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THE INTERNAL STRUCTURE OF AFFRICATES

DARLENE LA CHARITÉ

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the School of Graduate Studies and Research
in partial fulfillment for the PhD.
degree in Linguistics

Université d'Ottawa/University of Ottawa



Darlene La Charité, Ottawa, Canada, 1993

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ABSTRACT

The conclusion of this thesis is that affricates are represented phonologically as stops. There is no phonological notion of affricatehood, nor is there any way of phonologically defining an obstruent class containing all possible affricates and fricatives, to the exclusion of stops.

Three types of evidence support this hypothesis. The first consists of the patterns of distribution of affricates in the segment inventories of over two hundred languages. In almost half the inventories considered, affricates and stops are in complementary distribution with respect to place of articulation. This is unaccounted for by any theory which assumes that affricates comprise a distinct obstruent class. In nearly all of those inventories where both an affricate and a stop occur at a single place of articulation, overlap occurs in the dental/alveolar region. However, these cases do not require the assumption of a distinct affricate class because the affricate can always be distinguished from the homorganic stop by an independently required feature. Typically, this feature is [+strident]. Dental affricates [tʃ], [dʒ] and alveolar affricates [ts], [dz] are strident stops. It is further argued that the feature [strident] should be interpreted as sibilant, which defines the following set of segments: [s, z, ts, dz, ʃ, ʒ, č, j].

The second and third types of evidence not only justify the proposed affricate representation but, in so doing, validate the idea that the distribution of segments in inventories provides a valuable source of information about the featural makeup of those segments. The second body of evidence consists of analyses of rules that have been used to argue that affricates pattern with fricatives. These rules and constraints (from Modern and Classical Yucatec Maya, English, Chumash, and Basque) demonstrate that

only the sibilant fricatives and affricates pattern together. Notably absent are rules that involve a broader range of affricates and fricatives. The rules and constraints that show affricates patterning with fricatives are profitably reanalyzed as targeting segments that are [+strident].

The third type of evidence supporting the view that affricates are stops focuses on analyses of several morphological processes in southern Bantu languages, specifically Shona and Setswana, that derive affricates from a variety of different segments, including both stops and fricatives. These processes have often been considered suppletive. However, the assumptions that affricates are stops, and that the alveolar affricates are strident stops, provide the tools for an elegant and insightful analysis of the consonant mutations involved. Despite apparent lack of relationship between the input and output of consonant mutation, the two can be shown to be featurally identical, or very similar. Individual feature differences between the input and output of consonant mutation are explained by independently attested feature co-occurrence restrictions of the language. These co-occurrence restrictions, which may be violated in causative, passive, and diminutive formation, trigger repair strategies whose goal is to produce feature combinations that reflect those occurring in the underlying representation.

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Chapter One

Introduction

This thesis rejects the idea that affricates are phonologically part stop and part fricative. The view argued for in this thesis is that, phonologically, affricates are stops. There is no phonological class containing all and only affricates, nor is there a class containing affricates and fricatives, to the exclusion of stops. Affricates are united only in the class of stops. This means that, in current terms, they are not underlyingly defined by the feature [+continuant]

This introductory chapter begins with an examination of the properties for which an affricate theory must account. Also discussed are some pseudoproperties of affricates. The subsequent section examines some influential precursors to currently held models of the affricate, with a view to establishing how those antecedents relate to the properties and pseudoproperties of affricates. Following this overview of previous theories, an alternative view of the affricate is proposed. This view of the affricate is embedded in theories of feature geometry (following Clements, 1985 and Sagey, 1986), as well as Radical Underspecification (following Archangeli, 1984; D Pulleyblank, 1986). The basic tenets of these theories and their particular consequences for the present proposal are discussed in Sections 1.4.1 and 1.4.2. Section 1.4.3 provides an extensive discussion of the feature [strident], which plays a prominent role in the proposed affricate theory. This is followed in Section 1.4.4 by a discussion of the relationship between the claim that affricates are stops and the question of which continuant value is underlyingly specified. This discussion suggests that, while affricates are universally considered stops underlyingly, the choice of specified continuant value is language specific.

The text of this thesis is organized into five chapters. Of course, the first chapter consists of the Introduction that has just been outlined. Chapter Two presents evidence from inventories that strongly supports the view that

affricates are underlyingly stops. It establishes that the distribution of affricates in segment inventories is dependent upon the distribution of stops (cf. Steriade, 1989). Over two hundred inventories (taken primarily from Maddieson, 1984) were considered in this part of the investigation into an appropriate affricate representation. Therefore, the conclusions rest on a strong empirical foundation. Chapter Three is devoted to the analysis of rules and processes that have assumed, or been used to demonstrate, that affricates are phonologically part fricative, as defined in the feature [+continuant]. This evidence reveals, first, that a very narrow range of affricates and fricatives actually pattern together. These are coronals, typically [ts] and [tʃ] and fricatives [s] and [ʃ], that are traditionally considered sibilant. Chapter Three further shows that formulating rules and processes that affect affricates and fricatives in terms of the feature [strident] (which is considered synonymous with sibilant) provides a more accurate and enlightening analysis of the facts. No case requires the assumption that affricates are [+continuant]; in many cases such an assumption is detrimental to the analysis. The fourth chapter then demonstrates how the view of affricate [ts] as a strident stop provides the tools for an elegant analysis of causative formation in Shona and Setswana. This process, among others of these languages, derives primarily, but not exclusively, coronal affricates from a variety of segments. It poses serious problems for previous approaches, though its widespread nature suggests that it is by no means idiosyncratic. A number of southern Bantu languages exhibit such derivations. Also, the derivation of affricates is not limited to the morphological operation of causative formation. In the fifth and last chapter of the thesis, attention is focused on other processes in Setswana implicating affricates. First, the derivation of primarily alveopalatal affricates in diminutive formation is considered. Like the analysis of the previous chapter, it illustrates how the assumptions of this thesis cope with a previously problematic set of derivations. Then, other affricates of the language, including [tʃ] and [kx], are shown to be treated like stops and they are derived by processes that produce stops. Chapter Five ends with a

summary of the general conclusions of the present research and some suggestions for further study.

1.1 The Properties and Pseudoproperties of Affricates

There is little explicit discussion of the affricate properties for which a theory is expected to account, but the literature on affricates suggests, often implicitly, the following common core of properties. Affricates constitute a distinct obstruent class. The most notable property of this class is taken to be that the members are part stop and part fricative. The stop and fricative portions of the affricate are necessarily homorganic, or in the case of [pf], very nearly so.

The purpose of this section is to reconsider the properties for which an affricate theory must account, and to distinguish true properties from what will be referred to as pseudoproperties. Some influential affricate theories are then evaluated with respect to these properties and pseudoproperties. The essence of the argument advanced in this section is that the fricativehood of the affricate is phonologically irrelevant. This negates the notion of a class containing all affricates and fricatives, to the exclusion of stops, and the notion of a distinct affricate class. Because all of the following affricate theories espouse the phonological fricativehood of affricates in general, they are inadequate.

As a point of departure, the following list of affricate properties and pseudoproperties is proposed:

1. a. Properties of Affricates

- i. Stophood: whatever defines stops also characterizes affricates;
- ii. Stop-Affricate Dependency (SAD): the distribution of affricates in inventories, with respect to place of articulation, is dependent on the distribution of stops;

- iii. Limited fricativity: the sibilant affricates and fricatives, most commonly [s, š, ts, č], may pattern together.

b. Pseudoproperties of Affricates

- i. Affricates in general are characterized as fricatives phonologically;
- ii. Affricatehood is a phonological notion.

1.1.1 The Properties of Affricates

At the phonetic level, affricates exhibit the closure that is characteristic of stops. That is to say, both stops and affricates involve total obstruction of the airstream at some point in the oral cavity. Affricates are also stop-like in their behaviour. Phonological rules involving stops commonly affect affricates as well. Examples of such rules, which are very informally stated here, are provided below.

2. Rules Affecting Affricates and Stops

a. Basque Stop Deletion: The first of two adjacent [-continuant] features is deleted (see 3.5.3 for further discussion). The rule affects both stops and affricates.

- i. /bait + naiz/ → [bainaiz] 'since I am'
- ii. /guk + pitsu/ → [gupitsu] 'we light'
- iii. /hits + tegi/ → [histegi] 'dictionary'
- iv. /harits + ki/ → [hariski] 'oak wood'

(Hualde, 1988a & b; 1989)

b. Turkish Stop Devoicing: Stops and affricates are devoiced in syllable-final position, but fricatives are not.

- i. sebebî 'reason (poss.) vs. sebeb
- ii. pabuju 'slipper (poss.) vs. pabuč
- iii. denizi 'sea (poss.) vs. deniz

(Archangeli & Pulleyblank, 1987)

c. Loque Stop Voicing: Non-continuants, including stops and affricates, are voiced following a nasal. Fricatives are not affected.

- i. min + pa → minba 'he comes'
- ii. pan + čaki → panjaki 'figure of a man'
- iii. winsaʔu 'he received' *winzaʔu

(Wonderly, 1951)

Rules that treat a range of affricates like stops, to the exclusion of fricatives, are abundant and they occur in a wide variety of languages. The data also show that affricates are affected by rules that target all the stops of an inventory, not just a particular subset. Based on evidence such as this, it is reasonable to conclude that the affricate's phonetic stophood is reflected in a phonological attribute. That is to say, whatever property characterizes stops, in general, also characterizes affricates.

One of the main tenets of this thesis is that affricates exhibit a distributional property that has not yet been sufficiently investigated and for which current theories do not account. In the segment inventories of languages, the distribution of affricates is dependent on the distribution of stops. The weight of this evidence, which is presented and discussed in Chapter Two, overwhelmingly indicates that the dependence between the distribution of stops and affricates in an inventory is not accidental. Of particular interest at this point is the fact that systematic dependency between stops and affricates (SAD) is unexpected behaviour for a distinct

natural class of segments, such as affricates are generally assumed to be. Any theory that assumes affricates to be characterized by the feature(s) of a distinct obstruent class fails to account for Stop-Affricate Dependency.

1.1.2 The Pseudoproperties of Affricates

The assumption that affricates are phonologically stops is well motivated. The situation is not entirely parallel when it comes to the fricativehood of affricates. Certainly affricates are **phonetically** similar to fricatives, in that both involve a severe constriction of the airstream. The articulatory gestures involved in modifying the airstream to produce a fricative are identical to those involved in the production of a homorganic affricate, though the duration of the fricative is longer. Moreover, severe constriction of the airstream at some point in the oral cavity is a phonetic characteristic of all fricatives and all affricates. These facts are widely accepted (O'Connor, 1973; Ladefoged, 1982; MacKay, 1987; Rogers, 1991). Evidently, this phonetic similarity and uniformity between affricates and fricatives, along with the fact that the affricate's stophood is phonologically relevant, has encouraged the assumption that fricativehood is also phonologically relevant. In short, we have presumed another property of affricates, that they pattern with fricatives with respect to phonological rules and processes. However, as Goldsmith (1990, p. 72) remarks, there is actually a paucity of evidence that affricates form a natural class with fricatives to the exclusion of stops. In contrast to the number of processes across languages that treat affricates like stops, there are relatively few examples of affricates patterning together with fricatives. The second point worthy of note is that these few processes, in fact, show a very narrow range of affricates and fricatives patterning together. Two examples are provided here; a more extensive discussion of such processes is provided in Chapter Three.

3 Rules Affecting Affricates and Fricatives

a. Chumash Sibilant Harmony: Two coronal fricatives or affricates in a word must agree in anteriority.

- i. /na + s + xintila/ → [hasxintila] 'his Indian name'
- ii. /na + s + xintila + waš/ → [hašxintilawaš] 'his former Indian name'
- iii. [katskaw] 'sin' ~ [ačkawiš] 'a sin'

(Beeler, 1970)

b. Modern Yucatec Maya Morpheme Structure Constraints: If both consonants in a root are [+continuant], they must be identical. Therefore, only the following CVC roots containing fricatives or affricates are permitted.

s V s ts V ts š V š č V č

(Straight, 1976)

These processes/constraints are representative in showing the sibilant fricatives and affricates patterning together. Notably absent are rules that show affricates patterning with a full range of fricatives, including those that are not sibilant. Also glaringly absent are rules showing a range of affricates, including some that are non-sibilant, patterning with fricatives. Despite the lack of evidence showing that affricates pattern with fricatives, fricativehood is generally accepted to be a phonological property of affricates. In fact, it is a property for which theories seem to be at particular pains to account. However, in the absence of phonological evidence to this effect, it is clearly unjustified to assume that because affricates are phonetically similar to fricatives, they are phonologically marked for fricativehood.

Repudiation of an affricate's phonological status as a fricative has consequences for something else widely assumed of affricates, that there is a distinct natural class containing all and only affricates. If all affricates are phonologically stops, on the one hand, and they are all phonologically fricatives, on the other, then it follows that there is a distinct class containing all and only such dual natured members. However, if affricates do not bear a property of fricativehood phonologically, then the concept of a distinct affricate class, at least as currently conceived, is seriously undermined. Indeed, there is a complete absence of rules, processes, or constraints that target a range of affricates, to the exclusion of stops and fricatives, or that target all obstruents except affricates. That is to say, no language with a range of both coronal and non-coronal affricates has a rule that identifies all those affricates and only the affricates as triggers or targets. This suggests that there is no single feature or feature complex that defines affricatehood. Put another way, affricatehood is not a phonological notion.

1.2 Influential Views of the Affricate

At this point we will consider some views of the affricate that have most profoundly influenced affricate theories currently prevalent within the framework of feature geometry. Throughout this discussion, we must keep in mind that any theory which assumes affricates to be phonologically part fricative predicts that rules may refer to affricates and fricatives, to the exclusion of other types of segment, notably stops. Such a theory further predicts that rules may refer to affricates in general, a class defined by its dual nature. If affricates constitute a distinct obstruent class, then the distribution of affricates in inventories is expected to be independent of the distribution of other segments, specifically stops and fricatives. These predictions are demonstrably false; therefore any theory that embodies the notion that all possible affricates are phonologically part fricative is empirically inadequate. The review of influential affricate theories which follows endeavours to show how they have incorporated the two

misconceived affricate properties of fricativehood and affricatehood. At the same time I will show, in passing, where these theories fail with respect to other assumed or predicted properties of affricates, for instance, homorganicity and linear ordering of the affricate's stop and fricative portions. If the affricate is phonologically part fricative, and the fricative portion is necessarily homorganic to the affricate's stop portion, then homorganicity should be determined in a principled manner. However, in reviewing influential affricate theories it becomes clear that this is by no means a principled consequence of each account. In some cases, such as in the model proposed by Campbell (1974), homorganicity seems entirely fortuitous. In other accounts, such as that of Clements and Keyser (1983), one must employ a rather charitable synthesis of views to derive homorganicity. Though this is mainly a theory internal complication, it is an inconsistency that is indicative of a problem that must be addressed, either by revising the model or the assumptions upon which the model rests.

The view that affricates are part stop and part fricative is certainly nurtured by the traditional IPA transcription for affricates. For example, the alveolar stop is represented with the symbol [t], the fricative with the symbol [s], and the alveolar affricate with [ts], strongly suggesting that it is an amalgam of an alveolar stop and a homorganic fricative. This is perhaps an entirely adequate and economical phonetic description; it is less adequate as a phonological description, even if phonemes/segments are considered basic entities of sound. For this reason, North American linguists eschewed the compound symbols [ts], [tʃ], etc. in favour of symbols [c] and [č] that more clearly indicated the affricate's single segment status phonologically. Yet the view that affricates are part stop and part fricative persisted and, it is argued, influences current affricate theories.

1.2.1 Chomsky and Halle (1968)

Chomsky and Halle (1968, p. 322) (henceforth SPE) rejected the Jakobson, Fant, and Halle (1952) (henceforth JFH) notion of characterizing affricates as

strident stops on the grounds that not all affricates could be considered strident. (See the discussion of [strident] later in this chapter for some elucidation of the Jakobson, Fant, and Halle view.) One implication of SPE's rejection of JFH is that all affricates share some special property of affricatehood that needs to be recognized by the phonology. At the same time, SPE continues to characterize affricates [ts] and [tʃ] as [+strident]. The SPE objection to the use of the feature strident to characterize affricates, on the one hand, and the continued characterization of affricates as strident, on the other, might be construed as contradictory. However, this continued use of the feature [strident] is motivated at least partly by the view that a segment is characterized by one or the other value for all possible features. There is no contradiction under the assumption of a natural class containing all and only affricates, a subset of which may be [+strident]. This theory, though it wrongly predicts the existence of a distinct affricate class, thus provides a principled means of characterizing the common behaviour of strident fricatives and affricates.¹

In the view of SPE, affricates and stops are alike in that both are [-continuant]; they are different in that affricates are [+delayed release], whereas stops are [-delayed release]. Affricates and fricatives are similar insofar as both are [+delayed release]; they are different because affricates are [-continuant], while fricatives are [+continuant]. This is summarized in the following table:

¹. To distinguish [f] from [ɸ], SPE included [f] among the strident fricatives, so capturing the class [s, ʃ, ts, tʃ] that actually patterns together requires reference to Coronal stridents, rather than simply stridents. Nonetheless, such reference is possible and does not, in fact, strain the credibility of the theory

4 The SPE View of the Stop, Fricative, Affricate Distinction

Stops	Fricatives	Affricates
-continuant	+continuant	-continuant
-delayed release	+delayed release	+delayed release

The assumption of two pseudoproperties of affricates, that they are fricatives phonologically, and a distinct class phonologically, is obvious in the SPE feature representation. Because of this, SPE predicts a body of rules involving all and only affricates (i.e. [-continuant +delayed release] segments) and a body of rules targeting affricates and fricatives generally (i.e. [+delayed release] segments). The fact that such rules are unattested is problematic.

SPE groups together stops and affricates by virtue of the fact that both are [-continuant]. However, while SPE assumes that some common ground between stops and affricates needs to be captured in the feature representation of both, it further assumes that affricates and stops belong to distinct classes. The assumption that affricates are not entirely stops is arguably attributable to the fact that affricates uniformly share a phonetic attribute of fricatives, constricted release, and to the more basic assumption that this phonetic fact should not be ignored by the phonology. In other words, the assumption that affricates are part fricative probably results from a failure to maintain a clear distinction between the classificatory function of features and the phonetic function. As shown in the table above, affricates are distinguished from stops, in the view of SPE, by the fact that the former are designated [+delayed release], while the latter are [-delayed release]. In fact, there is some confusion about the SPE use of this feature. Initially, SPE states that release features pertain only to sounds produced with closure (p. 318), that is to say, stops and affricates. This clearly suggests that the feature [delayed release] is intended to distinguish

between stops and affricates; it suggests nothing about an assumed class containing both affricates and fricatives. In this sense, the feature [+delayed release] might well be replaced by a feature [+affricate], a claim made by Campbell (1974, p. 59). However, this conclusion overlooks one of the SPE marking conventions (SPE, p. 406, 422), which states that [+continuant] → [+delayed release]. Since fricatives are [+continuant], this convention renders them [+delayed release]. Extending the feature [+delayed release] to fricatives prevents it from being equated with [+affricate]. It also raises questions of its motivation. Though this is not made explicit, it must be motivated by a perceived need to capture common ground between affricates and fricatives. In other words, in addition to assuming a need to distinguish between a class of stops and a class of affricates, another unstated assumption of SPE must be that there is a need to characterize a natural class containing all affricates and fricatives, to the exclusion of other types of segments. The grounds for this assumption are not discussed, but SPE promotes a view of features that makes it particularly susceptible to assuming erroneously that an obvious phonetic property is phonologically relevant. Sounds are not arbitrarily grouped together by the phonology; they are grouped together on the basis of one or more phonetic properties that are reflected by particular phonological features. In the case of affricates, SPE seems to have mistakenly assumed that obvious phonetic similarities are **necessarily** reflected in the phonological representation. As discussed earlier, once it is accepted that affricates are phonologically part stop and part fricative, then it is reasonable to conclude that they constitute a distinct class characterized by their dual nature. The feature [delayed release] seems to have been adopted primarily to capture an assumed double nature of affricates.

Quite apart from any other criticisms of the SPE approach to affricates, it does not account for SAD. Given the fact that affricates are characterized as a distinct class, there is no reason to expect the distribution of affricates to be dependent on that of stops in inventories. The affricate is distinct from a homorganic stop by virtue of carrying a class creating feature that differs

from that of stops. There is no need for them to be distinguished on the basis of place of articulation as well.

As far as the homorganicity of the affricate's stop and fricative portion are concerned, it is well accounted for by SPE. Affricatehood resides in one or two features in a single feature matrix. There is no way, within SPE theory, that the stop and fricative portions of the affricate could have different place specifications.

1.2.2 Campbell (1974)

At the same time as Kenstowicz and Kisseberth (1979) explicate the SPE view of the dual nature of affricates, they express reservations about the feature [delayed release], remarking that "a number of writers have suggested that the similarity affricates bear to both stops and fricatives can be better expressed as complex segments having a stop phase followed by a fricative phase" (p.253). One of the first to make such a proposal is Campbell (1974), who criticizes the 'low functional load' of the feature [+delayed release] and who suggests, instead, that the affricate be represented with two feature matrices. One of the affricate's feature matrices contains the feature [-continuant], while the other contains the feature [+continuant]. His example of a representation for the affricate [č] is given here:

5. Campbell's View of the Affricate

[č]	
-anterior	+strident
+coronal	+continuant
-continuant	

Campbell advances a number of arguments for this complex representation. These arguments are particularly relevant to current affricate theories. The

first argument for the complex representation is that it captures the sequential nature of such segments as affricates. As we shall see shortly, the essential difference between the affricate theories of Sagey (1986) and Lombardi (1990) resides in different answers to the question of whether or not the phonological representation of an affricate **should** capture the sequencing of the affricate's stop and fricative phases. Lombardi effectively rebuts the idea that the continuant specifications should be ordered. Phonological ordering of the stop and fricative portions is shown not be a property of affricates. This undermines both Campbell's argument and his affricate representation.

Another argument proposed by Campbell for the dual continuant affricate representation is that it is useful in describing processes in which affricates are created by the merger of two underlyingly distinct segments, such as that illustrated by this Skagit example, provided by Campbell. The relevant sounds are in boldface.

ò. x^w1 + g^we + **d** + s + ?el + ed → x^wig^wats^weled
 not subj rel pro my nom. eat trans 'I'm not going to eat'

In his criticism of the autosegmental view of the affricate, Goldsmith (1990) notes that affricates are never formed from the merger of a stop and a fricative. However, the analysis of Shona and Setswana causatives, put forward in Chapter Four, and the Athabaskan D-effect, discussed later in this chapter, support the idea that affricates can, indeed, be created by merging stops and fricatives. An idea not supported by this thesis is that such merger brings together two values for the feature [continuant]. Goldsmith also argues that alternations between affricates and fricatives are rare, in contrast to alternations between stops and affricates. This criticism is supported by the present research.

The complex segment representation presented above is also claimed by Campbell to capture the essence of simplification rules such as when [ts] → [s] or [tʃ] → [ʃ]. Finally, it is justified on the grounds that it better accounts

for gemination rules in which part of an affricate is geminated. For instance, Campbell claims that *Vote* geminates the stop portion of an affricate, such that [ts] → [tts]. The present investigation does not directly address these issues, but even a cursory examination of such processes indicates that they do not hinge on the assumption of a dual-continuant affricate. In the simplifications referred to by Campbell, only stridents are involved. However, even alternations such as [kx] ~ [x] and [pf] ~ [f] would not require the affricate to bear both continuant values. Such alternations might reasonably be assumed to involve loss of [-continuant], for example. Similarly, the gemination facts do not require the assumption of a dual continuant affricate. In fact, this assumption arguably complicates a gemination account, since one must account for the spread of one continuant value, but not the other. Under current views, certain features (e.g. [anterior]) spread. The fact that only one value spreads is attributable to underspecification; an unspecified value can not be active in the phonology. If both values are present, then both should spread. Consider, as an example, Poser's 1982 and Steriade's 1987 treatment of Chumash Sibilant Harmony under assumptions of Contrastive Underspecification. If affricates are specified with both [continuant] values, then lack of specification can not explain why in *Vote*, for example, one value of [continuant] spreads while the other is inert.

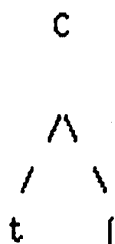
In addition to questions about the arguments used to justify the complex representation of affricates, there are other problems with Campbell's view, most notably the accidental nature of the similarity between the two matrices of the affricate. Other than the fact that each of the two matrices bears a different continuant specification, they are virtually identical, a fact for which the dual matrix theory can not account. The similarities of the affricate's matrices seem accidental and there is nothing in the theory to rule out a segment combining any two matrices, comprised of totally different features. Nonetheless, the legacy of Campbell's view is to seriously undermine the feature [delayed release] proposed by SPE, replacing it with both values for the feature [continuant]. Somewhat

ironically, this legacy may be partly attributable to a disregard for the tentative spirit of Campbell's example and for his observation that the feature [+continuant] in 5. is redundant. What survives from Campbell's proposal is the view that affricates simultaneously bear both continuant values. It thus fails to account for SAD, the absence of rules involving all and only affricates, and the absence of rules involving affricates and fricatives generally.

1.2.3 Clements and Keyser (1983)

Clements and Keyser (1983) do not set out to address either the question of an appropriate affricate representation or the problems of Campbell's theory. However, in combining notions of a CV tier within the syllable and notions of autosegmental phonology, Clements and Keyser do provide a more principled way of linking the affricate to both continuant values.

7 The Representation of [č] (Clements and Keyser, 1983)



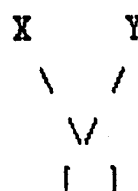
At first glance, this seems little different from Campbell's complex representation, but there are crucial differences between the views. CV phonology is influenced by autosegmental theory (following Williams, 1976; Goldsmith, 1976; Kahn, 1976, etc.). Of particular interest are the notions that a particular feature may be 'lifted out' of the feature matrix, or autosegmentalized, to occupy a distinct tier, and that there may be one-to-many and many-to-one linkages between the autosegment and the

phonological material on another level. Thus, one autosegment may be associated with more than one matrix, or one matrix may be associated with more than one autosegment.

8. a. One-to-many linking

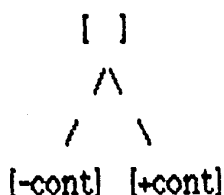


b. Many-to-one linking



The Clements and Keyser view of the affricate is also indebted to Steriade (1982) who specifically proposes that the feature [continuant] behaves autosegmentally and that the affricate links one feature matrix to both values of [continuant] residing on an autosegmental tier.

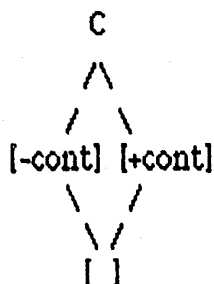
9. Steriade's Affricate Representation



The Steriade view accounts for the similarity of the affricate's stop and fricative features. Except for the two values of the feature [continuant], only one set of features is involved, explaining why the stop and fricative phases of an affricate are homorganic. Because homorganicity is a stable characteristic of affricates, it should be accounted for in a principled way. Herein lies a potential disharmony between the insights of Steriade and those of Clements and Keyser. The essential innovation of CV phonology is another tier of representation, the CV tier. From the point of view of an affricate representation, this succeeds in linking the two continuant specifications, not just to a matrix of features, but to a unit, labelled C, on a

timing tier that mediates between the syllable tier and the segmental tier. It is not entirely clear how a synthesis of the Steriade and Clements and Keyser views should be formalized, but the affricate not only links both continuant values to a single slot on the timing tier, it must also link both values for continuant to a single set of place features.

10.



This representation of the affricate, like that proposed by Campbell, embodies inherent claims about the order of the affricate's continuant specifications. SPE assumes that features within a single matrix are phonologically unordered, so that in the SPE view, the order of the affricate's stop and fricative portion has to be considered a phonetic rather than a phonological concern. Phonologically, there is a single continuant feature and a formally unrelated release feature within a single matrix of features. However, one matrix is phonologically ordered with respect to another matrix. Thus, in linking the affricate to two continuant values, contained in two separate matrices, Campbell succeeds in ordering those continuant specifications phonologically. The assumption is that the ordering of the stop and fricative phase of an affricate is phonological, not simply phonetic. This notion is retained by both Steriade and Clements and Keyser (1983). Therefore, the affricate is a stop on its left edge, because the lefthand matrix bears the [-continuant] feature and it is a fricative on its right edge, because the righthand matrix bears the [+continuant] specification. The ordering of the stop and continuant portions of the affricate, as already mentioned, makes inaccurate predictions about affricate behaviour (see the following section on the views of Sagey and Lombardi for a fuller discussion of this).

Therefore, the CV affricate representation (and, of course, Steriade's) is inadequate in this respect.

Natural classes are not discussed, but it is clear that Clements and Keyser are making the same assumptions about the classes of stops, fricatives, and affricates, as those made by Campbell and SPE. That is to say, affricates and stops form a natural class by virtue of the fact that both are [-continuant]. Fricatives and affricates are a natural class because both are [+continuant]. There must, therefore, be a natural class containing all and only affricates that are characterized as segments linked to both values for the feature continuant. Thus, this view, like those that precede, is unable to account for the SAD property of affricates, the absence of rules involving all and only affricates, and the absence of rules targeting a general class of affricates and fricatives. The fact that only sibilant affricates and fricatives pattern together is also unexplained.

1.2.4 Sagey (1986) Versus Lombardi (1990)

Current views of the affricate, typified by Sagey (1986) and Lombardi (1991), are similar in assuming that the affricate is characterized by both values for the feature [continuant], unlike stops, which are assumed to carry only one value, [-continuant], and fricatives, which are assumed to carry only one value, [+continuant]. The simplest statement of the representation of the obstruents within both these models is shown here:

1.1. The Obstruent Features according to Sagey and Lombardi

Stops	Fricatives	Affricates
-continuant	+continuant	-continuant +continuant

This view of obstruents clearly presupposes the affricate properties of fricativehood and affricatehood that have just been discussed. The above affricate representation must rest on, or entail, the following assumptions:

- All possible affricates, like all possible stops, are characterized as [-continuant]. Stops and affricates are thus united in a class of segments designated by the feature [-continuant], from which other segment types are excluded.
- All possible affricates, like all possible fricatives, are characterized as [+continuant]. Again, this implies that there is a natural class, designated by the feature [+continuant], containing all affricates and fricatives, to the exclusion of stops.
- There is a natural class of segments, presumably characterized by both values for the feature [continuant], that contains all possible affricates, to the exclusion of all other segment types, such as stops and fricatives.

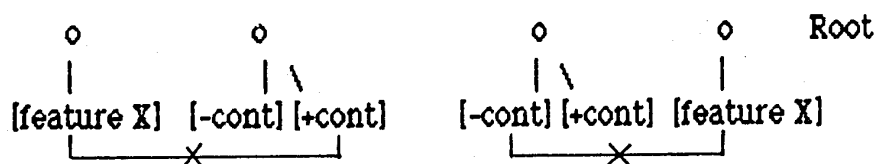
Recent debate over an appropriate affricate representation has focussed on two alternatives, exemplified here in the theories proposed by Sagey (1986) and Lombardi (1990). The opposing views are centrally differentiated by whether they assume that the affricate's continuant specifications are phonologically ordered or not. Feature geometry (following Clements, 1985) assigns each distinct feature to a different tier in the feature hierarchy, so it follows that affricates in Sagey's framework are characterized by two values on the same tier. Within the context of feature geometry, this entails the linear ordering of the two continuant values, which is assumed to be [-continuant] [+continuant]. The [-continuant] value is thus adjacent to the nearest segment on the left, whereas the [+continuant] value is adjacent to a segment on the right. Crucially, [-continuant] intervenes between the affricate's [+continuant] and the nearest specification to the

affricate's left, preventing interaction between [+continuant] and the lefthand segment. Similarly, the [+continuant] specification should prohibit interaction between [-continuant] and the specifications of a segment on the right. This is illustrated here:

13.

a.

b.



Aside from other problems with this dual continuant affricate representation, it is quite unconstrained. Though Sagey attempts to constrain representations with the proposal that only terminal nodes may branch, nothing in the theory precludes a segment with all branching terminal features. Of course, no such segment has ever been, or is likely to be, attested. Equally unthinkable is an inventory of segments, each of which exemplifies a different branching feature. Yet this, too, is permitted by the theory. In short, it is not clear what permits some terminal features, such as [nasal] and [continuant], to branch but not others. It might be suggested that features which spread and/or act as morphemes are permitted to branch, but a moment's reflection shows that this provides little in the way of explanation. Various terminal features have been shown to spread, notably [anterior] (Poser, 1982; Schein & Steriade, 1986; Hualde, 1988a, among others). Archangeli & Pulleyblank (forthcoming) suggest that [ATR], [round], [back], [low], and [high] spread and/or function as morphemes in a variety of languages, including Tiv, Yoruba, Haya, Ainu. Yet no one has proposed that these features branch (though Goad, 1991) has suggested that [ATR] and [RTR] are distinct features, a proposal similar to Lombardi's claim that [-continuant] and [+continuant] are separate features). In fact, of the terminal features, that are supposedly permitted to branch (Sagey, 1986), only [continuant] and [nasal] are thought to do so (Sagey, 1986). The conclusion is

that, at best, ability to spread or function morphemically are poor predictors of branching behaviour.

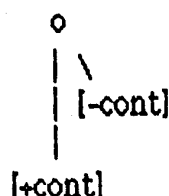
However, lack of constraint is not the only problem with the branching continuant approach to an affricate representation. Because of well documented problems with the predictions of an ordered continuant representation (cf. Hualde, 1989; Lombardi, 1990), the affricate's continuant specifications must be considered phonologically unordered. For instance, in Basque a stop that immediately precedes another stop is deleted (e.g. /bat paratu/ → ba paratu 'put one') (Archangeli & Pulleyblank, 1987; Hualde, 1987). This suggests that the adjacency of two [-continuant] features is the locus of the problem. However, the rule affects an affricate that precedes a stop, changing it to a fricative (e.g. /hitz + tegi/ → hiztegi 'dictionary'). If the affricate is phonologically characterized by ordered continuant values, a sequence of an affricate and a stop should yield a [-continuant] [+continuant] [-continuant] sequence. The affricate-stop sequence should not be treated the same as a sequence of two stops.

Turkish devoices syllable-final stops and affricates (Clements & Keyser, 1983; Archangeli & Pulleyblank, 1987). Syllable final fricatives remain unaffected:

14. a.. kitaba 'book (dative) vs. kitap 'book (nominative)'
- b. pabuju 'slipper (possessive) vs. pabuč 'slipper (nom.)'
- c. denizi 'sea (possessive) vs. deniz 'sea (nominative)'

However, if the affricate is specified [-continuant] [+continuant], it should be treated like a syllable final fricative. Lombardi (1990) provides several more examples of Edge Effect violations, in addition to the two examples shown here. This evidence suggests that, if the affricate is defined by both continuant values, those values can not be ordered. In terms of feature geometry, this means that they are on distinct tiers of the feature hierarchy. This is the representation of affricates put forward by Lombardi:

15 Lombardi's Affricate Representation

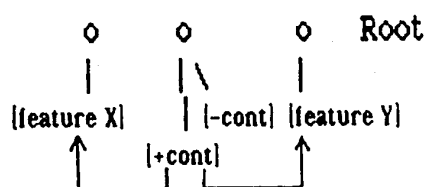
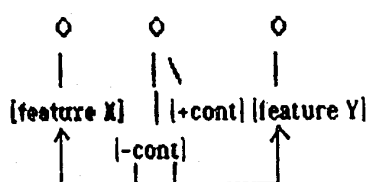


Though Lombardi continues to use the familiar +/-continuant labels for expository convenience, she in fact proposes that the affricate's defining features are monovalent [+stop] and [+continuant]. This half-heartedly addresses the question of why two values for one particular feature are distributed over distinct tiers, unlike opposing values for other features, which are assumed to occur on the same tier. However, the monovalent features invoked by Lombardi are not defined, and it is not clear why these particular terminal features are monovalent, while others are presumably binary. In any case, ordering of the gestures reflected in the [stop] and [continuant] features can be argued to be a phonetic artifact of being unable to effect both closure and non-closure at the same time.² At the phonological level, the features are unordered with respect to each other and both are thus adjacent to the nearest segment on either the right or the left.

16.

a.

b.



² Mohanan (1989) suggests that laterals are [-stop] and [-continuant]. If he is correct, this seems contrary to the claim that ordering the affricate's continuant specifications is attributable to being unable to effect both closure and non-closure at the same time. However, Mohanan defines [stop] as airflow through the oral cavity and [continuant] as referring to airflow through the midsagittal region. Thus air may flow through the oral cavity without flowing through the midsagittal region. In contrast, Lombardi leaves the terms [stop] and [continuant] undefined, so both presumably pertain to airflow through the oral cavity. If this interpretation is correct, then closure and non-closure must be phonetically ordered.

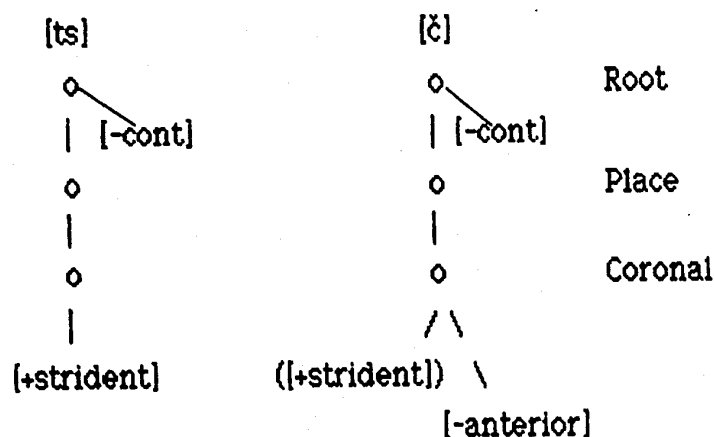
Removing linear ordering of the affricate's stop and fricative portion does not undermine the notions of a distinct affricate class or a class containing all and only fricatives and affricates. In this, as in previous views, affricates are [+stop], like the class of stops, and [+continuant], like the class of fricatives. As long as affricates are viewed in this way, they express the notion that they are part stop and part fricative phonologically. They are still presumed to constitute a distinct obstruent class by virtue of their dual nature. Thus, these views do not account for the absence of rules involving a putative class of affricates or the absence of evidence for a general class of affricates and fricatives. Nor do they address the question of why the distribution of affricates in inventories is dependent on the distribution of stops.

In sum, some problems, such as failure to account for homorganicity, or incorrect predictions about the phonological ordering of the affricate's stop and fricative portions are to a large extent independent of the dual continuant nature of the affricate. Some theories that espouse the dual continuant affricate account well for homorganicity and/or ordering, while others do not. However, any theory that assumes affricates to be phonologically part fricative suffers from empirical inadequacies. Such a theory implies a class of rules that target fricatives and affricates generally. Such rules are unattested. Second, the assumption that affricates are part fricative in turn implies the existence of a class of dual natured segments, the affricates, that excludes other obstruents. Such rules are again unattested. The assumption of a distinct affricate class also fails to account for the dependent relation between stops and affricates in segment inventories. As long as affricates are conceived to constitute a distinct class of obstruents, their distribution in inventories is expected to be independent of the distribution of stops.

