could actually have been remade as *-s by analogy with other paradigms, in which case the rule here might merely be *-s > ∅ / __#; but from my present perspective, it matters only that the coda be eliminated.

As noted above, the loss of *-s must have followed the loss of word final nasals and the loss of word-final *-t. A bit of evidence regarding the absolute dating of the sound change is the loan word which appears in OCS as *kъnęʒь. This is a loan from Germanic *kuningaz (Shevelov, p. 227); the word is unattested in the Gothic corpus but is probably a loan from Gothic, where *-az > -s. This argues for a relatively late date for this sound change.

### 4.4.5 Monophthongization of diphthongs ending in */j/ and */w/

Diphthongs where nuclear *e or *a was followed by a *j or *w offglide became monophthongs (except arguably in the case of *ĕ̄w > jū, where I will however assume that /j/ has become a part of the onset). Shevelov claims that this occurred around the 6th-7th centuries:

*ĕ̄j > ī
*ă̄j > ē
*ĕ̄w > jū
*ă̄w > ū

(Schenker 1995, p. 86)

Examples include:

***ej**

OCS iti 'to go' < *ī-tī < *ey- (cf. Gk. εἶσι !!!!! 'goes, will go', *etc.*)
OCS ližǫ 'lick (1 sg)' < *leyǵʰ - (cf. Skt. lēḍhi (2 sg. imperative < *laiźʰ -dʰi, Gr. λείχω)
Ukr. hlyvkýj 'glutinous', Slovak, Cz. hlíva 'fungus', Slovenian 'tree fungus', SC gljȉva 'sponge' (cf. Li. gleĩvės, Gr. γλοιος 'sticky moisture')

***aj**

*kainā 'price' > OCS cěna (cf. Lith kainà, Gk. ποινή < *kʷoynā́ )
*raikā > OCS rěka 'river'

***ew**

OCS bljudǫ ‘guard’ (cf. Gk. πεύθομαι ‘experience’, Goth. anabiudan ‘order’. The /l/ is epenthetic; see the discussion of Greek *lj in chapter 2.)

OCS ljudъ ‘people’ (cf. Gk. ἐλεύθερος ‘free (man)’, OHG liut ‘(a) people’ The singular of this word still existed in OHG; it was not until later German that *Leute* became pl. tantum.)

***aw**

OCS synu ‘son (gen. sg.)’ (cf. Lith sūnaũs)

OCS suxъ ‘dry’ (cf. Lith. saũsas, Latv. sàuss, OPr. sausai)

OCS obuti ‘put on (boots)’ (cf. Lith. aũti, Latv. àut)

In cases where the original diphthong was followed by a vowel (*i.e.*, where there was no onset in the following syllable), the glide *j or *w is not deleted, but rather is resyllabified as the onset of the following syllable (Shevelov, p. 271, 285):

*rai.u > *ra.jŭ > Russ. roj ‘swarm’

*glai.u > *gla.jŭ > Russ. glej ‘clay’

### 4.4.6 Elimination of nasal codas

Shevelov (p. 311) notes that there are three sources for VN sequences in Slavic:

- Some VN sequences continued tautomorphemic *oN, *eN, *aN sequences inherited from PIE.
- Other VN sequences were heteromorphemic, resulting from a vowel-final morpheme being followed by a nasal-initial suffix.

- *iN, *uN arose from the PIE syllabic nasals *m̥, *n̥ (see also Schenker p. 92-3).

With regard to the third source, there appears to be no single factor accounting for the selection of the vowel (*i or *u) arising in Slavic from an original syllabic sonorant. Shevelov (p. 87) gives a representative sampling of the reconstructible cases, and observes that the phonological environment appears to exert an influence (but only a probabilistic one, since the outcomes are not *lautgesetzlich*):

| Following consonant: | Instances of *u | Instances of *i |
|---|---|---|
| dental stop | 3 (23%) | 10 (77%) |
| velar stop | 19 (58%) | 14 (42%) |

Shevelov goes on to suggest that there might have been influence on a particular form from members of the same paradigm with full-grade rather than zero-grade vowels; but arguing this would involve attempting to establish which full-grade vowels were or were not present in a large number of paradigms in Pre-Proto-Slavic—a daunting undertaking at best.

Regardless of their origin, all VN sequences underwent the same changes in late Common Slavic (Shevelov, p. 311 ff.). Sequences in which the nasal was intervocalic were not affected, as in OCS klъnǫ ‘curse’; but Shevelov claims that there was a shift in syllabification, with the nasal now becoming the onset of the following syllable. It is not obvious to me, however, that this was not the syllabification from the time when the VNV sequences first arose.

When the nasal is in coda position (described by Shevelov as VNC or VN# sequences), the outcome is different. The nasal deletes, but the preceding vowel becomes contrastively nasalized (see also Schenker p. 92).

The nasalized front vowels merged into a single category /ę/, and the nasalized back vowels merged to /ǫ/. Thus, these were the only two nasal vowels at the time when OCS was first written (the OCS script represents the contrast between the nasalized and non-nasalized vowels; Shevelov, p. 312); and further, there are only these two nasal vowels reconstructible for Proto-Slavic (Ron Kim, p.c.).

Most dialects of Slavic eventually denasalize the nasal vowels, but nasal vowels are retained as such in a few dialects. Shevelov (p. 313) states that nasality was preserved in Polabian and in the northern dialects of Polish. Schenker (1995, p. 92) adds that it was preserved in some dialects of Bulgarian and Slovenian; Ron Kim (p.c.) is aware of this claim, but has not found any Bulgarian dialects retaining nasals.

Following are representative forms in the Slavic languages; notice that nasality is preserved in OCS and Polish:

| | | |
|---|---|---|
| OCS | kǫpina 'shrub' | skǫdъ 'indigent' |
| Russian | kupíná | skúdnyj 'scanty' |
| Belorus. | | pa-skúdny 'filthy, foul' |
| Ukranian | | pa-skúdny |
| Polish | kępina | ośkundzić 'revile' |
| Czech | kupina | |
| Slovenian | kopînja | oskọ́den 'scarce' |
| Serbo-Cr | kùpina | òskudan 'scanty' |
| Mac. | kapina | |
| Bulg | kəpína | oskə́den 'miserable' |

(Shevelov, p. 314)

### 4.4.7 *tl/*dl

Slavic originally permitted the clusters *tl and *dl. The outcomes of these clusters are not uniform throughout Slavic. In most of the West Slavic dialects, specifically, Polish, Upper Sorbian, Polabian, and Czech, the clusters *tl, *dl are preserved as such (Shevelov, p. 202; Schenker p. 92). Lower Sorbian preserves them with some exceptions. Slovenian (of South Slavic) and Slovak (of West Slavic) "are crossed by isoglosses of the phenomenon" (Shevelov 1965); he presumably means that some dialects of these languages preserve *tl, *dl, and others do not.