1.3. An Alternative to the Dual Continuant Affricate

A basic argument of this thesis is that affricates are phonologically united only in the class of stops. This accounts for their well documented ability to pattern as stops. Additionally, there is evidence that affricates may display limited fricative-like behaviour. Chapter Three provides an extensive discussion of several such processes. Specifically, only coronal affricates [ts] and [tʃ] (as well as their voiced or aspirated or ejective counterparts) pattern with fricatives [s] and [ʃ]. This suggests that these affricates and fricatives are characterized by a common feature. I assume (following Shaw, 1989; 1991) that [ts] and [s] are [+strident]. The alveopalatals [tʃ] and [ç] are [+strident] and/or [-anterior]. For the sake of expository clarity, the following representations of affricates [ts] and [tʃ] are presented, though they raise questions, for example about the universal specification of [-continuant] and redundancy of [+strident] in the case of [-anterior] affricates, that need to be discussed. These ideas are explored in greater detail subsequently, with particular attention being given to the feature [strident].

17. The Representation of Affricates [ts] and [tʃ]



Because 'fricativehood' resides in a single feature, [+strident], that may characterize particular stops or fricatives, the notion that the affricate is

part fricative is very restricted. Not all affricates and fricatives share a common feature; normally, only the strident coronal affricates and fricatives appear to. The particular affricates that bear the feature [strident] may behave like other segments, such as fricatives, that also bear that feature. Likewise, affricates that are [-anterior] may behave like other segments, including fricatives, that are so characterized. There is no means for referring to a class of affricates and fricatives generally or to a class of all and only affricates that excludes stops. This accounts for the notable lack of rules of each type.

Under the view that affricates are handled phonologically as stops, and that they lack a property of fricatives in general, their distribution in inventories is expected to be dependent on the distribution of stops. If affricatehood is not a phonological notion, it can not be used to differentiate stops and affricates underlyingly. This implies that other means must be employed to distinguish a stop from an affricate. The second chapter of this thesis explores and verifies this prediction, providing abundant support for the view that affricates are phonologically stops and that affricatehood is not recognized by the phonology. To a great extent, affricates are in complementary distribution with stops with respect to place of articulation. Where stops and affricates are homorganic, there is always another feature, excluding a feature or feature complex expressing a general state of affricatehood, to differentiate the stop and affricate. Typically, the feature [strident] serves this function.

Another question settled by the proposed affricate representation is that of homorganicity. There are no distinct stop and fricative portions of affricates in general. Some affricates carry a feature that may also be borne by certain fricatives, but a single feature hierarchy is involved. Therefore, there is no way that the affricate's closure and release could be other than homorganic.

In considering the benefits of the proposed view of the affricate, some attention is focused on certain theory internal problems that are cleared up under the present assumptions. If the notion of a dual continuant affricate

representation is combined with that of radical underspecification (following Kiparsky, 1982;1985; Archangeli, 1984) a theory internal problem is implicated. Radical underspecification suggests that, in a given environment, a single value for any feature occurs underlyingly. Yet affricates have both values for a single feature, [continuant]. Presumably, both those values define the class of affricates. However, other obstruent classes are not necessarily required to carry their defining continuant value. For instance, if stops are assumed to be [-continuant] and that is the marked value, then fricatives are assumed to be unmarked for [continuant]. Conversely, if [+continuant] is the marked value, then it is normal within the framework of radical underspecification to assume that stops are unmarked for continuant. The assumption of a distinct affricate class, defined by both continuant values, thus requires an exception to the general rule that only a single value for any feature may occur underlyingly.

Other theory internal problems are raised when notions of radical underspecification and feature geometry are combined. Within the currently assumed model of feature hierarchy theory, a segment without coronal dependents is widely assumed to lack a Coronal Node at the level of underlying representation (Davis, 1990; Paradis & Prunet, 1989a, 1989b, 1991; Shaw, 1991; Yip, 1991). It behaves like a segment without place specifications, often being ignored by processes that target segments with specified place features. Despite arguments against the universal absence of the Coronal Node at UR (e.g. Clements, 1988; Avery & Rice, 1989; Mester & Itô, 1989), there is considerable cross-linguistic support for the idea that in a wide variety of languages, if not all, segments [t], [d], [l], [n] lack a Coronal Node at UR by virtue of the fact that these segments lack coronal dependents at that level. Consider Sibilant Harmony in Chumash (Beeler, 1970; Shaw, 1991) and Basque (Hualde, 1988a) that are discussed in Chapter Three. In both languages, [t], [d], [n], and [l] are transparent to [anterior] spread; they neither undergo nor block the spread of this feature. In Basque this occurs despite the presence in the inventory of segments [ɲ] and [ʎ], [-anterior] nasals and laterals. This suggests that inability of the

[+anterior] coronals [t], [d], [l], [n] to serve as anchors for [-anterior] does not provide an adequate explanation for their transparency. Tahltan Coronal Harmony, discussed in Shaw (1991) and in section 1.4.3 and Chapter Two of this thesis, exhibits similar traits; [t], [d], [n], [l] are ignored by a harmony process that spreads [distributed], [anterior], and/or [strident], and that affects [θ], [ʃ], [s], [z], [ʒ], and [ʒ̥]. Chumash, Tahltan, Basque, along with Telugu (see section 1.4.4), Modern Yucatec and English (see Chapter Three) are a few of the languages that show how coronal affricates [ts], [dz], [tʃ], and [dʒ] consistently behave like segments with a specified Coronal Node (see Paradis & Prunet, 1991, for a thorough investigation of the properties of coronal segments). Under a dual continuant account, it is unclear why they should have place specifications, particularly in an inventory that has affricates at a single coronal place of articulation, since the feature [continuant] is a dependent of the Root Node. By assuming that affricates are unspecified for [+continuant], and that the most common coronal affricates are characterized by the coronal dependents [+strident] and/or [-anterior], we provide a principled account for their place features at UR.

Sometimes we are inclined to give inadequate consideration to theory internal problems. The assumption is that problems disappear once appropriate amendments are made to the model. However, it is not always clear which aspect of the theory is in need of revision. In this respect theory internal problems can be useful. In the present case, the steps necessary to address the empirical inadequacies of the dual continuant affricate representation also remove theory internal problems and inconsistencies presented by it. The removal of these inconsistencies thus provides additional support for the proposed representation.

1.4 Assumptions of the Model

As noted at the outset of this chapter, the proposed model of the affricate is embedded in the context of a theory of feature geometry, following Clements (1985) and Sagey (1986), and a theory of Radical Underspecification,

following Archangeli (1984). The proposal relies heavily on the feature [strident]. Arguments about the nature and placement of this feature are presented in Section 1.4.3. Though affricates are assumed to be stops underlyingly, the defining [-continuant] feature of stops is not assumed to be universally marked at the level of underlying representation. This raises a question about the sense in which an affricate unmarked for [continuant] can be considered a stop. This matter is discussed briefly in Section 1.4.4, which presents two arguments for not assuming that [-continuant] is the universally marked continuant value.

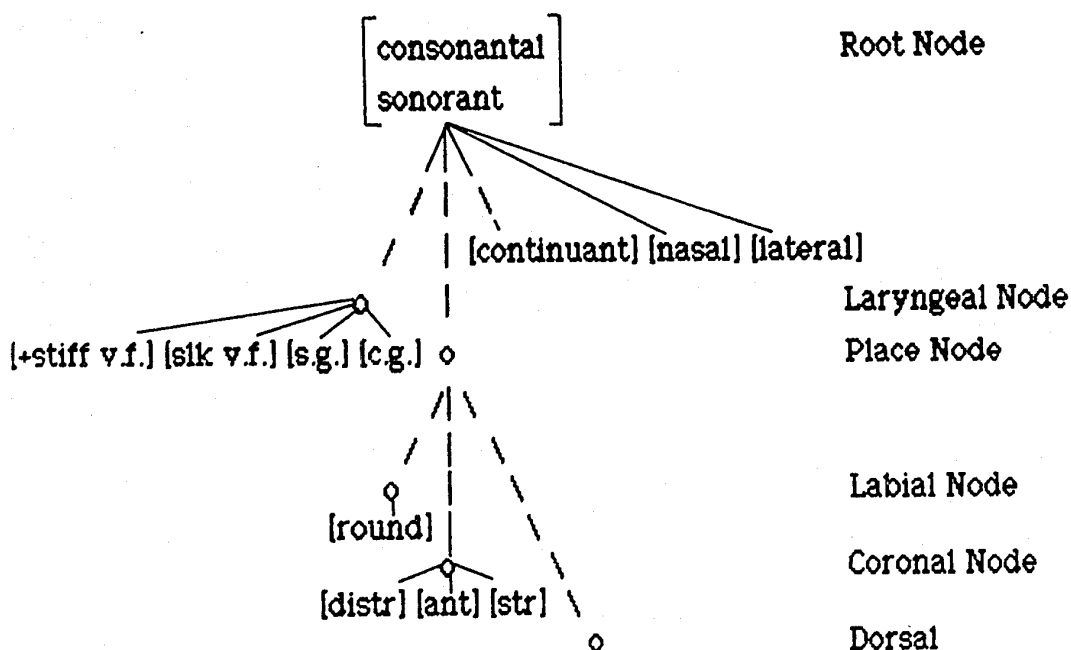
1.4.1 Feature Geometry

For a thorough discussion of the properties and assumptions of feature hierarchy theory in general, the reader is referred to Clements (1985), Sagey (1986), and McCarthy (1988). The essential notion of feature hierarchy theory is that the features of a segment are hierarchically organized, each feature occupying a distinct tier in a hierarchy. Within the hierarchy, most features are organized under unary nodes and this organization defines the parameters of 'group' behaviour. Features dominated by a given node may function individually or as part of a group that includes all the features dominated by that node. Phonological theory must allow the possibility of processes involving a single feature or non-arbitrary, constrained, groups of features. Thus, a single feature may spread, delete, etc., or a particular group of features may exhibit such behaviour. The way features group is remarkably stable across languages. For example, it is not unusual for nasals to take on the place features of a neighbouring segment. This occurs in a variety of diverse languages, including Setswana and English, and it suggests that particular groups of place features, for example Coronal and [-anterior], can move together in a non-arbitrary way. These possibilities are allowed by grouping features under different nodes, so that processes can, by affecting a node, involve all its dependents. Ideally, the complete inventory of features potentially available to a language, the basic structure of the

hierarchy, and a feature's placement in the hierarchy will be shown to be universal. The placement of some features, and the nature and identity of the organizing nodes continues to be debated.

Another important aspect of feature hierarchy theory is that it models what is at least partly a physical reality. Different models take varying positions on which aspects of the physical reality are reflected in the phonology and the degree of abstractness assumed. More than two dozen versions of the feature hierarchy have been proposed and not all differences can be attributed to development of the model and the particular focus of the research (e.g. Clements, 1985; Sagey, 1986; Archangeli & Pulleyblank, 1986; Avery & Rice, 1988; Hualde, 1988; D. Pulleyblank, 1988; Avery & Rice, 1989; Clements, 1989; Gorecka, 1989; McCarthy, 1989; Myers, 1989; E. Pulleyblank, 1989; Hess, 1990; Myers, 1990; Piggott, 1990; Lahiri & Evers, 1991; Shaw, 1991, to name only some). Still, an amazing degree of consensus has been achieved. The particular feature hierarchy assumed throughout this thesis most closely follows the active articulator model argued for in McCarthy (1988), which is closely modelled on Sagey (1986). It departs from Sagey in two main respects. First, McCarthy assumes that the features [sonorant] and [consonantal] define the Root Node, rather than being dependents in the hierarchy. Second, McCarthy's model does not include a Supralaryngeal or Soft Palate Node, his argument being that the proposed dependents of these nodes do not exhibit group behaviour.

18. The Model of Feature Geometry Assumed



I follow McCarthy in assuming that the features [consonantal] and [sonorant] define the Root Node, but for the sake of simplicity, these features are omitted from most of the diagrams throughout this thesis. In fact, wherever possible, features irrelevant to the discussion are overlooked for the sake of clarity and convenience. Thus diagrams are normally shown without a Pharyngeal Node, for example, though there are persuasive arguments for this articulator (see McCarthy, 1988).

One notable departure from McCarthy made in this thesis concerns the repositioning of the feature [lateral], which McCarthy assumes is a Coronal dependent. Research by Shaw (1991), upon which this thesis draws, and by Rice and Avery (1991), indicate that [lateral] must occur above the Place Node. Because the model adopted here, unlike that proposed by Sagey, lacks a Supralaryngeal Node, [lateral] is assumed to be a direct dependent of the

Root Node. Another point of difference between McCarthy's 1989 model and the model assumed here concerns the placement of the feature [strident], which is not directly discussed by McCarthy 1989, but which I argue depends on the Coronal Node. The arguments for this placement are presented in Section 1.4.3. Further innovations to the hierarchy are discussed in Chapter Five, when the representation of vowels is taken into consideration.

I also suggest that, contrary to the claim by Sagey, terminal features may not branch. Only nodes may branch, for example the Place Node, producing multiply articulated segments. Which particular nodes may branch is language specific. Some languages, such as Yucatec Maya, discussed in Chapter Three, may preclude even a branching Place Node. However, no language may have two daughters on the same tier. This rules out both values for a given feature being linked to a single node, two identical articulator nodes being linked to one Place Node, two Place Nodes linked to one Root Node, etc. Though the focus of this thesis is the structure of affricates, this claim has implications for the structure of prenasalized segments, too. I predict that prenasalized segments are not contour segments. Contour segments are ruled out altogether. Prenasalized consonants are discussed briefly in Chapter Four, but a thorough investigation of their behaviour with respect to the present claim remains a topic of future study.

1.4.2 Radical Underspecification

As a point of departure, I assume that segments are radically underspecified (Kiparsky, 1982; D. Pulleyblank, 1983; Archangeli, 1984). In general, the analyses presented in this thesis support Radical Underspecification, with a couple of modifications. According to the theory of Radical Underspecification, a segment is underlyingly represented with the minimum amount of featural information necessary to distinguish the

segment from all others in the inventory. The analysis of Setswana Strengthening presented in Chapter Five of this thesis suggests that in Setswana voiceless fricatives are specified [+spread glottis] underlyingly, though the specification of aspiration is not required to distinguish fricatives in the language. I conclude from this that the underlying representation must be permitted to contain more than the minimum amount of featural information required to distinguish segments. However, none of the language problems presented in this thesis is ever forced to rely on the notion of Contrastive Underspecification. Only one value for any feature occurs underlyingly, so that [+F] or [-F] is contrasted with the absence of that feature at the level of underlying representation. It is possible that the newly articulated theory of Combinatorial Underspecification (Archangeli & Pulleyblank, forthcoming) will provide an even better model than Radical Underspecification. However, Combinatorial Underspecification is still in a relatively early stage of development and to try to fit the material covered in this thesis into this new framework is a massive undertaking that would overshadow the present concern for the structure of the affricate. Therefore, I have chosen instead to work within the framework of Radical Underspecification and to point out problems of fit where they occur. Indications are that these points of discomfort do not undermine the conclusions about affricates.

The main differences between Radical and Combinatorial Underspecification stem partly from different views of the status of the segment. Radical Underspecification assumes that the segment is the basic unit of a lexical formative and it seeks to define each segment uniquely and minimally. Combinatorial Underspecification begins with features (deduced from phonological processes) and combines them to derive segments. Thus a lexical formative is a feature complex. Some features are linked to particular Root Nodes at UR, while others float and link by rule. Both theories assume that only one value for each feature is marked at UR. Combinatorial Underspecification refers to these as 'active' values. Unmarked values are absent and, therefore, inert. The two theories take different positions on the

necessary absence of features that are predictable from other features. For example, in Radical Underspecification, Setswana voiceless fricatives should not be [+spread glottis] underlyingly. Because it is a predictable property of voiceless fricatives in the language, [+spread glottis] should be assigned to them by a redundancy rule. In contrast, Combinatorial Underspecification assumes that languages activate a subset of possible features; these combine to derive segments. A given segment may often be defined by more than one possible combination of features, not all of which constitute the barest description. A language is free to choose a less than minimally specified representation for a segment, or a segment class.

Let us now turn to the question of which feature value occurs at the level of UR. Kiparsky (1982) assumes that only the universally marked feature value occurs underlyingly. For example, under this view, a language may not specify vowels as being [+voice] or [-nasal], since that is the universally unmarked, or predictable, situation. Even if a language contrasts nasal and oral vowels, it is assumed that [+nasal] is the feature that is marked underlyingly, while the unmarked situation is represented by the absence of a specification for that feature. However, there are differences of opinion over how far this may be taken. In her dissertation, Archangeli (1984) allows for language-particular selection of marked feature values. For instance, Archangeli and D. Pulleyblank (forthcoming) demonstrate that some languages mark [+ATR] underlyingly, while others mark [-ATR]. Section 1.4.4 of this thesis argues that in some languages [-continuant] is the marked value, while in others [+continuant] is marked underlyingly. I conclude that languages are free to activate (i.e. specify at UR) either value of a binary feature.

Radical Underspecification has new implications when it is incorporated into a theory of feature geometry. The preceding discussion of which value is active underlyingly pertains to terminal features in the hierarchy. However, the organizing nodes are unary. That is to say, they are either present or absent. A segment can not be [-Labial] or [-Laryngeal]. These nodes are there or they are not. There is a high degree of consensus

that, among the articulator nodes, the Coronal Node is special (cf. Paradis & Prunet, 1991). If a segment is labial or velar, it must have a Labial or Dorsal Node (but see Trigo (1988) for a different view), though those nodes may be unspecified for terminal dependents. In contrast, a coronal segment is widely assumed to require a Coronal Node only if it sports a coronal dependent (Davis, 1991; Paradis & Prunet, 1989; Shaw, 1991; Stemberger & Stoel-Gammon, 1991; Yip, 1991).³ If a segment has a coronal dependent then the dominating node is necessarily present, as is the case with any other terminal feature and its dominating node. The possibility of being unmarked for a Coronal Node is considered by several researchers (e.g. Davis, 1991; Paradis & Prunet, 1989; 1991; Shaw, 1991; Stemberger & Stoel-Gammon, 1991; Yip, 1991) to underlie the special properties that coronals exhibit cross-linguistically. I follow such research in assuming that coronal consonants lacking coronal dependents [distributed], [strident], and/ or [anterior] lack a Coronal Node underlyingly. Some researchers (e.g. Paradis & Prunet) go further by assuming that unmarked coronals lack not only a Coronal Node, but a Place Node as well. I remain uncommitted on this issue, though unmarked Coronals are often depicted in this thesis without a Place Node, for the sake of simplicity.

³ Avery & Rice (1989) and Rice & Avery (1991) depart from this view by assuming that the Coronal Node may be activated by a Coronal contrast. Thus, a language that contrasts a [+anterior] and [-anterior] segment will specify only one value for the feature [anterior], but both the segment bearing the marked [anterior] value and the segment unmarked for anterior have a Coronal Node at UR. This view thus allows for bare Coronal Nodes at UR.

1.4.3 The Feature [strident]

A major claim of this thesis is that affricates are not defined by both values for the feature [continuant]. They are stops underlyingly. Nonetheless, there are rules and processes which show affricates patterning together with fricatives, so it is assumed that such affricates and fricatives have a feature or features in common. It is subsequently shown (see Chapter Three) that these rules and processes invariably involve a particular subset of fricatives and affricates, the dental/alveolar and alveopalatals [s, ts, š, č]. I suggest that this class is appropriately characterized as Coronal [+strident]. The purpose of the ensuing discussion is to clarify what is meant in this thesis by the term [strident] and to justify its location under the Coronal Node.

The feature [strident] has been widely used, though it is something of a poor relation among features, one that can not be dispensed with, but a feature that is used with some mistrust. This is undoubtedly due to the fact that [strident] has been inconsistently defined, that the sets of segments claimed to be strident have varied somewhat, that there is doubt about the validity of some definitions proposed, that [strident] is out of sync with other features in an articulatory framework.

19. Some Divergent Views of the Feature [strident]

a. Trubetzkoy (1939) (summarized in Baltaxe, 1978)

Stridents are sounds that are more, as opposed to less, audible.

Stridents: labiodentals, sibilants, prevelar, true laryngeals

Mellow sounds: bilabials, postvelar, pharyngeals

b. Jakobson, Fant, and Halle (1952)

Sounds that have irregular waveforms are called strident...They are opposed to sounds with more regular waveforms...Strident phonemes are primarily characterized by a noise which is due to turbulence at the point of articulation. This strong turbulence, in its turn, is a consequence of a more complex impediment which distinguishes the strident from the corresponding mellow consonants...A supplementary barrier that offers greater resistance to the air stream is necessary in the case of the stridents... The rush of air against such a supplementary barrier following the release of the strident stops yields the characteristic fricative effect that distinguishes these from other stops (p. 23-24)

STRIDENT		MELLOW
STOPS	AFFRICATES	[p, b, t, d, k, g]
CONSTRUCTIVES	[f, v, s, z, š, ž, χ]	[φ, β, θ, ð, ç, ʃ, x, γ]

c. Halle (1959)

The perceptual counterpart of stridency, a high degree of noisiness, is produced by a random distribution of acoustical energy...formant structure is one of the two major cues for the absence of stridency...A random distribution of acoustical energy is produced by a turbulent airstream. Turbulence is ordinarily generated in the human vocal tract by forcing air through a narrow constriction. The efficiency of conversion of the energy contained in the air flow into sound is dependent upon the radius of curvature of the obstacle

generating the turbulence as well as on the angle at which the turbulent airstream strikes the obstacle. The smaller the radius of curvature – i.e. the sharper the obstacle – and the closer the angle of incidence of the air stream is to 90° , the more efficient the conversion into sound, the more noise produced for the same effort. These considerations explain why /s/ and /š/ are more strident than /x/ and /f/, for the former have an additional obstacle against which the air stream strikes at almost 90° (p. 140).

d. Chomsky and Halle (1968)

Strident sounds are marked acoustically by greater noisiness than their nonstrident counterparts. When the air stream passes over a surface, a certain amount of turbulence will be generated depending upon the nature of the surface, the rate of flow, and the angle of incidence. A rougher surface, a faster rate of flow, and an angle of incidence closer to ninety degrees will all contribute to greater stridency (p. 329).

Stridents: f, v, s, z, š, ts, strident liquids, ts, dz, č, j

Non-stridents: φ, β, θ, ð, ç, tθ

Lass (1984) observes that the strident feature is somewhat incongruent with other features used by SPE, because it is acoustic rather than articulator based. The implication is that he rejects the articulatory criteria SPE adopts for stridents. Also, according to Lass, the relevant acoustic parameter of strident sounds is **high frequency noise**, rather than simply noise or irregularity of the waveform. However, Lass introduces an element of confusion when he claims that high frequency noise is what makes sibilants ([s, z, š, and ž]) [+strident]. On the one hand, sibilance and stridency are distinguished by the same criterion, suggesting that they are the same

feature. On the other hand, by referring to sibilants as a subset of stridents, Lass suggests that sibilancy and stridency are not the same thing. To add to the confusion, both terms, strident and sibilant, are used interchangeably by some researchers (O'Connor, 1984; Clark & Yallop, 1990) in reference to only the alveolar/dental and alveopalatal fricatives [s, z, š, ž]. Lass's definition of stridency and the singling out of the alveolar/dental and alveopalatal fricatives hearken back to the discussion of traditional consonant features by Ladefoged (1982). There, the term 'sibilant', rather than 'strident', is used in reference to sounds characterized by the presence of high frequency energy. Ladefoged uses this feature to distinguish the fricatives [s, z, š, and ž]. This implies, first, that high frequency noise is what distinguishes some fricatives from others and, second, that the set so distinguished includes only [s, z, š, ž], not [f, v, χ], as claimed by JFH and SPE.

Nartey (1982) points out that the acoustic parameter (regularity of the waveform) selected by JFH is a poor measure of fricatives in general, but particularly of voiced ones. The main problem is that voicing introduces an element of regularity which confounds the hallmark irregularity of the fricative waveform. In a study of a wide range of fricatives in more than a dozen languages, Nartey (1982) concludes that the sibilant/non-sibilant distinction, as reflected in relative amounts of energies in the higher frequencies, is what sets certain fricatives apart from others, within and among languages. This measure clearly sets the most commonly occurring dental/alveolar and alveopalatal fricatives, [s], [z], [š], and [ž], apart from other fricatives, across languages. It allows sibilant fricatives to be more easily and accurately identified than non-sibilant fricatives. Nartey's criterion allows for (albeit rarely used) language specific inclusion of non-sibilant fricatives articulated in the dental/alveolar regions, but it precludes the possibility of non-coronal strident fricatives.

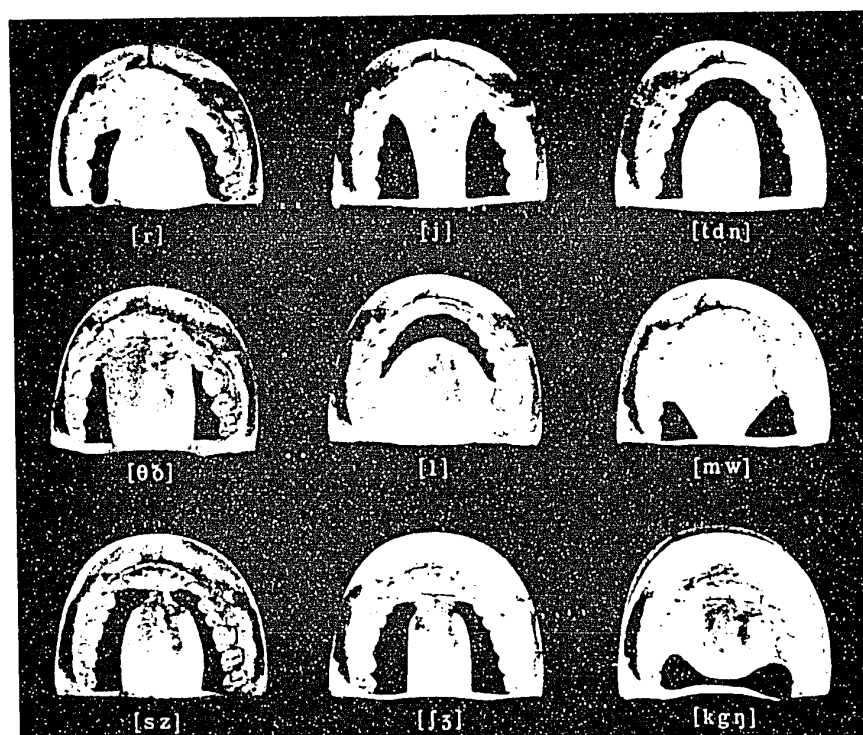
Despite the diversity of opinion, there is important common ground in all views of the feature [strident]. The sounds traditionally known as 'sibilants' are held up as the quintessential stridents in every framework.

These include [s, z, ʃ, ʒ, tʃ, dʒ, ts, dz, ʂ, ʐ, ʧ, ʤ]. It is this set of fricatives and affricates that invariably pattern together, often to the exclusion of other affricates and fricatives. I propose, therefore, that the term 'strident' be restricted to this set of segments and equated with the more traditional 'sibilant'. This use of the term strident, applied to the set defined by sibilancy, is further justified on the grounds that phonological research has been based largely on studies of the behaviour of the most common fricatives and affricates [s, ts, ʃ, ʧ]. In other words, researchers who have recognized a larger set of 'strident' fricatives have nonetheless focused their investigations on the smaller set that are traditionally considered sibilant.

Adopting this proposal means abandoning or modifying existing articulatory definitions for [strident] (e.g. the engagement of a supplementary barrier), since they are invoked as articulatory correlates of a broader class of segments. Sibilance is normally defined only in acoustic terms as high frequency energy, so there is a problem incorporating this feature into current models of feature geometry which are based on the notion that features reflect articulatory properties of speech sounds. However, there is a clearcut articulatory property underlying the production of sibilants. Ladefoged and Maddieson (1986) discuss the 'pitting and grooving of the tongue' in the formation of [s] and [ʃ], which Keating (1991) suggests is linked to the feature [strident] and relevant only to segments with a coronal place of articulation. MacKay (p.c.) notes that for the production of sibilants the blade of the tongue at the aperture is more cup-shaped than it is slit, which is the case in other fricatives made with the tongue. A careful reading of Palmer (1972) indicates that the anterior fibres of the genioglossus muscle are involved in the production of the sibilants in a way that they are not in other fricatives. For instance, [θ], which is also made with the blade of the tongue, involves the medial and posterior, rather than the anterior fibres of the genioglossus muscle. The genioglossus is the largest of the extrinsic tongue muscles; it extends from the tip of the tongue to the root. The anterior fibres are the frontmost fibres that control the shape of the tongue tip. Palatograms show how the tongue configuration is

similar for the sibilants, and how it differs from that of other consonant sounds, including the alveolars [t, d, n] and the laminal fricatives [θ, ð]. This cupping of the tongue blade has specific acoustic effects, which we identify as sibilance. The net implication of this discussion over phonetic correlates is that there are relatively clearcut articulatory and acoustic parameters for stridency, provided that [strident] is equated with sibilance and applied to a subset of the coronal fricatives, most notably [s, z, š, ž] and, by extension, to affricates [ts, dz, č, ǰ].

20. Palatograms of Selected English Segments



(Zemlin, 1968)

In the framework adopted in this thesis, features have both a classificatory and a phonetic purpose. They characterize segments that function as a group in phonological rules, but they are also assumed to be

abstractions of an articulatory property common to those sounds. As Halle (1983:p. 94) notes, 'phonological rules in the most varied languages involve groups of sounds that are readily characterized in terms of their phonetic properties, whereas rules involving...phonetically unnatural groups...are unattested or extremely rare'. Phonetic relationships are also encoded in prevailing feature hierarchies. For instance, the features for voicing and aspiration are placed under the Laryngeal Node, partly because they are effected by adjustments of laryngeal structures. Clements and Hume (forthcoming) state that

features are either articulator-bound, in the sense that they depend on a specific articulator for their execution, or articulator-free, in the sense that they are not restricted to a specific articulator. Articulator-bound features, when present in a tree, further prescribe the specific nature of the constriction formed by a given articulator. All such features are located under the articulator node whose activity they delimit.

Determining whether a given feature is articulator-bound or free is motivated by different considerations, the first of which is whether the feature is relevant to one specific active articulator. By this criterion, the feature [strident] is appropriately placed under the Coronal Node. Under the definition proposed, only sounds made with the front of the tongue may be strident.

The feature [strident] is already widely assumed to be a dependent of the Coronal Node (Keating, 1991; Lahiri & Evers, 1991; Paradis & Prunet, 1991; E. Pulleyblank, 1989; Shaw, 1989; 1991; Yip, 1988; 1989; 1991). However, it is not clear that this placement has always been made on principled and well argued grounds, rather than having been assumed. For example, E. Pulleyblank (1989) places [strident] under the Coronal Node, presumably because he adopts McCarthy's (1988) hierarchy. In the paper where this particular hierarchy is proposed, McCarthy argues against the

Manner and Supralaryngeal nodes on the grounds that the features presumed to depend from them never function as a unit. The feature [strident], along with the features [nasal], [continuant], [consonantal], [sonorant], and [lateral], had been assumed by Clements (1985) to depend on the Manner Node, which in turn depended on the Supralaryngeal Node. Dispensing with the Supralaryngeal and Manner nodes necessitated the relocation of their orphaned dependents. To this end, [strident] was placed under the Coronal Node. However, McCarthy does not provide phonological arguments for that decision. Of course, it is a reasonable assumption; as indicated above, there are good phonetic grounds for placing [strident] under the Coronal Node. As Keating (1991) and Lahiri & Evers (1991) specifically note, stridency is pertinent only to coronal segments. However, phonological assumptions must be justified on phonological grounds; after all, laterals are also typically coronal, though placing [lateral] under the Coronal Node (Levin, 1988) is increasingly suspect (Avery & Rice, 1991; Shaw, 1991).

One way of approaching this question is through the issue of transparency. The segments [s], [ʃ], [ts], and [č] are triggers and targets in processes such as Chumash Sibilant Harmony and Tahltan Coronal Harmony which indicate that [s] and [ts] have a Coronal Node at a point in the phonology when other coronal segments, including [t], [n], [l], are shown to lack place features (Shaw, 1989; 1991). It is their lack of place features at this point (implying a lack of place features at UR) that renders [t], [n], [l] transparent with respect to processes like Sibilant Harmony in Chumash and Coronal Harmony in Tahltan (Shaw, 1989; 1991). The defining features of the above transparent segments, [-continuant], [+nasal], and [+lateral], are located above the Place Node, so they are invisible to processes operating below the level in the hierarchy at which they bear their specifications. For example, segments unspecified for a Place Node will be unaffected by processes targeting coronals. Segments unspecified for place features underlyingly are assumed to receive their Coronal place of articulation by default at some later point in the derivation, after harmony ceases to exert an influence. Because [s] (and [ts]) are affected by the harmony processes, at a point

where other coronals such as [d] behave as though they do not have place features, it is assumed that they do not receive their coronal place of articulation by default; rather it is part of their underlying representation. The general pattern of transparency is illustrated by the following Chumash examples taken from Shaw (1991). These examples show that strident coronal segments agree in their value for the feature [anterior] with the rightmost strident coronal in the word.

21. a. k-sunon-us 'I obey him' vs. k-šunon-š 'I am obedient'
 b. ušla 'with the hand' vs. usla-siq 'to press firmly by the hand'
 c. uqsti 'of throwing' vs. š-uxšti-meš 'throw over to'
 d. /s-iš-tiši-yep-us/ 'they two show him' > [s-is-tisi-yep-us]

If stridents have a Coronal Node at UR, the question is the basis on which it is assigned. Is it assigned by virtue of the fact that [strident] is a dependent of the Coronal Node, (so to be specified [strident] is to be specified for a Coronal Node), or is it assigned on some other basis?

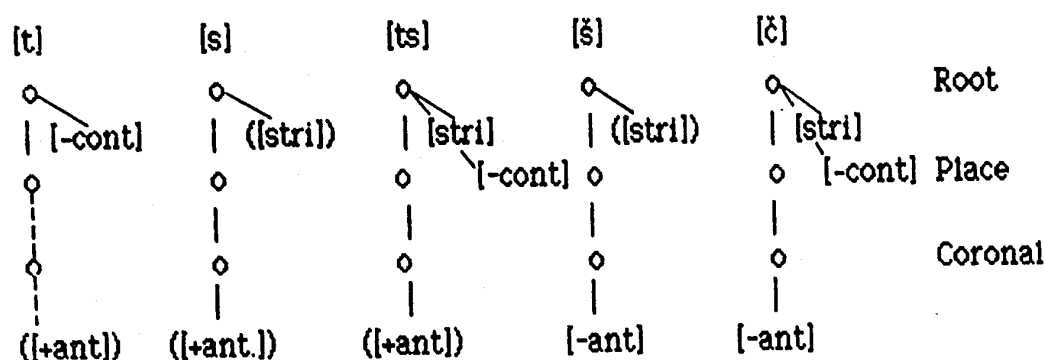
Shaw (1989; 1991) does assume that [strident] is a Coronal dependent, a proposal that is adopted here. Nonetheless, one alternative explanation for stridents having place features can be culled from Shaw's own brief review of Chumash, which recapitulates the approach taken by Avery & Rice (1988; 1989). Shaw's discussion suggests that [s] and [ts] may have place specifications, not by virtue of their strident specification, but because the stridents contrast on the basis of the feature [anterior], which is considered (uncontroversially) to be a Coronal dependent. For reasons that will be presented shortly, both [s] and [ts] would have a bare Coronal Node at UR, while their contrasting counterparts [š] and [č] would be specified as Coronal [-anterior].⁴ In this view, the feature [strident] might at first appear to be

⁴ Avery & Rice (1989) assume that terminal features are monovalent, so that in their view, [č] and [š] are actually Coronal [posterior]. I will ignore this difference in the ensuing discussion. Though important, the question of whether features are binary or monovalent is tangential to the present discussion and not of central importance here.

redundant. However, it is not redundant under Shaw's assumption (and mine) that affricates are stops underlyingly, that [-continuant] is the marked continuant value, and that [+continuant] is unmarked at the level of UR. One reason to reject the view that the affricate [ts] and [dz] could become strident redundantly is that it is unclear why a [-continuant] segment, which affricates and stops are claimed to be, would become [+strident] redundantly. There would have to be a way to assign [strident] to [-continuant] 'would-be' affricates, which overlooks [-continuant], 'not-to-be-affected' stops. Moreover, without [strident], at least on the affricate, there is no way to draw the necessary distinction between the alveolar stops and the homorganic affricates.⁵

Nonetheless, it may be possible to assume that [+strident] is underlyingly specified, without assuming that it is a Coronal dependent. This is shown in the following diagrams. Parentheses around a feature indicate its potentially redundant status.

22. An Alternative Representation for [t], [s], [ts], [ʃ], [č]



5. The following chapter provides extensive inventory evidence that affricates are not distinguished by both values for the feature [continuant]. The logic of underspecification, which is implied by [anterior], would presumably require both values of continuant as well. Let us ignore the inconsistencies in these representations; my purpose is simply to remove [strident] from under the Coronal Node and explore alternative reasons for the presence of the Coronal Node.

Even though both values for the feature [anterior] may not be marked underlyingly, the presence of a contrast on the basis of this coronal dependent may necessitate that even the potentially placeless [s] and [ts] be underlyingly Coronal. This is essentially the position argued for in Avery & Rice (1988;1989), whose Node Activation Condition is stated as follows:

23. Node Activation Condition (NAC, Avery & Rice, 1989)

If a secondary content node is the sole distinguishing feature between two segments, then the primary feature is activated for the segments distinguished. Active nodes must be present in underlying representation.

Let us consider the application of this analysis to Tahltan, which has [+anterior] and [-anterior] affricates. According to Shaw, there are five series of coronal stops in Tahltan. These are shown here and each series is numbered for convenience. Also for ease of reference, the actual or potential trigger and target are underlined and the transparent segments are printed in boldface.

24. The Coronal Stops of Tahltan

1.	2.	3.	4.	5.
d	dɪ	<u>dʒ</u>	<u>dʒ</u>	<u>dʒ</u>
t	tɪ	<u>tʃ</u>	<u>tʃ</u>	<u>tʃ</u>
t'	tɪ'	<u>tʃ'</u>	<u>tʃ'</u>	<u>tʃ'</u>

The transparency of the segments in series 1. and 2 is illustrated by the following examples; these segments are neither triggers nor targets of Coronal Harmony, which involves the features [distributed], [anterior], and [strident].

25. a. [dɛsɪdzɛɪ] 'we shouted'
 b. [tɛsɛɪnɛʃudʒut] 'we chased it away'
 c. [xɑʔɛtʰaθ] 'I'm cutting the hair off'
 d. [dɛθɪɡɪtɬ] 'we threw it'

Example 25a shows the /θ/ of the first person dual marker /θi(d)/ being realized as [s] because of a following [dz]. It further shows that [d] is unaffected. The harmony process does not affect either [d] or [l], nor is /θ/ affected by [l] (see also 25d.). The second example shows the /θ/ of the same marker, /θi(d)/, being harmonized to [dʒ] in terms of its stridency and/or anteriority. Here, [t], [d], [n] are unaffected. The last example shows that /θ/ is unaffected by a subsequent [tɬ]. In example 25c., the underlying /s/ of the first person singular marker is harmonized to the following /θ/, showing harmony to involve the feature [distributed] and to leave ejective coronal [tʰ] unaffected.