In *most* of the dialects of East and South Slavic (specifically, Serbo-Croatian, Macedonian, Bulgarian, Belorussian, Ukranian, and standard Russian) the clusters *tl and *dl became /l/:

| Polish | Russian | |
|---|---|---|
| radło | ralo | 'plow' |
| mdleć | mlet' | 'faint' |
| gardło | gorlo | 'throat' |
| mydło | mýlo | 'soap' |
| sadło | sálo | 'lard' |

(Shevelov, p. 373)

In some of the Slavic dialects, *tl > *kl and *dl > *gl. This occurred in the Pskov and Novgorod dialects of Russian and the Kashubian and Mazovian dialects of Polish. These dialects all border on Baltic-speaking areas, where *kl, *gl are the regular outcomes of *tl, *dl (*i.e.*, in Latvian, Lithuanian, and the Pomeranian dialect of Prussian; Shevelov, p. 370). However, the *kl, *gl forms in Slavic later mostly disappeared, leaving a few remnants (Schenker 1995, p. 92). Shevelov (p. 370) claims that this disappearance was due to the influence of standard Russian, Polish, and Belorussian, where the change did not occur. However, in older texts from these dialects, the change *tl, *dl > *kl, *gl is evident.

Pskov:
bljuglisja 'beware (3 pl perf)'
sustrěkli 'meet (3 pl perf)'
žereglo 'mouth' (cf. Polish źródło, Ukranian džereló)
žagló 'sting' (Russian žálo)
perečok 'reread (sg pret)' (Russian perečël) (-l > $\emptyset$ in the Pskov form)

(Shevelov, p. 370)

Further, there are some loan words from Slavic in Estonian preserving the *kl, *gl clusters:

mugl∼mogl 'alkaline solution' (from local Slavic *myglo 'soap'; cf. Russian mýlo, Polish mydło)
vigla 'pitchfork' (from local Slavic *vigla; cf. Russian vila, Polish widła)

(Shevelov, p. 371)

With regard to the dating of the rules eliminating *tl/*dl, Shevelov (p. 202) notes that all the other consonant cluster simplification rules were uniform across Slavic. We can conclude that these developments occurred earlier, during Proto-Slavic unity; the *tl, *dl rules happened after the dialects had begun to disperse. Shevelov further notes that the changes must have happened after the West Slavic groups had migrated west (4th or 5th century CE) but before the intrusion of Germans and Hungarians which separated Proto-Slovak from Proto-Slovenian (8th-9th centuries CE). However, as Don Ringe (p.c.) points out, this assumes that the dialects retaining *tl, *dl must have been in contact, which is a dubious assumption.

Shevelov (p. 371) notes that there are some cases of /t/ and /d/ appearing where we would expect them to have been eliminated before *l; this tends to happen in paradigms where the original *t/*d was followed by *l in some forms but not all, suggesting that the /t/ or /d/ has been analogically restored.

### 4.4.8 Elimination of liquid codas

The elimination of *r and *l in coda position is a very complicated matter, with the outcome depending on the preceding vowel, the presence or absence of a preceding onset in the same syllable, and the particular dialect. The environments in which these changes occurred are denoted schematically in the literature; there is variation among authors as to the designations for these environments:

| Traditional | Schenker | Shevelov |
|---|---|---|
| oRT | ăRC | ORC |
| TeRT | CĕRC | CORC |
| ToRT | CăRC | CORC |
| TьRT | CĭRC | CiSC |
| TъRT | CŭRC | CuSC |

(Schenker 1995, p. 93; Shevelov, p. 391, 466. I am not clear why Shevelov writes S rather than R in certain cases.)

In connection with the ORC sequences, there are two areas, designated as north and south, each with a distinct outcome. As for the CORC sequences, there are four such areas.

### 4.4.9 ORC

In all dialects, metathesis applied, moving the original coda liquid into onset position. However, the details differ by dialect. In the South Slavic dialects (Slovenian, Serbo-Croatian, Macedonian, Bulgarian), as well as in Czech and Slovak, *aRC > RāC; in all cases, the vowel was lengthened.

In the northern Slavic dialects (*i.e.* all of East Slavic, and the Lechitic dialects, meaning all of West Slavic except Czech and Slovak), the outcome depends on the original pitch. In acute syllables (rising pitch), aRC > RaC; but in circumflex syllables (falling pitch), aRC > RoC. Unlike south Slavic and Czech/Slovak, the original vowel length contrast is reflected in the later reflexes. Shevelov (p. 397) notes that the qualitative distinction in the northern Slavic dialects was originally a quantitative distinction, where *ā > a and *ă > o. The rather remarkable development in the northern dialects, then, reduces to a question of the interaction between vowel quantity and pitch.

| | | South | North |
|---|---|---|---|
| Acute (rising) | *aŕ(d)la 'plow' | ralo (a < *ā) | radlo (a < *ā) |
| Circumflex (falling) | *ârstu 'growth' | rastu (a < *ā) | rost (o < *ă) |

With regard to the dating of these developments, notice that the outcomes are not the same in all dialects; hence the changes must have happened as Proto-Slavic was beginning to break up into the precursors of the modern languages. However, Czech and Slovak shared the innovation with the South Slavic dialects, suggesting that the change apparently happened before the Magyar invasion effected a geographic division between north and south (late ninth century).

### 4.4.10 CeRC and CoRC

There were four types of outcome for CeRC and CoRC sequences:

| | | |
|---|---|---|
| I | South Slavic + Czech, Slovak | CaRC > CRaC, CeRC > CRěC |
| II | East Slavic | CaRC > CoRoC, CeRC > CeReC |
| III | Polish and Sorbian | CaRC > CRoC, CeRC > CReC |
| IV | Polabian and Kashubian | CaRC > CoRC, CeRC > CeRC |

In areas I and III, metathesis occurred; in area I, the vowel was always lengthened (/a/ is the outcome of *ā), but in area III, no lengthening occurred. In area II, a vowel with the same quality as the original vowel was inserted between the liquid and the following consonant; this is known as *pleophony* (Russ: *polnoglasie*). In area IV, no change took place (Shevelov, p. 391-2; Schenker 1995 p. 94).