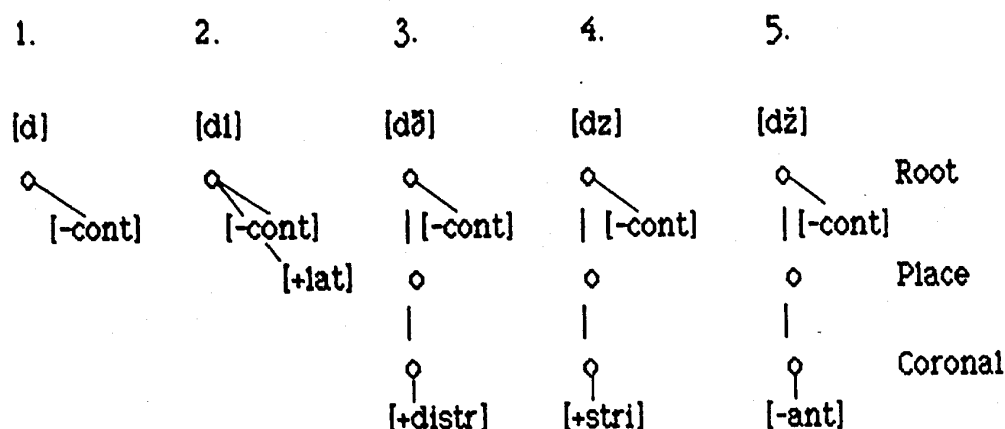
All the features involved in Coronal Harmony, [strident], [anterior], and [distributed], are assumed (by Shaw and many other researchers, including Levin, 1988) to be Coronal dependents, something Shaw uses to argue against locating [lateral] under the Coronal Node. In 26a. the first person singular /s/ remains unaffected by [ɬ]. Example 26b. shows that the same marker is affected by distributed segments, but not by [ɬ]. Conversely, [ɬ] is unaffected by [-anterior] segments, as shown in 26c.

26. a. [nɛstɬɪ] 'I'm sleepy'
 b. [θɛθɬɪ] 'I'm hot'
 c. [ɬɛnɛstʃuʃ] 'I'm folding it'

The logic is that segments with coronal dependents are affected; laterals are unaffected. On the other hand, segments with coronal dependents trigger harmony; laterals do not. Therefore, they have no coronal dependents and

are not specified as Coronal segments at this stage. The feature [lateral], which has been widely assumed to be a Coronal dependent, following Levin (1988), is shown not to be. In fact, Shaw assumes that the relevant segments are underlyingly represented as follows (one representative of each series is shown; laryngeal differences are ignored):

27. The Representation of Tahltan Coronal Stops



The representations show that the transparent segments of series 1. and 2. lack place features, or at least a Coronal Node, underlyingly. In contrast, the segments in series 3., 4., and 5. are assumed to have a Coronal Node underlyingly. The representations further imply that each of the non-transparent segments has a Coronal Node because it is distinguished by one of the Coronal dependents.

However, let us consider the alternatives, which include the following possibilities:

1. The segments of series 4., represented here by [dz], actually lack a Coronal Node;

2. The segments of series 4 have a Coronal Node for one of the following reasons:

- a. Contrastive Underspecification;
- b. NAC;
- c. they are [+strident], which is a Coronal dependent.

Paradis & Prunet (1991) argue that otherwise unspecified [+anterior] coronals lack an underlying Place Node universally, whether or not there is an anterior contrast in the language. If their arguments are correct, then it can be assumed that [dz] does not receive its Coronal Node by virtue of an anterior contrast in Tahltan. Under this view the most reasonable and straightforward assumption is that the Coronal Node is present because [dz] is strident and [strident] depends on the Coronal Node. However, let us ignore P & P's arguments for the moment and pursue the possibility that [dz] is assigned a Coronal Node at UR on some basis other than the fact that they are [strident], which feature is a dependent of the Coronal Node. Let us consider whether Shaw's data and analysis really argue for the presence of the feature [strident] and for placing [strident] under the Coronal Node, as opposed to elsewhere in the tree.

To begin with, the fact that [s] and [ts] are triggers and targets shows that, by whatever mechanism, they are specified for a Coronal Node at a point in the derivation where segments lacking coronal dependents (i.e. those in series 1. and 2, such as [d] and [dl]) lack also a specified Coronal Node. The possibility that [z] and [dz] lack a Coronal Node must be rejected, first, because they would then be expected to behave like [d], [n], [l]. They do not. To assume that they participate in the harmony on some other basis than having a Coronal Node compromises the entire analysis to no purpose. There is nothing to be gained and everything to lose by assuming that Tahltan [z] and [dz] lack a Coronal Node. In cases where, for example, [θ] harmonizes to a following [s], the absence of structure on [s] would apparently trigger delinking of the Coronal Node of [θ]. Surely we do not want to appeal to lack of structure as a trigger. In the reverse case, where

[s] harmonizes to [θ], the structure of latter would be the trigger. What is required, under the assumption that the series 4. consonants lack a Coronal Node, is a non-structural account of harmony. I foresee no such alternative. Therefore, the first alternative, that the consonants of series 4., lack a Coronal Node, is rejected.

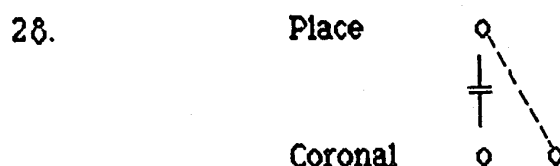
The non-transparent segments in series 3. and 5., such as [dʒ] and [dʒ̥], are specified with a Coronal Node, ostensibly by virtue of having coronal dependents [distributed] or [anterior]. Let us suppose that [z] and [dz] from series 4. have a Coronal Node because they contrast with series 5. [-anterior] [ʒ] and [j]. Two possibilities are consistent with this assumption, Contrastive Underspecification and the NAC. Let us first consider an account based on the notion of Contrastive Underspecification. There is also a [distributed] contrast among the [+anterior] segments of Tahltan, so under assumptions of Contrastive Underspecification, we expect [dz], [ts], [tsʰ], [s], and [z] to be specified [+anterior] [-distributed]. If this is the case, is the feature [+strident] still required at UR? The answer is yes: As long as a single continuant value is assumed underlyingly, the feature is not redundant for the affricates [dz], [ts], [tsʰ] of series 4., which must be distinguished from the alveolar stops [d], [t], and [tʰ]. Also, as noted previously, it is difficult to motivate a redundant [+strident] for a segment specified [-continuant], particularly if it is to apply to one [-continuant] segment and not another. In fact, even redundant application to fricatives is problematic. The feature [+strident] can not be redundant for the fricatives, since not all the coronal fricatives are strident. How could its subsequent redundant insertion be expressed? The redundancy rule can not be stated as applying to coronal continuants (or non [-continuant]) because the distributed segments are presumably also coronal and they must be prevented from becoming redundantly [+strident]. It might simply be specified that non-distributed coronal continuants become redundantly [+strident], but this seems suspiciously stipulative. Still, cases in which [s] → [θ] (e.g. 26b.) might be seen as involving the acquisition of a [+distributed] feature (or, as Shaw assumes, the Coronal Node that dominates it), thereby blocking the

application of the default [+strident] assignment. Of course, if it is correct that stridents normally involve laminal articulation, (see discussion to follow later in this section), then such blocking is difficult to justify. The opposite process, in which [θ] → [s] (e.g. 25a.) could be explained as the acquisition of [+anterior], and/or subsequent loss of [+distributed], leading to default [+strident] assignment. However, it is not clear how in cases where [tθ] → [ts], the [strident] feature would be assigned. By what mechanism would [+strident] be assigned to a [-continuant] segment? Why is the resulting segment not simply a coronal stop, which would be redundantly [+anterior]? The net result is that we can not assume that the same mechanism is responsible for the harmony of fricatives as is responsible for the harmony of affricates. It is both more economical and more reasonable to assume that [strident] is specified underlyingly than it is to assume Contrastive Underspecification with or without the specification of the feature [+strident]. If we try to get around these problems by appealing to the idea that affricates and fricatives are underlyingly defined as [+continuant], then we must confront the fact that a dual continuant affricate does not account for SAD, which is subsequently shown to be a property of affricates.

Assuming that series 4. consonants have a Coronal Node because of the NAC leads to the same problem. If contrasts are the basis on which the Coronal Node is activated, even on segments lacking coronal dependents, then under the view that affricates are stops, [t], [tʰ], and [d] should have a Coronal Node. They are in contrast with stops [ts], [tsʰ], and [dz]. However, a cornerstone of the analysis is that the series 1. consonants lack a Coronal Node. Therefore, we are forced to assume that the affricates constitute a distinct segment class. However, this does not account for SAD. One might think that the possibility of a distinct affricate class should be admitted in some cases, such as when languages have stop [t] and affricate [ts] (discussion in Chapter Two will clarify this line of argument). However, these are not the only cases when this assumption would be required. For instance, in English the affricates [tʃ] and [dʒ] are in complementary distribution with stops with respect to place of articulation, suggesting that it

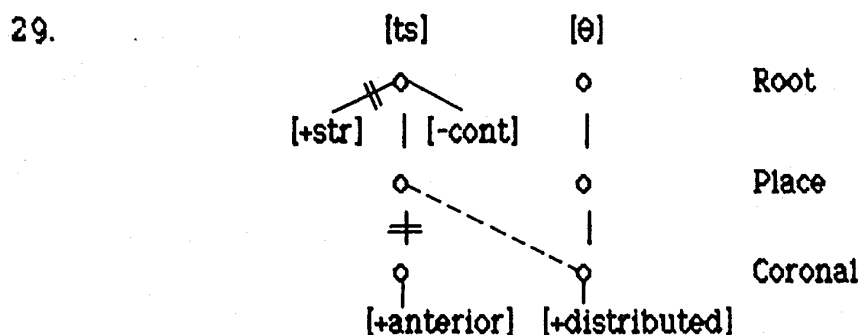
is a language in which affricates may be unproblematically assumed to be stops. However, if the affricates are stops, and if they are Coronal [-anterior] (or, as Avery & Rice assume, Coronal [posterior]), then the English Coronal stops would be required by the NAC to have a Coronal Node at UR. However, Avery & Rice (1989, p. 190) present arguments to show that this is not the case. Therefore, there is no advantage to assuming that affricates are stops on a language specific basis. This is not the only case in which the assumptions of this thesis come into conflict with the NAC. For example, Avery & Rice argue that Catalan lacks a coronal contrast, though it has two distinctive Coronal nasals, [n] and [ɲ]. They assume that the palatal nasal is a complex coronal-dorsal, but that the Coronal Node is unspecified. However, I assume that [ɲ] is Coronal [-anterior], as suggested by Setswana causatives and diminutives (see Chapters Four and Five of this thesis) and by Kinyarwanda sibilant harmony (referred to in Chapter Three). If I am correct, the Coronal Node of [ɲ] must indeed be specified. If other processes of Catalan indicate that [n] lacks a Coronal Node, then the NAC must be rejected.

This brings us to the last possibility, that the series 4. consonants are Coronal because they are [+strident] and [+strident] is a Coronal dependent. Before accepting this conclusion, let us address more directly the question of whether [strident] is necessarily a coronal dependent, as opposed to a feature located elsewhere in the tree. According to Shaw (1989;1991) Coronal harmony involves spreading the rightmost Coronal Node, and delinking an existing Coronal Node, as shown here:



If a segment, such as [ts] is specified as [+strident], and that feature is located above the Place Node, then acquiring the Coronal Node of a segment

to the right will, in some cases, require subsequent delinking of the [+strident] feature as well.



Of course, subsequent delinking of [+strident] is not that problematic. It may even be justified on grounds of structure preservation. Presumably, distributed stridents do not occur in Tahltan. This restriction against the co-occurrence of [strident] and [distributed] must be lifted at some subsequent point. The [-anterior] segments of series 5. are presumably [+distributed] and [+strident], at least redundantly. In these cases, [+distributed] does not prevent the default assignment of [+strident]; nor does a [+strident] prevent the default assignment of [+distributed].

However, this explanation must be weighed against the fact that [strident] does not just 'come along for the ride' in harmony processes; it actively participates. If [strident] is considered to be actively involved in the coronal harmony process, rather than being passively contingent, as the language facts imply, the effects of removing [strident] from under the Coronal Node are more damaging. An account of the facts of Tahltan consonant harmony would be fragmented and considerably obscured were [strident] not a coronal dependent. To begin with, harmony could not simply be described in terms of Coronal Spread. Under Shaw's assumption that Consonant Harmony necessarily involves Minimal Scansion (cf. Archangeli & Pulleyblank, 1987), [anterior] and [distributed] seek a Coronal Node. Assuming that [strident] is not a Coronal dependent, but that it is involved in the spreading, and that it is subject to the same condition of Minimal

Scansion, it should seek out some other Node, for example a Laryngeal or a Root Node, whichever is presumed to dominate it, rather than a Coronal Node. This predicts that, unlike what happens in the case of [anterior] and [distributed], any segment with a Root Node (that is to say, all of them), or a Laryngeal Node (the voiced and glottalized obstruents), should be targets for Strident Harmony. This is clearly false. Moreover, the facts show in other ways that another placement for [strident], for example under the Root Node or the Laryngeal Node, is unlikely. Other root dependents [lateral], [continuant], and [nasal] do not exhibit the behaviour evidenced by [strident], [anterior], and [distributed]. Neither do other Laryngeal dependents, [voice] and [constricted glottis], display this behaviour.

30. a. [deʃidzəl] 'we shouted'
 b. [tʰeɖneʃudʒut] 'we chased it away'
 c. [xəʔeɖt'aɖ] 'I whipped myself'

In short, [strident] behaves like a coronal dependent, while the laryngeal and root dependents do not. The evidence suggests, therefore, that [strident] is properly located under the Coronal Node. Whether the presence of the Coronal Node can be accounted for on the basis of a contrast in [anterior] is irrelevant. Though this possibility is indirectly raised by Shaw herself, the most elegant analysis of Tahltan relies on placing [strident] under the Coronal Node. Finally, it should be noted that Tahltan coronal harmony is not the only process that would be difficult to explain under assumptions that [strident] is not a coronal dependent. Chapter Three provides additional examples of processes in a variety of languages showing the interaction of the feature [strident] with [anterior] and/or [distributed], and of the close connection between [strident] and a coronal place of articulation. Suffice it to say here that assuming [strident] is **not** a coronal dependent raises questions for the theory of feature geometry in general and results in less straightforward phonological accounts.

Prior to leaving the discussion of Tahitan Coronal Harmony, the problems of a dual continuant affricate analysis will be briefly considered. Specifying affricates with both continuant values does not suffice to distinguish one affricate from another in Tahitan. Given the range of coronal affricates in the language, additional features are required to distinguish one dual continuant affricate from another. For instance, the affricate [dǝ] can not be distinguished from the affricate [dž] if both are simply [-continuant] [+continuant]; another feature, in this case [+distributed] and/or [-anterior], is necessary to distinguish the two affricates. Thus, the employment of features such as [anterior] and [distributed] is not at issue, though it might be noted that as soon as these supplementary features are employed the feature [+continuant] is rendered redundant.

One might accept the necessity of using supplementary features, such as [anterior], [distributed], and [lateral], but reject the idea that [strident] is one of those features, and the idea that all the affricates of Tahitan need to be specified for both values of [continuant]. For instance the relevant segments might have the following representations:

31. Representing Tahitan Coronals without [strident]

	d	dɬ	dǝ	dz	dž
anterior					-
distributed		+	+		+
lateral		+			

Under this view, the only segments in need of disambiguation are [d] and [dz]. Differently stated, only [dz] needs to be characterized with both values for the feature [continuant]. If [dz] is [-continuant], does it need to be specified [+strident]? Perhaps [+continuant] renders [+strident] redundant, rather than the reverse. The problem with this assumption is the same as for the assumption that [strident] is not a coronal dependent, but a feature

located above the Place Node. That is to say, we must account for the fact that [dz] behaves like a segment with a coronal dependent and it does not exhibit the lack of participation that segments without coronal dependents do. Assuming that [strident] is unspecified or that it is synonymous with [+continuant] and therefore occurs above the Place Node, raises similar problems for a dual continuant affricate as for a single continuant affricate. There has to be some reason for Tahitan affricates of series 3., 4., and 5. to have a Coronal Node, under the assumption that having this node is at the heart of their ability to trigger and undergo harmony. If [+strident] is not that feature in the case of [dz] then we are led to assumptions of contrastive underspecification or Node activation, the problems of which have already been discussed. The conclusion is that the assumption of a dual continuant affricate complicates the analysis of Tahitan coronal harmony while offering no advantages. The issue is one of accounting for the patterning of segments. The best account assumes that the coronal affricate [dz] is [+strident] and that [strident] is a coronal dependent. However, this feature, like [anterior] and [distributed] makes it unnecessary to assume that affricates carry both continuant values. Because of this, the notion that any or all of the Tahitan affricates are dual continuant segments is rejected.

Abandoning the notion that affricates are defined by both values for the feature [continuant] does leave us without a means for referring to a class of all and only affricates. However, there is no reason to assume a class containing all and only affricates in Tahitan. One might, at first glance, conclude that harmony involves dual continuant segments, but the failure of lateral affricates to trigger or undergo harmony indicates the implausibility of this analysis. From the point of view of redundancy, the features [lateral], [strident], [distributed], or [anterior] are necessary, but the feature [+continuant] is not.

In the present view, if [strident] is specified, so too is the coronal place of articulation. Conversely, if place is unspecified, so is [strident]. This line of reasoning raises the possibility that [strident] may not always be specified. Yip (1991) argues that [s] is placeless in English. Let us consider

evidence of strident underspecification, keeping in mind how this reflects on the assumption of that feature's dependency on the Coronal Node. On the basis of its occurrence in consonant clusters, Yip contends that initial, medial, and final consonant clusters within the morpheme are governed by the Cluster Condition, according to which adjacent consonants are limited to a single place specification underlyingly. Thus, clusters such as -sp and -sk, in which [p] and [k] are clearly marked for place of articulation, indicate that [s], like coronals [t], [d], [n], [l], and [r], is unmarked for place at the level of UR. A disturbingly large number of monomorphemic words such as rhythm [rɪðəm], auction [akʃən], stigma [stɪgmə], asphalt [æʃfalt], etc. cast doubt on the Cluster Condition which, if incorrect, is not evidence that stridents are unspecified for place features in English. However, if the Cluster Condition is correct, and if the present assumption also holds, then we must assume that not only is place unspecified in English, so too is [strident]. In fact, there is no problem in assuming that [strident] is unspecified at UR in English. There do not seem to be any early rules that depend on its underlying specification and it is not needed to distinguish the segments of the inventory, as will be shown below. But then what about English plural formation that seems to require reference to the feature [strident]? Though later rules such as English plural formation do refer to the feature [strident], the evidence presented below in 32. suggests that by the time [strident] is present in the representation, the cluster condition is no longer in effect. Therefore, there is no problem in assuming that at the level where [strident] is a factor (which I assume is the case by the time plural formation inserts/fails to delete a schwa following a noun ending in a strident fricative), place has necessarily been assigned. Some word-level processes, which occur before or at the same level as regular inflection (depending on how many levels are assumed for English), are demonstrably unconstrained by the Cluster Condition. The letters indicating the relevant segments are underlined in the following examples:

32. Level II morphological processes

a. Compounding

- i. lunch pail
- ii. blackball
- iii. pickpocket
- iv. gumshoe

b. Suffixation

- i. kingship
- ii. improvement
- iii. depth
- iv. length
- v. sixth

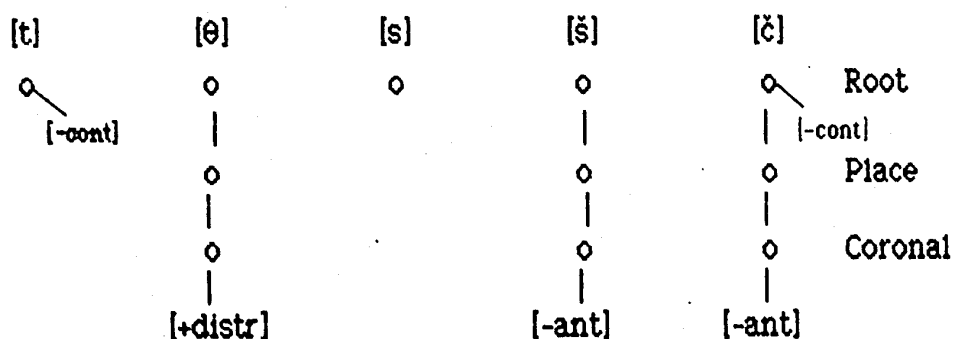
These examples indicate that, at the level at which morphemes are concatenated and internal brackets are erased, consonants with different overt place specifications freely adjoin and are deemed acceptable. However, other evidence shows that, at these same levels, the OCP exerts its influence over adjacent identical [+strident] features, showing that it is present. Words such as baths [bæθs], discussed in 3.1, rule out the possibility that adjacent Coronal Nodes are the source of the problem.

33. a. horse shoe → [ho:ʃu] *[ho:ʃʃu] vs. *[haufajʃ] 'housefire'
 b. roses → [ʃozəz] *[ʃozz]

The present view predicts that there can be no overlap between the domain of the Cluster Condition (where place specifications of [s] are absent) and the domain of sensitivity to [strident] (where place specifications of [s] are necessarily present). Though the evidence is far from conclusive, it is consistent with the view that if [strident] is specified at UR, the segment must have place.

A question raised by the possibility of underspecification of [strident] concerns the conditions under which it is underspecified. In keeping with general assumptions of radical underspecification, a feature is unspecified if it is predictable (c.f. Kiparsky, 1982; 1985; Archangeli, 1984). Consider strident predictability in the light of the English evidence. A central point of this thesis is that the segment inventory of a language provides one source of information about the appropriate representation of segments. Therefore, it is worth noting that in the inventory of English, [s] can be disambiguated from other segments even if it is underlyingly unspecified for place and [strident]. Under the assumption that [-continuant] is the value that occurs underlyingly, [t], [θ], [s], [ʃ], can be distinguished as follows:

34. Distinguishing English Coronals without [strident] Specification



In this respect, strident is predictable because it is not required to express a contrast, in this case between segments of the inventory.

It is also worth noting that the distribution of [s] in clusters is largely predictable. The first consonant of a three consonant cluster within a morpheme can only be [s]. That is tantamount to saying that the first consonant of a three consonant cluster in English is predictably [+strident]. Similarly, if the second member of a two consonant cluster is a voiceless stop, the first is predictably a voiceless coronal strident [s]. There are no two consonant clusters containing [s] in which the second member is a voiced

stop. If the second consonant is a nasal ([n] or [m]), the first consonant must be [s]. In all three of these cases, the initial consonant is predictably a [+anterior], voiceless, strident fricative. Of course, both the inventory and distributional evidence suggest that some segments may consist of nothing but an unspecified root node, the redundant values for which are predictable at least partly on the basis of syntagmatic occurrence. Because this presupposes a template in which reference may be made to such constituents as 'onset' and 'coda' this may be particularly problematic for a moraic view of the syllable. It is not a trivial problem even for views which assume roots to be attached to X-slots or unspecified C-slots. However, I leave for future investigation the interesting and important questions this possibility raises. The point to be taken from this discussion is that underspecification of strident coincides with its predictability. The specific claim is that the feature must be predictable to be underspecified. The feature [strident] is predictable in the following way: A segment unspecified for a place of articulation becomes Coronal redundantly (Paradis & Prunet, 1989; 1991; etc.). A coronal continuant (or perhaps non-occlusive) obstruent is redundantly [+strident]. These assumptions are well supported cross linguistically. As Maddieson (1984) observes, if a language has a single fricative, it is invariably coronal (dental or alveolar) and strident. Though the inventory of fricatives is language specific, such an inventory necessarily includes a coronal strident. It is further noted that assuming that [+strident] is redundantly assigned to coronal non-occlusive consonants in English works equally well for other coronal fricatives of the language [ʃ] and [ʒ]. As will be shown in the course of this thesis, in the discussion of inventories and in the discussion of processes that target fricatives and affricates, this is often the case with the [-anterior] stridents [ʃ] and [ʒ]. These sounds, though strident according to the definition set out in this thesis, often become specified as such by default.

The data presented by Yip to support the Cluster Condition do not argue that [s] is universally placeless; it may even bear place specifications in some of the six languages on which Yip draws to support the Cluster

Condition. The facts of Diola Fogny as given by Yip do not require that [s] be underlyingly placeless, since it does not occur in any of the clusters shown. Similarly, an analysis of the Japanese facts does not rest on the assumption that [s] is placeless, since in the data provided it crops up in one coda and is, in fact, part of a geminate [s] (tossa 'impulsively'). One would normally assume only a single place specification for the geminate anyway. Ito (1986) indicates that sc clusters are prohibited in Japanese, suggesting that [s] does, indeed, have place specifications in that language. In fact, cross linguistically, there is a marked lack of evidence for dental/alveolar placeless stridents and Yip's data do not argue that [strident] is universally unmarked at UR. Moreover, the data in no way suggest that [strident] may not be a Coronal dependent. Indeed, the evidence put forward by Yip underscores the relationship between [strident] and place.

A question that has been raised (Piggott, p.c.) is whether the feature [strident] might be equated with the feature [distributed]. This is a particularly intriguing possibility given the arguments that [strident] is dependent on the Coronal Node, as is [distributed] (see the discussion of this point in the following chapter). However, there are immediate and serious problems in equating [strident] with either value for [distributed]. Though stridents involve the lamina, it is cupped rather than flattened as for most distributed sounds. Therefore, [strident] can not be equivalent to [distributed] unless the latter is interpreted as a cover feature for laminal involvement, irrespective of its particular configuration. However, laminals are not necessarily strident, so the two can not be equated. The sets defined by the two features are not the same, whether phonetic or phonological criteria are applied. The feature [strident] is needed, in addition to [distributed], for classificatory reasons; some languages have dental non-strident fricatives in addition to strident fricatives. Icelandic is claimed to be such a language (Ladefoged & Maddieson, 1986). Some Chinese dialects are reported to contrast palatoalveolar and palatal fricatives, both of which are [-anterior] and [+distributed]. Such contrasts indicate that [distributed] can not make all the necessary distinctions; they also indicate that [distributed]

and [strident] are separate features. Also according to Ladefoged and Maddieson (1986), several languages of California contrast alveolar [s] with dental [ʃ]. Moreover, there is evidence in these languages that [strident] is present on the dental fricatives, independent of [distributed]: Change is reported to involve the loss of stridency, so that dental [ʃ] → [θ]. In short, a third feature, most likely [strident], is needed to distinguish the two fricatives in each of these cases. As we have seen, some languages, such as Tahitian, contrast [ts] and [tθ]. Interestingly, all languages that have the interdental affricate necessarily have the dental/alveolar affricate [ts] as well. While dispensing with the feature [strident] is not advocated in the case of Tahitian, it nonetheless seemed feasible to distinguish these two affricates without it. However, if [distributed] were equivalent to [strident] we would have to explain how, in these cases, the supposedly non-distributed segments become strident, while the distributed affricates do not. Clearly, we could not maintain the position that [distributed] is equivalent to [strident] or that stridency is simply entailed by laminality. Finally, it should be noted that, while we can not look to phonetics to justify our assumptions, there is nonetheless a clear phonetic correlate for [strident] and a clear correlate for [distributed] (see Chapter Two). However, finding a clear phonetic property shared by all the members of a combined set seems highly unlikely. A cover feature for both would necessarily be considerably more abstract. In sum, it seems safe to assume that [strident] and [distributed] are distinct features, phonetically and phonologically. While it is undoubtedly true that in some languages, one may entail the other, hence requiring the specification of only one at the level of underlying representation, each represents an independent entity that may be activated by the phonology of a language.

This seems an auspicious point to clarify claims that are not intended by the present thesis. It is claimed that only coronal affricates and fricatives can be strident. This is encoded in the dependency of the feature [strident] on the Coronal Node. This is not intended to suggest, however, that all coronal fricatives and affricates are necessarily strident, that is to say, that non-strident coronal affricates and fricatives may not occur. This would be

obviously false. For instance, there is apparently a need to distinguish between strident and non-strident coronal fricatives in Chinese (Ladefoged & Maddieson, 1986). However, non-strident coronal fricatives and affricates are relatively rare. Cross linguistically, the most commonly occurring coronal fricatives and affricates are strident (Maddieson, 1984). In a notable number of inventories the only fricatives and/or affricates that occur are strident. It is doubtless the overwhelming predominance of Coronal strident fricatives and affricates, and their commensurate common involvement in rules that has lead to the erroneous assumption that all affricates carry a feature characteristic of all fricatives. My claim is that there is no general obstruent class containing all and only affricates and fricatives.

A second point has already been raised, that is the question of whether [strident] is always specified at the level of underlying representation. The facts suggest that it is not. I do claim that [strident] is properly included in the inventory of universal features that a language may employ distinctively. I further suggest that it is a dependent of the Coronal Node, so that to be marked strident is to be marked for place features, specifically a Coronal Node. It is further suggested that the presence of dental/alveolar affricates in the inventory, which must be distinguished from homorganic stops, signals that [strident] is active in the phonology of the language. It is true that non-strident affricates, such as [tθ] and [tʃ] occur in languages; these would be instances of non-strident coronal affricates. However, as noted earlier, these non-strident affricates always occur along with strident affricates. No language has been found to contain interdental or lateral affricates, but not strident affricates. The main concern of this thesis is to demonstrate that affricatehood is not a phonological notion; affricates are underlyingly stops. However, in a significant number of inventories dental/alveolar affricates must be distinguished from homorganic stops. I claim that the appropriate feature for this task is typically [strident].

1.4.4 The Unmarked Value for [continuant]

The claim that affricates are classed as stops underlyingly is distinct from the issue of which continuant value is present underlyingly. If [-continuant] is the active value, then stops and affricates are so designated underlyingly. On the other hand, if [+continuant] is the marked value, then fricatives will be marked as such, while affricates and stops will lack a continuant specification underlyingly. Both these possibilities are consistent with the claim that affricates are classified as stops underlyingly and that affricatehood is not a phonological phenomenon. Shaw (1991) assumes that [-continuant] is the universally marked underlying value; this assumption is based largely on the fact that it provides for a straightforward analysis of Tahltan Coronal Harmony (see previous section) and for the D-effect, to be discussed shortly. The assumption of an underlyingly active [-continuant] specification likewise provides an elegant account of causative formation in Setswana and Shona (see Chapter Four). Despite the attraction of this claim, the present research does not provide unambiguous support for the universally marked status of [-continuant]. If simplicity of the analysis is the criterion by which such decisions are made, the results of the present research must be seen to suggest that the choice of an active continuant value is language specific. To demonstrate this, let us consider the Athapaskan D-effect, which provides a convincing argument that [-continuant] is the active value, and the case Modern Yucatec Maya (see Chapter Three), and Telugu, which are more simply accounted for under the assumption that [+continuant] is the active value.

The D-effect

The D-effect is the name given to a set of morphophonemic alternations exhibited by the Apachean and Northern Athabaskan languages (Richardson, 1963; Howren, 1971; Rice, 1987). Howren's summary of the changes in five languages is reproduced below:

35. The D-effect Mutations in Five Athabaskan Languages

Dogrib	Chipewyan	Sarsi	Carrier	Navaho
$d + ? \rightarrow t'$	$d + ? \rightarrow t'$	$d + ? \rightarrow t'$	$d + ? \rightarrow t'$	$d + ? \rightarrow t'$
	$d + y \rightarrow j$	$d + y \rightarrow j$	$d + y \rightarrow d$	$d + y \rightarrow d$
			$d + y \rightarrow g$	$d + y \rightarrow y'$
				$d + y \rightarrow dz$
$d + n \rightarrow d$	$d + n \rightarrow d$	$d + n \rightarrow d$	$d + n \rightarrow d^n$	$d + n \rightarrow n'$
$d + m \rightarrow b$				$d + m \rightarrow m'$
$d + l \rightarrow dl$	$d + l \rightarrow dl$	$d + l \rightarrow dl$	$d + l \rightarrow dl$	$d + l \rightarrow dl$
	$d + \delta \rightarrow d\delta$		$d + \delta \rightarrow d\delta$	
$d + z \rightarrow dz$	$d + z \rightarrow dz$	$d + z \rightarrow dz$	$d + z \rightarrow dz$	$d + z \rightarrow dz$
$d + \check{z} \rightarrow j$				
$d + \gamma \rightarrow g$	$d + \gamma \rightarrow g$	$d + \gamma \rightarrow g$	$d + \gamma \rightarrow g$	$d + \gamma \rightarrow g$
			$d + \gamma^\omega \rightarrow g^\omega$	

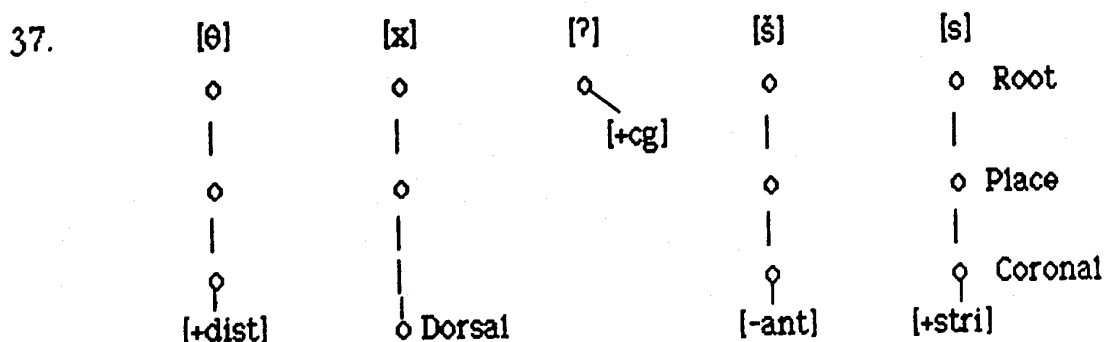
The effects are similar for Slave, discussed by Rice (1987) and for Tahltan (Shaw, 1991). The latter will serve as an example here:

36. A Summary of the D-Effect in Tahltan

- | | |
|---------------------------|-------------------------------------|
| a. $d + l \rightarrow dl$ | d. $d + \theta \rightarrow d\delta$ |
| b. $d + x \rightarrow g$ | e. $d + ? \rightarrow t'$ |
| c. $d + s \rightarrow dz$ | f. $d + \check{s} \rightarrow j$ |

A maximally simple account can be achieved under assumptions of radical underspecification and the following structures for the relevant segments. Let us further assume, as suggested for Slave by Rice (1987), that the

voiceless stops are underlyingly ejective or aspirated, and that voicing is a default value, supplied in the absence of a specification for aspiration or constricted glottis.



Rice and Shaw assume that the 'd' classifier consists of a floating [-continuant] specification. Differences between the two positions stem partly from divergent assumptions about the characterization of segments underlyingly. Rice considers fricatives underlyingly marked as [+continuant] and stops as unmarked for [continuant]; they receive their [-continuant] value by default. Her assumptions about Radical Underspecification make it impossible to grant the 'd' classifier full segment status (as manifested in an organizing Root Node) and a [-continuant] specification while other stops at the same level of lexical operations are unmarked for [-continuant] and fricatives bear a contrasting [+continuant]. Rice is also restricted by her assumption that affricates are contour segments. Accounting for the D-effect therefore becomes a problem of bringing both continuant values together (in the correct order) during the course of the derivation. This requires the invocation of negative configurationality constraints, an important one of which rules out non-coronal branching segments. However, this constraint refers to [-coronal], an option unavailable under the commonly held assumption (but see Cho, 1991, for an opposing view) that place nodes, such as Labial, Coronal, and Dorsal are privative features and the assumption of Radical Underspecification that a rule can not refer to the absence of a

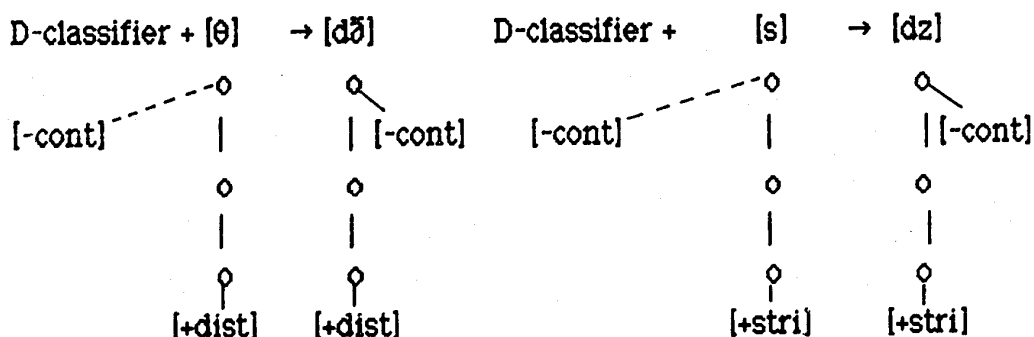
feature (Kiparsky, 1982, 1985; Archangeli, 1984; Archangeli & Pulleyblank, 1986, etc.).

On the other hand, Shaw regards [-continuant] as the active value throughout; stops and affricates are [-continuant] underlyingly, while fricatives are unmarked for continuancy and receive a [+continuant] specification by default. The 'd' classifier, like the stops in the inventory, relies on the notion of an active or marked [-continuant]. Consider the following representations of two derivations:

38.

a.

b.



Now let us address the possibility that [+continuant] is underlyingly specified, within the current assumptions of Radical Underspecification and the assumption that affricates are stops. To simplify the analysis, let us assume that the D-classifier is a segment, rather than a floating feature. If [d] were unmarked for [continuant], not only would the stophood of the resulting segments be unaccounted for, the mutations would be difficult to explain in any coherent manner. For instance, one might assume that in a case such as $d + ? \rightarrow t^?$ the stophood of the resulting segment results from the application of the redundancy rules supplying a default [-continuant] specification. However, in a mutation such as $d + \gamma \rightarrow g$, one is required to account additionally for the loss of the putatively marked [+continuant] specification of the velar fricative. Another alternative might account for a

(acquired, presumably, by default) is added to the existing [-continuant] specification, unlike what happens in the derivation $d + \gamma \rightarrow g$. The assumption of a dual continuant affricate, like the assumption that [+continuant] is underlyingly marked, leads to an unnecessary complication of the analysis of the D-effect. The most straightforward and compelling account assumes that [-continuant] is underlying marked on stops and affricates and that [+continuant] is unspecified at the level of underlying representation.

The Cases of Telugu Assimilation and Modern Yucatec Maya

One case that is argued to be more simply explained under the assumption that [+continuant] is the specified value is Telugu. In Telugu (Gilbert, 1992), a placeless dental stop assimilates to a following retroflex stop, a following fricative, or a following affricate. Vowel deletion is presumed to occur prior to assimilation, but this is not discussed. The relevant processes are illustrated in the following data.