It has sometimes been claimed that area III passed through a stage CxROC, where O is the original vowel, and x is a yer agreeing with the original vowel in backness. Shevelov (p. 412-3) denies this claim, but Schenker (p. 95) cites Old Polish prepositional phrases of the sort *we proch* 'into dust' and *ze blota* 'out of mud', where the vowel in the preposition (originally a jer) implies the earlier presence of another jer in the next syllable (see Schenker p. 97 for discussion of the phonology, which involved the "strong position" and "weak position" of the jers).

Examples include:

| | | 'threshhold' | 'gold' | 'chaff' |
|---|---|---|---|---|
| I. | OCS | pragъ | zlato | plěva |
| | Sk | prah | zlato | pleva |
| | Cz | práh | zlato | pleva (dial. plíva) |
| | Sn | pŕag | zlatô | plẹ́va |
| | SC | prȁg | zlâto | plȅva |
| | M | prag | zlato | plevna |
| | Bg | pŕag(ət) | zlató | pljáva |
| II. | Russ | poróg | zóloto | polóva |
| | Br | poríh | zólata | polóva |
| | Ukr | poríh | zóloto | palóva |
| III. | Pol | próg | złoto | plewa |
| | LS | prog | złoto | plowa |
| | US | proh | złoto | pluwa |

| | | | | |
|---|---|---|---|---|
| IV. | Ka | parg ∼ prög | | |
| | Pb | porʒái | zlåtə | |
| cf. | Lith | | žel̃tas | pẽlūs |
| | Latv | | zèlts | pelus |
| | OPru | | | pelwo |

#### 4.4.11 CĭRC and CŭRC

It has been claimed that the sequences *ur, *ir, *ul, *il developed into the syllabic sonorants *r̥ and *l̥, essentially resuming their PIE values. Schenker (p. 94) accepts this view, but Shevelov (p. 466) disagrees.

Schenker claims that the resulting syllabic liquid was “soft” (palatalized) if the original vowel were *ĭ, and “hard” (not palatalized) if it were *ŭ. The later developments of these syllabic liquids are very complex and vary greatly across dialects (Shevelov Ch. 30), but since I am concerned here only with the elimination of syllable codas, I will leave these later developments aside.

#### 4.4.12 Residue

In this section, I will discuss a few sound changes which could be construed as involving the loss of codas. I include these rules here for the sake of completeness, but I will not consider them to be a part of the open syllable conspiracy or include them in my analysis, for reasons which I discuss in each case.

Shevelov (p. 225-6) discusses the possibility that word-final *-r $>$ $\emptyset$. If such a rule existed, it was prevented from applying to all of the instances of original PIE word-final

*-r, because Pre-Proto-Slavic sometimes added a suffix which was not originally present in PIE (*e.g.* OCS bratrъ < *brātr + os 'brother'). If there was such a rule, it must have been very early, perhaps even late Proto-Indo-European (or in the satem dialect continuum), since the final *-r is similarly missing in Indo-Iranian. It is not clear that there ever was such a loss, however; George Cardona (p.c.) argues that word-final *r was simply not present in the nom. sg. of the kinship terms in PIE, and that the languages where *-r is present have added it by analogy with other members of the same paradigm. In any case, even if the deletion of *-r is real, it dates to perhaps two millennia earlier than the developments belonging to the open syllable conspiracy, all of which take place in or very near the first millenium of the common era.

Shevelov (p. 182) claims that there was a rule *tt > *st, *dd > *zd in Pre-Proto-Slavic. Ron Kim (p.c.) has pointed out that this is somewhat misleadingly stated. When *tt arose in PIE as a result of affixation, the resulting cluster was fairly clearly pronounced *[tst] (Watkins 1992 p. 12 §6.1.7.3), as evidenced by the way it developed in the other IE branches (most often to *st, except in Anatolian, where [tst] survives, in Celtic, Italic, and Germanic, where it becomes *ss, and in Indic, where it becomes *tt; Don Ringe, p.c.; Ron Kim, p.c.). Once again, even though the development of *tst > *st can be argued to have eliminated a syllable coda, the rule is so early that I assume that it is not a part of the open syllable conspiracy.

Shevelov cites three forms in which is is claimed that *pt > *st by an early rule, which once again would appear to eliminate a coda (he also cites one form where the *pt > *st would be expected to apply but did not). As discussed above, the usual outcome for *p + t, *b + t is simply *t. Shevelov's claim is that there was an early development *pt > *st, followed by a long period where new instances of *p + t, *b + t arose in certain morphological environments; then there was recent development *p,*b + *t > *t which applied to these new instances. I will assume that Shevelov is correct in giving a very early date to *pt > *st, and that this rule is not formally a part of the open syllable conspiracy.

## 4.5 Notes on the relative chronology of the rules

I will assume that any rule whose outcome is not uniform across the Slavic dialects (implying a late enough date for there to be dialect diversification) dates later than any rule whose outcome is uniform. In principle, this need not hold true; a rule could spread with a uniform outcome across an already diversified continuum. Such cases are potentially detectable from the relative chronology, but I am aware of no reason to assume that such developments occurred in Slavic.

Thus, the rules in the first list are earlier than those in the second list:

1. a. N $>$ $\emptyset$ / $\breve{V}$__#

   b. t, d $>$ $\emptyset$ / __#

   c. $C_{[\text{-son,-cont}]} > \emptyset$ / $\_\_C_{[\text{-son}]}$

   d. s, x $>$ $\emptyset$ / __#

   e. N $>$ $\emptyset$ / $\_\_]_\sigma$

2. f. Elimination of *tl, *dl

   g. ORC metathesis

   h. Metathesis or pleophony in CORC sequences

## 4.6 Analysis

Following Bethin, I claim that the Slavic open syllable conspiracy corresponds to the rise in ranking of the constraint NoCoda:

> NoCoda: The right edge of a syllable is not aligned with the right edge of a consonant. (Kager 1999 p. 94; cf. Prince and Smolensky 1993)

At the heart of the conspiracy are three rules eliminating coda obstruents:

obstruent $>$ $\emptyset$ / __obstruent

t, d $>$ $\emptyset$ / __#

s, x $>$ $\emptyset$ / __#

I assume here that these three rules occurred simultaneously. I am aware of no evidence that any of the rules is temporally ordered with respect to either of the others.