- 39 a. $a\dot{d}i$ 'that' + $\dot{d}abba$ 'can' $\rightarrow$ $a\dot{d}\dot{d}abba$ 'that is a can'
 b. $pa:\dot{t}a$ 'old' + $\dot{t}e:bi\dot{l}u$ 'table' $\rightarrow$ $pa:\dot{t}\dot{t}e:bi\dot{l}u$ 'old table'
 c. $a\dot{d}i$ 'that' + $sarip$ 'to be sufficient' $\rightarrow$ $assaripo:yin\dot{d}i$ 'that was sufficient'
 d. $pa:\dot{t}a$ 'old' + $saruku$ 'stuff' $\rightarrow$ $pa:ssaruku$ 'old stuff'
 e. $ko:\dot{t}i$ 'monkey' + $\dot{c}eppin\dot{d}i$ 'told' $\rightarrow$ $ko:\dot{c}\dot{c}epin\dot{d}i$ 'the monkey told'
 f. $a\dot{d}i$ 'that' + $\dot{j}aringin\dot{d}i$ 'moved' $\rightarrow$ $a\dot{j}\dot{j}aringin\dot{d}i$ 'that moved'

Normally, the placeless stop must precede, and there is evidence that the affricates [č, j] are usually treated as segments with place that do not assimilate to a following retroflex. This is shown in g. - i. below.

- g. $va:\dot{d}i$ 'him' + $\dot{d}aggara$ 'near' $\rightarrow$ $va:\dot{d}\dot{d}aggara$ 'near him'
 h. $va:\dot{d}i$ 'him' + $sabbu$ 'soap' $\rightarrow$ $va:\dot{d}sabbu$ 'his soap'
 i. $ga:\dot{j}u$ 'glass' + $\dot{t}e:bi\dot{l}u$ 'table' $\rightarrow$ $ga:\dot{j}\dot{t}e:bi\dot{l}u$ 'glass table'

Gilbert uses the data to argue that the affricate is best considered a stop in Telugu, rather than a complex or contour segment. His argument is based primarily on the fact that affricates do not trigger spirantization, nor are affricates created in the process of spirantization. The details of those arguments are not included here, but I would like to point out that the inventory of Telugu (cf. Krishnamurti, 1956; Krishnamurti & Gwynn, 1985; Gilbert, 1992) also leads to the conclusion that the affricates are stops underlyingly. According to the criteria set out in Chapter Two, Telugu has a Type AI inventory in which the affricates and stops are in complementary distribution. This argument forms the focus of Chapter Two and will not be further discussed here, except to point out Telugu's conformity to the observed patterns of distribution of affricates in segment inventories.

40. The Obstruents of Telugu

	Labial		Dental		Palatal	Retroflex		Velar
Stops	p	b	t̪	d̪		ʈ	ɖ	k g
Affricates					ɕ ʝ			
Fricatives				s		ʂ		

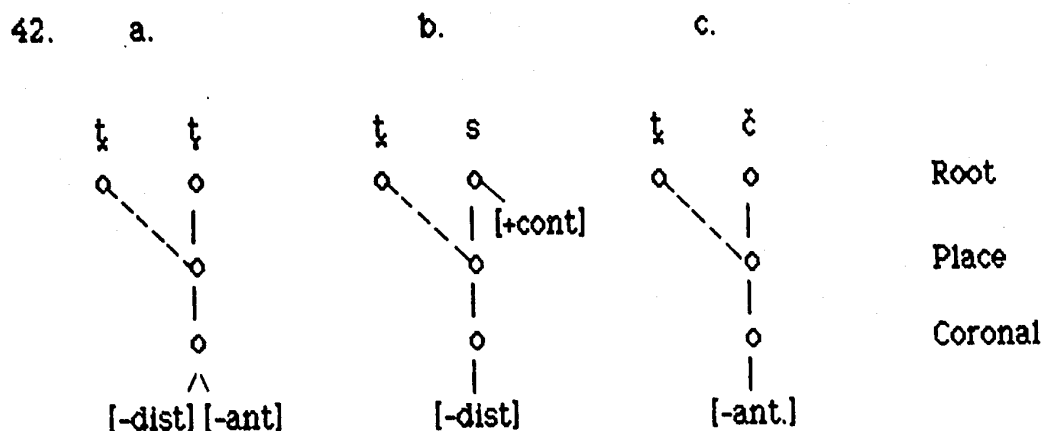
Where affricates are in complementary distribution with stops, there is no need to assume that they are characterized by the feature(s) of a distinct obstruent class. They may be considered stops and distinguished by their place of articulation. Note that the stops are dental, that is to say [+distributed], but the fact that such stops consistently assimilate, when stops with place specifications do not, suggests that [+distributed] is unmarked at

the level of underlying representation. This is consistent with the assumption made by other researchers that dental is normally the unmarked place of articulation (Cho, 1991; Paradis & Prunet, 1991). Where this is true, [-distributed] segments are assumed to be so specified at UR. That means that [s] and the retroflex stops [ʈ] and [ɖ] are underlyingly [-distributed]. Some support for this comes from the transformation of the word [t̪e: bilu] (see 39 i.), which is obviously borrowed from English 'table'. The English stop [t] is alveolar, therefore, [-distributed]. In Telugu, [-distributed] stops are [-anterior]; there are no [+anterior] [-distributed] stops. Thus, English [t] → [t̪] in loan words. By the same reasoning, the dental stops are considered to be unmarked for the feature [anterior], and [-anterior] is considered to be underlyingly marked. The retroflexes and the palatal affricates are assumed to be [-anterior]. Both the dental stops and palatal affricates become [+distributed] by default. The relevant segments are characterized as follows:

4.1. The Representation of Telugu Coronals

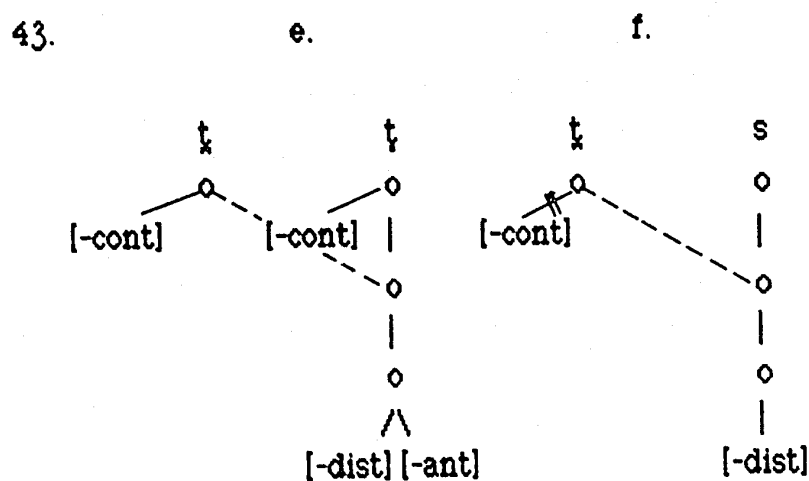
a.	b.	c.	d.	
t̪	s	ʈ	t̪	
o	o	o	o	Root
	[+cont]			
	o	o	o	Place
	o	o	o	Coronal
			^	
	[-dist]		[-dist] \	
		[-ant]	[-ant]	

The assimilations illustrated by the Telugu data involve place assimilation as follows:



These assumptions permit a straightforward analysis, provided [+continuant] is assumed to be the marked continuant value. A placeless dental stop assimilates in place to a following segment with a specified coronal place of articulation.

In contrast, assuming that [-continuant] is the active value requires [-continuant] delinking to account for the fact that in cases such as b. the result of assimilation is not an affricate. The complications of the [-continuant] analysis are illustrated here as a point of comparison.



Example f. shows [t̥] assimilating in place to a following [s], unmarked for the feature [continuant]. To explain the fact that the resulting cluster would be [ss] (see 39 d.), [-continuant] must delink and a default [+continuant] be supplied. The fact that [-continuant] is consistently required to delink means that a [+continuant] analysis is simpler. Under the view that [-cont] is marked, the rule is feature changing and the fact that it applies to dentals seems arbitrary. There is no reason that a resulting [ts] should not be permitted.

One might argue that Telugu does not provide a particularly strong case for an underlyingly marked [+continuant], in view of the fact that the assimilations might feasibly be regarded as a case of root spread, rather than place assimilation or coronal spread. However, that analysis can not easily explain why [t̥] and [ɖ] are the only targets of assimilation. One might hypothesize that [t̥] lacks even a Root Node underlyingly and that it is, in fact, some kind of default consonant that surfaces when features are not otherwise provided, as for example by Root Node spread from an adjacent consonant. The same argument can not be made for [ɖ], which is specified for [voice] and which must have a Root Node, under the assumption that the presence of a feature implies the presence of all nodes dominating that feature. If Telugu involves Root Node spread, then when [ɖ] is the target, its [+voice] specification (at least) must be delinked, as evidenced by example 39c. (aɖi 'that' + sarip 'to be sufficient' → assaripo:yinɖi 'that was sufficient'). Like the assumption that [-continuant] is underlyingly marked, this would make the rule feature changing. If the rule is feature changing, then it is unclear why [t̥] and [ɖ] are singled out as targets.

The case of Modern Yucatec Maya also presents a challenge to the view that [-continuant] is the universally specified underlying continuant value. In the Modern Yucatec Maya case, the crux of the problem is that if [-continuant] is assumed to be specified, it must be exempt from the OCP, unlike other active features of the language such as [+strident], [+constricted glottis], and [+round]. Alternatively, one might assume that two segments may share a single [-continuant] specification, though the sharing of other

features is prohibited in Modern Yucatec. Except with the possible exception of [-continuant], if one feature is shared, so are all others, resulting in a single feature hierarchy being linked to two timing slots. It is obviously undesirable to assume, without independent evidence, that one particular feature is exempted from general restrictions on other features, for no apparent reason. The Modern Yucatec Maya case is discussed at length in Chapter Three. The simplicity metric suggests that [-continuant] is unmarked at the level of underlying representation in this language. In the face of evidence that assuming [-continuant] is the active underlying continuant value complicates the analysis of facts in at least two languages, Telugu and Modern Yucatec, it is assumed that the choice of active continuant value is language specific, rather than being universally determined.

Chapter Two

The Distribution of Affricates in Inventories

The purpose of this chapter is to demonstrate that affricates exhibit a distributional property that has not yet been sufficiently investigated and for which current theories do not account. I refer to this property as Stop-Affricate Dependency (SAD). In inventories where both a stop and an affricate occur at a given place of articulation, and where the two sounds contrast in the language, there is at least one feature, besides the feature(s) responsible for distinguishing the class of stops from the putative class of affricates, to distinguish the affricate from the stop. Where such a feature is not invoked or is unavailable (because the particular language does not employ a feature that might be so used) the place distribution of affricates in the inventory is dependent on the distribution of stops. What this means is that, in a large number of inventories, affricates and stops are in complementary distribution with respect to place of articulation. This is not expected behaviour for a segment that belongs to a distinct class, distinguished by a unique feature, such as [delayed release] or by a unique feature complex, such as both values for the feature [continuant]. However, this behavioural property is expected if affricates are indistinguishable from stops on the basis of manner features. Specifically, if an affricate is characterized as [-continuant] underlyingly, as are other stops, then it is expected that affricates must be distinguished from stops by some other feature(s) such as laryngeal features or those characterizing place of articulation. The assumption that the entire range of affricates is characterized only as stops further implies that there is no way of specifying a general segment class containing all and only affricates. This view receives support to the extent that the distribution of affricates is demonstrably dependent on the distribution of other stops in the inventory and to the extent that there is another feature, besides a feature of affricatehood, to

distinguish stops and affricates at a single place of articulation. Inventories in which affricates and stops are apparently independently distributed, such as seems to be the case when stops and affricates are identical except for the fact that one segment is an affricate, the other a stop, present a challenge to the claim that affricates are stops underlyingly. It is my intention to reconcile the proposal that affricates are stops underlyingly with the significant class of apparent counterexamples. In demonstrating that affricates are stops underlyingly and that their distribution in an inventory is dependent on the distribution of stops, the further point is made that the distribution of segments in the inventory reveals something about the featural makeup of those segments and that, because of this, an inventory provides a valuable source of evidence about the internal structure of the segments of a language.

The inventories considered in this investigation are mainly, though not exclusively, those presented in Maddieson (1984). This source was selected because it provides a data base of phoneme inventories that attempts to be 'representative, extensive, and uniform in analysis as far as possible' (Maddieson, p. 3). Three of the inventories provided there have been disregarded because they contain a large number of clicks, including affricated clicks, whose properties are largely unexplored. Many questions about these sounds remain unanswered and it is not always clear where the division between affricate and click lies, so the click languages in Maddieson's inventory have been omitted. These include Zulu, Nama, and Iku. The inventories of languages that have presented themselves in the course of this research, but which are not in Maddieson's sample, are also considered. These include Setswana and Tahitian among others. Significantly, such languages came to be considered because they appear to present a particular challenge to the Stop Affricate Dependency hypothesis. In total, 322 inventories have been considered. Three main surface patterns, two of which are further divided into two subpatterns, are exhibited by the inventories. These are presented in Appendices 1, 2, 3, and 4. The first main pattern (A) contains those inventories in which affricates are in

complementary distribution with stops with respect to place of articulation. Complementary distribution between stops and affricates with respect to place of articulation is accidental under an account that assumes a class containing all and only affricates. Yet such inventories account for almost half of the inventories studied. This group of inventories is further subcategorized into two subgroups, designated AI and AII. In AI there is overlap between affricates and fricatives with respect to place of articulation, though it may not occur at each place where there is an affricate. Subpattern AII shows affricates in complementary distribution with both stops and fricatives with respect to place of articulation; at places of articulation where affricates occur, there are neither stops nor fricatives. This distinction between AI and AII is drawn in order to determine whether affricates can be claimed to be stops universally, or whether they may be otherwise specified in some language. It is subsequently shown that there is no need to distinguish between these two groups. The relevant point in both cases is that affricates are in complementary distribution with stops with respect to place of articulation.

The second main pattern (B) contains inventories which have at least one stop and affricate with the same place of articulation. This category is accounted for under the assumption that affricates comprise a distinct class of segments and, of course, it is this group of inventories that suggests that the distribution of affricates in an inventory is independent of the distribution of stops in an inventory. For this reason, the Type B inventories are the focus of the ensuing discussion. This group of inventories is divided into two subcategories. The first subcategory (BI) considers inventories where the lack of a place distinction between stop and affricate occurs only in the alveolar/dental region. That is to say, these inventories have both dental/alveolar stops and affricates. Assuming that this overlap justifies the need to distinguish a class of affricates from the class of stops overlooks the fact that there is another feature, ([strident]), available to distinguish the two. In other words, dental/alveolar affricates are nearly always strident stops. In a few cases a language has lateral and/or interdental affricates, in

addition to the much more usual strident stops. Lateral affricates are discussed only briefly, in the context of discussion of the inventories in which they occur. Though they are not a focus of discussion, they serve to demonstrate the general point that there is another feature, besides a specific affricate feature/feature complex to distinguish a homorganic stop and affricate. Much of this thesis seeks to demonstrate the independent need for the feature [strident], even under the assumption of a distinct affricate class.

The second subcategory of inventories (B11) shows overlap between stops and affricates at places other than the alveolar/dental, though that may occur as well. The inventories in this group are those containing labial, palatal, and/or velar affricates. These inventories are of interest because, under the assumptions made here, the feature [strident] is unavailable to distinguish affricates from stops at non-coronal places of articulation. The third main category of inventories, (C), includes those inventories without affricates. This category is included only for the sake of completeness; there is no further discussion of Type C inventories.

In classifying languages into the various patterns, there were a large number of ambiguities concerning potential place distinctions. These ambiguities were resolved in a manner deemed least biased in favour of the present proposal. For instance, no distinction is made between the dental and alveolar place of articulation, or the alveopalatal and palatal, unless there is strong independent evidence for such distinctions in a given language. The frequent reference to alveolar/dental and (alveo)palatal is meant to reflect the fact that no distinction is being made between alveolar and dental, or between alveopalatal and palatal. Even if a language is claimed to have dental stops but alveolar affricates, or palatal stops but alveopalatal affricates, the stops and affricates are still considered to be homorganic for purposes of classifying the languages as Type A or B. Though distinctions between the dental and alveolar, or between the alveopalatal and palatal, are clearly possible, languages are assumed to base a phonological distinction on such small place differences only rarely. It is, therefore,

imprudent to assume a fine place distinction is being made (phonologically) between stops and affricates without robust phonological evidence to that effect. Similarly, potential place distinctions between the labial stop and labiodental affricate are disregarded for the purpose of classifying the languages. However, this distinction, in particular, is subject to extensive subsequent discussion and reconsideration.

Other, less generalizable ambiguities also arose, but they have been resolved on an individual basis. For instance, Osmanli is claimed to have both alveopalatal affricates and palatal stops, suggesting that it is a Type BII inventory. However, the palatal stops are claimed to occur only in unassimilated loan words, so they are disregarded as segments of the inventory, leading to Osmanli's classification as Type A, where affricates are in complementary distribution with stops. Individual treatment was required in only three or four instances, so it should not affect the general picture. Though care has been taken to be consistent with the available facts, the goal of classification and the presentation of the numbers of inventories of each type is not statistical rigour, but a clearer picture of how affricates pattern in inventories. The question at the heart of this facet of the investigation into the internal structure of affricates is whether or not we need to appeal to the notion of a distinct affricate class in order to distinguish the affricates in an inventory. Also at issue is what the assumption that affricates are stops underlyingly implies about the representation of other obstruents, particularly stops, in a given language.

The numbers and percentages of languages falling within each category are summarized in the following tables:

1. Number of inventories of each type

A		B		C
I	II	I	II	
COMP. DISTR. WITH STOPS	COMP. DISTR. WITH STOPS & FRICATIVES	DENT/ALV OVERLAP	OTHER OVERLAP	NO AFFRS.
62	32	113	21	94

2. Percentage of inventories of each type

A		B		C
I	II	I	II	
COMP. DISTR. WITH STOPS	COMP. DISTR. WITH STOPS & FRICATIVES	DENT/ALV OVERLAP	OTHER OVERLAP	NO AFFRS.
19.3 %	10 %	35 %	6.5 %	29 %

If inventories without affricates are excluded, the total number of considered inventories is reduced to 228. The percentage of inventories of each of the remaining types is then as follows:

3. Percentage of inventories of each type (affricate containing inventories only)

A		B	
I	II	I	II
COMP. DISTR. WITH STOPS	COMP. DISTR. WITH STOPS & FRICATIVES	DENT/ALV OVERLAP	OTHER OVERLAP
27 %	14 %	49.5 %	9 %

2.1 Group AI: Affricates in Complementary Distribution with Stops

As shown in 3., almost a third of the inventories considered fall into the AI category. In these inventories, affricates occur at places of articulation where stops do not. However, this generalization reveals little about the true nature of the distribution of stops and affricates in these inventories. It is more accurate to say of all but one of the inventories: The affricates are (alveo)palatal. The one inventory that is not included in this generalization is Wolof, which has palatal stops, but in which the affricate is uvular. This general pattern suggests that the affricate is best considered a stop, phonologically. Stops articulated in the postalveolar region tend to be laminal; laminality is intimately linked to affrication, a fact discussed by Ladefoged & Maddieson (1986). Thus, affrication can be regarded as a

phonetic byproduct of a stop's (alveo)palatal place of articulation. Lending further credence to the notion that these affricates are stops underlyingly is the fact that, in the majority of cases, (45 out of 62 or 72.5%), the affricates parallel the stops at other places of articulation in other respects. For instance, if the stops include a voiced and voiceless member, the (alveo)palatal affricates include a voiced and voiceless member. In many inventories the parallel is quite striking. In Washkuk, for example, the voiced affricate is prenasalized, as are all other voiced stops. In Guajiro, stops are plain or preaspirated, as are the (alveo)palatal affricates. Yana has aspirated, glottalized and plain-voiced alveopalatal affricates that parallel stops at other points of articulation.

In the remaining cases, the affricate is somehow different from stops at other points of articulation. I have not explored the range of variation that may occur between the alveopalatal affricate and stops at other points of articulation, so no explanations can be offered. However, a cursory review of the differences suggests that some, at least, may be phonologically interesting and phonetically explicable. For instance, in several inventories, including Irish, Farsi, Osmanli, Akan, Luo, Somali, and Wapishana, the voiceless stops are claimed to be aspirated whereas the voiceless affricate is not (e.g. p^h , t^h , k^h , vs. $\check{c}$). It seems as though affrication replaces aspiration in the (alveo)palatal region. Moreover, the absence of a contrast between unaspirated and aspirated stops in such inventories suggests that it is not necessary to encode aspiration in the phonological representation of the stops. A study of the phonologies of these languages is needed to confirm or disconfirm this idea. If confirmed, it would further suggest that affrication, like aspiration in these cases, is a phonetic rather than a phonological concern.

2.2 AII: Affricates in Complementary Distribution with Stops and Fricatives

In these inventories, there are neither stops nor fricatives at places where there are affricates. The focus of this section is whether the distribution of affricates may be dependent on the distribution of fricatives in these inventories and, if so, what the implications are for the representation of the affricate. A closer look at the nature of these inventories suggests that the absence of fricatives with the same place of articulation as the affricate is accidental and should not be considered in relation to the affricate's representation. The tables above indicate that a fairly small percentage of the inventories considered fall into this category. Only 14% of the affricate containing inventories display affricates in complementary distribution with both stops and fricatives with respect to place of articulation. All but two of the inventories of this group are covered by the generalization that the alveopalatal is realized as an affricate. In the remaining two inventories the affricate is palatal, rather than alveopalatal. In three-quarters of these inventories the affricate parallels the stops; that is to say, if the stops include a voiceless and a voiced member, so does the affricate.⁶ These facts suggest that in these inventories, as in those of the previous category, the (alveo)palatal stop is realized as an affricate and that affrication itself is a phonetic, rather than a phonological, feature of these sounds. These inventories, along with those of AI, indicate that the affricate is a stop underlyingly

Disregarding the absence of homorganic fricatives in AII inventories appears even more reasonable when we consider the fact that about three quarters of the inventories in this category have fricatives at three or fewer places of articulation. In other words, the lack of overlap between fricatives and the single affricate of these inventories appears to have more to do with

⁶ In the simplest case, when there is a voicing contrast, there may be voiced and voiceless fricatives as well as voiced and voiceless affricates. However, there are no striking symmetries between fricatives and affricates, such as those involving prenasalization. Neither are there cases in which the affricate parallels the fricatives, but not the stops with respect to features such as voicing, aspiration, etc.

a general paucity of fricatives and affricates than with any potential problem in distinguishing homorganic affricates and fricatives. The fewer fricatives and affricates there are in an inventory, the less likelihood there is that both will occur at a particular place of articulation. Moreover, there is some asymmetry between the places of articulation favoured by affricates and those favoured by fricatives. A single affricate is overwhelmingly likely to be (alveo)palatal, but a single fricative is almost always dental/alveolar. If the inventory has two fricatives, the second is more likely to be labiodental than alveopalatal. The alveopalatal normally emerges when an inventory has fricatives at three places of articulation (Maddieson, 1984). However, this is not highly predictable. Maddieson's figures indicate that, although [ʃ] is very common, it occurs in only 37% of the languages with between two and four fricatives. I therefore conclude that the complementary distribution of affricates and fricatives should not be considered in determining an appropriate affricate representation; these inventories pose no threat to the view that affricates are stops underlyingly.

2.3 B1: Overlap Between Dental/Alveolar Stops and Affricates

Within the four patterns of affricate containing inventories, the largest subcategory consists of inventories in which there is overlap between stops and affricates, but only at the alveolar/dental place of articulation. To reiterate, this is a category that seems to justify the traditional assumption that affricates are distinct from stops on the basis of some kind of manner distinction, such as [delayed release] or both values of the feature [continuant]. It is also a category that is apparently problematic for the view that affricates are simply stops underlyingly and that they are in complementary distribution with stops in the inventory. However, this group of inventories, though large, still encompasses only half the data. Even when B 11 (in which overlap between stops and affricates occurs at places of articulation other than alveolar/dental) is included, barely over half the

data is accounted for. Inventories AI and AII, where the affricate is in complementary distribution with stops with respect to place of articulation, constitute 41 % of the data. Yet they are unexplained by prevailing affricate theories.

The present proposal is that alveolar/dental affricates, [ts] and [dz], are strident stops, that is to say, they are underlyingly distinguished from the alveolar/dental stops by the feature [+strident]. This allows us to account for the largest class of apparent counterexamples to the notion that the distribution of affricates in an inventory is dependent on the distribution of stops. It allows us to maintain the claim that affricates are simply stops underlyingly. Two objections to this view are most likely. The first is that calling dental/alveolar affricates strident stops does not account for non-strident affricates, such as [tʃ]. This objection presupposes that there is a class of segments containing all and only affricates. Those who objected to a similar proposal by JFH (1952) (e.g. SPE; Lombardi, 1991) did not claim that [ts] and [tʃ] are poorly characterized as strident stops. Rather, they objected because not all possible affricates could be reasonably characterized as strident stops and they assumed that some kind of universal characterization of affricates was required. The complete lack of rules involving both strident and non-strident affricates, to the exclusion of stops and fricatives, indicates that such an assumption is unwarranted. My response to the objection is, therefore, that the features [-continuant] and [+strident] are not intended to characterize all possible affricates. However, the most commonly occurring affricates, [ts] and [tʃ], may justifiably be described as such.

The second kind of objection quite rightly calls for independent justification for the feature [strident]. In other words, it is necessary to demonstrate that [strident] is required even if one assumes that affricates are somehow characterized as a distinct class. For instance, if it is necessary to assume that [ts] is [+strident], independent of being [+delayed release] or [-continuant] [+continuant], then [strident] can be assumed to be independently motivated. In fact, a closer consideration of rules that show affricates patterning with fricatives in a variety of languages (see Chapter

Three) indicates that this is the case. However, because this is the subject of extensive discussion elsewhere in the thesis, I will not consider in any detail the case for the feature [strident] at this point. Suffice it to say here that the rules just referred to require the feature [strident], even though they are rooted in the assumption that it is necessary to characterize a natural class that includes all affricates and fricatives, and even though different mechanisms are used to capture that assumption. For instance, SPE extended the feature [delayed release] to fricatives to capture a natural class of affricates and fricatives, but accurate reflection of the facts of English plural formation still require reference to the feature [strident]. Of course, given the cool reception that [delayed release] received, it is not surprising that its even less well motivated extension to fricatives (Anderson, 1974) was controversial from the outset. Nonetheless, it is important to realize that objections focused not on whether the assumption that affricates and fricatives shared a common feature was justified, but on whether SPE was able to capture that common ground adequately. The advent of autosegmental phonology, which permitted the affricate to be simultaneously linked to two matrices, and thus to two different continuant values, seemed to solve the delayed release problem rather elegantly. Thus, the predominant current view is that affricates and fricatives form a natural class by virtue of the fact that both are [+continuant]. However, assuming that affricates and fricatives are united in the class of [+continuant] segments does not obviate the need for the feature [strident] in the expression of rules like English plural formation. Moreover, to my knowledge, no one has demonstrated that any but a select few of the possible affricates and fricatives pattern together. Those few are invariably [s], [ʃ], [ts], and [tʃ], those affricates and fricatives that are claimed here to be stridents. In fact, the stridency of these segments must be taken into account under the contour affricate theory anyway to distinguish them from other affricates and fricatives. The reanalysis of the aforementioned rules suggests that the affricates and fricatives in question pattern together by virtue of the fact that both are [+strident] and that the rules are profitably rephrased in these

terms. In some cases, (for instance, English plural formation) the rules can not be simply and adequately stated without appealing to the feature [strident]. The net result of the reanalysis is to show that, with respect to rules that treat affricates and fricatives as a natural class, the affricate's putative [+continuant] feature is redundant, whereas [strident] is not.

Of course, if an affricate is characterized as [+strident], then it is potentially distinguishable from a homorganic stop by virtue of this feature. The alveolar/dental stop is [-continuant], whereas the dental/alveolar affricate is [-continuant] [+strident]. There is no need to assume a continuancy distinction between stops and affricates to differentiate the stop from the affricate because an independently motivated [+strident] distinguishes them. Within the framework of assumptions made here, [strident] is available to distinguish between only coronal stops and affricates, but this succeeds in accounting for the largest body of apparent counterexamples to the claim that affricates are [-continuant] stops underlyingly. If [strident] is justifiably invoked, then the claim that affricates are stops can be straightforwardly extended to over ninety percent (90%) of the inventories considered.

2.4 BII: Stop and Affricate Overlap at Other Points of Articulation

While the problem of dental/alveolar overlap between stops and fricatives may be resolved by appealing to the feature [strident], overlap at other points of articulation can not be handled in this way. Cases of labial, velar, and uvular overlap contained in the inventories of BII stand as apparent counterexamples to the claim that affricates do not need to be characterized as a distinct segment class.

In explaining these apparent counterexamples, the following points need to be raised. First of all, such cases represent less than 10% of the total number of inventories considered. While this body of data can not be rejected out of hand, it is obviously theoretically undesirable to assume, as a

matter of course, a representation for all affricates that is required by only a small percentage of them. To represent affricates with both values for the feature [continuant] predicts that their distribution in inventories should be independent of the distribution of stops, a prediction that is incorrect in up to 90% of segment inventories. The second point to be raised is that it is by no means certain that even these few counterexamples to the present proposal **require** the assumption of a distinct affricate class. This point will be discussed in some depth.

To be a counterexample to the proposal, a homorganic stop and affricate must be distinct phonemes. This is considered rare for labial, palatal, and velar stops and affricate pairs, even among those who presume that affricates and stops belong to separate classes of obstruents. If a homorganic stop and affricate are found to be in complementary distribution, a distinct underlying representation for each is not an issue. It is not clear how many of the twenty-one counterexample languages are affected by this possibility, but the facts of Setswana, particularly, suggest that it is a possibility worth exploring. In Setswana, the velar affricate and stop are actually in a traditionally conceived relation of complementary distribution. One occurs before front vowels, the other elsewhere. The case of German is different in a significant way, but there, too, the labial affricate and labial stop may be seen to be in a kind of complementary distribution. In German, there are very few words distinguished on the basis of [p] versus [pf], raising the possibility that German may not need to distinguish underlyingly between the labial stop [p] and the labiodental affricate [pf]. Whether a word is articulated with a stop or an affricate in German is an indication of its origin (Vennemann, 1969). In Old High German there was a split of the /p/ phoneme into three allophones, [p], [pf], [f]. The affricate and fricative phonemicized relatively soon after (Keller, 1978). It is not clear that [p] and [pf] have done so, even though some words entering the language at a later stage do not respect the original boundaries of [p] and [pf] distribution. One might say that [pf] occurs in a particular environment in words of origin X, while [p] occurs elsewhere. The pronunciation of some

words with [p] and others with [pf] may thus be a historical accident that neither requires nor justifies the assumption of a distinct underlying representation for the labial stop and affricate. If the labial stop and affricate have a single underlying representation, the prediction is that new words can not be coined with [pf] that contrast with existing words containing [p]. The reason cited (by several native German speakers consulted) for the rarity of minimal pairs of this nature is that [pf] historically evolved from [p]. However, one can argue that in some Latin-based vocabulary of English [f] evolved from [p] (cf. Latin pisces vs. English fish). Nonetheless, the two sounds are clearly distinct phonemes of English, as evidenced by an abundance of such minimal pairs as fall-pail, full-pull, fair-pair, laugh-lap. Therefore, the simple fact that one sound evolved from another does not prevent them from being separate phonemes of the language. Other factors must be involved. The present suggestion is that [p] and [pf] have a single underlying representation in German. Those words that are realized phonetically with [pf] (or [p]) may carry a lexical specification that is used postlexically to determine which allophone will be employed. While the absence of minimal pairs is by no means conclusive proof that two sounds do not constitute separate phonemes, and while lexical marking is not the most appealing possibility, it is one that can not be rejected without consideration.

There are, however, more likely explanations for German [pf]. One possibility is that [pf] is not an affricate, but a cluster. Traditional German grammars tend to present [ts] and [pf] as affricates, but linguistic treatments at least acknowledge that there are strong arguments for concluding that [pf] is synchronically a cluster, akin to [ps], rather than an affricate (Moulton, 1962; Keller, 1978). In fact, both Moulton and Keller conclude that [pf] is a cluster. First of all, [pf] is considered an affricate mainly by analogy to [ts]. That is to say, because [ts] seems to be an affricate, it is assumed that [pf] is as well. However, the case for even [ts] being an affricate is vulnerable. Apparently, [ts] can occur before [v], whereas other clusters can not. However, only [ts], [k] and [g] occur before [v], so this is a weak case for the

affricate status of [ts]. If Keller and Moulton are correct, then German does not in fact contrast [p] and [pf] any more than English contrasts [s] and [sp] (e.g. *sit* vs. *sput*). The net result of this discussion has been to cast serious doubt on the assumption that [p] and [pf] are distinct phonemes in German and, consequently, on the assumption that German presents a counterexample to the claims of this thesis.

To be a counterexample to the proposal that affricates are stops, a stop and affricate must be truly homorganic. At least, their place differences must be phonologically irrelevant. The classification of affricate containing inventories was carried out under the commonly held assumption that no place distinction between labials and labiodentals or between alveopalatals and palatals is phonologically possible. To understand better the weakness of this assumption and how it relates to this problematic group of languages, consider the following points about the alveopalatal/palatal distinction. The categorization of ten languages (Angas, Azerbaijani, Margi, Muinane, Haida, Hupa, Acoma, Jaqaru, Zoque, and Basque) as counterexamples to the proposal rests on the assumption that there is no distinction between the alveopalatal and palatal places of articulation in the language. My first objection is that even if this is true, alveopalatals are coronal segments, so it is possible to distinguish alveopalatal affricates from palatal stops with the feature [strident], even if a place distinction, *per se*, is not drawn between an alveopalatal and a palatal place of articulation. Six of the ten potentially affected inventories, that is well over a quarter of the entire body of counterexamples in BII, have dental/alveolar affricates in addition to the alveopalatal, indicating that [+strident] is active in the inventory. Therefore, the possibility that [+strident] may create the necessary distinction between a (non-strident) palatal stop and a [+strident] alveopalatal affricate should seriously be considered. This possibility alone could remove ten languages from the list of twenty-one counterexamples.

Even if [+strident] is not used to distinguish the alveopalatal affricate from the palatal stop, there remains the possibility of a place distinction, *per se*, between alveopalatals and palatals. The existence of a palatal stop and a

contrastive alveopalatal affricate may actually be evidence for a distinction between the palatal and alveopalatal place of articulation. Of course, given the focus of the investigation, this is preferably not assumed without independent support from the distribution of other segments in the inventory. Some researchers such as Lahiri & Blumstein (1984) have suggested that the alveopalatal and palatal stop places of articulation never contrast within the stop manner of articulation. This is partly attributable to misconceptions about a lack of articulatory control in this region (Recasens, 1990). However, Recasens argues for a fairly high degree of articulatory precision in the alveopalatal to palatal region, indicating that there are no physical limitations forcing a lack of distinction between the alveopalatal and palatal place of articulation, as previously thought. Indeed, evidence that such place distinctions are possible lies within some of the inventories examined for the purposes of the present research. Ladefoged & Maddieson (1986) refer to specific counterexamples, including Komi and some dialects of Malayalam. According to the inventories provided by Maddieson (1984), Hungarian and Gununa-Kena (both BI) make a distinction between an alveopalatal and a palatal place of articulation. The reason that these languages present no problem for the hypothesis that stops and affricates are in complementary distribution with respect to place of articulation is that both the alveopalatal and the palatal are claimed to be realized as affricates. The status of almost half of the twenty-one apparent counterexamples to the present hypothesis rests on the untested assumption that no place distinction is being made between the alveopalatal affricate and the palatal stop. Yet such distinctions are clearly possible and, judging by languages in which such distinctions are contrastive, at least occasionally necessary even when a distinction between stops and affricates is not the issue.

The assumption that [p] and [pf] are necessarily homorganic also rests on the more basic assumption that there is no place distinction (at least potentially) between labials and labiodentals. This assumption will be attacked with two lines of argument. The first is that it does not account for

a total absence of bilabial affricates, such as [pɸ], which are logically and articulatorily expected; the second line of objection to the assumption is that it does not take into account attested contrasts that rely on a distinction between bilabial and labiodental sounds. The first line of argument considers the fact that truly bilabial affricates do not occur at all in Maddieson's survey and are generally unattested. This is relevant in the case of three more counterexamples (German, Beembe, and Teke). It is a fact that the present hypothesis is able to explain, but for which a theory that assumes a distinct affricate class is unable to account. The present hypothesis precludes any language having a bilabial stop, [p] or [b], and a contrastive bilabial affricate, [pɸ] or [bɸ], because the contrast between such segments is considered a phonetic, not a phonological distinction. Phonologically, both are assumed to be labial stops. A phonological contrast may not exist where two segments are identical except for the fact that one segment is a stop and the other an affricate. Because bilabial stops are nearly universal, it is expected that, phonologically, bilabial affricates [pɸ] and [bɸ] are extremely rare, if they occur at all. Certainly they are not expected to occur as contrastive segments in any inventory that contains bilabial stops, [p] and [b], identical in terms of laryngeal features, etc. By contrast, a theory that assumes affricates to be characterized as a distinct class is unable to account for the fact that labial affricates are labiodental, rather than bilabial. The dearth of bilabial affricates is unexplained.

In addition to the lack of explanation provided by the assumption of a distinct affricate class, there is the question of why the labial affricate's closure and release are not entirely homorganic. The labiodental rather than a bilabial release goes against the strong general tendency of affricates to involve totally homorganic stop and fricative phases. The most common affricate [tʃ], often transcribed as [tʃ] might appear to be analogous to [pf] in involving nearly homorganic, rather than completely homorganic, stop and fricative phases; however, it is repeatedly noted that the stop phase is not dental/alveolar, but alveopalatal in this case. Unlike in the case of [pf], it is only the transcription conventions that give the impression of a non-

homorganic closure and release in the case of the alveopalatal affricate. One might argue that non-homorganicity in the case of [pf] is attributable to the universal absence of labiodental stops (cf. Ladefoged & Maddieson, 1986). The teeth do not permit the absolute closure fundamental to the articulation of a stop. However, the implication of this argument is that the closure would be articulated as labiodental if that were possible. That is to say, the affricates are underlyingly labiodental, though closure is articulated bilabially. If this is true, it supports the position that affricates and stops in an inventory are in complementary distribution with respect to place of articulation. The stop [p] is bilabial; the affricate [pf] is labiodental.

What suggests that the affricate is underlyingly labiodental and that the bilabial closure is just a phonetic accommodation to the inability to effect complete closure with the lips and teeth? The first fact to suggest this is the absence of labial affricates with a bilabial release. A labial fricative may be either bilabial or labiodental, as evidenced by the occurrence of both even within the inventory of a single language (e.g. Ewe and Iai). Given the preference for affricates to involve a totally homorganic stop and fricative phase and the possibility of bilabial fricatives, the absence of labiodental stops should favour affricates [pɸ] and [bβ] over actually-occurring [pf] and [bv], under the assumption that the stop and affricate are both underlyingly specified simply as labial. Of course, [f] and [v] occur with far greater frequency than [ɸ] and [β], probably because they are more perceptible. Nonetheless, there are a significant number of inventories that contain a bilabial fricative (e.g. Hausa, Sui, Kan, Washkuk, Kewa, Fasu, Yareba, Otomi, to name only some) rather than a labiodental fricative, in disregard for the phonetic disadvantages (Maddieson, 1984; Ladefoged & Maddieson, 1986). This selection of the bilabial fricative over the labiodental fricative, though it occurs in just over 12% of the languages in Maddieson's sample, contrasts with the total absence of truly bilabial affricates. Other factors must take precedence over total homorganicity. The present contention is that the homorganicity requirement is overridden by the near universal presence of bilabial stops, from which completely homorganic, necessarily bilabial,

affricates are underlyingly indistinguishable, both being characterized as labial stops. If a language has both a labial stop and an affricate, the former must be characterized as bilabial and the latter as labiodental.