The general constraint dispreferring deletion of segments is MAX. To a first approximation, the three rules can be captured by the following reranking:

| | |
|---|---|
| Pre-proto-Slavic: | MAX $\gg$ NOCODA |
| Proto-Slavic: | NOCODA $\gg$ MAX |

Thus, the change *plekto > *pleto is due to the reranking pictured in tableau 4.1.

| /plekto/ | NOCODA | MAX |
|---|---|---|
| plek.to | *! | |
| ☞ ple.to | | * |

Figure 4.1: *plekto > *pleto

Of course, the candidate *pleko is as well-formed as the winning candidate in terms of the preceding tableau. I assume here an account involving contiguity, following Lamontagne (1996). The general constraint CONTIGUITY requires that for any pair of segments which are linearly contiguous in the SR, the correspondents of those segments in the UR must be contiguous as well (McCarthy and Prince, 1995) Thus, all cases of insertion and deletion are violations of CONTIGUITY except at the edge of the domain in question, which is typically the word, but which might also be a unit such as a reduplicant. Lamontagne refines this idea by proposing that the general constraint CONTIGUITY is to be articulated as family of constraints relativized to particular prosodic domains (syllable, foot, prosodic word, *etc.*). The specific constraint I will use here is as follows:

> D-CONTIG$\sigma$ : For any two contiguous elements $\alpha$ and $\gamma$ within some syllable S in the SR, the UR elements $\beta$ and $\delta$ ($\alpha\Re\beta$ and $\gamma\Re\delta$ ) are contiguous as well. (cf. Lamontagne p. 14)

Thus, in the case of the candidate /ple.ko/, D-CONTIG$\sigma$ is violated, since within the syllable /ko/, the two segments are contiguous on the surface but not in the UR; but /ple.to/ does not violate D-CONTIG$\sigma$, because within each of the two syllables, the contiguous elements are also contiguous in the UR. It is true that /e/ and /t/ are contiguous on the surface but not in the UR; but this is not a violation of D-CONTIG$\sigma$ because the two segments do not lie within the same syllable on the surface. Tableau 4.2 illustrates this.

| /plekto/ | NOCODA | D-CONTIG$\sigma$ | MAX |
|---|---|---|---|
| plek.to | *! | | |
| ple.ko | | *! | * |
| ☞ ple.to | | | * |

Figure 4.2: Preference for intrasyllabic contiguity

Further, there is a candidate *ple.kto, where the original coda segment is resyllabified as part of the following onset without deletion of the original onset segment. I will assume that the onset /kt/ is ill-formed, and will make use of a cover constraint ONSETCOND which enforces the appropriate phonotactic restrictions on onsets. ONSETCOND almost certainly comprises more than one constraint, one of which, SON-SEQ, requires that any segment in the onset is of higher sonority than any preceding segment in the same onset (Kager 1999, p. 267). There are clearly additional restrictions, since not all onsets satisfying SON-SEQ are permitted in Slavic; but rather than attempt a full account of the rather complex set of Slavic onsets here, I will simply assume some formulation of ONSETCOND which rules out the appropriate cases. ONSETCOND is illustrated in tableau 4.3.

| /plekto/ | NOCODA | D-CONTIGσ | ONSETCOND | MAX |
|---|---|---|---|---|
| plek.to | *! | | | |
| ple.ko | | *! | | * |
| ple.kto | | | *! | |
| ☞ ple.to | | | | * |

Figure 4.3: ONSETCOND

### 4.6.1 Preferential parsing of segment categories

Not all coda types are eliminated from Slavic at the same time. The earliest coda deletion rule, *i.e.* of final nasals, is demonstrably earlier than the deletion of obstruent codas; it is as though obstruents are more resistant to deletion than nasals, at least for Slavic. Liquid codas persist the longest, and unlike the other codas, they are resolved by epenthesis or metathesis rather than by deletion; liquids thus appear to be the most resistant to deletion of all.

Pulleyblank (1998) discusses preferences within Yoruba for the parsing of certain vowel types over others: non-high vowels resist deletion more strongly than do high vowels; and the high back vowel /u/ resists deletion more strongly than does the high front vowel /i/. Pulleyblank proposes a category of MAX constraints which are sensitive to the particular values of features (+ or -). For example, MAXNOHI is violated just if a [-high] vowel in the UR has no corresponding segment in the SR.

I assume here a set of contraints of the type proposed by Pulleyblank, except that the features in question are consonantal:

MAX-NAS: For any segment $\alpha$ in the UR, where $\alpha$ is marked [+nas], there is some segment $\beta$ in the SR, $\alpha\Re\beta$.

MAX-OBST: For any segment $\alpha$ in the UR, where $\alpha$ is marked [-son], there is some segment $\beta$ in the SR, $\alpha\Re\beta$.

MAX-LIQUID:For any segment $\alpha$ in the UR, where $\alpha$ is marked [+cons, +son, -nas], there is some segment $\beta$ in the SR, $\alpha\Re\beta$.

MAX-GLIDE:For any segment $\alpha$ in the UR, where $\alpha$ is marked [-cons], there is some segment $\beta$ in the SR, $\alpha\Re\beta$.

Based on the temporal ordering of the rules, I conclude that the ranking for Slavic is MAX-LIQUID $\gg$ MAX-OBST $\gg$ MAX-NAS. The essence of the analysis I will discuss here is that as NOCODA rises in ranking, it comes first to dominate MAX-NAS, and then MAX-OBST. It is not necessarily the case that NOCODA ever comes to outrank MAX-LIQUID, since liquid nasals are resolved by means other than deletion.

### 4.6.2 On the ranking of MAX-GLIDE

Recall also that when an obstruent is followed by a glide, it is the glide which is deleted (*ŏbwīdētēj $\rightarrow$ obiděti; contrast with *plekto > pleto). One possible view is that this change is not connected with the open syllable conspiracy at all; perhaps the syllabification was /o.bwi/, and then there was a later change in the makeup of ONSETCOND which forces deletion of *w.

This is possible, but it is questionable whether /bw/ was ever permissible as an onset in Slavic. /bw/ did not occur word initially. Of course, this does not necessarily mean that /bw/ is not permitted as an onset (as noted above, there might historical gaps where a permissible onset chances not to occur in a particular position); but it does mean that the most compelling type of evidence for /bw/ as an onset is wanting. Onsets of the type

/bw/ did not exist in Indo-European, at least word-initially; and I am not aware of cases in the daughter languages where such onsets arise (*i.e.*, perhaps the resistance to such onsets tends to persist over time).