Let us sum up the arguments against the view that the co-occurrence of labial stops and affricates in an inventory motivates the assumption that affricates and stops are members of different obstruent classes. The fact that the stop and fricative phases of an affricate are usually homorganic leads us to expect non-occurring labial affricates [pɸ] and [bβ], rather than actually occurring [pf] and [bv]. Articulatory considerations explain why the stop portion of a labial affricate can not be labiodental, but they do not explain why the release is not bilabial. While phonetic factors favour labiodental over bilabial fricatives, they certainly do not preclude bilabial affricates, or explain their complete absence. The assumption that affricates are a class of segments distinct from stops suggests no reason why stops should be bilabial, while affricates are invariably labiodental. Under this view, the fact that labial affricates have a labiodental release is unexplained. In contrast, the view that affricates are stops underlyingly precludes a contrast between a bilabial stop and affricate since the same underlying representation is required for both. The fact that bilabial stops are nearly universal means that bilabial affricates will be, at best, extremely rare. In an inventory containing both a bilabial stop and a contrastive labial affricate, the distinction is based on place of articulation; the stop is bilabial, the affricate labiodental. The fact that the affricate's closure phase is phonetically bilabial is due to the articulatory impossibility of a labiodental closure.

The second line of objection to the assumption that the bilabial place of articulation is indistinguishable from the labiodental precipitates a digression into the possible representation of this difference. To recapitulate, the argument put forward in this entire discussion of overlap between labial stops and affricates makes the following points. The first is that such overlap occurs very rarely and that it is undesirable to allow a rare phenomenon to drive an affricate theory. In the case of overlap between bilabial and

labiodental affricates, only 3 languages in the sample (1 % of the affricate-containing inventories) are involved. The second point, which has just been discussed, is the notable absence of bilabial affricates, a gap for which there is no apparent phonetic reason and for which current affricate theories do not account. The third point in this argument represents the point of departure for this subsection. It is that there is an independent need to recognize a distinction between a labial and a labiodental place of articulation. What emerges from this is a discussion of the fact that the means currently at our disposal do not provide a straightforward and unproblematic way to make the labial/labiodental distinction. However, this should be evaluated as evidence of a shortcoming in the theory; it can not be dismissed as a lack of necessity for the distinction. This discussion indicates that an appropriate means of distinguishing labials and labiodentals is potentially available for distinguishing the bilabial stop from the labiodental affricate. The obvious conclusion is that it is ill-advised to justify the existence of a distinct affricate class on the basis of overlap between labial stops and affricates.

The possibility of a linguistically relevant distinction between bilabial and labiodental fricatives, such as occurs in Ewe and Iai, shows that there must be a way to encode this distinction phonologically, without appealing to the feature [continuant]. This contrast is admittedly rare, occurring in only two above-mentioned languages in Maddieson's sample, as well as in two languages closely related to Ewe, Avatime and Logba, and four southern Bantu languages, Kwangali, Rugciriku, Kovango, and Venda (Ladefoged & Maddieson, 1986). Ewe is noted to have several minimal pairs distinguished by the contrast between [f] and [ɸ], which must be taken as evidence of a phonemic distinction between the two sounds. Some examples provided by Ladefoged and Maddieson (1986) are shown here:

- | | | | | |
|----|---------|--------------------|------|----------------|
| 4. | a. éɸá | 'he polished' | éfa | 'he was cold' |
| | b. èɸè | 'the Ewe language' | èvè | 'two' |
| | c. éɸlè | 'he bought' | éflè | 'he split off' |

d. èβló 'mushroom'

èvló 'he is evil'

Thus, we may conclude that a distinction based on the difference between the bilabial and labiodental places of articulation is disfavoured, but we may not conclude that it is phonologically impossible. Its possibility raises the question of how it is encoded in the representation. While it may be plausible (though not desirable, in my view) that labial affricates are distinguished from bilabial stops by virtue of carrying both values for the feature [continuant], rather than only the single [-continuant] borne by stops, the same device can not be used to distinguish between segments, such as the two fricatives [ɸ] and [f], bearing the same continuancy specification. When two labial segments carry the same continuancy specification, the distinction must be made on some other basis, plausibly on the basis of a distinction between the bilabial and the labiodental places of articulation. Thus, inventories that contrast bilabial and labiodental fricatives not only suggest that this place distinction is phonologically possible, they also show that appealing to the notion of a distinct affricate class does not obviate the need to draw such a place distinction. Indeed, Ewe has affricates [ts] and [dz] that would, in the prevailing current views, be distinguished from [t] and [d] by the fact that they bear both continuant values, as opposed to the single [-continuant] value of stops. However, this means of distinguishing the alveolar stops and affricates is of no use in making another crucial distinction between bilabial fricative [ɸ] and labiodental fricative [f]. In contrast, the assumption that affricates are stops relies on the possibility of a place distinction between bilabials and labiodentals that could be used to distinguish between [ɸ] and [f] as well as between [p] and [pf]. The present approach is therefore more economical, insofar as it assumes a single mechanism that is required regardless of one's view of the affricate's representation.

2.4.1 Encoding the Bilabial/Labiodental Distinction

Encoding the bilabial/labiodental distinction using currently available features and dependency relations is not a straightforward matter, as the ensuing discussion reveals. One might appeal to the notion of some kind of enhancement feature in the case of [f], rather than a labiodental place of articulation, *per se* (cf. Stevens, Keyser, & Kawasaki, 1986; Stevens & Keyser, 1989). This does not necessarily jeopardize the point being made here, that the feature used to distinguish the labial and labiodental is potentially available to distinguish the labial stop and affricate. However, finding an appropriate candidate for an enhancement feature among those currently available is not easy, if it is possible at all. For instance, one possibility for an enhancement feature is [+spread glottis]. The Setswana evidence (see Chapter Four) suggests that [ɸ] is underlyingly [+spread glottis]. In languages that contrast [f] and [ɸ], the latter might conceivably be characterized as [+spread glottis]. Extending this approach to affricates, one can suppose that if [pf] is Labial [-continuant][-spread glottis], then it can not contrast with [p] in a given language. However, there is evidence that all voiceless fricatives, not just [ɸ], are [+spread glottis] (see Chapter Five for further discussion of this). This suggests that the answer to the problem of distinguishing the bilabial and labiodental fricatives, and the bilabial stop and labiodental affricate, is not to be found in the feature [+spread glottis].

Alternatively, E. Pulleyblank (personal communication) assumes that [f] is [+round] and that [ɸ] involves lip compression that might be characterized as [-round]. If this is accurate, then one might consider [f] and [pf] as being enhanced by roundness. This implies that lip compression is characteristic of ordinary bilabial stops as well as bilabial fricatives [ɸ] and [β]. The features Labial [-continuant] [+round] are those that would normally be assumed for a labialized labial [p^w], so this predicts that [pf] and [p^w] may not contrast in a language. Maddieson's sample contains no languages that challenge this prediction, so the use of [round] tentatively remains a viable option. However, there is phonetic evidence against characterizing [f] as

[+round] that comes from the very languages that contrast bilabial and labiodental fricatives. Ladefoged (1990) shows that [f] in Avatime, Logba, and Ewe involves upper lip raising while [ɸ] involves lip compression. The articulation of the labiodental in the southern Bantu languages, Kwangali, Rugciriku, Kovango, and Venda involves lower lip retraction. Thus, it seems phonetically suspicious to use the feature [round] to characterize the labiodental [f] and thus the distinction between the bilabial and labiodental fricatives.

Now let us consider the possibility of a place distinction between [ɸ] and [f] that might also be used to distinguish [p] and [pf]. The distinction between a place of articulation feature and an enhancement feature is not always clear, as the discussion of the following (presumably place) features [strident] and [distributed] will show. Therefore, I will not press a distinction between an enhancement feature and a place difference. The reader is reminded that a difference based on an enhancement feature of some sort poses no a priori threat to the basic claim that [p] and [pf] can be distinguished without recourse to the notion of a distinct affricate class. Furthermore, there is independent evidence for the need to recognize, possibly in a more straightforward way than is currently available, a dental place of articulation, which is more obviously characteristic of [f] than is an enhancement feature such as [spread glottis] or [round]. Because few languages contrast bilabial and labiodental segments of a given type the potential for this contrast has received relatively little attention. For instance, in addition to the few languages cited that contrast the bilabial and labiodental fricative, only one language in Maddieson's sample (Teke) contrasts a bilabial and labiodental nasal. Despite the rarity of the contrast, Ewe, in particular, is taken as evidence for the fact that such a distinction is phonologically possible. Typically, however, the slight place distinction between labials and labiodentals—though it occurs phonetically in a vast array of languages—occurs in concert with other, more phonologically relevant, distinctions. In such cases, the distinction between labial segment X and labiodental segment Y can, and should be, handled as other than a

place distinction phonologically. English provides a good example of this. It has bilabials [p] and [b], along with contrasting labiodentals [f] and [v] (e.g. pat vs. fat vs. bat vs. vat), but the former are stops and the latter are fricatives. The distinction between the bilabial and labiodental places of articulation appears to be incidental, in contrast to the stop/fricative distinction that is independently required. However, as previously noted, languages such as Ewe that contrast [ɸ] and [f] indicate that the distinction between the bilabial and labiodental places of articulation can not always be handled in this way.

One possibility for distinguishing [f] and [ɸ] that is available within the framework of SPE is the feature [strident]. The former is designated [+strident], while the latter is considered [-strident]. This could possibly (though not desirably, in my view) be extended to distinguish the bilabial stop from the labiodental affricate, which might be considered Labial [-continuant] [+strident]. Of course, if [p] is [-continuant] and [pf] is properly considered [-continuant] [+strident], then under assumptions of underspecification, the affricate class designation is redundant. The feature [strident] accomplishes the job of distinguishing the stop from the affricate. However, one serious problem with extending the feature [strident] to the labiodental fricative (and by implication to [ɸ]) is that rules do not treat [f] as [+strident]. English plural formation is an example of this. Words ending in [s], [z], [ʃ], [ʒ] form the plural with [sɪz], but those ending in [f] or [v] do not. One might impose a coronal restriction to account for the facts of English, such that only coronal stridents (i.e. not labiodental stridents) are affected. However, processes such as Tahltan Coronal Harmony (discussed in Chapter One) argue that [strident] is a dependent of the Coronal Node. Therefore, if [f] is properly considered [+strident], the coronal restriction would not work unless it were stated in terms of sounds that are exclusively coronal, as opposed to, say, labiocoronal, as [f] would be if it were a strident labial. Even if this were an acceptable solution, the unexplained fact remains that there are no rules that treat as a natural class all and only the segments that SPE regards as [+strident]. Moreover, as discussed in the previous chapter, there

is no articulatory/acoustic basis for defining such a set as SPE considers [+strident], whereas there is a clear acoustic and a good articulatory basis for classifying the sibilants [s], [ʃ], [ts], and [ʈ] together. The present hypothesis rests on the assumption that the appropriate set designated by the feature [strident] includes [s], [ʃ], [ts], and [ʈ] and does not include fricatives [f], [θ], [ç], and [x]. It further assumes that the most likely acoustic and articulatory correlates of the feature [strident] are those associated with the more traditional term 'sibilant'. Therefore, under the assumptions of this thesis, the option of distinguishing [f] (therefore [pf] also) as [+strident] is unavailable as well as undesirable.

Another possibility for distinguishing bilabials from labiodentals, also found in SPE, involves an appeal to the feature [distributed], which SPE uses to facilitate place distinctions among coronals. In SPE, the feature [anterior], in conjunction with the feature [coronal], distinguishes four broad areas of articulation: labial, dental, palato-alveolar, and post-alveolar. These are shown in the following table:

5. SPE Coronal Distinctions

	[+coronal]	[-coronal]
[+anterior]	dental	labial
[-anterior]	palato-alveolar	post-alveolar

The post-alveolar area subsumes the palatal, velar, uvular, and pharyngeal places of articulation that are further distinguished with the features [high], [low], and [back]. However, SPE notes that finer place distinctions are also required within the coronal region to account for distinctions among dentals, alveolars, retroflexes, and alveopalatals. The feature [distributed] is employed primarily for this purpose. It is specifically stated, though, that while [distributed] captures the distinction between apicals and laminals, it

is not synonymous with laminal. The articulatory definition given for the feature [distributed] is as follows:

Distributed sounds are produced with a constriction that extends for a considerable distance along the direction of airflow; non-distributed sounds are produced with a constriction that extends only for a short distance in this direction.

(SPE, 312)

This definition implies that non-coronals, as well as coronals, may be [+/-distributed]. In terms of current feature geometry, this suggests that [distributed] is not dependent on a particular articulator. In fact, SPE states that bilabials may be distinguished from labiodentals by means of this feature. Bilabial [ɸ] is considered [+distributed], and [f] is [-distributed]. This distinction could reasonably be extended to distinguish the bilabial stop from the affricate [pf]; the affricate could be considered [-distributed], whereas the stop would be unmarked for the feature [distributed]. A specification Labial [-continuant] [-distributed] would imply a labiodental, as opposed to a bilabial, constriction. Phonetically, that would be realized as a release phase of a [-continuant]. In other words, the phonetic result of this feature combination would be an affricate. This solution, as with the feature [strident], renders the features of an affricate class redundant. However, this proposal is also problematic. To begin with, Keating (1991) points out that considering constriction length independently from a particular articulator leads to questionable classifications. As an example, she states the fact that retroflexes generally involve constrictions that are about the same length as velars, though retroflexes are generally considered [-distributed] and velars [+distributed]. One might conclude that constriction length is relative within an articulator, rather than across articulators. Thus, there might be no contradiction in the fact that the least distributed velars are still distributed compared to a distributed coronal. However, according to Keating, if interpreted as constriction length, [distributed] is a poor way to distinguish

sounds even within a single articulator. Consider the case with coronals, where the feature [distributed] is normally assumed to play a role. Apicals, which are assumed to be [-distributed], may in some cases actually involve a greater constriction length than that of laminals, which are assumed to be [+distributed]. In short, if segments were correctly categorized according to their constriction length, it would not yield the classifications that are normally assumed. Keating recommends that the feature [distributed] be interpreted to mean laminal. This implies that it is a specifically coronal feature, in contradiction to the claims of SPE. If the feature [distributed] is not actually used to make distinctions at points of articulation other than the coronal, replacing the feature [distributed] with the feature [laminal] seems to be a reasonable course of action.

Unfortunately, replacing the feature [distributed] with the specifically coronal feature [laminal] does not automatically ensure the resolution of all the apparent phonetic contradictions – either those linked to the bilabial/labiodental distinction, or others related to equating [distributed] with laminality. Ladefoged & Maddieson (1986) raise the problem of variability among so-called laminals and apicals. For instance, [ʃ] is claimed to be laminal, but their investigations of California and British English indicate considerable interspeaker variability. In short, [ʃ] is not consistently laminal. This may not be a serious objection if variability is correlated with phonological irrelevance: English does not need to make a phonological distinction between distributed and non-distributed segments, so variation is a purely phonetic concern. The 'apicals' and 'laminals' are more usually distinguished by their place of articulation, with [s] being alveolar and [ʃ] being alveopalatal. According to information provided by Ladefoged & Maddieson, in a language such as Standard Chinese, which contrasts a number of stridents in the alveolar and postalveolar regions, laminality is found to be consistent. One might reasonably hypothesize that, in a language such as Chinese, the feature [distributed] is phonologically specified and, thus, contrastive. The phonetic component presumably responds to the

phonological distinction by consistently realizing [-distributed] sounds as apical and [+distributed] sounds as laminal.

A more serious problem in equating [distributed] with 'laminal' and using this particular feature to distinguish bilabials from labiodentals is that it implies that the tongue is actively involved in the articulation of labiodentals. The problem is exacerbated by the widely held view in current, presumably articulator-based, feature geometry that [distributed] is a Coronal dependent (Sagey, 1986; Pulleyblank, 1988; Avery & Rice, 1988; McCarthy, 1989; Yip, 1989; Shaw, 1990; Paradis & Prunet, 1991). SPE and articulator theory generally assume coronal sounds to be those made with the blade or tip of the tongue. If [distributed] is a dependent of the Coronal Node, and if [f] is properly considered [-distributed], this oddly implies that labiodentals involve the tongue as an active articulator. This is articulatorily incorrect. Within the context of an articulator-based theory, [distributed] can only reasonably be used to characterize labiodentals if it is not exclusive to the coronal articulator and it is not equated with laminality.

In an effort to solve this problem, let us set aside earlier comments about the inadequacy of the phonetic basis for 'distributed' and the recommendation that it be considered synonymous with 'laminal' and reconsider the placement of [distributed]. In other words, let us assume that [distributed] may occur with any articulator, not just the coronal articulator. The rationale for the placement of [distributed] under the Coronal Node is quite explicit in a statement by McCarthy (1989) that the dependency is "essentially definitional: [distributed] indicates a finer distinction of [coronal]" (p. 104). However, placing [distributed] under the Coronal Node just because it is most often required to make distinctions among coronals is reasonably questioned. Perhaps apicality/laminality is simply the coronal manifestation of the +/- distributed distinction. What are required to justify a dependency are principled phonological arguments to the effect that a particular feature pertains only to a specific articulator, as well as arguments showing that the dependents of a given articulator, in this

case, [distributed], [anterior], and [strident], function as a unit with regard to rules.

Some relevant evidence is suggested by Sanskrit n-retroflexion discussed by Schein & Steriade (1986) and Tahltan Coronal Harmony described by Shaw (1991) and referred to in the previous chapter. The Sanskrit evidence suggests that [-distributed] and [-anterior] function as a unit. Both are implicated in a process involving coronal linking. Transparency and opacity effects in the Tahltan case also suggest that [distributed] is appropriately placed under the Coronal Node, along with [strident] and [anterior].

Consider, first, the case of n-retroflexion in Sanskrit. The evidence is most straightforwardly accounted for if [distributed] is a coronal dependent. An [n] to the right of a retroflex [ɖ] or [ʂ] becomes [ɳ]. Only a Coronal nasal followed by a nonlateral sonorant undergoes retroflexion. Intervening non-coronal segments are overlooked by the propagation of retroflexion; they neither block nor undergo the process:

6. a. (-ṇa- 'passive participle') vṛk-ṇa- 'cut up'
- b. (-āṇa- 'middle participle') kṣubh-āṇa- 'quake'

Intervening coronals block the spread of retroflexion, but do not undergo it:

7. a. (-ṇā- 'present') mṛd-ṇā- 'be gracious'
- b. (māṇa- 'middle participle') kṛt-a-māṇa- 'cut'
- c. (-āṇa- 'middle participle') marj-āṇa- 'wipe'

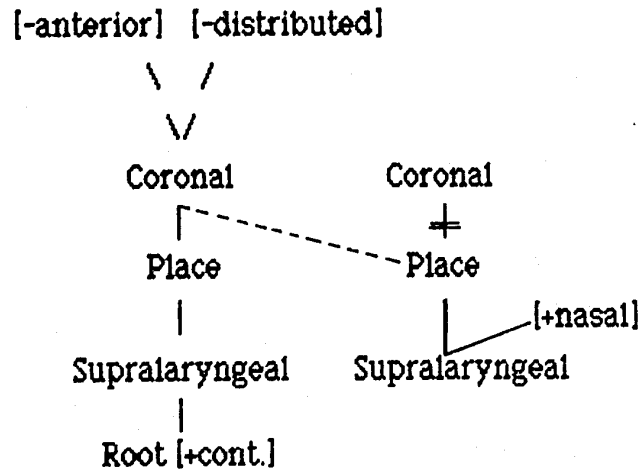
For the sake of convenience, the inventory of Sanskrit consonants is summarized here (Coulson, 1976; Gonda, 1968; Uhlenbeck, 1977):

8. Inventory of Sanskrit Consonants.

	Labial	Dental	Retroflex	Palatal	Velar	Glottal
Stops	p ph b bh	t̪ th d̪ dh	ʈ ʈh ɖ ɖh	ç çh j̥ jh	k kh g gh	
Fricatives		s̪	ʂ	ç		h
Nasals	m	n̪	ɳ		ŋ	
Liquids		l̪	ɭ			
Glides		v			j	

The defining features of retroflexion are [-anterior] [-distributed] (SPE, p. 313; Schein & Steriade, 1986; Cho, 1991). Becoming retroflex seemingly involves acquiring these features. If both features are specified and spread simultaneously, then it is assumed that the process of retroflexion involves the spread of their mutually dominating node, the Coronal Node. Acquiring the Coronal Node of a retroflex continuant results in the nasal becoming retroflex. The rule is formulated by Schein & Steriade (1986: 718) as follows:

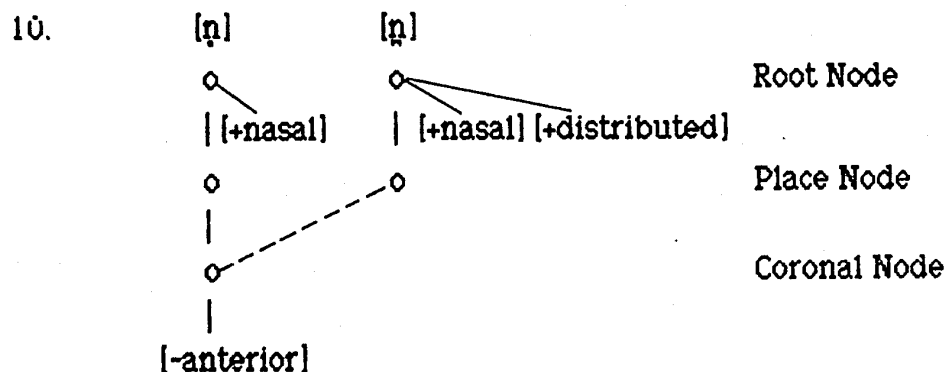
9. Schein and Steriade's Rule of n-Retroflexion



Failure to undergo the process of retroflexion is easily explained; the target must be a nasal. It is the blocking behaviour of non-nasal, non-retroflex coronals, [t̪] and [d̪], compared to the transparency of non-coronals, [b] and [k], that is of interest. The opacity of [t̪] and [d̪] suggests that they are specified for a Coronal Node. Under present assumptions this further implies that they bear at least one coronal dependent. Independent evidence suggests that [-anterior] is active elsewhere in the language. Just one example of the active nature of [-anterior] is found in the fact that [ŋ] becomes [ɲ] following [č] and [ʃ], which are assumed to be characterized as [-anterior] (jā-ŋa > jaɲa 'sacrifice', Gonda, 1968). If [-anterior] is the active value, then [+anterior] is unspecified. This means that [t̪] and [d̪] can not be coronal by virtue of being [+anterior]. In keeping with their dental articulation, it is assumed that [+distributed] is specified and that [t̪] and [d̪] are coronal because they are [+distributed].

What are the problems in assuming that [t̪] and [d̪] are blockers by virtue of being specified [+distributed], without assuming that [distributed] is a coronal dependent? For one thing, it leaves the blocking behaviour of [t̪] and [d̪] unexplained. Without a coronal dependent, these segments are expected to lack a Coronal Node. Without a Coronal Node, they are not expected to block the spread of retroflexion without undergoing it. One might assume a non-structural explanation for their blocking behaviour, such as a co-occurrence restriction against the features [-anterior] and [+distributed]. On this view, the feature [-anterior] could not spread to a segment already specified as [+distributed]. The reader is reminded that if [-distributed] is assumed to be the marked value and [+distributed] is considered unmarked, this co-occurrence restriction account is precluded at the outset. There would be no feature of the dentals on which to base a co-occurrence restriction. However, a restriction against the co-occurrence of [+distributed] and [-anterior], both of which must be marked, is belied by the presence in the inventory of [č] and [ɲ] that must be distinguished from [t̪] and [ŋ]. The affricate might be distinguished from the retroflex stop [t̪] by the feature [strident], but this will not serve to distinguish [ɲ] from [ŋ]. Either [ɲ] must

be [+distributed] or [ŋ] must be [-distributed]. In addition to these problems, the proposal suggests that two unrelated features, one coronal and the other not, are involved in retroflexion. The alternative is to assume that retroflexion involves the spread of the first node that commonly dominates the two features, that is to say, the Root Node. This should be blocked by any intervening segment with a Root Node, which includes [b] and [k]. This is incorrect. A different incorrect prediction arises as a result of assuming that [+distributed] is the marked value and still trying to remove [distributed] from under the Coronal Node. For instance, if [ŋ] is [+distributed], but that feature occurs above the Place Node, say as a direct dependent of the Root Node, then when the dental nasal links to the Coronal Node of a preceding retroflex, it should yield [ɳ], rather than [ŋ].



To conclude, in trying to remove [distributed] from under the Coronal Node, the Sanskrit evidence presents the following dilemmas. We are unable to do without the feature [distributed], because one or the other value is required to distinguish the segments of the inventory. Assuming that a particular value of [distributed] is unspecified is of no help, because both retroflexes ([-distributed] segments) and dentals ([+distributed] segments) are implicated in the process of n-retroflexion. If [+distributed] is assumed to be unmarked, then, in the process of retroflexion, diversely situated features [-anterior] and [-distributed] must move as a unit, without involving other nodes and features. This is inimical to the whole notion of feature geometry. If [+distributed] is specified, then (alveo)palatal nasals, rather

than retroflex nasals, are wrongly predicted. The Sanskrit evidence therefore indicates that [distributed] is a coronal dependent.

The case of Tahitan also suggests that [distributed] is a coronal feature. In Tahitan, distributed segments are created when a Coronal segment, presumably characterized as [+strident], is succeeded by a distributed segment. The 1st person singular subject indicator /s/, shown in boldface, surfaces as [θ] if succeeded by a [θ], [ʃ], [tθ], or [dʃ].

11. a. **ssk**ʔa 'I'm gutting fish'
 b. θsθʃs4 'I'm hot'
 c. taθtθa4 'I'm dying'
 d. sssxs4 'I'm going to kill it'

Example d. is included as an aside; it shows that [x] does not trigger the change and must therefore be considered to lack the [+distributed] feature. This is relevant for the assumption that [distributed] may apply to non-coronals, since velars have been characterized as [+distributed] (cf. Ladefoged & Maddieson, 1986, 28). The last example also shows that [ʃ] does not trigger the change [s] → [θ], a fact whose pertinence will be shown shortly.

On the other hand, the /θ/ of the first person dual subject marker, which is assumed to be [+distributed], surfaces as [+strident] or [-anterior] if followed by [+strident] or [-anterior].

12. a. dsθigt4 'we threw it'
 b. dsidzel 'we shouted'
 c. iʃitʃot4 'we blew it up'

Together, the two sets of examples above show that coronal segments become [distributed] while non-coronals do not and that [+distributed] segments are, in turn, affected by coronal dependents [strident] and [anterior] that leave other, presumably unspecified coronals such as [t] and [ʃ], alone.

It has been suggested that [lateral] is simply one possible manifestation of the feature [distributed] (Spencer, 1984). This is significant because Shaw uses Tahltan Coronal Harmony to argue that [lateral] should be placed higher in the tree, rather than under the Coronal Node, as is normally assumed. If lateral were simply a manifestation of [distributed], their placement should be the same. If [lateral] belongs higher in the tree, so too does [distributed], if that is really what laterals are. However, this view is unable to reconcile the asymmetric behaviour of laterals and distributed segments. Laterals neither trigger nor undergo any harmony processes, while distributed segments do. One might argue that laterals are unaffected by Coronal Harmony because [lateral] is incompatible with the other spreading features [anterior] and [strident]. If this were the case, [ɬ] and [tʰ] would remain unaffected, but they would be expected to trigger [distributed] harmony, which they do not. Of course, one would expect precisely the same behaviour from other distributed segments, in any case. One must conclude that [lateral] and [distributed] are distinct features and that, as such, the placement of one is independent of the placement of the other. Arguments to the effect that [lateral] does not belong under the Coronal Node have no bearing on whether [distributed] is properly considered a coronal dependent.

Nonetheless, the nature of the lateral argument is enlightening from the point of view of determining whether [distributed] is properly considered a coronal dependent or not. The essence of Shaw's argument is that only segments with a specified Coronal Node are triggers or targets of the Coronal Harmony processes. [t] and [n], which are coronal, but which are widely assumed to lack Place features underlyingly, because they are unspecified for any coronal dependents, are transparent with respect to the spread of [distributed], [anterior], and [strident]. Segments that are [+strident] and [-anterior] are triggers and targets, precisely because these features are coronal dependents. To bear these features is to have a Coronal Node. If [distributed] were not a coronal dependent, the distributed segments should lack an underlying Coronal Node, like the [t], [tʰ], [d], [n],

[n], and presumably the laterals. However, again there is an asymmetry between the behaviour of the laterals and the unspecified coronals on the one hand, and the distributed segments on the other. In short, the distributed segments do not behave like the segments assumed to lack a Coronal Node. They behave like the segments with a Coronal Node. Segments are assumed to have a Coronal Node by virtue of being characterized by a Coronal dependent. If [t̪], [d̪], [θ], and [ð] are characterized by the feature [+distributed], it must be a Coronal dependent. Thus, both the Sanskrit n-retroflexion evidence and the Tahitian coronal harmony evidence strongly support placing [distributed] under the Coronal Node.

If [distributed] is properly considered a coronal dependent and labiodentals may be characterized as [-distributed], then labiodental fricatives are at least potentially represented as complex labio-coronal segments. This is an undesirable conclusion insofar as labiodentals can not be considered coronal under the usual interpretation of the term. Most theorists working within the framework of feature geometry seem to assume a slight variation, (reflecting the shift in emphasis from place of articulation to focus on the active articulator, and the need to include palatals among coronals), of the definition of [coronal] proposed in SPE: Coronals are those sounds produced with the tip or blade of the tongue. Dentals are considered coronal, not because dentals are laminal or [distributed], or because they involve the teeth, but because the tongue blade is the active articulator. Labiodentals do not involve the tongue at all. Indeed, calling them labiocoronal seems rather spuriously motivated by the desire to characterize them as [-distributed]. The truth of the matter is that it does seem necessary to distinguish the bilabial and labiodental places of articulation, but none of the available features serves that purpose very well. Appealing to the notion of a distinct affricate class does not solve this basic inadequacy of our feature system; it only permits us to distinguish bilabial stops from labiodental affricates. Given the tiny percentage (1.4% of the relevant inventories in the sample) of cases where these segments co-occur, and some doubt as to whether such segments really contrast phonemically, it is not

clear that this should be a priority. Researchers, including Ladefoged & Maddieson (1986) and Keating (1991), have acknowledged the need to further elaborate the feature system to enable certain possible contrasts to be made. Ladefoged & Maddieson state that

...there is no doubt that we need to distinguish between bilabial and labiodental gestures. Chomsky and Halle do this by means of the feature distributed. We can see no phonological motivation for this feature, which groups ϕ , $\underline{s}$, j together as distributed sounds, and f , θ , $\underline{s}$ as non-distributed. We think it preferable to simply add the bilabial-labiodental distinction as a new feature, if one is operating within a binary system. (p. 92).

They also demonstrate the need to distinguish between laminal and dental; though dental sounds are usually laminal and retroflexes are normally apical, neither is necessarily so. Ladefoged & Maddieson discuss cases in which it seems necessary to encode the independence of laminality/apicality from the dental/non-anterior places of articulation within the coronal region. If the suggestions of the preceding discussion surrounding labiodentals were combined and implemented, the existing hierarchy would change in the following respects: The coronal feature currently called [distributed] would be renamed [laminal] and a new feature pertaining to dentals would be introduced. How such a feature might be incorporated into the hierarchy is unclear. Gorecka (1989) solves the problem by recognizing a distinction between the active and the passive articulators (referred to as the Site). Bilabials have a labial site and labial articulator, while labiodentals have a dental site and labial articulator. I leave open the question of how best to integrate the dental place of articulation into the hierarchy, noting only that it is independently required and would provide a means of distinguishing labial affricates from bilabial stops. It is further noted that extremely few languages contain both a bilabial stop and a labial affricate; only three

languages in Maddieson's sample contain a labial affricate. Moreover, the most widely known of these languages, German, does not even use the distinction contrastively. Another often-cited language that is not included in the data set, Swiss German, is expected to exhibit a similar lack of distinction between labial affricates and stops. These facts suggest that using such cases to justify representing affricates as a distinct class is misguided.

2.4.2 The Remaining Cases of Non-Coronal Overlap

Some other apparent counterexamples to the view that affricates are stops, Chipewyan, Kabardian, and Gilyak, have been included in the category of exceptions only to give the antithesis the widest possible latitude. In fact, they further illustrate the point that affricates must be stops underlyingly. The succeeding discussion draws on a premise put forward by Pike (1975) that inventories tend to exhibit symmetry. Because this premise is often denounced, particularly by phoneticians, it is worth elaborating a couple of points. To begin with, Pike warns that language inventories are not required to be symmetrical, though that is a strong general tendency. He further cautions that asymmetry should serve only as a checking device; it should not be used, in isolation, to **determine** the distinctive sounds of a language. Pike is primarily concerned with inaccuracies in phonetic transcription of sounds, due perhaps to rarity of occurrence of a particular sound or to the language bias introduced by the transcriber's own phonological system. I am extrapolating from Pike in assuming, first, that symmetry of an inventory is not necessarily at the purely phonetic level. I am further assuming that phonetic detail may sometimes obscure an underlying symmetry in the system. Of particular interest to me are inventories in which symmetry would be revealed if affrication were regarded as a phonetic, rather than a phonological phenomenon.

The Type BII inventories, in which overlap between stops and affricates occurs at points of articulation other than the dental or alveolar, provide three examples. In Chipewyan, there is overlap between velar stops

and affricates, but the inventory provided by Maddieson (1984) shows that while most of the affricates in the inventory are plain, ejective, and aspirated, the velar affricates are simply aspirated. Note, however, that the velar stops are plain and ejective (k , k' , k^ω , $k^{\omega'}$). The following chart shows the distinctive obstruents of Chipewyan provided by Maddieson.

13. Chipewyan Obstruents

	Bilabial	Dental	Alveolar	Velarized Alveolar	Alveopal	Palatal	Velar	Labialized Velar
Stops	p		t t'	$tʃ$			k k'	k^ω $k^{\omega'}$
Affricates		t^{θ} $t^{\theta h}$ $t^{\theta'}$	t^s t^{sh} $t^{s'}$		$\check{c}$ $\check{c}h$ $\check{c}'$		kxh	$k^{\omega h}$
			$t^{\dagger}$ $t^{\dagger h}$ $t^{\dagger'}$					
Frictives		θ θ'	s z		$\check{s}$		x γ	x^ω γ^ω

There is no problem of overlap between the ejective alveolar stops and affricates, because the features [strident] and [lateral] are available to distinguish the affricates. However, under the assumptions of this thesis, if the velar affricates were either plain or ejective, they would be phonologically indistinguishable from the plain and ejective velar stops. The asymmetry here suggests that the distinction between the velar stops and affricates rests on the aspiration/ejective/plain distinction rather than on any inherent class distinction between stops and affricates. The velar aspirates are simply affricated phonetically. These revised distinctions are captured in 14., which incorporates a couple of other incidental changes in the interests of greater accuracy. Rice (p.c.) claims that the velarized alveolar is, in fact, $[t^h]$ and that there is also a voiced alveopalatal fricative in the language.

14. Revised Chart of Chipewyan Obstruents

	Bilabial	Dental	Alveolar	(Alveo)pal	Velar	Labialized Velar
Stops	p	t ^h t ^h t ^h	t t ^h t ^h	č č ^h č ^h	k k ^h k ^h	k ^h k ^h k ^h
			ts tsh ts ^h			
			t ^h t ^h t ^h			
Fricatives		θ ð	s z	š ž	x γ	x ^h γ ^h

The same principle is illustrated by Kabardian, which has both uvular stops and affricates. Shown in the following chart are the distinctive stops and affricates of the language, as indicated in Maddieson (1984). There is a large inventory of fricatives in Kabardian which are omitted in the interests of space and simplicity. Their omission does not compromise the point being made here.

15. Kabardian Stops and Affricates

	Bilabial	Dental	Velar	Labialized Velar	Uvular	Labialized Uvular	Glottal	Labialized Glottal
Stops	p ^h p b	t ^h t ^h d	k ^h k ^h g	k ^h k ^h g ^h	q ^h	q ^h	ʔ	ʔ ^h
Affs.		ts ts ^h dz			qχ	qχ ^h		

The uvular stops (q^h q^h) are ejective, whereas the uvular affricates (qχ, qχ^h) are plain. Here, too, it seems that the distinction is between ejectives and non-ejectives, rather than between stops and affricates. Moreover, the fact that stops at other points of articulation are aspirated, rather than simply plain, suggests that the uvular affricates are functioning as the aspirated counterparts to the uvular stops. The general pattern for obstruents in

Kabardian is to have a voiceless, a voiced, and an ejective member. Stops at the labial, dental, and velar places of articulation are aspirated, as well as being voiceless. The predictability of aspiration on the stops argues for its removal from the description of distinctive obstruents. However, if affrication is equated with predictable aspiration, then it should also be regarded as a phonetic, rather than a phonological fact. Thus, it further strengthens the view that affricates are stops underlyingly. The revised chart of Kabardian stops is shown below.

16. Revised Chart of Kabardian Stops

	Bilabial	Dental	Velar	Labialized Velar	Uvular	Labialized Uvular	Glottal	Labialized Glottal
Stops	p p' b	t t' d	k k' g	k ^ω k ^ω ' g ^ω	q q'	q ^ω q ^ω '	ʔ	ʔ ^ω
		ts ts' dz						

The inventory of Gilyak reiterates the point that affricatehood is not a phonological state of a segment. According to Maddieson, Gilyak has in its inventory of obstruents an alveopalatal affricate [č^h] and a palatal stop [c].

17. Gilyak Obstruents

	Labial	Dental/Alv	Palatal	Velar	Uvular
Stops	p ph b	t t ^h d	c — j	k k ^h g	q q ^h G
Affricates			č ^h		
Fricatives	f	s z		x γ	χ ʁ

Ignoring the possibility of a place distinction, or a distinction involving the feature [strident], consider the fact that the affricate is aspirated and the stop is plain. There are two series of stops in Gilyak, a plain series and an aspirated series that co-occur at each point of articulation except the (alveo)palatal. What is immediately obvious is the absence of an aspirated palatal stop, unless the aspirated palatal affricate serves this function. More than providing another possible means of distinguishing the affricate and stop in question, aspiration of the affricate echoes that made between stops at other points of articulation. In other words, it looks as though [čʰ] is the aspirated counterpart to [c]. In this case, aspiration is phonologically relevant, but affrication is not.

18. Revised Chart of Gilyak Obstruents

	Labial	Dental/Alv	Palatal	Velar	Uvular
Stops	p	t	c	k	q
	ph	tʰ	čʰ	kʰ	qʰ
	b	d	ʃ	g	G
Fricatives	f	s z		x γ	χ ʁ

The inventory of Setswana shows a similar dependence of the distribution of affricates on the distribution of stops in the inventory. This language is not included among the UPSID inventories, but it is relevant to the present discussion in a number of respects. To begin with it has an unusually rich inventory of affricates and apparent overlap between stops and affricates at both the alveolar and velar places of articulation. The inventory of relevant obstruents follows (cf. Tucker, 1929; Cole, 1955):

19. The Setswana Obstruents

	Labial	Alveolar	Alveopal.	Velar
Stops	[p'] [ph] [b]	[t'] [th] [d]	-----	[k'] [kh]
Affricates	-----	[ts'] [tsh] [t4'] [t4h]	[č'] [čh] [j]	[kx]
Fricatives	[ɸ]	[s]	[š]	[x]

The alveolar region includes aspirated and ejective stops, aspirated and ejective strident affricates, and aspirated and ejective lateral affricates. The velars include an ejective and an aspirated stop and a plain affricate. In each case where there is overlap in terms of place of articulation, there is at least one feature available, besides some affricate feature or feature complex, to distinguish between the affricate and a homorganic stop. In other words, it is not necessary to assume that the affricates are distinguished by the fact that they are affricates, since this is never the sole distinction. The coronal affricates [ts] and [t4] (laryngeal specifications are ignored for the moment) can be distinguished from the coronal stop [t] by the features [strident] and [lateral]. The problem lies in distinguishing the velar stops and affricates. Notice, however, that the stops and affricates generally include an ejective and an aspirated member. In contrast, the velar affricate is plain. An opposition exists between ejectives and aspirates at other points of articulation that is lacking in the case of velars. It might be reasonably supposed that this gap results from the need to distinguish the velar affricate from other [-continuant] velars at the level of the underlying representation. If the affricate were ejective, like other affricates in the inventory, it would be indistinguishable from the ejective velar stop. If it were aspirated, it would be indistinguishable from the aspirated velar stop. The velar stops are thus plausibly distinguished from the velar affricate by

virtue of a feature expressing aspiration or glottalization, rather than by a feature expressing affricatehood. Even if we assume that the velars are distinguished on the basis of stophood or affricatehood, we still need the features for aspiration or glottalization to make within-category distinctions. Moreover, under that assumption the fact that the velar affricate is plain, in contrast to affricates at other places of articulation, is unexplained. Note, however, that in the previous cases greater symmetry is revealed by relegating affricatehood to non-phonological status. In the case of Setswana, asymmetry results. No where else in the inventory do plain stops occur. One might therefore consider whether the affricate [kx] is functioning, not as a plain stop, but as a voiced velar stop. The phoneme chart of the language would resemble the following:

20. Chart of Setswana Obstruents: First Approximation

	Labial	Alveolar	Alveopal.	Velar
Stops	[pʔ] [ph] [b]	[tʔ] [th] [d] [tsʔ] [tsh] [tɬʔ] [tɬh]	[čʔ] [čh] [j]	[kʔ] [kh] [g]
Fricatives	[ɸ]	[s]	[š]	[x]

Is there any reason to consider that [kx] is functioning as a voiced velar plosive? Certainly at the phonetic level [kx] is not voiced. In fact, phonetically, it is often aspirated, [kxh], leading us to question whether we are not faced with an intractable case of velar overlap. However, other facts suggest that there is no real problem here. First, it is noted by both Cole (1955) and Tucker (1929), the primary sources of information about this language, that [kx] derived historically from /g/. Orthographically, [kx] is represented with the digraph *kg*. In current Setswana there are no voiced

velars. The velar fricative, represented orthographically as *g*, is pronounced [x]. However, it is noteworthy that in the closely related languages, SaPedi and SeSotho, the voiceless velar fricative of Setswana is systematically replaced by a voiced fricative (Tucker, 1929).

	Setswana	SaPedi	SeSotho	
21.	a. moàxi	moàyi	moàfi	'builder'
	b. naxeŋ	nayeŋ	nafeŋ	'in the field'
	c. xòpòtsa	yòpòča	fiòpòtsa	'to remind'

Thus, assuming that [kx] is phonologically /g/ may not be so wildly speculative as it first seems.

However, there is a much more likely explanation for the Setswana facts that is more promising and less obscure. To begin with, historical changes in the language show that [kh] also developed from /g/. Both Cole and Tucker observe that it is a moot point whether [kx] and [kh] are actually separate phonemes synchronically. The affricate occurs before all vowels, except the close [u] and [i]. There, its occurrence is rare indeed.

22. a. kxaka 'guinea fowl'
 b. kxosi 'chief'
 c. kxetse 'sack'

When it does occur in these environments the velar scrape is noted to be considerably softened, and whether or not it is pronounced distinctly from [kh] seems to be a matter of individual variation. The aspirated velar plosive has a very limited distribution; not surprisingly, it occurs before [u] and, occasionally, before [i].

23. a. Khumo 'riches' (used as proper name)
 b. khudu 'tortoise'

c. khiba 'skin, apron'

I therefore conclude that [kx] and [kh] are in complementary distribution and that there is no phonemic distinction between [kx] and [kh]. I further propose that the obstruents of the language include the following distinctive sounds.

24. Revised Chart of Setswana Obstruents

	Labial	Alveolar	Alveopal.	Velar
Stops	[pʔ] [ph] [b]	[tʔ] [th] [d] [tsʔ] [tsh] [tɬʔ] [tɬh]	[tʃʔ] [tʃh] [ʃ]	[kʔ] [kh]
Fricatives	[ɸ]	[s]	[ʃ]	[x]

The preceding discussion casts serious doubt on several of an already tiny number of inventories that seem to argue for a distinct affricate class. In fact, the number of problematic cases is reduced to three, (Cayapa, Komi, and Tavgy), which represents just over one percent of the inventories considered for this research. On the basis of the information provided by Maddieson, these cases appear to require a distinction between an affricate class and a stop class. However, cases such as Gilyak, Chipewyan, Kabardian, and German indicate that we should carefully review the evidence suggesting that the affricates and stops in question are distinct phonemes and that they are identical in all respects except for the fact that one is a stop and the other an affricate. In the meantime, given that it is obviously undesirable to base an affricate representation on a foundation of what are obviously exceptions to the general pattern, the notion of a distinct affricate class is rejected. In general there is at least one independently needed

feature, such as [strident], to distinguish the affricate from the homorganic stop. Such a feature renders the assumption of a distinct affricate class redundant for purposes of distinguishing the segments of the inventory. Worse yet, the assumption of a distinct affricate class fails to account for the distribution of affricates with respect to stops in inventories. The assumption that affricates are stops underlyingly solves both the redundancy and the distribution problems. The fact that this is true of such a large body of diverse inventories suggests that it is universally true. I therefore conclude that affricates are stops and that, where there is overlap between a stop and an affricate with respect to place of articulation, an independently required feature distinguishes the two. In the most usual case of overlap between dental/alveolar stops and affricates and dental/alveolar affricates, the feature [strident] distinguishes the affricate. Dental [ts] and alveolar [ts] are strident stops. This feature may also characterize the alveopalatal affricate [č], though the evidence suggests that in many cases (cf. the Tahltan case versus the Yucatec Maya discussed in Chapter Three) the alveopalatal need not always carry the feature [strident] at UR. I assume this is largely attributable to the fact that dental/alveolar plosives are universal (so that [strident] must be specified to distinguish the affricate and stop), whereas (alveo)palatal plosives are considerably less common, requiring that alveopalatal affricates be distinguished from homorganic stops far less often.

An Analysis of Rules in which Affricates Behave Like Fricatives

The claim that affricates carry both continuant values derives at least partly from the ability of affricates to pattern with both stops and fricatives. Because the class of fricatives is now generally assumed to be defined by the feature [+continuant], it is further assumed that affricates are as well. This suggests that the feature [+continuant] can be used to capture a natural class containing all possible affricates and fricatives. The claim made here is that affricates are stops at the level of underlying representation. They are never underlyingly [+continuant] and there is no class containing all possible affricates and fricatives. The rules and processes that have been used to demonstrate that affricates and fricatives pattern together, in fact, involve a standard subset of possible affricates and fricatives. This subset includes the dental/alveolar and alveopalatals, [s, š, ts, č] (along with their voiced/aspirated/ejective counterparts). A further claim of this thesis is that [ts] and [s] are best characterized by the feature [+strident], as it is defined in the Introduction, rather than the feature [+continuant]. The segments [č] and [š] are phonologically [-anterior] and, at least redundantly, [+strident]. Non-coronal affricates and fricatives may not bear this feature. The specific purpose of this section is to demonstrate that this constellation of assumptions provides us with the tools for a superior analysis of the constraints and processes involving both fricatives and affricates. The following analyses indicate that such rules and constraints apply to stridents, rather than affricates and fricatives per se.

Discussed here are several examples of rules and constraints in which affricates pattern with fricatives. In all cases, the affricates and fricatives involved are dental/alveolar and/or alveopalatal. An analysis that assumes these segments to be commonly characterized by the feature [strident] is not only possible, but has definite advantages over a continuant analysis. The relevant rules, processes, and constraints are tabled below. No attempt is

made, at this point, to phrase the rules in terms consistent with the present proposal. The rules are informally stated, in terms more likely to be familiar to the reader:

1. Rules That Group Together Affricates and Fricatives

<u>Rule</u>	<u>Summary of Effects</u>	<u>References</u>
English Plural Formation	The English plural is [s] following coronal affricates and fricatives, but [s] or [z] following stops.	K & K (1979) Lombardi (1990) Sagey (1986)
Chumesh Sibilant Harmony	Affricates and fricatives in a word must agree in anteriority.	K & K (1979) Beeler (1970) Poser (1982)
Modern Yucatec Maya Morpheme Structure Constraints	If both consonants in a CVC root are [+continuant] they must be identical. The rule affects both affricates and fricatives.	Lombardi (1990) Straight (1976)
Classical Yucatec Maya Morpheme Structure Constraints	If a CVC root contains an affricate it can occur in the righthand consonant slot only.	Lombardi (1990)
Basque Stop Voicing	Stops are voiced following a nasal or lateral. The rule does not affect affricates.	Hualde (1988) Lombardi (1990)
Basque Stop Palatalization	Stops, but not affricates or fricatives, are palatalized following a high front vowel [i].	Hualde (1988) Lombardi (1990)

3.1 English Plural Formation

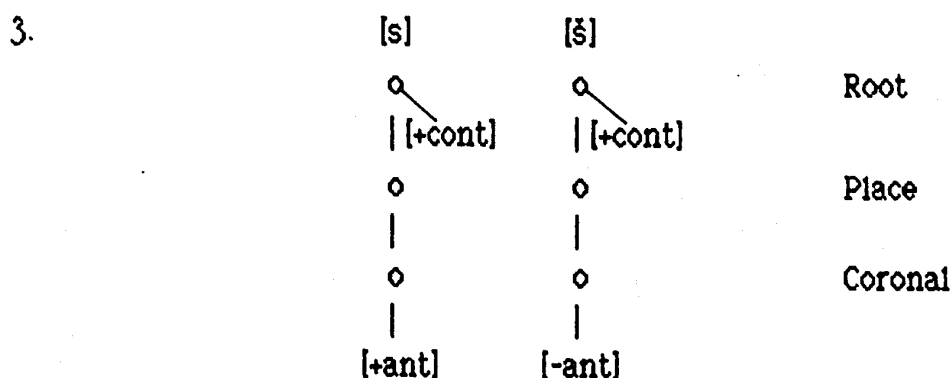
According to Kenstowicz & Kisseberth (1979) (henceforth K & K), affricates in English pattern with fricatives with respect to plural formation. While the plural morpheme surfaces as [s] or [z] following voiceless and voiced stops, respectively, it is [əz] following affricates and fricatives. K & K further assume that fricatives and affricates are both characterized as [+continuant]. However, if the English plural rule is formulated to target [+continuant], it wrongly predicts that the plural form is [əz] following all fricatives. The data in 2 a. - d. illustrate the well known fact of this incorrect prediction. Indeed, only [s], [ʃ], [č] (2 e. - g.) and their voiced counterparts take the plural form [əz].

2. a. *[leðəz] 'lathes'
- b. *[bæθəz] 'baths'
- c. *[rʊfəz] 'roofs'
- d. *[fɹɪkətɪvəz] 'fricatives'
- e. [besəz] 'bases'
- [vezəz] 'vases'
- f. [ɹæʃəz] 'rashes'
- g. [ɹɪčəz] 'riches'
- [bæʒəz] 'badges'

K & K recognize the inadequacy of a plural formation rule formulated to target [+continuant] segments. In addition, they assume that [strident] characterizes affricates and fricatives 'produced with greater turbulence' (p. 253) and, like SPE, they consider [f,v] to be stridents. Therefore, to capture the facts of English plural formation correctly, they conclude that the English plural [əz] occurs after 'coronal obstruents that are [+strident]' (p. 253). However, as noted in the previous chapter, under the assumption that

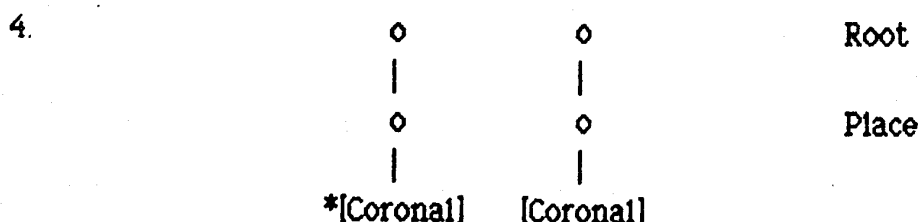
[strident] is a coronal dependent, this would not succeed in capturing a class that excluded [f,v] if these sounds were, indeed, strident (hence, coronal).

Borowsky (1986) concludes that the plural form [ɛz]⁷ surfaces when the output would be identical or 'near identical' consonants, in violation of the OCP. The near-identity amendment to the OCP is required because sequences *šz, *jz, and *čz are not completely identical. Both are coronal, but [š, j, č] are [-anterior], while [z] is [+anterior]. However, this claim does not hold up to scrutiny. To demonstrate this, let us consider the plurals of other fricatives, [θ] and [ð]. First, plurals such as [bæθs] and [leðz] indicate that adjacent [+continuant] specifications are not the locus of the problem; these forms are acceptable, in spite of the fact that both final segments are [+continuant]. If the OCP is behind the presence of the schwa in the plurals of words ending in [s, z, š, ž, č, j], either [+continuant] is underspecified at this stage, or the violation must be focussed on place of articulation. However, [s] and [z] are not completely homorganic to [š], [ž], [č], and [j]. Under the assumption that the fricatives are underlyingly [+continuant], the segments are represented along the following lines (issues of underspecification and irrelevant features are omitted for the sake of simplicity):

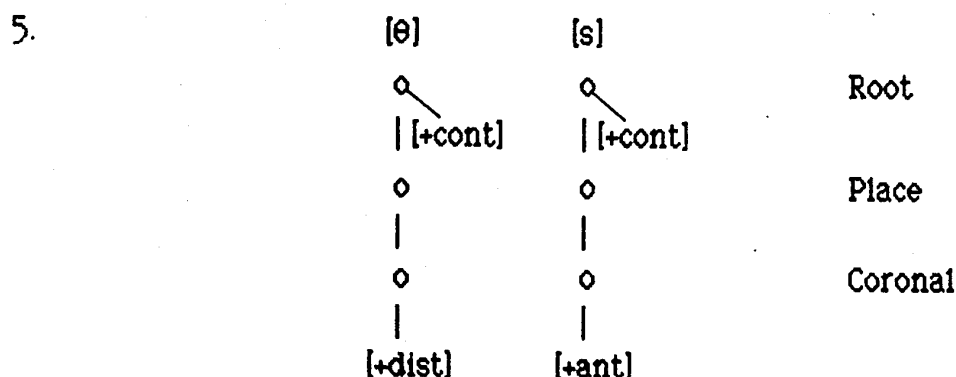


⁷ Borowsky assumes, on theory internal grounds, that schwa fails to delete in this case, rather than that it is inserted. I am not bound by the same theory internal considerations, so I assume that schwa is inserted. This point is not crucial to the proposal made here, but I prefer to assume that the more specific case (the schwa plural) is accounted for by a well motivated insertion rule than that the more general case ([s] and [z] plurals) is accounted for by a rule of deletion. Why does the schwa not simply remain in all plurals?

Because these segments do not have a common coronal dependent under these assumptions, the conclusion must be that adjacent Coronal Nodes are problematic:



However, this claim can not be correct. Plurals such as [bæθs] 'baths' and [leðz] 'lathes' show this. Segments [θ] and [ð] are characterized as [+distributed] (SPE; Keating, 1988b). This has been shown to be a coronal dependent (see Chapter Two). Thus, these acceptable plurals also involve adjacent Coronal Nodes.



The obvious conclusion is that the immediate adjacency of two Coronal Nodes is not responsible for the presence of the schwa in [əz] plurals.

Consider, in contrast, a strident analysis. By assuming that [s], [z], [ʃ], [ʒ], [ç], and [j] are [+strident] the English plural rule can be straightforwardly formulated to target the correct group of sounds, while maintaining the complete identity requirement of the OCP. It is possible to explain variation in the plural, in terms of the OCP, by assuming that the plural morpheme in English introduces the feature [+strident]. This terminal feature, like others,

can not occupy a position directly adjacent to another identical feature without creating an OCP violation.

- 6.
- | | | |
|---------------|-------------|---------|
| o | o | Root |
| | | |
| o | o | Place |
| | | |
| o | o | Coronal |
| | | |
| * [+strident] | [+strident] | |

The schwa of the -az allomorph occurs following [s, z, š, ž, č, j], which are claimed here to be characterized by the feature [+strident]. The presence of the schwa prevents an OCP violation that would result from suffixing the strident plural morpheme immediately adjacent to a strident consonant. This analysis leaves no reason to expect schwa insertion (or failure to delete) in the case of plurals such as [bæθs], and [leʒz], which involve adjacent Coronal Nodes, but only a single [strident] specification.

- | | | | | | | | | |
|----|----------|---|---------|-----|-------------|---|---------|---------|
| 7. | [l e ʃ] | + | [z] | vs. | [w e j] | + | [z] | |
| | o | | o | | o | | o | Root |
| | | | | | | | | |
| | | | | | [-cont] | | | |
| | o | | o | | o | | o | Place |
| | | | | | | | | |
| | o | | o | | o | | o | Coronal |
| | | | | | / | | | |
| | [+distr] | | | | / | | | |
| | | | [+stri] | | / * [+stri] | | [+stri] | |
| | | | | | / | | | |
| | | | | | [-ant] | | | |

This is essentially the conclusion reached by Lombardi (1990), whose analysis demonstrates that a natural class of affricates and fricatives, defined by [+continuant], does not obviate the need for the feature [+strident]. Even when affricates and fricatives are assumed to be commonly characterized [+continuant], the feature [+strident] is required to capture the facts of English plural formation accurately. Note, however, that if we assume that these particular affricates and fricatives are characterized by [+strident], there is no role for the feature [+continuant] in the process of English plural formation.

3.2 Chumash Sibilant Harmony

Given the general scarcity of consonant harmony (cf. Shaw, 1991) it is interesting to note the comparative frequency of sibilant harmony. It occurs in Quechua (Mannheim, 1988), Navajo (Kari, 1976), Kinyarwanda (Kimenyi, 1979), Basque (Hualde, 1988a), as well as in Chumash. The facts are sufficiently similar in each case that Chumash can serve as an example.⁸ Where notable differences occur, they are pointed out.

K & K use Chumash Sibilant Harmony to demonstrate that affricates and fricatives form a natural class. As previously stated, they further assume that this natural class is captured by the feature [+continuant]. However, it is important to realize that only the **sibilant** affricates and

⁸ In fact, there are significant differences between Kinyarwanda and the Chumash and Navajo sibilant harmony, insofar as in the latter, a rightmost [s] triggers harmony, much the same as a rightmost [ʃ]. This leads Poser (1982) and Steriade (1987) to assume that both values for [anterior] are underlyingly specified. This conclusion is at odds with the assumptions of this thesis, and there is reason to believe that it is incorrect to assume that both values of [anterior] are specified at UR. Harrington (1974) discusses the asymmetry of the anterior harmony triggered by [s] and [ʃ], noting that the latter is stronger, more often observed, and operates over a more defined domain. The harmony triggered by [s] is gradient, often not employed at all, and leaves some leftmost sibilants in its domain untouched. Facts such as these have lead Shaw [p.c.] to reanalyze anterior harmony as involving two separate rules, one of [-anterior] spread, and a later [-anterior] delinking rule. In fact, [+anterior] harmony, regardless of how it is formally characterized, is what Kiparsky (1985) calls 'a prime candidate for the status of phonetic implementation rule...' (p.94). In contrast, [-anterior] spread has the characteristics of a phonological rule.

fricatives [s], [š], [ts], and [č] are actually involved in the process in all the above-mentioned cases. Though segments other than affricates and fricatives may be affected in some languages (cf. Kinyarwanda example discussed below), no non-sibilant affricates and fricatives are ever involved in the process.

In Chumash, as in the other languages cited above, all coronal affricates and fricatives of a word must agree in their value for [anterior]. As the succeeding examples show, all the coronal fricatives and affricates of a word are either [+anterior] or [-anterior].

8. a. /ha + s + xintila/ ---> [hasxintila] 'his Indian name'
 /ha + s + xintila + waš/ ---> [hašxintilawaš] 'his former Indian name'
 b. /s + kuti/ ---> [skuti] 'he sees'
 /s + kuti + waš/ ---> [škutiwaš] 'he saw'
 c. /s + api + čho + it/ ---> [šapičhoilit] 'I have a stroke of good luck'
 /s + api + čho + us/ ---> [sapitsolus]
 d. [k - iškin] 'I save it' ~ [[k - iskin - us] 'I save it for him'
 [k - atskaw] 'I sin' ~ [ačkaw - iš] 'a sin'

(Data from Poser, 1982)

The examples show that the coronal stops [t] and glottalized coronal stop [t'] neither participate in, nor condition, the harmony. Example a. shows that the coronal nasal [n] is unaffected by the process, as are the velar fricative [x] and the lateral [l]. The segments that are triggers and targets differ somewhat across languages (see the brief discussion of Kinyarwanda to follow), but the sibilant fricatives and affricates form a common core. If a set of segments of a language exhibits alternations such that all are [+anterior] or all are [-anterior], that set invariably includes the sibilants. To my knowledge, there are no cases of harmony that involve other types of segments, but not the sibilant fricatives and affricates of the language.

The consonant inventory of Chumash is shown in the following table (Beeler, 1970). Parentheses around a segment indicate that its phonemic

status is questionable:

9. The Consonant Inventory of Chumash

	Labial	Alveolar	Alveopalatal	Velar	Uvular	Glottal
Stops	p p'ph	t t' th ts ts' tsh	č č' čh	k k' kh	q q' qh	ʔ
Fricatives		s s' sh	š (š') šh	x x' (xh)		h
Sonorants	m m'	n n'				
		l l'				
	w w'		j j'			

The fact that all sibilants of a word in Chumash are either [+anterior] or [-anterior] argues that, as far as sibilants are concerned, [anterior] is a property of particular morphemes rather than of the sibilants themselves. Once introduced by a morpheme, [anterior] affects all coronal affricates and fricatives of a word. In accord with its predictability and status as the property of a morpheme, let us assume that [anterior] is unlinked underlyingly (Archangeli & Pulleyblank, 1986). This treatment of the sibilants is justified by the asymmetric behaviour of the palatal glide in Chumash. Though [j] is characterized as [-anterior] (see Chapter Five), it may co-occur with [+anterior] sibilants (e.g. loʔisja 'his arrow'; tsjuqmit' i 'it is slender'). The fact that the palatal glide neither triggers nor undergoes harmony shows that [anterior] is not spreading off one segment to another in Chumash. It suggests that we are dealing with two different behaviours for the feature [anterior]. In one case the feature spreads; in another it does not. This is straightforwardly accounted for if [anterior] is considered an unlinked morphemic property in one case and a linked segmental property in another (cf. Archangeli & Pulleyblank, 1986; forthcoming). Another (not necessarily mutually exclusive) possibility is that the palatal glide is specified with a

bare Coronal Node and no [-anterior] dependent (Hume, 1992) when the morphemic [-anterior] is introduced and spread. When this occurs, it will affect the palatal glide as well as the stridents, but its effect will not be readily detected, because the palatal glide becomes [-anterior] redundantly, in any case. If [-anterior] is not introduced by the morpheme, the coronal consonants receive a default [+anterior] specification and the palatal glide a default [-anterior]. In short, the [-anterior] of the palatal glide does serve as a target for morphemic [-anterior], but it does not trigger the process because its own [-anterior] feature is not present when [-anterior] harmony occurs.

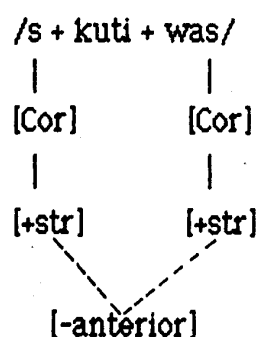
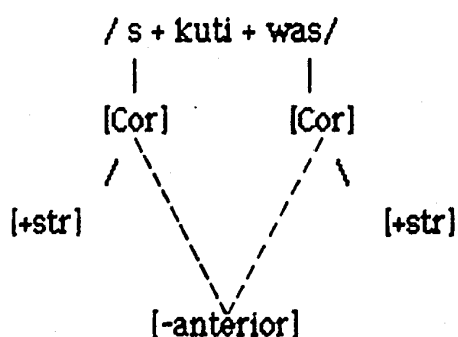
Harmony can be viewed as a case of linking a morphemic [anterior] to segments characterized as [+continuant] or as [+strident], but the two views are not simply notational variants. There are two conditions on targets of anterior harmony: they must be coronal, as well as being either strident or continuant. The problem with a [+continuant] analysis is that there is no relationship between [+continuant] and [Coronal]. One might equally well expect a rule of anterior harmony that affects the velar continuants or coronal non-continuants, both of which also occur in Chumash. By contrast, the two features [anterior] and [strident] are both dependents of the Coronal Node. A process that targets [strident] necessarily affects only segments which have a Coronal Node. On the other hand, a process that targets coronals necessarily affects segments that are [+strident], because [strident] is a coronal dependent.

Either of the preceding alternatives seems plausible and it is not my intention to make a principled choice between them for Chumash. To do so would require a thorough study of anterior harmony in all languages exhibiting this behaviour and would take us far afield of the present focus. However, I will say a few more words about this question subsequently. The basic facts of feature geometry incline me to favour the view that anterior harmony targets coronals, rather than stridents specifically. The attraction of assuming that anterior harmony targets coronals, rather than stridents or continuants, per se, is that [anterior], being a coronal dependent, is expected

to be restricted to coronal targets. It is not so obvious why anterior would seek continuants, or even stridents. An argument against the view that coronals are the target might be that [t], [t'], [n], and [l] are also coronal segments but, as previously mentioned, they are not subject to anterior harmony. However, a likely reason for the lack of participation by these segments is that at UR these segments lack a Coronal Node which is not supplied by the time anterior harmony applies (cf. Avery & Rice, 1989; Davis, 1990; Paradis & Prunet, 1991). If the above reasoning is correct, then the class targeted by the rule of anterior harmony can indeed consist of coronal consonants. The fact that the palatal glide in Chumash does not participate in the harmony is accounted for by the assumptions that [-anterior] is the spreading feature and that palatal glide [j] is already specified [-anterior]. (Recall that the occurrence of the palatal glide is not predictable from the occurrence of [-anterior] sibilants in the word.) The two alternatives for [anterior] linking are illustrated here. Of course, b. is ruled out by the hierarchy, but this is not the point; that is discussed subsequently.

10. a. Linking to Coronal

b. Linking to Strident



Though the distinction between these analyses is surely important, the feasibility of the strident analysis is unaffected by the outcome of this argument over whether [anterior] targets segments with a Coronal Node or

stridents specifically, because of the intrinsic relationship between [strident] and the Coronal Node. The same is not true for the [+continuant] analysis. If [s] and [ts] are properly characterized by the feature [+continuant], and if segments without coronal dependents lack a Coronal Node, there is no reason to assume that [s] and [ts] have a Coronal Node. It is obviously undesirable to assume that some segments are without a Coronal Node, by virtue of lacking coronal dependents, while other segments lacking coronal dependents are assumed to have a Coronal Node. Thus, in addition to there being no relationship between the conditions shared by the targets under a continuant analysis, it is not clear, under the continuant analysis, why [s] and [ts] meet the structural description of targets. In contrast, if Chumash affricates and fricatives are strident, they are overtly coronal and subject to the rule.

To digress briefly, let us return to the claim that it is undesirable to assume that some segments are without a Coronal Node because they lack coronal dependents, while other segments lacking coronal dependents have a Coronal Node. The Node Activation Condition proposed by Avery & Rice (1989), presented in Chapter One of this thesis, suggests a principle by which this might actually occur. However, cases of anterior harmony that involve not only the stridents, but also the alveopalatal nasal [ɲ], contradict the notion of the NAC. Consider the case of Kinyarwanda. Though the targets of harmony in Kinyarwanda include the sibilants, they also include [n]. The triggers in Kinyarwanda include the sounds [ɲ] and [j], neither of which triggers harmony in the other languages cited above. This is shown in the following examples taken from Kimenyi (1979):

11. a. [guʃuʃaafia] 'to draw'
- b. /a- sas- je/ 'he just made (the) bed' → [aʃaʃe]

Such examples indicate that [j] and [ɲ] as well as the alveopalatal fricative [ʃ] and the alveopalatal affricate [tʃ] are Coronal [-anterior]. In languages which have both [n] and [ɲ], [n] should, by the NAC, have a Coronal Node. This is

the case in Catalan, as mentioned in the Introduction of this thesis. In fact, Avery & Rice argue that [n] is placeless in Catalan. This claim can only be maintained if the [ɲ] is not specified as a coronal segment or by rejecting the NAC. Anterior harmony involving [ɲ] contradicts the first option. Therefore, I reject the notion of the Node Activation Condition. Segments lacking coronal dependents are placeless (or lacking a Coronal Node, at least) even if they contrast with segments specified for a coronal dependent.

Of particular interest to the present concern are the following points: First, anterior harmony provides a good argument that alveolar affricates are strident stops. More generally, it suggests that the alveolar affricates and fricatives are characterized as [+strident], rather than [+continuant]. Some languages exhibiting anterior harmony, for instance Kinyarwanda, indicate that the palatal glide [j] and the palatal nasal [ɲ] are characterized by the feature [-anterior]. This point assumes some importance in the discussion of Setswana and Shona causatives (see Chapter 4) and Setswana diminutives discussed in Chapter Five.

3.3 Modern Yucatec Maya Morpheme Structure Constraints

There are four constraints on CVC roots in Modern Yucatec Maya (Straight, 1976):

1. If both consonants in a root are ejective, they must be identical;
2. In a CVC root containing occlusive obstruents, one of which is ejective, the two must differ in place of articulation and/or one of the two occlusives must be an affricate;
3. If both obstruents in a CVC root are non-ejective continuants, they must be identical. This applies to both fricatives and affricates;
4. If the final consonant of a CVC root is a labiovelar glide [w], the vowel can not be [o] or [u]. If the final consonant is a palatal glide

[j], the vowel can not be [i].

The first three of these constraints are the main focus of the present discussion, but the fourth assumes some importance in the evaluation of alternative proposals as well.

The obstruent inventory of Modern Yucatec is shown in the following table (Straight, 1976):

12. Obstruent Inventory of Modern Yucatec

	Labial	Dental/Alveolar	Alveopalatal	Velar
Stops	p p' b	t t'		k k'
Affricates		ts ts'	č č'	
Fricatives		s	š	

The first three constraints and the obstruent inventory theoretically admit or rule out the CVC roots shown in the following table. The blank cells indicate that the root is permitted; a numbered cell indicates that a particular root is ruled out by the constraint corresponding to the number shown. Where two numbers occur, the root may be ruled out by separate constraints:

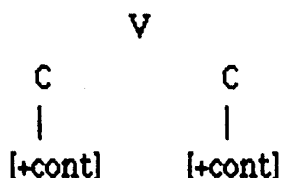
13. Non-occurring Roots of Modern Yucatec Maya

	Second Consonant											
	p	t	ts	č	k	s	š	p'	t'	ts'	č'	k'
First Consonant	p							2				
t									2			
ts					3			3	3		2	2/3
č				3				3	3		3	2/3
k												2
s				3	3			3			(3)	3
š				3	3			3			3	3
p'	2									1	1	1
t'		2							1		1	1
ts'				2	2/3			(3)	3	1	1	1
č'				2/3	2			3	3	1	1	1/3
k'						2			1	1	1	1

One problem with this prediction of permissible and impermissible roots is that some ejective affricates are exempted from the third constraint. That means that when one continuant of a CVC root is an ejective affricate, the other need not be identical. Roots [ts'V s], [s v ts'] do occur, despite the fact that the constraints indicate they should not. This is shown by enclosing the constraint in parentheses in the table above.

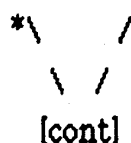
Lombardi (1990) focuses exclusively on the third constraint and uses the relevant data to argue for an affricate with unordered continuant specifications. The thread of her argument is that the two consonants in a CVC root are on a separate tier from the vowel and, therefore, adjacent on the consonant tier. If both consonants are [+continuant], those features are also adjacent.

14.



Adjacent identical features violate the Obligatory Contour Principle (OCP); one means of avoiding an OCP violation is to have the two segments share a single [+continuant]. However, according to Lombardi, there is a constraint (referred to here as the NBC) against a branching [continuant] in Mayan. I take the liberty of formalizing this constraint as follows:

15.



This forces branching at the root, yielding identical consonants. In other words, two [+continuant] consonants in a CVC root are prohibited by the OCP from each having their own [+continuant] specification, and they are prohibited by a language specific constraint from sharing a single [+continuant] unless they share all other features as well. Logic dictates that there are two possible ways a CVC root can satisfy both constraints: either two continuant consonants can be identical, thus sharing all features, or one consonant can be [+continuant] and the other [-continuant]. It is important to appreciate this consequence because an affricate and a stop, or two stops do co-occur. Though these combinations are not discussed, they suggest that adjacent [-continuant] features are permitted, or that [-continuant], unlike [+continuant], may be shared by two consonants, or that [-continuant] is unspecified at the point where this condition is in effect. These possibilities are discussed below. At this point the relevant fact is that the constraints do not permit a co-occurrence of non-identical fricatives or a co-occurrence

of an affricate and a fricative in a CVC root. This allows the CVC roots shown in a. and prohibits those in b.

16. a. sVs tsVts šVš čVč
- b. *sVts *tsVs *šVs *čVs
 *sVš *tsVš *šVts *čVts
 *sVč *tsVč *šVč *čVš

Clearly, a comparable argument is available if the affricates and fricatives in question are characterized by [+strident] rather than [+continuant]. CV tier separation need not be assumed if the relevant feature is [+strident]. This feature can not be borne by a vowel, so if two consonants in a CVC root are [+strident], those features are adjacent even if the consonants and vowels are on the same tier. Two adjacent [+strident] features can be assumed to violate the OCP, requiring that the feature be shared by the two consonants. One may further assume a language specific constraint against a branching [strident] in Mayan. Meeting the requirements of these two constraints results in a CVC root with only one strident consonant or a root with identical strident consonants.⁹

17. a. OCP b. OCP Effect c. No Branching Constraint:
- *[+stri][+stri]
- V

C C

\ /

 \ /

[+strident]

V

*C C

\ /

 \ /

[+strident]

This analysis obviously works as well as Lombardi's, but its

⁹ Throughout this and the subsequent section I will continue to use C's and V's and CV tier separation for expository convenience. This is not to be taken as a claim for a CV tier or even a skeletal tier, as opposed to a moraic view of the syllable. I assume the facts could be translated straightforwardly into a moraic framework.

presentation does not thus far reveal any clear advantage. Indeed, the advantages of the strident analysis are revealed only when the other Morpheme Structure Constraints (MSCs) of Modern Yucatec Maya are considered. Then it is obvious that focusing on the behaviour of only fricatives and affricates obscures some problems of a dual continuant approach and prevents us from understanding the true nature of the constraints in Modern Yucatec.

There are three main problems with the dual continuant analysis, the most serious aspects of which emerge when other language facts are considered. To begin with, the dual continuant analysis is more limited in scope. An OCP constraint against adjacent identical [+continuant] specifications, and an NBC against branching [+continuant] are of no use in accounting for other MSCs of the language. Even when two accounts provide an equally adequate description of the facts under consideration, an analysis that makes use of more general and widely assumed mechanisms is to be preferred to one that requires language specific, or even process-specific ones. The second problem of the dual continuant analysis is that it does not mesh with other MSCs of the language. In other words, the mechanisms assumed by the dual continuant analysis to explain the distribution of affricates and fricatives in CVC roots are not only of no help in explaining other constraints, they are at odds with assumptions required to explain them. In particular, the dual continuant analysis relies crucially on CV tier separation, which notion is contradicted by the fourth constraint. The approach proposed here avoids this problem because it does not need to assume CV tier separation. Finally, the proposed analysis encompasses the behaviour of ejective affricates, which are exceptions to Lombardi's analysis. The intent of this section is to demonstrate that an analysis based on the idea that affricates are stops is not only simpler, it addresses these problems and provides a better account of the Modern Yucatec facts.

The proposed analysis is based on the following assumptions. First, it assumes that affricates are stops underlyingly; this assumption embodies the further notion that [ts] and [s] are [+strident]. The second assumption is that

[+continuant] is the marked continuant value that occurs underlyingly; stops and affricates are unmarked for the feature [continuant]. It is assumed that they become [-continuant] by default, by virtue of the fact that they are defined as non-sonorant consonants. The third assumption is that the OCP rules out adjacent identical features. It is formalized as follows:

18. OCP: *[aF] [aF]

Finally, there is assumed to be a language-specific No Branching Constraint (NBC) that prohibits branching features.

19. NBC: $\begin{array}{c} * \backslash \quad / \\ \quad \vee \\ \quad [aF] \end{array}$

The assumptions of the two approaches are laid out in the following table:

20. A Comparison of Assumptions

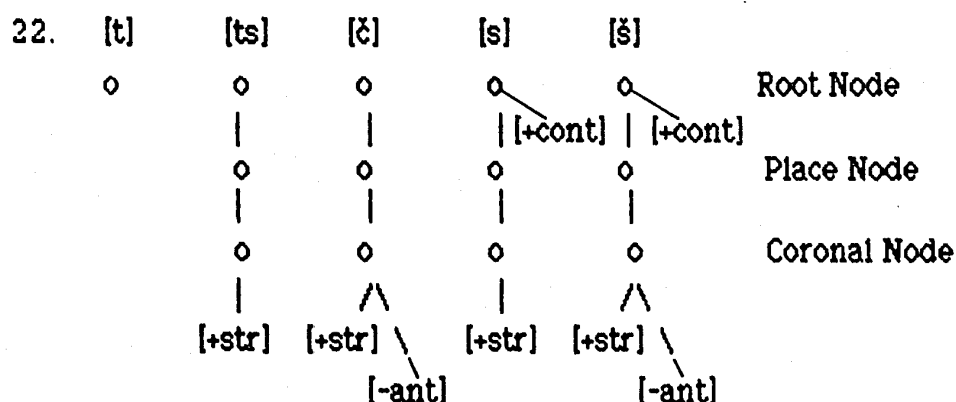
Assumptions of a Dual Continuant Analysis	Assumptions of the Proposed Analysis
1. Affricates are characterized by both continuant values;	1. Affricates are stops; [ts] is a strident stop;
2. [+continuant] is marked underlyingly [-continuant] is unmarked at UR; (This is unstated, but it must be assumed to account for the facts)	2. [+continuant] is marked underlyingly; [-continuant] is unmarked at UR;
3. OCP: *[+cont] [+cont]	3. OCP: *[aF] [aF]
4. NBC: prohibits branching [+cont]; if [+cont] is shared, so are all other features.	4. NBC: prohibits branching features; if one feature is shared, all features are shared.