I suggest an alternative analysis here which assumes the syllabification /ob.wi/. Deletion occurs to satisfy NoCoda, but the deletion of /w/ rather than /b/ is predicted if Max-Obst outranks Max-Glide (tableau 4.4).

| /ŏbwīdētēj/ | NoCoda | Max-Obst | Max-Glide |
|---|---|---|---|
| obwiděti | *! | | |
| owiděti | | *! | |
| ☞ obiděti | | | * |

Figure 4.4: Preference for parsing obstruents

Of course, the winning candidate /obiděti/ violates D-Contigσ, since the surface syllable /bi/ contains contiguous segments whose UR correspondents are not contiguous. The correct outcome is predicted if Max-Obst outranks D-Contigσ (tableau 4.5.). However, D-Contigσ still distinguishes the correct output in the case where both of the consonants in the UR are obstruents (tableau 4.6.)

| | /ŏbwīdētēj/ | NoCoda | Max-Obst | D-Contig$\sigma$ | Max-Glide |
|---|---|---|---|---|---|
| | obwiděti | *! | | | |
| | owiděti | | *! | | |
| ☞ | obiděti | | | * | * |

Figure 4.5: Max-Obst $\gg$ D-Contig$\sigma$

| | /plekto/ | NoCoda | Max-Obst | D-Contig$\sigma$ | Max-Glide |
|---|---|---|---|---|---|
| | plek.to | *! | | | |
| | ple.ko | | * | *! | |
| ☞ | ple.to | | * | | * |

Figure 4.6: Obstruent clusters and intrasyllabic contiguity

### 4.6.3 Deletion of nasals

As noted, there are two rules deleting nasals. The earlier rule deletes word-final nasals except following a long vowel. The later rule deletes all nasal codas, including the word-final nasals not deleted by the first rule. In connection with the earlier deletion, the nasality is simply lost; however, with the second deletion, the nasality is transferred to the preceding vowel, giving rise to an oral/nasal vowel contrast.

In terms of the chonology of the rules, the most important question is why non-final nasals resisted deletion longer than final ones. I suggest that this is one again a matter of contiguity, but the domain in this case is the prosodic word rather than the syllable:

> D-CONTIGω : For any two contiguous elements $\alpha$ and $\gamma$ within some prosodic word W in the SR, the UR elements $\beta$ and $\delta$ ($\alpha\Re\beta$ and $\gamma\Re\delta$) are contiguous as well. (cf. Lamontagne p. 14)

NOCODA is still dominated by D-CONTIGω at the stage where word-final codas are deleted, preventing deletion of word-internal nasals. Later, NOCODA rises in ranking to outrank D-CONTIGω, at which stage word-internal nasals are deleted.

Thus, Slavic went through the following stages:

1. 1. D-CONTIGω | MAX-NAS $\gg$ NOCODA

2. 2. D-CONTIGω $\gg$ NOCODA $\gg$ MAX-NAS

3. 3. NOCODA $\gg$ D-CONTIGω | MAX-NAS

At the first stage, no nasals delete. Word-final nasals are deleted at the second stage. All coda nasals come to be deleted at the third stage.

The exception to the first rule—*i.e.*, where final nasals delete except after long vowels—is odd, because superheavy syllables are ordinarily maximally dispreferred. I will assume that these nasals are extrametrical, and therefore do not incur violations of NOCODA, since they are not syllabified as codas. Constrative vowel length is eventually eliminated in Slavic; there is no evidence to date the loss of vowel length relative to the second nasal deletion, but I will assume here that the shortening of these vowels led to the parsing of the nasal as a coda. Thus, these new codas violate NOCODA and come to be deleted.

A further issue to be discussed is the transfer of the nasality of the deleted segment to the preceding vowel. I will assume that there is actually a coalescence (V + N > Ṽ) rather than a deletion in the cases where nasality is preserved on the vowel. The constraint ordinarily taken to prohibit coalescence is UNIFORMITY (McCarthy and Prince 1995; cf. the *MC [Multiple Correspondence] of Lamontagne and Rice, 1995; but see Kager p. 63 ff. who invokes LINEARITY to prohibit coalescence).

> UNIFORMITY: No element in the SR has multiple correspondents in the UR. (McCarthy and Prince 1995 p. 123)

At the stage where nasals coalescence occurs, UNIFORMITY has come to be ranked relatively low—at least, lower than MAX-NAS, which prevents simple deletion of the nasal, and NOCODA, which triggers the UNIFORMITY violation (tableau 4.7).

Additional evidence for the low ranking of UNIFORMITY is arguably to be found in the outcomes of CьRC/CъRC sequences, where it is claimed (at least for South Slavic) that ъR became a syllabic sonorant, and ьR became a palatalized syllabic sonorant: thus, there was arguably a kind of coalescence between ь and R.

Because of the low ranking of UNIFORMITY, we might expect coalescence in a broad-

| | anC, an# | NoCoda | Max-Nas | Uniformity |
|---|---|---|---|---|
| | an. | *! | | |
| | a. | | *! | |
| ☞ | ã. | | | * |

Figure 4.7: Vowel nasalization

er range of cases, but I will assume that most such cases are ruled out because there is no permissible surface form incorporating features from both UR correspondents. For example, consider what coalescence would mean in the case of /plekto/. The only features distinguishing /k/ and /t/ are place features; but a segment marked simultaneously for both place features is presumably ruled out by some constraint which is undominated in Slavic (cf. languages which permit coarticulated /kp/, /gb/, where this general type of coalescence should in principle be possible). One can imagine vacuous cases of coalescence, *e.g.* a surface /t/ in correspondence with *both* /k/ and /t/ in the UR would satisfy the same markedness constraints as plain /t/ in correspondence with UR /t/ only; but I will assume that this case is ruled out by a highly ranked IDENT-PLACE constraint. Similar arguments can be made for other cases where coalescence does not occur.