The justification for most of these assumptions will emerge through the course of the analysis and a comparison of the four constraints on CVC root in Modern Yucatec. However, consider, first, the assumption that affricates are stops, in relation to the inventory, which is repeated here for convenience:

21. Obstruent Inventory of Modern Yucatec

	LABIAL	DENTAL/ALVEOLAR	ALVEOPALATAL	VELAR
Stops	p p' b	t t'		k k'
Affricates		ts ts'	č č'	
Fricatives		s	š	

The following general representations are assumed for the coronal obstruents (laryngeal distinctions are not specified; an ejective may be assumed to be Laryngeal [+constricted glottis], a voiced segment to be Laryngeal [+voice]):



Overlap between stops and affricates occurs only in the alveolar region. This may be taken to indicate that [+strident] is active in the phonology. Another possible means of distinguishing the alveolar stops and

affricates is with the feature [distributed]. This is the approach taken by Steriade (1989); she characterizes the difference between the stops and affricates of Modern Yucatec as involving the feature [laminal], rather than [strident]. Steriade is also concerned with showing that the affricates in the inventory are stops, rather than a distinct class of segments. However, other than showing briefly that [laminal] could be substituted for [+continuant] in Lombardi's analysis, Steriade does not work through the details of Modern Yucatec. Of course, the point that the affricates are stops holds regardless of which feature is considered to differentiate the stops from the homorganic affricates. The crucial point is that there is a feature available to distinguish the two, besides some feature of affricatehood. I reject the notion that [laminal] is the salient feature because Straight specifically notes (p. 45) that the [+anterior] sibilants are apical, while the [-anterior] sibilants are laminal. If this is true, the class of laminals would not include both affricates of the language and the feature [+distributed] could not be employed as a cover feature for the class of affricates in Modern Yucatec.

The feature [+strident] may not be considered redundant for the [-anterior] fricative and affricate. If [+strident] were unspecified for [č] and [š], then roots such as *s V č and *ts V š should be permitted. As we will see, they would not be ruled out by any of the constraints of the language. The fact that they are not suggests that [+anterior] (the unmarked value) and [-anterior] fricatives and affricates bear the same feature. Under the assumption that affricates can not be defined by both values for the feature [continuant], that common feature must be [+strident].

Though the inventory provides no indication of which continuant value is active, the fact that stops and affricates, or heterorganic stops occur freely in roots suggests that [+continuant] is active in the phonology, and that [-continuant] is underlyingly absent. The alternative is to assume that [continuant], unlike other terminal features, is immune from either the OCP or the NBC. In fact, the assumption that [-continuant] is unmarked at UR is much more crucial to a dual continuant account, particularly if the continuant values are unordered, to account for the fact that affricates and

stops, or two stops, freely occur in roots. If [-continuant] were specified, each of the following should violate the OCP. Roots such as [k V ts], [ts V k], and [k V t], which are unproblematic, should be ruled out.

23.	a.	b.	c.
	stop affricate	affricate stop	stop stop
	\	\	
	*[-cont] [-cont] \	*[-cont] \ [-cont]	*[-cont] [-cont]
	[+cont]	[+cont]	
	e.g. [k V ts]	e.g. [ts V k]	e.g. [k V t]

Though it may not be completely outside the possibilities afforded by a grammar, it is obviously undesirable to assume, without substantial evidence, that the OCP rules out adjacent [+continuant], but not adjacent [-continuant] features. It is equally undesirable to claim that [-continuant] may branch, while [+continuant] may not. In sum, a specified [-continuant] would, under the assumptions of this thesis, force us to conclude that [continuant] is exempt from constraints governing other features. Under the assumption of an unordered dual continuant affricate, we would be forced to conclude that one particular value for the feature continuant, but not the other, was exempt from those constraints. The assumption that [-continuant] is underlyingly specified is thus more problematic for a dual-continuant account.

The third and fourth assumptions of the proposed analysis have just been implicated in the preceding discussion. Clearly, both are also required under a dual continuant approach. These are assumptions about the role of the OCP and the NBC. In the dual-continuant approach, the OCP is stated as holding over adjacent [+continuant] features. It is now being stated in much more general terms, as holding over adjacent identical features. This formulation receives independent support from elsewhere in the grammar, not to mention being a much more widely assumed effect of the OCP

(Archangeli & Pulleyblank, 1985; Archangeli, 1986; McCarthy, 1986; Pulleyblank, 1986, etc.). This more general formulation receives support from the fourth constraint which states that if the final consonant of a CVC root is [w], then the vowel must be unrounded. If the final consonant is a palatal glide [j], the vowel can not be [i]. This fits with usual current assumptions that these particular vowels and glides differ only in terms of their position in the syllable, not in terms of their features (cf. Clements & Keyser, 1983). It is also worth noting that this constraint contradicts the notion that the consonants and vowels are on distinct tiers, a crucial assumption of the dual continuant analysis. The constraint prohibits what are assumed to be adjacent [+round] and [+high] (or [-anterior]) specifications. Clearly, the effects of the OCP are not limited to prohibiting adjacent [+continuant] features. However, the features [+round] and [+high] would not be adjacent if the consonants and vowel of a CVC root were on distinct tiers.

The fourth assumption of the present proposal is the constraint against branching features. Again, the dual continuant account is required to make a similar assumption, but stating the NBC in terms of a constraint against a branching [+continuant] seems much more stipulative because it fails to relate to other MSCs of the language. To clarify the nature of the relationship between the first three constraints, we begin by considering the first two constraints of Modern Yucatec, which are repeated below:

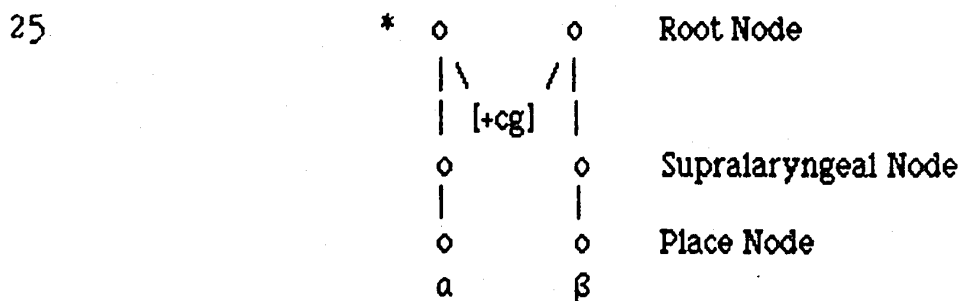
1. If both consonants in a root are ejective, they must be identical;
2. In a CVC root containing occlusive obstruents, one of which is ejective, the two must differ in place of articulation and/or one of the two occlusives must be an affricate;

24. Roots Permitted or Ruled Out by the First Constraint:

a. [p'Vp']	[t'Vt']	[ts'Vts']	[č'Vč']	[k'Vk']
b.*[p'Vt']	*[t'Vp']	*[ts'Vp']	*[č'Vp']	*[k'Vp']

*[p'Vts']	*[t'Vts']	*[ts'Vt']	*[č'Vt']	*[k'Vt']
*[p'Vč']	*[t'Vč']	*[ts'Vč']	*[č'Vts']	*[k'Vts']
*[p'Vk']	*[t'Vk']	*[ts'Vk']	*[č'Vk']	*[k'Vč']

According to the OCP if two adjacent consonants are ejective, the feature must be shared. However, this constraint suggests that if [+constricted glottis] is shared, so must all other features. Ejective consonants with different place of articulation features are prohibited because they are required by the OCP to share a single [+cg] feature. However, with distinct place specifications, they are in violation of the all-or-nothing approach to feature sharing.



Now let us consider this constraint from a different angle. Let us assume a bidirectional restriction to the effect that if two consonants share place specifications, they must share laryngeal specifications as well. The advantage of this perspective becomes clear when the other constraint is considered.

The second constraint restricts the range of possible roots containing a single ejective. The second constraint states that in a CVC root containing two occlusives, one of which is ejective, the two consonants must differ in offset and/or the two consonants must differ in place.

26. Roots Ruled Out By the Second Constraint

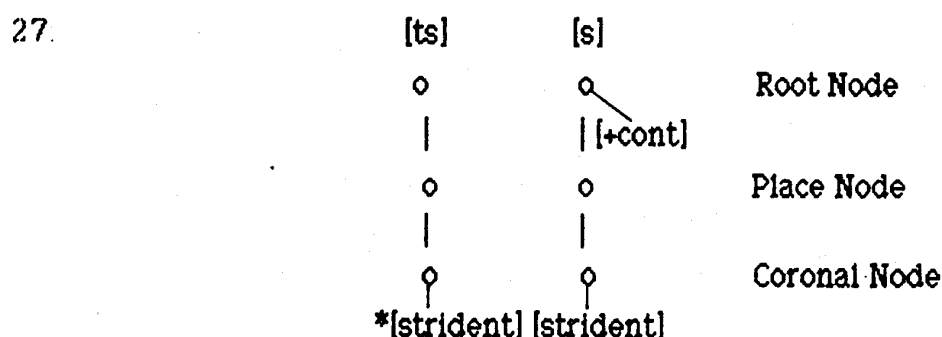
*p' V p	*t' V t	*ts' V ts	*č' V č	*k' V k
*p V p'	*t V t'	*ts V ts'	*č V č'	*k V k'

The implication of the offset condition is that one consonant must be an affricate and the other a stop. If [ts] is a strident stop and [č] a [-anterior] stop, the two conditions on offset and place are united by the following logic. A difference in the abruptness of offset is expressed in the features [+strident] and [-anterior], which distinguish those stops we think of as affricates from others. Because [+strident] and [-anterior] are dependents of the Coronal Node, which in turn depends on the Place Node, a difference in the abruptness of offset is a place difference. In other words, the condition can be reduced to a single statement to the effect that if only one consonant in a CVC root is ejective, the two consonants must differ in place. Thus collapsed, the constraint can be viewed from the opposite perspective as a constraint on consonants that share place features: the constraint then states that if two consonants in a root share place features they must also share a [+cg] feature, if that is present. To sum up, the view that [ts] is a strident stop and [č] a [-anterior] stop, and that these features are Coronal dependents, allows us to unite the two conditions of the second constraint. In turn, this permits us to unite this constraint with the one previously considered. If we assume a constraint against branching features, rather than simply against a branching continuant, the first and second constraints follow as consequences. As we shall see, the same is true of the third constraint.

The third constraint is the one that forms the focus of Lombardi's [+continuant] analysis. Roughly paraphrased, it states that if two consonants in a root are characterized by the feature for fricativehood, the consonants must be identical. In other words, if two consonants in a root share the feature for fricativehood, they also must share the features for place. In the present approach the relevant features are assumed to be [+strident] and

[-anterior]. Viewed from the perspective of a restriction on consonants sharing features, the third constraint, too, indicates that if a feature (in this case, [+strident] and/or [-anterior]), is shared, so are all other features. All three constraints can thus be seen to follow from a more general constraint to the effect that if one feature is shared, so are all others. Modern Yucatec Maya does not permit any nodes or features to branch.

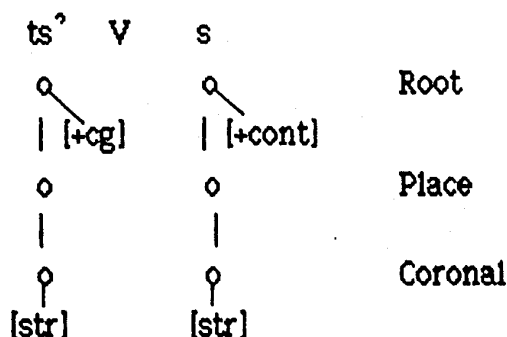
The identity of affricates and fricatives in CVC roots is accounted for in the following way:



The OCP prohibits adjacent identical [+strident] features, but the NBC prohibits the sharing of a single such feature. This results in complete merger. Both consonants are now specified as [+continuant] and [+strident], that is to say [s]. If [+continuant] were not in the hierarchy, both consonants would surface as affricates.

Roots such as [ts' V s] seem to suggest that ejective affricates enjoy some special dispensation from the restrictions of the OCP and the NBC. The assumptions of the present analysis make it possible to show that they do not. Consider the case of a root like [ts' V s], which would be represented as follows (ignoring the specifications of the vowel):

28.



The presence of two adjacent [+strident] features violates the OCP; yet, the two segments can not be merged because one is specified [+constricted glottis] and the other [+continuant]. The crucial fact is not just that one consonant is ejective, but also that the non-ejective is a fricative. Ejective fricatives are extremely rare among the world's languages; they do not occur in Modern Yucatec. However, the OCP might also be satisfied by the deletion of one [+strident] value. Let us arbitrarily assume the rightmost [+strident] is deleted. In fact, the Coronal Node may also violate the OCP (cf. Archangeli & Pulleyblank, 1986) and may therefore also be deleted. The segment will become Coronal by default, and because it still bears a continuant specification, [+strident] as well, thereby obscuring the fact that it has actually conformed to the OCP.

In conclusion, an analysis of the MSCs of Modern Yucatec that is based on the assumption that affricates are stops provides a more comprehensive account than the dual continuant approach. While it requires an equal number of assumptions, those assumptions are much more general. The proposed analysis is motivated, not by the restrictions on affricates and fricatives alone, but by other constraints and processes in the language. Finally, the present approach can be extended to ejective affricates, which are exceptions to the dual-continuant account.

3.4 Classical Yucatec Maya Morpheme Structure Constraints

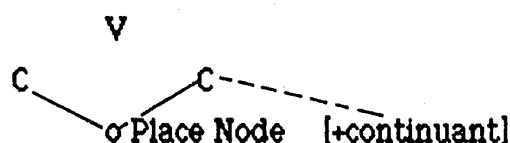
The range of possible CVC roots in Classical Yucatec Maya is shown in the following table, taken directly from Lombardi (1990). The numbers indicate the number of tokens of each type.

29. CVC Roots of Classical Yucatec

First C of CVC Root	Second C of CVC Root											
	p	t	ts	č	k	p'	t'	c'	č'	k'	s	š
p	5	6	2	6	6	0	0	4	3	3	5	4
t	5	5	1	5	7	5	0	5	2	2	4	4
ts	2	0	4	0	4	0	0	0	0	2	0	0
č	1	0	0	4	6	1	0	0	0	5	0	0
k	5	6	6	6	7	2	0	1	2	0	4	4
p'	1	4	0	2	6	1	0	0	0	0	6	3
t'	1	0	1	3	2	0	5	0	0	0	1	1
ts'	2	3	0	0	5	0	0	3	0	0	2	0
č'	3	2	0	1	6	0	0	0	5	0	0	2
k'	6	4	1	7	1	0	0	0	0	4	6	6
s	5	6	0	0	5	4	1	6	0	3	10	0
š	4	3	0	2	7	3	4	0	3	5	0	2

Lombardi claims that if a CVC root of Classical Yucatec Maya (CYM) contains an affricate, the affricate can occur only in the righthand consonant slot. The fact that the order of the affricate is so often predictable argues for the removal of its association line to the feature [+continuant] from the lexical entry (Lombardi, 1990; Archangeli & Pulleyblank, 1986; forthcoming). Lombardi accounts for the (largely) predictable position of the affricate by means of a floating [+continuant] which links right to left:

30.



However, she adds that this restriction holds only of non-glottalized coronal consonants. It does not apply to roots in which one of the consonants is glottalized or if the consonants differ in place of articulation. It is not clear how the floating continuant distinguishes between situations in which it **must** link to the righthand consonant slot and those in which it is permitted to link to the lefthand slot. In concrete terms this means that the following acceptable affricate containing roots are unaccounted for by the generalization that an affricate occurs only in the righthand consonant slot. Those roots in a. are those in which the rightmost consonant is non-coronal; those in b. are those in which the affricate is ejective.

31. Unaccounted-for Roots Containing Affricates

a.	b.
ts V p	ts' V p
ts V k	ts' V k
ts V k'	ts' V s
č V p	č' V p
č V k	č' V t
č V p'	č' V k
č V k'	č' V š

Fricatives are not discussed, but it is reasonable to ask whether they may be incorporated into the analysis, given that they are also presumed to be characterized by [+continuant] underlyingly, or susceptible to [+continuant] linking. In other words, can the distribution of fricatives be accounted for by means of a floating [+continuant] that links right to left?

Unfortunately, using the floating continuant analysis to account for the distribution of fricatives, as well as affricates, results in several more exceptions to the generalization that [+continuant] links to the righthand consonant slot. These are shown in 32.

32. [s V p], [s V t], [s V t'], [ʃ V p], [ʃ V t], [ʃ V k], [ʃ V p'], [ʃ V t'], [ʃ V k']

Among these new counterexamples are four, (s V t, s V t', ʃ V t, ʃ V t'), that do not even fit the profile of exceptions. The rightmost consonant is not non-coronal, nor is an ejective affricate involved. Thus, Lombardi must assume that [+continuant] is underlyingly linked for fricatives, if not for affricates.

One can assume that the unlinked feature is [+strident], rather than [+continuant], since there are no non-strident affricates and fricatives. However, the two approaches are not equally effective. Under a strident analysis, the actual distribution of affricates in Classical Yucatec Maya (CYM) receives a better account. Moreover, a floating feature account can be extended to fricatives, whose distribution can then be incorporated into the analysis. It allows us to account immediately and straightforwardly for all but three apparent exceptions – though even these three can be accommodated within the present framework. The assumptions of a strident analysis are that [ts] and [s] are appropriately (though not underlyingly) characterized as stridents.

Let us assume that [-continuant] is marked underlyingly. Since [+strident] is unlinked at UR, there are no underlying affricates, only ([-continuant]) stops and ([Ø continuant]) fricatives. (The [s] will then be characterized as a bare Root Node.) Because [strident] is a dependent of the Coronal Node, it can not link to a Labial or Dorsal Node.

33

X

^

a. *[strident] [Labial]

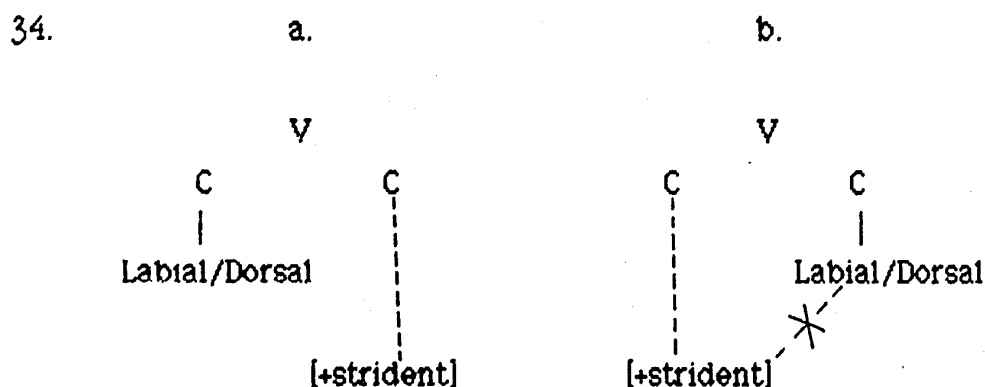
X

^

b. *[strident] [Dorsal]

There is no further discussion of these feature co-occurrence restrictions in Classical Yucatec, but they receive support from the fact that similar restrictions are required to account for Shona and Setswana consonant mutations. These are discussed in chapters Four and Five.

As a result of structural properties (and possibly also a constraint on a branching Place Node, as in Modern Yucatec Maya) the fricatives and coronal stops serve as anchors for a floating morpheme level [+strident]. If the rightmost consonant is neither Labial nor Dorsal, then [+strident] can link. This is shown in 34a. If the rightmost consonant has a Labial or Dorsal Node, [+strident] may not link to the rightmost consonant without violating the feature co-occurrence restrictions stated in 33. The floating [+strident] may in that case link to the lefthand consonant, provided that it does not have incompatible place features. In that case, C₁ is the rightmost appropriate target, as shown in b.



This explains why the affricate can occur in the lefthand consonant slot if the rightmost root consonant has a different (i.e. non-coronal) place of articulation. Under a [strident] analysis, the order of the affricate is shown to be predictable for roots containing both coronal and non-coronal consonants. This analysis also takes care of several roots that are claimed to be exceptions to the [+continuant] analysis by virtue of the fact that the

affricate is ejective. The following examples illustrate that they respond in the same way as non-ejectives, implying that being ejective is irrelevant.

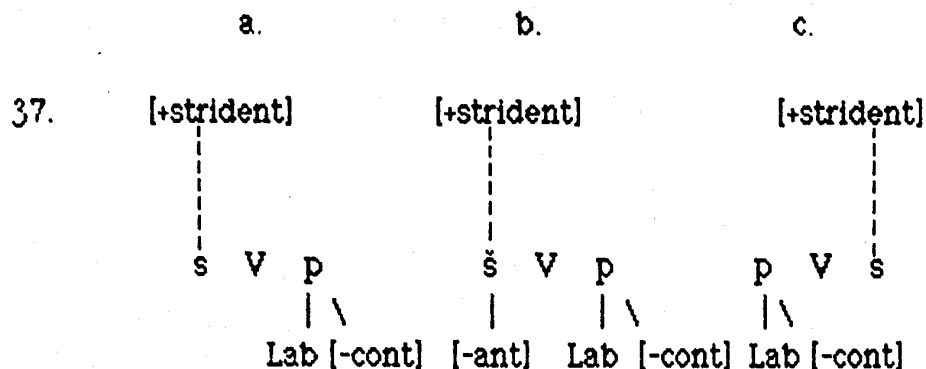
35. a. $\begin{array}{c} [+strident] \\ | \\ ts \quad V \quad p \\ | \quad \quad | \backslash \\ [-cont] \quad Lab \quad [-cont] \end{array}$ b. $\begin{array}{c} [+strident] \\ | \\ ts' \quad V \quad p \\ / | \quad \quad | \backslash \\ [+cg] \quad [-cont] \quad Lab \quad [-cont] \end{array}$
- c. $\begin{array}{c} [+strident] \\ | \\ ts \quad V \quad k \\ | \quad \quad | \backslash \\ [-cont] \quad Dor \quad [-cont] \end{array}$ d. $\begin{array}{c} [+strident] \\ | \\ ts' \quad V \quad k \\ / | \quad \quad | \backslash \\ [+cg] \quad [-cont] \quad Dor \quad [-cont] \end{array}$

Several of the counterexamples contain the alveopalatal affricate, rather than the alveolar. These are accounted for in the same way. The feature [+strident] links right to left, to the first non-labial or non-dorsal consonant, whether it is ejective or not.

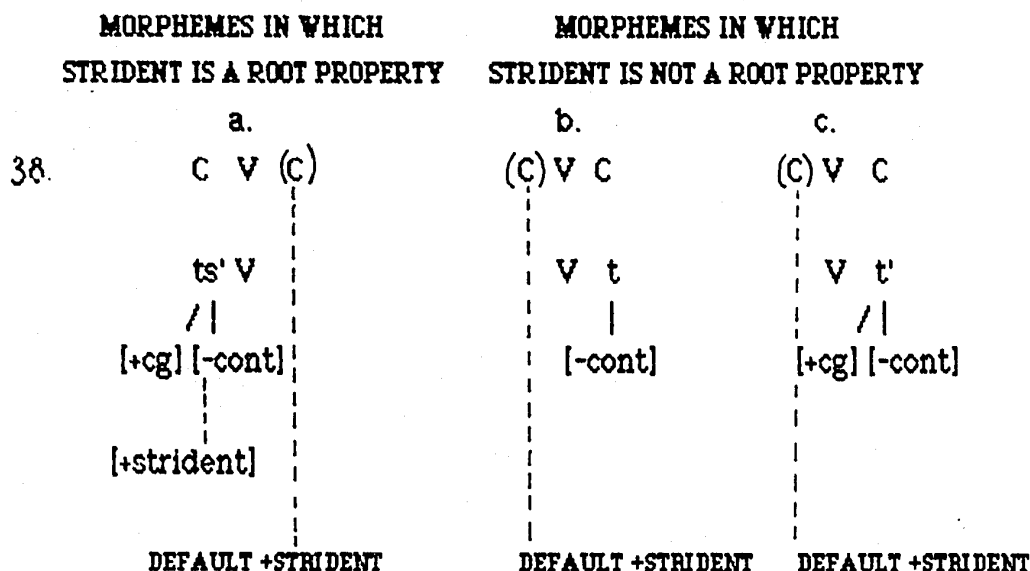
36. a. $\begin{array}{c} [+strident] \\ | \\ \check{c} \quad V \quad p \\ | \backslash \quad \quad | \backslash \\ [-ant] \quad [-cont] \quad Lab \quad [-cont] \end{array}$ b. $\begin{array}{c} [+strident] \\ | \\ \check{c}' \quad V \quad p \\ / | \backslash \quad \quad | \backslash \\ [+cg] \quad [-ant] \quad [-cont] \quad Lab \quad [-cont] \end{array}$

With the exception of three apparent counterexamples, this approach permits us to account straightforwardly for the distribution of fricatives in Classical Yucatec Maya roots. Again, we may assume simply that [+strident] links right to left to the first non-labial or non-dorsal consonant. If the first appropriate consonant is [-continuant], an affricate results. However, if the consonant lacks a continuant specification (or, alternatively, if it is

[+continuant]), it surfaces as a fricative. Three examples are shown here.



This leaves three residual problems, all involving the fricative [s]. These include [ts' V s], [s V t], [s V t']. The question that concerns us is why, in two of these cases, [+strident] does not link to the first appropriate consonant on the right. In [s V t] and [s V t'], the rightmost consonant is an appropriate host according to the criteria that have been set out. They are neither labial nor dorsal, yet they do not become [+strident]. The other problematic root, [ts V s], raises the question of how the feature [+strident] is apparently linked to both consonants of the root, though other cases (e.g. [t V s]) suggest that [+strident] does not spread. The answer lies in the fact that [+strident] is a property of the morpheme, not a property of particular segments at the underlying level and that, if [+continuant] is unmarked, [s] is featureless underlyingly. In all three apparently exceptional roots, [s] may be a default consonant, rather than having been acquired by virtue of the fact that strident is a property of the particular root. The analysis suggests that though the root template is CVC, in these particular cases the underlying content consists only of CV or VC. The surface occurrence of [s] is thus considered to be the result of inserting default values in a manner that satisfies CVC root template requirements.



Not all coronal stops are predictably strident. Placeless [-continuant] segments become Coronal by default, but not [+strident] by default. Affricates result only if [+strident] is introduced by the morpheme. On the other hand, the fricatives of the language are predictably [+strident]; a segment lacking a [-continuant] specification becomes strident even if the feature is not a property of the morpheme.

In sum, there are two ways in which a fricative may become [+strident]. A fricative may surface by virtue of the fact that the feature [+strident] is a property of the root or it may surface as the result of a default specification. One might be tempted to account for all the fricatives by assuming a default [+strident], but this seems unlikely. It suggests that [+strident] is a root property only when an affricate would result, but that it is never a root property if a fricative would result. In addition, such an account would be required to assume that, lexically, [+strident] specifically requires a [-continuant] specification, or that it is repelled by a [+continuant] specification. Either alternative is unattractive and unmotivated. Therefore,

it is assumed that some fricatives are an indication that [+strident] is a property of the root while others are not. The two possible sources for the feature [+strident] feature follow from the assumptions of the analysis. These assumptions and their implications allow us to account, without exception, for the distribution of both affricates and fricatives in Classical Yucatec Maya.

3.5 Processes Pertinent to Basque Affricates

Hualde (1988) presents Stop Voicing and Stop Palatalization in Basque as evidence that affricates are not contour segments as suggested by Sagey, but rather that they are complex segments. That is to say, an affricate's defining features are on different tiers, leaving them phonologically unordered with respect to each other. Hualde continues to assume that the features in question are [-continuant] and [+continuant].¹⁰ I intend to show that affricates need not be considered [+continuant] at all, that they do not, in fact, pattern with fricatives with respect to Stop Voicing and Stop Palatalization. Following discussion of these two processes, Sibilant Harmony and Fricativization in Basque are considered. These processes indicate that, while the Basque affricates are not necessarily [+continuant], they are correctly considered [+strident].

3.5.1 Basque Stop Voicing

For reference, the obstruent inventory of Basque is presented in the following table (Hualde, 1988a). Orthographic symbols, which may cause confusion in transcriptions, are presented in brackets.

¹⁰ As noted in Chapter One, affricates in Basque also pattern with stops. Basque Stop deletion deletes a stop succeeded by a stop and applies to both stops and affricates. It is used by both Hualde and Lombardi to show that affricates pattern with stops and that their continuant specifications can not be ordered, as Sagey suggests. I accept these points, and the process will not be further discussed here. My concern is processes showing affricates patterning with fricatives (or not patterning with stops).

39. Basque Coronal Obstruents

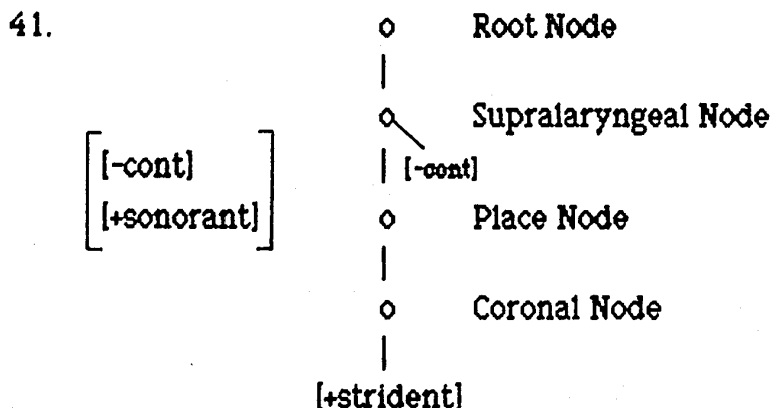
APICAL-DENTALS APICAL-ALVEOLARS LAMINAL-DENTALS (ALVEO)PALATALS

STOPS	[t] [d]			
AFFS.		[ts] [tʰs]	[tʰs] [tʰz]	[tʰ] [tʰx]
FRICS.		[s] [ʃ]	[s] [ʒ]	[ʃ] [x]

A rule voicing stops that follow non-continuant sonorants does not affect affricates.

40. a. /lan-tu/ ---> [landu] 'labour'
 b. /afal-tu/ ---> [afaldu] 'have dinner'
 c. /egin-ko/ ---> [eyingo] 'do, make'
 d. /il-ko/ ---> [ilyo] 'die, kill'
 e. /afal-tsen/ ---> [afaltsen] 'have dinner' *[afaldzen]
 f. /lan-tsen/ ---> [lantsen] 'labour' *[landzen]

Since the trigger is adjacent to the [-continuant] specification of the affricate, they are expected under a contour segment view to undergo voicing. The fact that they do not is an effective argument against the contour segment view, but it does not automatically throw support to a complex segment view of the affricate. Under that view the trigger should still see the affricate's [-continuant] portion and respond by voicing the affricate.



The essential problem for all views, including mine, is to explain the failure of affricates to pattern with stops here.

Though Hualde concedes that a voiced affricate occurs only in 'some Biscayan dialects...in a reduced number of words' (p. 19), he rejects the argument that affricate voicing is blocked by the absence of a voiced affricate. His solution to the problem is to stipulate the existence of what Lombardi calls the Exclusivity Parameter. This determines whether or not a rule can be applied to a segment that contains both values of a given feature rather than just the one value specified by the rule. Basque Stop Voicing is presumably set to target only [-continuant], not [-continuant][+continuant].

Lombardi argues against this ad hoc theoretical device by showing that it is unnecessary. She argues that, contrary to what Hualde claims, voiced affricates may indeed be ruled out on grounds of structure preservation since they occur rarely and under highly constrained conditions. Specifically, she contends that they occur in initial position in a few onomatopoeic words in one dialect. Thus, the affricate does not voice, not because it contains both values for the feature [continuant], but because there are no voiced affricates in Basque. The present approach accepts this line of defense, but views the evidence in a slightly different light. The fact that there are no voiced affricates in Basque is regarded as the result of a co-occurrence restriction against particular features, in this case [+voice] and some feature of the affricate. The presence of [d] in the inventory of obstruents (shown above and again below), along with the fact that stops become voiced following a non-continuant sonorant, indicates that the co-occurrence of [+voice] and [-continuant] is not a problem. However, note that there are no voiced fricatives or affricates in the inventory.

It is reasonable to assume that both the absence of a voiced affricate (or fricative) in the inventory and the failure of affricates to voice following a non-continuant sonorant are due to the incompatibility of [+voice] and [+strident]. Given the fact that vowels and glides are normally voiced, it is not equally reasonable to assume that [+voice] and [+continuant] are incompatible. The [+strident] analysis is thus to be preferred because it

suggests a reason why there are no voiced fricatives or affricates in Basque and predicts that processes that might bring about the co-occurrence of incompatible features are blocked. Moreover, a co-occurrence restriction against the features [+voice] and [+strident] is not particularly unusual across languages (cf. Maddieson, 1984 and discussion of Shona and Setswana in Chapter Four and Five). Further arguments for assuming that the affricates are strident stops, rather than being characterized by both values for the feature [continuant] are provided subsequently.

3.5.2 Basque Stop Palatalization

The explanation for the affricate's failure to undergo stop palatalization following [i] is not quite so obvious. Hualde notes that among the coronals [s] and [ts] fail to palatalize, suggesting that [+continuant] segments are exempt. We might replace the feature in question with [+strident] and assume that [+strident] blocks the application of the rule. The claim is then that all coronals except those that are [+strident] palatalize.

42. a. /itaun/ ---> [itjaun] 'question'
 b. /iʃudi-tu/ ---> [iʃuditʃu] 'imagine' (perf.)
 c. /mutil-a/ ---> [mutilja] 'the boy' (abs.)
 d. /ipin-i/ ---> [ipinji] 'put' (perf.)
 e. /gison/ ---> [gison] 'man'
 f. /itsaʃ-i/ ---> [itsaʃi] 'awake' (perf.)

Example b. indicates that this is not entirely accurate since neither /ʃ/ nor /tʃ/ palatalize. While these segments are arguably characterized as [+continuant], they most certainly are not [+strident]. This seems to support a [+continuant] analysis, if not the theoretical device of Exclusivity.

However, if the apical and laminal distinction is interpreted as a place distinction (cf. Ladefoged & Maddieson, 1984), the stops and affricates of Basque are in complementary distribution. The distinction between the

affricates and the stop can therefore be expressed as a place difference rather than requiring that stops are characterized by [-continuant] and affricates by both values for continuant.

43. Basque Obstruents

	APICAL-DENTALS	APICAL-ALVEOLARS	LAMINAL-DENTALS	(ALVEO)PALATALS
STOPS	[t] [d]			
AFFS.		[ts]	[tʃ]	[tʃ]
FRICS.		[s]	[ʃ]	[ʃ]

The rule of stop palatalization can be formulated to target a subclass of coronal stops, defined in terms of place of articulation, that does not include an affricate. Lombardi suggests something of this nature when she proposes that the segments are characterized as follows and that the palatalization rule actually targets [-distributed] coronal stops.

44. Lombardi's Characterization of Basque Obstruents

	[t]	[ts][s]	[tʃ][ʃ]	[tʃ][ʃ]	[l][n]
[distributed]	-	-	+	+	-
[anterior]	+	+	+	-	+

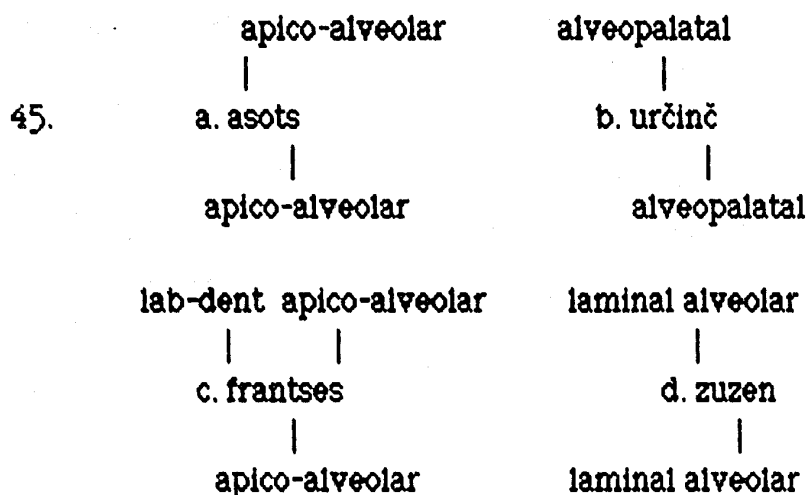
Crucial to Lombardi's analysis is the loss of a distinction between apical-alveolars and laminal-alveolars which results in the loss of the [-distributed] apical-alveolar affricate. This leaves only affricates that are [+distributed]. Because only [-distributed] Coronal stops are targeted, the set of segments that palatalizes includes the remaining [-distributed] stops [t, ɲ, n]. The failure of an affricate to palatalize is attributed to the absence of a

[-distributed] affricate. Lombardi thus demonstrates that it is unnecessary to appeal to an Exclusivity parameter which is theoretically undesirable and stipulative. In the final analysis, Lombardi is forced to rely on the notion that in Basque the affricates and stops are in complementary distribution with respect to place of articulation. However, their complementary distribution is accidental under the assumption that affricates are characterized as a distinct obstruent class. In contrast, it is expected if affricates are underlyingly characterized as stops.

3.5.3 *Basque Sibilant Harmony*

The reformulations of Basque Stop Voicing and Stop Palatalization demonstrate that we are not forced to assume that affricates are [+continuant] or that they are patterning with fricatives. That does not necessarily mean that they are [+strident]. In fact, the preceding analysis suggests that the relevant distinctions may be carried by the feature [distributed]. However, arguments that affricates are [+strident] are provided by Hualde, through his discussion of other processes involving the affricates of Basque. Although he assumes that affricates are complex, as opposed to contour segments, he nonetheless considers them to be characterized by both continuant values. Yet in order to describe the behaviour of affricates, Hualde is still required to assume that the coronal fricatives and affricates are [+strident]. To begin with, Hualde states that affricates pattern with stops and **sibilant** fricatives. Examples of this patterning are found in the process of Sibilant Harmony which requires all sibilants within a morpheme to share the same point of articulation. The rule can not be stated in terms of [+continuant] because the labiodental fricative [f] does not participate in the harmony. The rule can not be stated in terms of [distributed], because the process affects laminal alveolars, apical alveolars, and palatoalveolars, that is, both [+distributed] and [-distributed] segments. Moreover, the laminal/apical distinction is not made in any of the

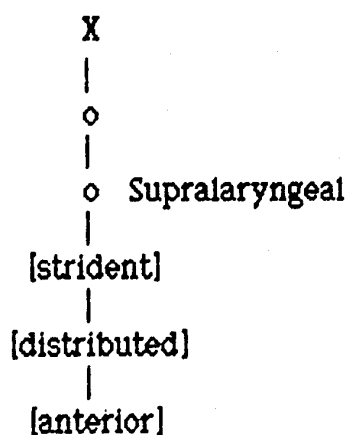
Biscay dialects, or in some parts of the Guipuscoa, though the process of Sibilant Harmony is apparently found in all dialects.