Following Kager (p. 71), I assume that the parsing of the [+nasal] feature of the original nasal stop is required by IDENT(nasal). There is an obvious question raised by this approach. The surface nasalized vowel corresponds to two segments in the UR: a [+nasal] nasal stop and a vowel which can arguably be taken to have the value [-nasal]. There should thus be a violation of IDENT(nasal) regardless of the surface value of [±nasal] for the coalesced segment. Kager (p. 71) discusses this specific problem, and cites earlier claims that the [nasal] feature is monovalent; IDENT(nasal) is thus only violated in the case where an underlying [+nasal] segment corresponds to a non-nasal surface segment.

### 4.6.4 Avoidance of high nasalized vowels

In the earlier nasal deletion rule, the nasal is simply deleted without nasalization of the preceding vowel; the quality of the preceding vowel is unaffected. In the later rule, the nasal feature is preserved by transfer of the nasal feature to the vowel; however, high vowels which are nasalized in this manner are lowered. Slavic appears to consistently avoid high nasal vowels (thanks to Don Ringe, p.c. and Ron Kim, p.c. for pointing this out). I assume the following constraint:

> *HI-NAS: A [+high] vowel is [-nas].

There are at least two strategies for avoiding high nasal vowels when one might otherwise arise: either the vowel height can be preserved at the expense of the loss of nasality altogether, or the nasality can be preserved while the vowel height changes. As already discussed, MAX-NAS plays a key role in requiring that the [+nas] feature of a nasal be parsed (recall that MAX-NAS is satisfied in the case where an underlying vowel and following nasal coalesce into a nasalized vowel). The constraint which would be violated in the case of vowel lowering is as follows:

IDENT[high]: If $\alpha\Re\beta$ and $\alpha$ is [$\gamma$high], then $\beta$ is [$\gamma$high].

(McCarthy and Prince 1995, p. 122)

The relevant grammar fragments from Pre-Proto-Slavic and from Proto-Slavic, then, are shown in tableaux 4.8 and 4.9.

| /iN/ | *HI-NAS | IDENT[high] | MAX-NAS |
|---|---|---|---|
| ĩ | *! | | |
| ẽ | | *! | |
| ☞ i | | | * |

Figure 4.8: Pre-Proto-Slavic

It should be noted that [+high] has no formal status in the feature geometry of Clements and Hume; they consider various ways of specifying a high vowel (Clements and Hume 1995, p. 282-3), but arrive at a feature [open] dominated by an aperture node (p. 292).

### 4.6.5 Variation among dialects

I turn now to the later developments where the dialects do not agree in their outcomes.

| ☞ | /iN/ | *HI-NAS | MAX-NAS | IDENT[high] |
|---|---|---|---|---|
| | ĩ | *! | | |
| ☞ | ẽ | | | * |
| | i | | *! | |

Figure 4.9: Proto-Slavic

Original *tl/*dl became kl/gl in some dialects, /l/ in others, and remained tl/dl in still others. I assume here that at the stage of Proto-Slavic where obstruent codas were eliminated, /tl/, /dl/ were permissible as syllable onsets. To the extent that *t was originally syllabified as a coda (but see chapter 2 for remarks on rising sonority across syllable boundaries), it came to be syllabified as a part of the onset (tableau 4.10).

| | /t.l/ | NOCODA | CONTIGUITY | ONSETCOND | MAX |
|---|---|---|---|---|---|
| | t.l | *! | | | |
| | .t | | *! | | * |
| | .l | | | | *! |
| ☞ | .tl | | | | |

Figure 4.10: Syllabification of *tl

This situation continued in those dialects where tl/dl remained. For the other dialects, I claim that there was a change in the set of permissible onsets. I assume a constraint NO-tl which prohibits /tl/ as an onset; if ONSETCOND were properly articulated, NO-tl would be among the constraints which ONSETCOND comprises. *tl/*dl is eliminated in those dialects where NO-tl is highly ranked. In the case where *tl/*dl becomes bare /l/, a segment is deleted, violating MAX; in the case where *tl/*dl become kl/gl, a segment changes its featural content, violating IDENT. The typological variation among the dialects corresponds to the set of possible rankings of NO-tl, MAX, and IDENT:

kl, gl: NO-tl | MAX ≫ IDENT

l: NO-tl | IDENT ≫ MAX

tl, dl: MAX | IDENT ≫ NO-tl

#### 4.6.6 Pleophony and metathesis

As discussed, CORC sequences (where R is a liquid) are resolved in some dialects by metathesis (CROC), and in others by insertion of a vowel, or pleophony (COROC); in still other dialects, CORC remains. Among those dialects where metathesis occurs, some dialects show compensatory lengthening of the vowel; others do not.

Since liquid codas are not deleted, I assume that MAX-LIQUID is undominated, or at least that it dominates the constraints prohibiting epenthesis and metathesis. Those constraints, respectively, are as follows:

DEP: "No insertion" Every element in the UR has a correspondent in the SR.

LINEARITY: "No metathesis" For every α, γ in the SR, and for every β, δ in the UR, $\alpha\Re\beta$ and $\gamma\Re\delta$, if α precedes β, δ does not precede γ.

(McCarthy and Prince 1995 p. 122-3)

The various outcomes of CORC sequences are a matter of the ranking of NOCODA, DEP, and LINEARITY. The typology predicted by the permutations of these three constraints is as follows:

| | |
|---|---|
| Metathesis: | NOCODA \| DEP ≫ LINEARITY |
| Pleophony (epenthesis): | NOCODA \| LINEARITY ≫ DEP |
| No change: | LINEARITY \| DEP ≫ NOCODA |

Above, I claimed that MAX-LIQUID was highly ranked in Slavic, accounting for the longer persistence of this kind of coda. Since liquid codas are not resolved by deletion, MAX-LIQUID ≫ DEP in the dialects where epenthesis occurs, and MAX-LIQUID ≫ LINEARITY in the dialects where metathesis is found.

There is a potential objection to the account I have given here. The epenthetic vowel is a copy of the original preceding vowel; hence it could be argued that there is no violation of DEP, since there is arguably a single vowel segment linked to two prosodic positions rather than a novel inserted vowel. What I assume is that while the original and epenthetic vowels match in their feature content, the epenthetic vowel is formally a separate segment which has merely taken on the features of the neighboring vowel (thanks to Gene Buckley, p.c. for suggesting this solution).

### 4.6.7 ORC

The metathesis ORC > ROC happens in all dialects. For those dialects where CORC > CROC, the outcome ORC > ROC is already predicted by the ranking DEP ≫ LINEARITY. In the previous section, I claimed that LINEARITY ≫ DEP in the dialects where CORC > COROC or where CORC is unchanged. For the COROC dialects where LINEARITY ≫ DEP, the analysis so far makes an incorrect prediction that ORC should become OROC.

As a first attempt at a solution, we might suppose that the constraint ONSET is involved. ORC > ROC does have the merit of producing an onset where none previously existed; and there is a tendency for Slavic to provide onsets for previously onsetless syllables, often by insertion of /j/ (*e.g.* Russ. jablo-ko ‘apple’, cf. Lith. obuolỹs < PBalt. *ābōlijas), suggesting that ONSET is highly ranked. Since LINEARITY outranks DEP in the dialects in question, however, the insertion of an onset should be preferred over metathesis (tableau 4.11).

| ORC | NOCODA | ONSET | LINEARITY | DEP |
|---|---|---|---|---|
| ORC | *! | * | * | |
| jORC | *! | | | * |
| ROC | | | *! | |
| ✗ jOROC | | | | ** |

Figure 4.11: Grammar incorrectly predicting ORC > **jOROC

What is needed is some constraint to rule out jOROC. The solution I propose here involves a constraint DEP[j] (cf. the MAX[j] of chapter 1):[1]

> DEP[j]: "Don't insert [j]" For every segment [j] in the SR, there is a correspondent in the UR.

Cf. the constraint MAX[j] mentioned in Chapter 2 in connection with a possible analysis of Greek; also cf. Pulleyblank 1998.

DEP[j] must be dominated by ONSET, since /j/ is inserted to resolve onsetless syllables in cases where metathesis is not an option. DEP[j] must outrank LINEARITY to prevent the correct candidate ROC from being ruled out as in the tableau above. The ranking for the LINEARITY $\gg$ DEP dialects, then, is as shown in tableau 4.12.

In the dialects where DEP $\gg$ LINEARITY, DEP[j] rules out the candidate *jOROC, but this candidate would fail upon DEP even if DEP[j] were ranked low or not present.

### 4.6.8 Remaining issues

In the first section of this chapter, I made mention of the fact that the diphthongs */ej/, */aj/, */ew/, */aw/ are eliminated during the same period when the open syllable conspiracy was in progress. It could legitimately be claimed that these vowel changes are not connected with the open syllable conspiracy, since the offglide of a diphthong is arguably not a coda.

[1] One reviewer suggested that a less *ad hoc* constraint would be one prohibiting [-cons] segments at the left edge of a syllable. I agree that this is a preferable solution, since it is stated in terms of a pereference for minimally sonorous onsets; but it is problematic for my suggestion below that /j/ might have been [+cons] at this stage of Slavic. If it is correct that /r/ and /j/ are both [-cons], then the statement of this preference for less sonorous onsets is probably not straightforward, since /r/ onsets seem not to be dispreferred.

| ORC | NoCoda | Onset | Dep[j] | Linearity | Dep |
|---|---|---|---|---|---|
| ORC | *! | * | | * | |
| jORC | *! | | * | | * |
| ☞ ROC | | | | * | |
| jOROC | | | *! | | ** |

Figure 4.12: **jOROC ruled out by DEP[j]

It has been claimed, however, that there are both consonantal and non-consonantal varieties of /j/ and /w/. For example, Buckley (1994, p. 56 ff.) argues that glides in Kashaya are [+cons].

If glides can be consonantal, then it is reasonable to suppose that consonantal glides are capable of violating NoCoda. The glides were presumably not originally [+cons] in PIE, since non-moraic glides were in alternation with moraic ones. If the glides did become [+cons] at some point in the prehistory of Slavic, then the elimination of */ej/, */aj/, */ew/, */aw/ falls out as a natural consequence of the rise in ranking of NoCoda.

## 4.7 Conclusion

In this chapter, I showed that the elimination of codas in Slavic can be modeled as the rise in ranking of NoCoda. Some of the earliest work on Optimality Theory (Prince and

Smolensky, 1993) was concerned with modeling restrictions on syllable types in terms of the rankings within a small set of constraints. The present chapter explored a case where a language shifted from one of these rankings to another, with a corresponding change in the set of permissible syllable types.

# Chapter 5

# Discussion

A major part of the agenda of Optimality Theory is to account for the typological variation among languages in terms of differences in ranking among a universal set of constraints (Prince & Smolensky, 1993, *etc.*). For any two languages A and B, the differences between the phonologies of the two languages reduces to differences in constraint ranking. I can see no reason for this to be any less true when language A happens to be an earlier historical state of language B. It follows that the historical changes from language A to language B correspond to a change in ranking of constraints. If we accept the agenda of Optimality Theory, then this view of historical phonological change appears to be inescapable.

Given the nature of Optimality Theory, it is to be expected that a single change in ranking sometimes corresponds to surface results which cannot be conflated to a single traditional rewrite rule (unless one is willing to accept rules of extreme complexity). It would be an extremely surprising finding if this kind of conspiracy were not to be found; such an absence would suggest that the field is on the wrong track in pursuing an account of cross-linguistic variation in terms of Optimality Theory. One might reject a claim regarding the reality of a *particular* conspiracy; one might also admit that the conspiracy is real but reject a specific analysis of it. What one cannot claim, so far as I can see, is that OT is the appropriate approach to phonological analysis, but that historical conspiracies do not exist as a general class of real-world phenomena—unless, of course, one adds principles to the theory to somehow permit only those changes in ranking whose surface effects can be stated in terms of a traditional rewrite rule.

The conspiracy analyses I have put forward in the preceding chapters are complex, and one might be led to doubt the reality of these particular conspiracies on these grounds. However, there might also be considerable complexity in a purely synchronic analysis of the language at any stage during the historical changes under consideration. An economy-based criticism of a conspiracy analysis is not helpful unless one can show that a substantially simpler analysis of the purely synchronic facts is possible.

This same argument holds in the diachronic dimension as well. Even if there is no grand pattern to the sound changes in question, it is still necessary to have an account for the individual sound changes, each of the which presumably corresponds to some change in ranking of constraints. To reject a conspiracy analysis on economy grounds, then, what one must show is that there is a simpler alternative analysis possible for each of the sound changes, and that these analyses are substantially simpler in the aggregate than the proposed conspiracy analysis. In the case where the sum of the individual analyses is only moderately simpler than the conspiracy analysis, one must weigh the economy argument against treating the collective, seemingly directed effects of the individual changes as a massive coincidence.

## 5.1 The role of phonetic pressures

There is a possible alternative to the general view I have been assuming. Perhaps the conspiracies in question are real, but have no formal phonological unity; perhaps they are the product of phonetic rather than phonological pressures. For example, voiced fricatives are said to be universally dispreferred for both articulatory and acoustic reasons; perhaps the explanation for the voiced fricative conspiracy of Chapter 3 is to be found in the phonetics, not the phonology.

My response is not to disagree with the idea that there are phonetic pressures involved with the conspiracies. I expect that such pressures are real, and are an important factor in determining the probability that a particular conspiracy will occur in a particular language (see comments in section 1.1). It does not follow, however, that there is not a formal unity to the conspiracies within the phonology. The reranking of constraints can be viewed as the orderly response by the phonology faculty to external pressures.

Accepting that phonetic pressures influence phonology does not entail that the shape of phonological systems is wholly and merely an optimization between potentially conflicting acoustic and articulatory demands. The phonology faculty has its own internal preference for orderliness— or to state the matter more precisely, when the child is confronted with noisy and ambiguous data, the phonology faculty errs in favor of an analysis with greater generality and symmetry. The worse the asymmetry, the greater the probability of any given sound change which reduces that asymmetry (*e.g.* the rule /sk/ > /š/ in Old English, which began as an ordinary palatalization before front vowels, but which was eventually extended to /sk/ before back vowels as well, in the absence of any obvious phonetic motivation). In cases where there is less or no ambiguity in the data (either because the input from the previous generation is quite clear in its presentation of the asymmetry, or because of compelling demands from the child's own auditory and articulatory apparatus), there is a correspondingly lower probability of a historical sound change which removes the asymmetry. The particular and peculiar shape of human phonological systems, then, is an uneasy compromise between various conflicting cognitive and anatomical demands. Historical sound change is in part the result of the continual push and pull among these competing considerations.

The conspiracies which have the highest overall probability of occurring, then, are those which are not only phonetically preferable, but which also increase the symmetry within the phonological grammar. Thus, there is no conflict between accepting both that phonetic pressures play a role in historical conspiracies, and that there is a formal phonological unity to the conspiracies as well.

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## Table of Special Characters

This table should not be bound with a printed version of the dissertation. It is included in the electronic version so that the reader can readily confirm that all non-ASCII characters are displayed properly.

Unicode encodings for each character are included to facilitate conversion. Encodings are from version 2.0 of the Unicode standard, as described in:

> *The Unicode Standard, Version 2.0.* The Unicode Consortium. 1996. Addison-Wesley Developers Press.

**Combining diacritics**

x is used as a dummy character.

| | |
|---|---|
| x́ | acute accent (U0301) |
| x́ | acute accent (higher) (U0301) |
| x̃ | tilde (nasal) (U0303) |
| x̄ | long vowel (U0304) |
| x̆ | short vowel (U0306) |
| x̄̄ | double-long (two macrons; looks like a ‘=’ character) (U0304 + U0304) |
| x̄̆ | long or short (macron with a short sign over it) (U0304 + U0306) |
| ẋ | overdot (Lithuanian; Old English) (U0307) |
| x̌ | hachek (U030C) |
| ẍ | diaresis (German umlaut) (U0308) |
| x̣ | underdot (U0323) |
| x̥ | ring beneath (PIE syllabic sonorant) (U0325) |
| x̨ | underhook open to right (Germanic and Slavic nasal) (U0328) |

**Precomposed vowels with diacritics**

From ISO 8859-1, a.k.a. Latin 1; i.e. U0080-U00FF

á a with acute accent (U00E1)
é e with acute accent (U00E9)
í i with acute accent (U00ED)
ó o with acute accent (U00F3)
ú u with acute accent (U00FA)
à a with grave accent (U00E0)
è e with grave accent (U00E8)
ì i with grave accent (U00EC)
ò o with grave accent (U00F2)
ù u with grave accent (U00F9)
â a with circumflex (U00E2)
ê e with circumflex (U00EA)
î i with circumflex (U00EE)
ô o with circumflex (U00F4)
û u with circumflex (U00FB)
ä a with diaeresis (U00E4)
ë e with diaeresis (U00EB)
ï i with diaeresis (U00EF)
ö o with diaeresis (U00F6)
ü u with diaeresis (U00FC)

**Greek alphabet:**

αβγδηζθικλμνξοπρστυφχψω (U03B1 - U03C9)

Examples of Greek accents:
ά alpha + acute
ᾶ alpha + circumflex
ἀ alpha + breathless
ἁ alpha + breathy
ἄ alpha + breathless + acute
ἅ alpha + breathy + acute
ἆ alpha + breathless + circumflex
ἇ alpha + breathy + circumflex

**Linguistic characters**

| | |
|---|---|
| $h_1$ | h followed by subscript 1 (First PIE laryngeal) (h + U2081) |
| $h_2$ | h followed by subscript 2 (Second PIE laryngeal) (h + U2082) |
| $h_3$ | h followed by subscript 3 (Third PIE laryngeal) (h + U2083) |
| ḫ | h with diacritic caron below (Hittite laryngeal) (h + U032C) |
| þ | Lower-case Germanic thorn character (U00FE) |
| ð | Germanic barred-d character (U00F0) |
| ƕ | Gothic h+w character (U0195) |
| ß | German ess-tset (U00DF) |
| œ | o+e ligature (U0153) |
| æ | a+e ligature (U00E6) |
| ь | Slavic soft sign (front jer) (U044C) |
| ъ | Slavic hard sign (back jer) (U044A) |
| ə | schwa (U0259) |
| ŋ | angma |
| ʎ | palatal lateral |
| ɲ | palatal nasal |
| ʒ | * z with descender (voiced alveopalatal fricative) |
| ᵉa | Small letter e followed by full-sized letter a (Slavic) |
| ᵒa | Small letter o followed by full-sized letter a (Slavic) |

**Other symbols**

| | |
|---|---|
| ... | ellipsis (three periods) (U2026) |
| — | em dash (U2014) |
| ‘ | single quotation left (U2018) |
| ’ | single quotation right (U2019) |
| “ | double quotation left (U201C) |
| ” | double quotation right (U201D) |
| ∅ | Null set sign (O with forward slash) (U2205) |
| ≈ | is approximately equal (wavy equal sign) (U2248) |
| → | Arrow pointing to right (‘rewrites as’) (U2192) |
| ← | Arrow pointing to left |
| ᚱ | R-rune |
| ᛉ | Z-rune |