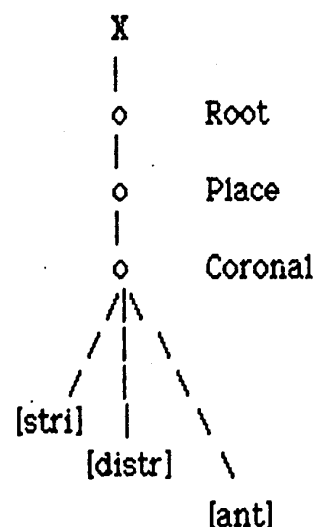
Hualde argues that [+distributed] is, in fact, a property of the morpheme that links to the leftmost strident and spreads rightward. This rule ignores [t], [d], [n], and [l], suggesting that they lack place features at this level. One might argue that there are no [distributed] distinctions for any of these segments, but this misses a generalization. Anterior harmony also ignores [n] and [l], though [ɲ] and [ʎ] are segments of the inventory. Attributing transparency to a lack of place features allows us to account for the exception of [t], [d], [l], [n] in a unified way. By this reasoning, the stridents must be specified for a Coronal Node, and thus coronal dependents. The fact that [distributed] is a property of the morpheme, rather than of individual segments, means that [distributed] is not the sub-coronal feature in question. In keeping with assumptions of radical underspecification, [strident] must be the salient feature. Hualde assumes that since [distributed] distinguishes only sibilants, it docks directly onto [strident]. He similarly assumes that [anterior] subsequently links directly onto [distributed]. Strident is further assumed to be a dependent of the Supralaryngeal Node. The net result of these assumptions is a rather unorthodox structure, as shown below. If features are allowed to dock onto other features, in

defiance of the normal structural relationships, the theory of feature geometry will be considerably weakened. A more conventional account is achieved by assuming that [strident] is a coronal dependent, along with the features [distributed] and [anterior]. I interpret the standard dependency relations of the feature hierarchy (Clements, 1985; Sagey, 1986; Archangeli & Pulleyblank, 1986; McCarthy, 1989, etc.) more strictly and assume that [distributed] and [anterior] dock onto the Coronal Node, which is present because [strident] is specified. These contrasting views are illustrated in a. and b. respectively.

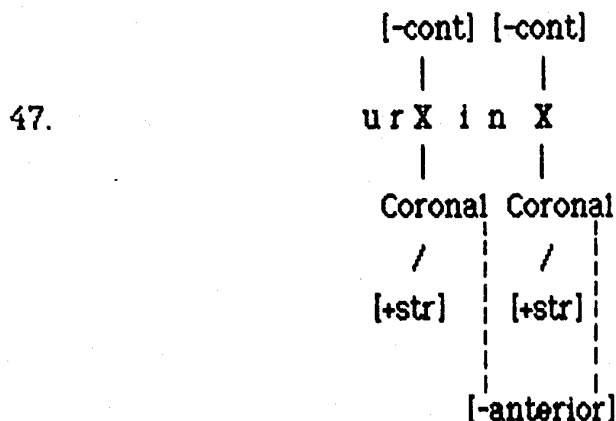
46. a. Hualde's View



b. The Proposed Representation



The derivation of a word in which [-anterior] is a morphemic property would be as follows (issues of iterativity versus automatic spread are ignored):

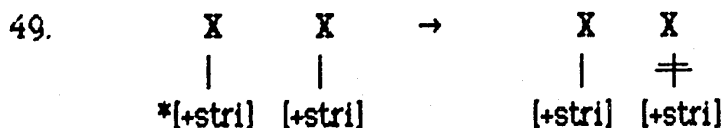


3.5.4 Basque Sibilant Deletion

Another rule of Basque deletes the second sibilant of a sequence consisting of a sibilant fricative and an affricate or two sibilant fricatives. Some examples are shown here (the process of Sibilant Harmony is ignored):

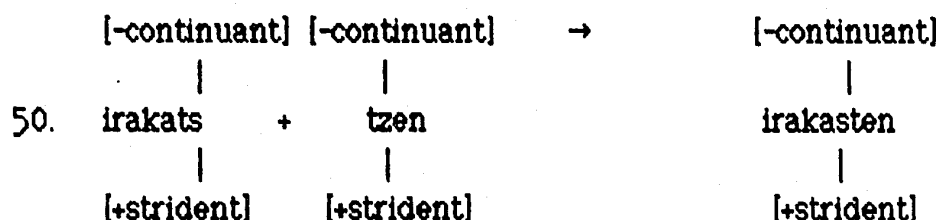
- 48.
- a. ikas- 'learn' + tzen 'imperfect' > ikasten
 - b. irabaz- 'earn' + tzen 'imperfect' > irabazten
 - c. ipin- 'put' + tzen 'imperfect' > ipintzen
 - d. irakats- 'teach' + tzen 'imperfect' → irakasten

This looks like an OCP effect on the feature [+strident]. When the morphology juxtaposes two [+strident] specifications, the rightmost is deleted, leaving a homorganic stop. The rule is shown here:

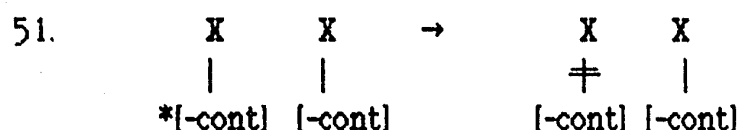


The idea that the OCP is at the root of this deletion is supported by the fact that a sequence of two affricates created by the morphology is

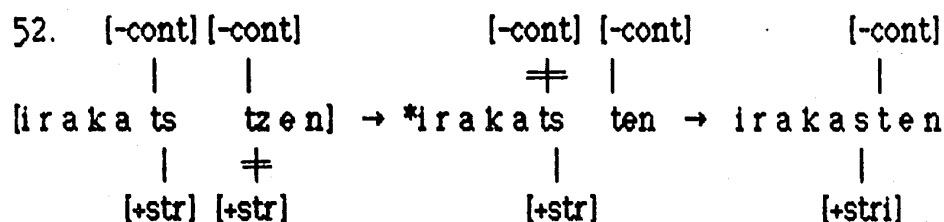
converted to a fricative-stop sequence.



We can assume that two adjacent [-continuant] specifications, like two adjacent [+strident] specifications, violates the OCP. In this case, the leftmost [-continuant] deletes, leaving a fricative-stop sequence.



The derivation of 50. must occur as follows (features irrelevant to the analysis are omitted, for the sake of simplicity):



The rightmost strident delinks, leaving [tz] specified [-continuant]. However, adjacent [-continuant] features are also in violation of the OCP. Deletion of the leftmost [-continuant] corrects this problem and yields the correct output, irakasten. Whether [-continuant] delinking is ordered with respect to [+strident] delinking is unclear and, for present purposes, the question is irrelevant.

Considered together, the facts of Basque suggest that affricates must be considered stops. First of all, the affricates are shown to be in complementary distribution with stops in the inventory. More important, there are processes in Basque that treat stops and affricates as a natural class. The phonology of Basque also suggests that even if affricates and fricatives are commonly characterized as [+continuant], they must still be specified as [+strident]. However, when the affricates and fricatives are characterized as [strident], the feature [+continuant] is rendered redundant. It is certainly not necessary to consider affricates [+continuant]. When affricates actively pattern together with fricatives, it is by virtue of [+strident] rather than [+continuant]. In short, it is necessary to characterize the coronal fricatives and affricates as [+strident] stops, but doing so renders the feature [+continuant] gratuitous.

3.6 Conclusions

All the rules and constraints considered here indicate that affricates need not have both values for continuant to explain the duality of their patterning. Without dispute, affricates pattern with stops. We therefore assume that they are characterized as stops. However, it is not clear that affricates pattern together with fricatives generally. All the rules considered here show that only the sibilant affricates and fricatives pattern together. Rules showing a range of affricates and fricatives patterning together are notably absent. Characterizing affricates with both continuant values and assuming that they pattern together with fricatives by virtue of a common [+continuant] feature is, therefore, inadequate. Rules such as English Plural Formation and Basque Sibilant Harmony indicate the weakness of the characterization. Without additional restrictions, the [+continuant] characterization inaccurately suggests that all affricates and fricatives are affected. Additional requirements, such as imposing a strident restriction, must consistently be stated to explain why most members of the assumed

class are unaffected. This raises the point that, while the [+continuant] specification of affricates is always superfluous, the feature [strident] is not. Even those accounts which assume the affricate to be characterized by both continuant values are required to assume that the dental/alveolar and alveopalatal fricatives and affricates are [+strident]. Thus the view that these affricates are [+strident], rather than [+continuant], is more economical. It simply exploits assumptions that are, for the most part, made anyway. Economy is also gained by assuming that [strident] is a coronal dependent. For example, under a continuant account, Sibilant Harmony must specify two apparently unrelated conditions on targets, continuancy and coronal place of articulation. Under a continuant account, the distribution of affricates with respect to other consonants in Classical Yucatec Maya roots must include a stipulation that the condition holds only of Coronals. In contrast, the present account has argued that [+strident] is dependent on the Coronal Node; if a target is [+strident], it is necessarily [Coronal] as well. If a process targets coronals, it will affect specified stridents, by virtue of the fact that having a [strident] specification entails having a specified Coronal Node. The evidence clearly indicates that affricates do not pattern with fricatives generally; it also suggests that the subset of affricates and fricatives that does pattern together is appropriately characterized as strident.

Chapter Four

Strident Stop Affricates in the Analysis of Shona and Setswana Causatives

The assumption that [ts] is a strident stop provides the tools for an elegant and insightful analysis of Shona and Setswana causatives. Though the inventory of a language is an important source of information that should not be ignored, the final arbiter of an appropriate segment representation is the phonology of the language. Phonological processes, as well as distribution in segment inventories, must confirm a proposed feature makeup. For instance, processes that bring together the features [-continuant] and [+strident] should result in the formation of coronal affricates and exclude the formation of non-coronal affricates. Such processes should further rule out the possibility that affricate formation is attributable to bringing together both values for the feature [continuant]. The identification of relevant processes must begin with the study of languages exhibiting at least the following characteristics:

- An array of affricates, including those that are non-coronal;
- Phonological processes involving affricates that force us to go beyond the familiar, if not fully understood, processes of palatalization.

Southern Bantu languages, of which Shona and Setswana are two representative examples, are appropriate. Each has a larger-than-usual inventory of affricates: Shona has labiodental affricates [pf] and [bv] and prenasalized [ɲdʒ], in addition to coronal affricates; Setswana has velar affricate [kx] and lateral affricate [tɬ], as well as the more usual coronal affricates. In addition, Setswana contrasts aspirated and ejective stops and affricates, the distribution of which has already been shown to be relevant to the deduction of an appropriate affricate representation (cf. discussion in

Chapter Two). Complete obstruent inventories for the two languages are provided shortly.

Both Setswana and Shona are characterized by morphological processes that result in the formation of coronal affricates from a variety of segments that includes both stops and fricatives. The particular morphological process that forms the basis for discussion in this chapter is causative formation. There is sufficient variation in the consonant mutations of causative formation within and between the two languages that considerable insight into the representation of the affricate can be gained from a comparison. Because the treatment of each language is fairly extensive, the facts and analysis of each are presented separately. The mutations of Shona are less complex and will serve as an introduction to the mutations of Setswana.

4.1 Shona Causatives

Shona forms the causative either by suffixing -isa (or -esa if the stem vowel is non-high) to the verb stem, or by mutation of the final consonant of the verb stem. Some representative data are shown in 1 a. - h.

The conditions that determine which stems undergo mutation and which form the causative via suffixation are not entirely clear. The identity of the final consonant plays some role, insofar as certain consonants are more likely to undergo mutation than others (there is some discussion of this in the course of the analysis). However, two stems ending in the same consonant may form the causative in different ways, (cf. 1 a. and c. below), so the conditioning factors are, at most, only partly phonological. Some items may form the causative by either suffixation or mutation but, in Shona, the alternatives vary slightly in meaning (cf. 1 i.). The primary sources of information about Shona are Doke (1931 and 1954); where additional sources or particular pages in these primary sources are relevant, specific references are provided.

1.
 - a. -bika 'cook' → -bikisa 'make (someone) cook'
 - b. -enda 'go' → -endesa 'make (someone) go'
 - c. -seka 'laugh' → -setsa 'make (someone) laugh'
 - d. -rira 'make a sound' → -ridza 'cause (someone) to make a sound'
 - e. -reba 'be long' → -redzva 'lengthen'
 - f. -tégá 'buy' → -ténzá 'sell'
 - g. -fióróǵá 'be moist, soft' → -fiórózvá 'soften, moisten'
 - h. -net- 'become tired' → -netsa 'make tired'
 - i. -kwírá 'go up, climb' → -kwírísá 'make (someone) climb' or
-kwídzá 'lift up'

The focus of the ensuing discussion is the consonant mutations of causative formation; suffixation is referred to only insofar as it sheds light on mutation. In the following derivations, only the verb radical is shown. The final vowel [a] that normally appears on the verb stem is omitted for the sake of clarity; it is an indication of voice that is always added, following any other processes to which the verb is subjected.

2. The Consonant Inventory of Shona

	LABIAL	LABIO- DENTAL	LABIO- CORONAL	DENTAL/ ALVEOLAR	ALVEO- PALATAL	VELAR	PHARYN- GEAL
STOPS							
voiceless	p	pʃ	tʃv	t̪ ts	tʃ̥	k	*
voiced	b	bʋ	dʒv	d̪ dz	dʒ	g	*
				r			
FRICATIVES							
voiceless	*	f	sv	s̥	ʃ̥	*	h
voiced	β	v	zv	z̥	ʒ̥	*	ɦ

PRENASALS	mb	mv	nzv	nd nz	ñdž	ŋg	*
NASALS	m	*	*	n	ñ	ŋ	*
GLIDES	w	*	*	j	*	*	

4.1.1 Description of Relevant and Less Familiar Sounds

Provided here as a preamble to the analysis and a justification for the segment representations assumed is a brief articulatory and behavioural description of sounds that are less familiar and particularly relevant to the discussion of causative mutation. The sounds [sv], [zv], [nzv], [tsv], and [dzv] are so-called 'whistling' sounds. These are termed labioalveolars by Doke (1954, p. 207) and "in the pronunciation of these there is lip-rounding and tongue-flattening to such an extent that considerable hissing (rather than whistling) accompanies the articulation".

The voiceless explosive stops in Shona are articulated with varying degrees of aspiration, depending on the dialect, but there is no contrast between ejective and aspirated stops as there is in Setswana. Except for the implosives, voiced consonants are murmur-voiced. Some sources (e.g. Doke, 1931; 1954; Myers, 1990) suggest that, in addition to implosives [ɓ] and [ɗ], Shona has (murmur) voiced alveolar explosives [b] and [d]. However, there are good reasons to reject this view. First, no phonemic contrasts are based on this distinction, as acknowledged by Doke. Second, [b] and [d] are not commonly found alone before vowels in Shona (Doke, 1931, p. 41). They are noted to be preceded by a homorganic nasal, which is to say that they occur as part of a prenasalized stop. In cases where they do not occur as part of a prenasalized stop, [b] and [d] occur only in words borrowed from English or Afrikaans, or in onomatopoeic words (Doke, 1931, p. 38). Additionally supporting the dismissal of [b] and [d] from the underlying inventory is the fact that alternations between voiced and voiceless stops involve, not [b] and [d], but implosives [ɓ] and [ɗ] (e.g. banga 'knife' > mapanga 'knives'; d'anga

'kraal' > matanga 'kraals'). Thus, I assume that [b] and [d] should not be considered part of the underlying inventory of Shona. The voiced velar is, however, always explosive; there is no velar implosive in Shona. This is in accord with the cross-linguistic rarity of velar implosives (Maddieson, 1984) compared to bilabial and dental/alveolar implosives.

The Shona [r] is phonetically and phonologically non-sonorant. Phonetically, it is reported to be a "fully rolled alveolar lingual" (Doke, 1931, p. 72) or a flap, often designated [d]. MacKay (personal communication) notes that it is phonetically incorrect to class all r-sounds together as sonorants. The sonorant r-sounds, such as occur in North American English, display clear formant structure, whereas trilled, fricative, and flapped r-sounds do not. There is also phonological evidence for the non-sonorant status of Shona [r]. It is claimed to alternate with [d] in Shona (cf. Doke, 1931, p. 72). Recall from the preceding discussion of Shona explosives that [d] occurs principally as part of the prenasalized alveolar stop [nd]. Specifically, in causative formation and in Class 9/10 mutation, which is not discussed here (but see Myers, 1990 for a discussion), [r] mutates to [nd] under the influence of the nasal. Therefore, whenever [r], as such, occurs it is as a rolled alveolar; in its alternations, it really alternates with [nd], rather than [d] itself. There is, in fact, a convincing body of phonological evidence that Shona [r] is not a sonorant, but an obstruent (see Myers, 1990, p. 40). Cross-dialectal variation also supports this view. Where [r] occurs in some Eastern Shona dialects, others substitute the alveopalatal affricate [tʃ]. Within the Eastern dialects, there are alternations between [r] and the flapped lateral. The latter occurs before [i] and is often represented orthographically as d. In sum, where [r] occurs in this particular dialect, different obstruents occur in others. In still other dialects, [r] patterns with stops and fricatives in a process that Doke (1931) calls velarization, which generally changes stops and fricatives to stops with a (labio)velar place of articulation. [r] becomes [g^w]. Whether non-sonorant [r] is phonetically a stop or a fricative is debatable; a phonetic argument could be made either way for the rolled [r].

Myers (1990) argues that it is phonologically a stop. The behaviour of [r] in causative formation, to be discussed subsequently, confirms this assumption.

The segment [β] is considered by Myers (1990) to be a bilabial sonorant (a liquid, to be specific), but it is described by Doke as a 'denti-labial semivowel' phonetically. In fact, there is evidence that [β] is phonologically a fricative. In his discussion of this sound, Doke (1931) observes that it is in complementary distribution with the labiodental fricative cross-dialectally. The Zezeru dialect of Central Shona, which is the dialect of interest here and which I assume to be the dialect referred to by Myers, lacks a bilabial fricative phonetically, but has a bilabial sonorant [β]. The same is true of the Tavara dialect. In contrast, the Karanga dialect of Central Shona and the Nambzuya dialect have a bilabial fricative, but lack a bilabial sonorant. The Korekore dialect of Central Shona has a bilabial fricative and a bilabial sonorant that are considered variants of the same sound. For the Ndau dialect, Doke specifically lists [β] as a variant of the bilabial fricative. The first point to be taken from this is that there is no dialect of Shona that has both a bilabial fricative and a bilabial sonorant phoneme. In dialects where both occur, the bilabial sonorant and the bilabial fricative are variants of a single sound. The question is whether this sound is represented phonologically as a sonorant or a fricative.

Other phonological evidence to determine whether the sound is a fricative or a sonorant underlyingly seems scanty, but [β] certainly does not appear to behave like the glide that Doke claims it to be phonetically. For instance, it is not involved in the process of consonantalization whereby vowels become glides before vowels. This process converts [i] to [j] and [u] or [o] to [w]; [β] is not involved. Another reason to reject the notion that [β] is a glide comes from mutations associated with the nasal. In forming the plural of certain noun classes, a nasal is prefixed to the noun stem. If the stem begins with the glide [j], the plural form begins with [ɲj]; if the stem begins with the glide [w], the plural form begins with [ɲw]. However, stems beginning with [β] undergo mutation to [mb].

3. a. -βoni 'pupil (of the eye)' → mboni 'pupils'
 b. -βeβa 'mouse' → mbeβa 'mice'

In sum, it seems that [β] is not a glide phonologically. Unfortunately, evidence that it is not a sonorant at all is less conclusive. However, it should be noted that there is a marked lack of evidence, besides its phonetic realization, that it is a sonorant or that it is **not** a fricative. I assume that, phonologically, [β] is a fricative.

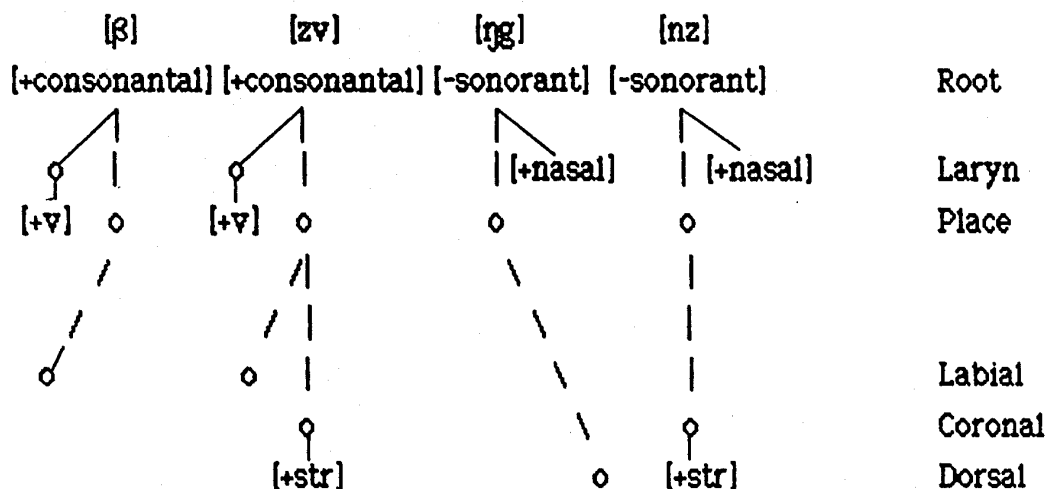
Prior to turning to the representation of segments relevant to the discussion of causatives, one further articulatory fact is of importance. The coronals [t], [nd], [s], [z], are dental; dialect variation involves the degree of dentality, from definite tongue protrusion to simply touching the back of the upper teeth with the tongue tip. The realization of [n] is preferably dental, but alveolar [n] is reported for some dialects. The affricates [ts] and [dz] and the whistling fricatives are noted to be alveolar, not dental.

4.1.2 Segment Representations

Let us turn now to the feature representations that are assumed for the obstruents of Shona. The following consonants undergo mutation in causative formation.

4. b → dzv k → ts
 t → ts β → zv
 r → dz ng → nz

In accordance with the discussion in Chapter Two of this thesis, the affricates are considered stops. Because of processes in Shona such as Nasal Hardening and Strengthening, that are not discussed here (but see Myers 1990;1991 and Chapter Five of this thesis), [-continuant] is assumed to be the active continuant value. The stops are thus characterized by a [-continuant] linked



The representation of the affricate [ts] has been discussed at length and justified in previous chapters. Implosion is assumed to be a phonetic fact in Shona; the bilabial and alveolar voiced stops are realized phonetically as implosives, rather than explosives. Independent justification for this assumption, apart from the consonant mutations of causative formation, is found in Nasal Strengthening alternations (e.g. -bud- 'come out' > mbudo 'mousehole'; -bat- 'grasp' > mbato 'pincers'; -berek- 'carry a baby' > mbereko 'carrying skin') and in the lack of contrast between voiced explosives and implosives. If implosion were phonologically specified, it would consistently be required to delink, leading to a complication, not only of causative formation, but of Nasal Strengthening as well.

Consider now the representation proposed for the prenasalized segments. One of the most notable features of the Shona inventory is the occurrence of prenasalized stops, fricatives, and affricates. The distribution of affricates in inventories (Chapter Two) has been used to argue that affricates do not need to be distinguished from stops by their specifications for the feature [continuant]. The same is true for the prenasalized stops and affricates of Shona. In fact, closer consideration of the prenasalized obstruents reveals that, on the whole, prenasalized stops, fricatives, and affricates are in complementary distribution with respect to place of articulation. That is to say that among the prenasals one does not need to

distinguish among stops, affricates, or fricatives on the basis of the feature [continuant]. For convenience the prenasalized segments of Shona are isolated from the rest of the consonant inventory in the table below:

6 Prenasalized Obstruents of Shona

	LABIAL	LABIO- DENTAL	LABIO- CORONAL	CORONAL	ALVEO- PALATAL	DORSAL
STOPS	mb	*	*	nd	*	ŋg
FRICATIVES	*	mv	nzv	nz	*	*
AFFRICATES	*	*	*	*	ndž	*

The pattern of distribution suggests that prenasalized segments are not distinguished on the basis of being stops, affricates, or fricatives, but on the basis of being prenasals with a particular place of articulation. As in the case of affricates, overlap occurs in the coronal region and the overlapping segments can be distinguished by means of sub-coronal features, notably the feature [+strident]. The analysis presented here goes even further by assuming that prenasalization is not represented by both values for the feature [nasal].¹¹ Instead, they are assumed to be generally characterized as [+nasal] and [-sonorant], that is to say, non-sonorant nasals. This is not crucial to the analysis, which would remain centrally unaffected if prenasalized obstruents are defined as [+nasal] [-nasal].

Finally, let us consider the representation proposed for [r]. It has already been stated that [r] is non-sonorant phonetically and phonologically. The alternations in which it participates, cross dialectally and within the

¹¹ Tourville (1992) focuses on the licensing mechanisms for the feature [nasal] and given the principles she proposes, it is impossible to license both values for the feature [nasal] for a single segment. She concludes that contour prenasalized stops can not be derived. On the assumption that derived segments do not differ structurally from underlying ones, underlying contour segment prenasalized stops are likewise prohibited.

processes of a single dialect, further indicate that it is phonologically a stop. In present terms this means that it is [-continuant]. A good deal of work remains to be done with respect to establishing the most appropriate representations for the range of r-sounds that occurs in the world's languages. What is offered here must be considered tentative, though not arbitrary. The alveolar place of articulation indicates that the Shona [r] is coronal; the fact that it alternates with voiced sounds suggests that its voicing is specified. This is consistent with the assumption that it is non-sonorant. Nonetheless, [r] must be distinguished from [d'], which is also a voiced coronal. The alternations of [b] and lack of contrast between implosives and explosives, generally, led to the conclusion that implosion is not phonologically marked at the level of underlying representation. Therefore, we can not rely on a feature for implosion to characterize the difference between [d'] and [r]. However, note that some coronal obstruents, including [t], are dental, whereas [r] is alveolar. Therefore, the [r] may be distinguished as a [-distributed] voiced coronal stop, whereas the dentals may be redundantly [+distributed]. This follows the line of reasoning opened by Myers to a more amenable conclusion. Again, nothing crucial hinges on the assumption that Shona [r] is a [-distributed] stop.

4.1.3 The Analysis of Shona Causatives

The above representations provide the tools for the analysis of Shona causative mutations. The present approach takes as its point of departure an idea fundamental to the analysis of Shona causatives proposed by Myers (1990; 1991). That analysis suggests that, rather than there being two causative processes, one of which involves consonant mutation and the other simple suffixation, there is a single causative suffix that has two possible effects. Myers assumes the single causative suffix to be -s. That segment is characterized as [+continuant]. However, its effects in causative mutation require that it be further characterized as [Coronal], though it lacks a coronal dependent. The present approach could be characterized as a formalization

of Myers' claim within a theory of underspecification and a demonstration of the advantages of that formalization. In fact, the present analysis goes somewhat beyond what is necessary to accomplish this. It assumes that the causative morpheme is a floating feature [+strident], rather than a segment per se. These two views do not make identical predictions and the analysis of Setswana, which is closely related to Shona, indicates that a floating [strident] is to be preferred. The alternations of Strengthening in Setswana (see Chapter Five) indicate that voiceless fricatives are phonologically specified [+spread glottis], in addition to their other feature specifications. If [s] were the causative suffix in Setswana, rather than simply the feature [strident], then it should create aspirated consonants when it merges with the final consonant of the stem. This is not what happens in Setswana, indicating that an analysis in terms of the floating feature [strident], rather than [s], is to be preferred. Shona lacks this direct evidence in favour of a floating strident, though when Myers' suffixation analysis of Shona is subsequently considered, we will see that a floating strident analysis is less cumbersome than assuming that the causative is the segment -s, per se.

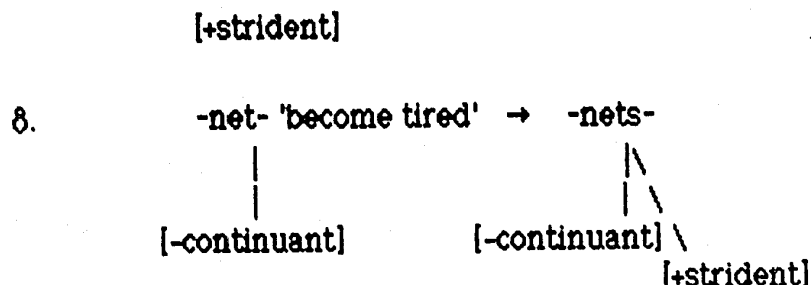
7. Shona causative examples

- a. -bika 'cook' → -bíkisa 'make (someone) cook'
b. -enda 'go' → -endesa 'make (someone) go'
c. -seka 'laugh' → -setsa 'make (someone) laugh'
d. -rira 'make a sound' → -ridza 'cause (someone) to make a sound'
e. -reba 'be long' → -redzva 'lengthen'
f. -tégá 'buy' → -ténzá 'sell'
g. -ñóróṣá 'be moist, soft' → -ñórózá 'soften, moisten'
h. -net- 'become tired' → -netsa 'make (someone) tired'
i. -kwírá 'go up, climb' → -kwírísá 'make (someone) climb' or
-kwídzá 'lift up'

In some cases the causative feature links to the final stem consonant, creating consonant mutation as shown in 7. c. - h. above. In other cases, [+strident] does not conjoin, but links to an empty slot, surfacing as [s]. When this occurs, it triggers epenthesis. This is manifest in examples a. and b. above. Epenthesis is justified at length by Myers (1990; 1991), its motivation being the impermissibility of consonant clusters in Shona. If the feature [+strident] does not meld with the final consonant of the stem, it surfaces as a consonant in its own right. However, it can not surface in the position immediately adjacent to the final consonant of the stem because of the constraint on consonant clusters in Shona. As previously mentioned, the concern of this chapter is mutation, rather than suffixation.

From Stop to Affricate: [t] → [ts], [r] → [dz], [b] → [dzv], [k] → [ts]

The mutations [t] → [ts] and [r] → [dz] are particularly straightforward. The causative feature [+strident] links to the rightmost consonant of the stem, which in the case of [t] bears only the feature specification [-continuant]. This creates a co-occurrence of the features [-continuant] and [+strident], which characterize the Coronal affricate [ts]. The voiceless coronal stop is redundantly [-distributed], but the stridents are redundantly [-distributed], which is to say, alveolar. Thus, in causative formation, [t] → [ts] (structure irrelevant to the discussion is not shown).



Even though [t] is underlyingly placeless (Paradis & Prunet, 1988; 1989; 1991), there is no problem; segments that become [+strident] must become

[Coronal], since [+strident] is a Coronal dependent (see the diagram for [ts] in 4.1.2). I am therefore assuming that the docking of [+strident] generates a Coronal Node that will be shown in all the following diagrams enclosed in parentheses. The formulation of Node Generation presented here is taken from Archangeli & Pulleyblank (forthcoming).

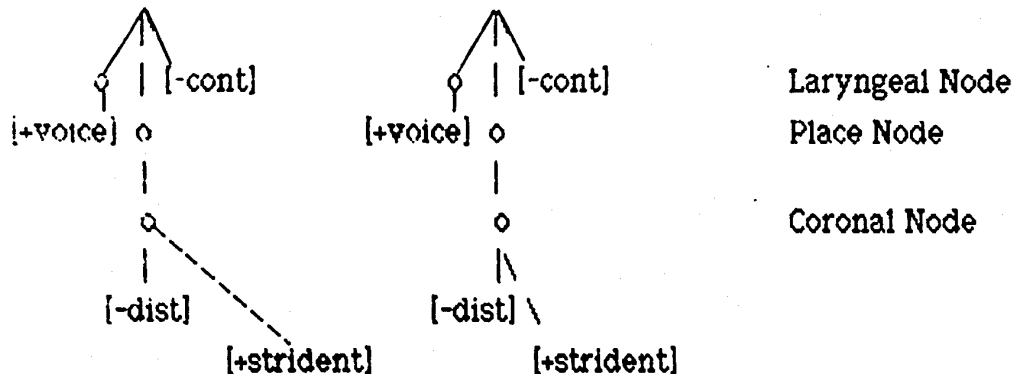
9. Node Generation

A rule or convention assigning some F-element α to some anchor β creates a path from α to β .

A path is informally construed as a set of associated nodes or features.

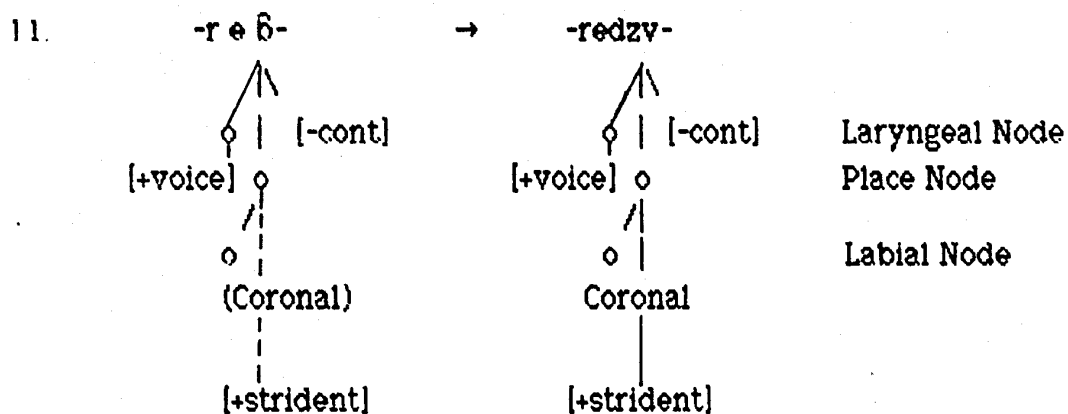
The mutations [r] → [dz] thus proceed as follows:

10. -rir- 'make a sound' → -ridza 'cause to make a sound'



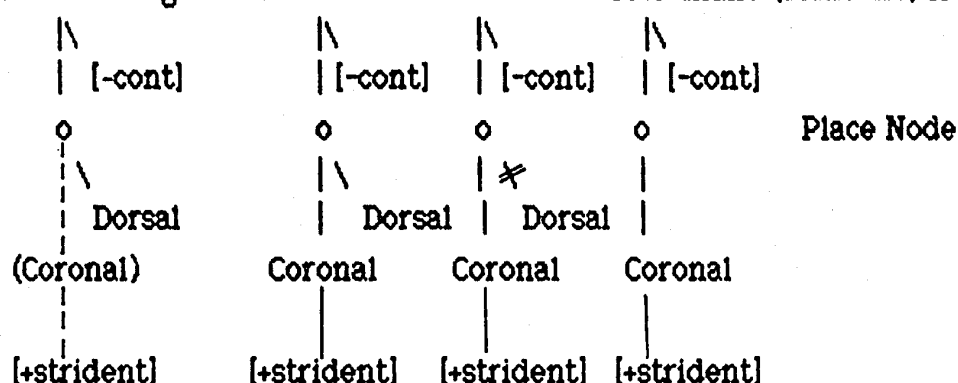
Because it is [-distributed], [r] already has a coronal place of articulation, so node generation is not required. (The presence of [-distributed] is not problematic because a strident would become [-distributed] redundantly anyway.) A voiced coronal strident is the counterpart to [ts], namely [dz]. Thus, when voiced alveolar [r] is linked to the feature [strident], the voiced alveolar affricate [dz] results.

Another stop to undergo mutation is the bilabial implosive [ɓ] which mutates to [dzv] in a completely expected manner. The bilabial stop is specified for voicing and a Labial place of articulation. When [strident] links in causative formation, it generates a Coronal Node, resulting in a voiced labio-coronal strident stop [dzv]. This is illustrated in the derivation of -redzv- 'lengthen' from -reɓ- 'be long':



The mutation [k] → [ts] is slightly more complex. Nonetheless, it is one of the most productive of the Shona mutations. The resulting mutation is strident, so apparently [strident] does link to the final [k] of the stem. In linking, it generates a Coronal Node, as evidenced by the fact that the resulting sound is indeed coronal. Generation of a Coronal Node presumably creates a complex Coronal-Dorsal segment. The fact that the resulting sound is not Coronal-Dorsal, but rather Coronal, is evidence that the Coronal-Dorsal complex created by causative linking is, for some reason, disallowed. More specifically, the fact that the resulting sound is Coronal, rather than Coronal-Dorsal, is an indication that the Dorsal Node of the stem consonant is subsequently delinked.

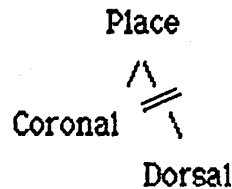
12. -sek- 'laugh' → *-se - → *-se . → -sets 'make (someone) laugh'



The reason for Dorsal delinking is debatable. Myers (1990) attributes it to the lack of a velar affricate in the language. The same general approach might be taken under the present analysis. Recalling that a similar constraint operates in Modern Yucatec Maya, it even seems somewhat more satisfying to attribute dorsal delinking to an incompatibility between the features [+strident] and Dorsal. However, there is a better explanation available. A widespread process called Velarization (Doke, 1931, Chapter XII) adds a labiovelar articulation to various segments of Shona, including coronals and even stridents, to derive segments such as [dy^w] (*kudy^wenga* 'to ask anxiously') and [sv^w] (*-tasy-* 'mount' > *-tasy^w-* 'be mounted'). This suggests that [+strident] and [Dorsal] are not incompatible in Shona. Though one might seek recourse to the notion that different feature combinations are permitted at different levels, claims of disallowed feature combinations in the present instance nonetheless seem superfluous.

However, the idea that mutations occur in different word formation processes yields a possible clue. Both passives and causatives are formed from verbs. If the causative of a verb ending in [k] were permitted to retain both the Coronal and the Dorsal specifications, there would be cases in which causatives were indistinguishable from passives. It would not be clear whether the features [strident] [Dorsal] were to be interpreted as the causative of an underlying velar or the passive of an underlying strident. The available sources do not provide enough data to determine how

widespread this problem might be. Therefore, it is not possible to claim with authority that this is the reason for Dorsal delinking. The Setswana data present a clearer picture and there we do see features delinked to maintain a distinction between the passive and the causative of particular items. In conclusion, I propose that Dorsal delinking is a morphologically conditioned rule that applies as follows:

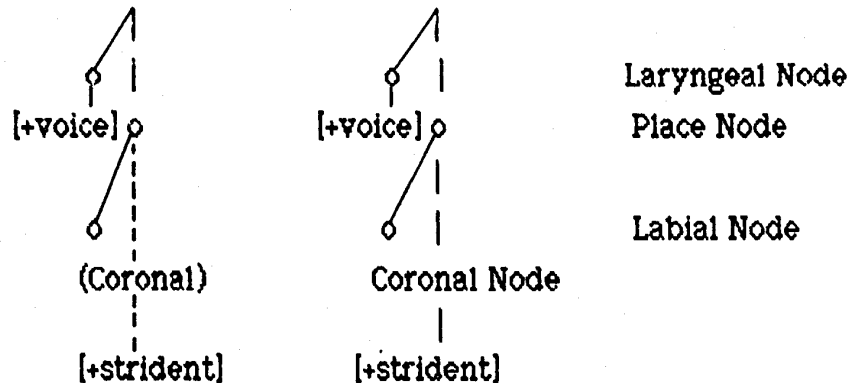


From Fricative to Fricative: [β] → [zv]

Let us now consider how the proposed analysis handles another type of case in which the final stem consonant is a fricative rather than a stop. The only such case is [β] → [zv]. If [β] is phonologically a fricative, then it is expected to be specified for [+voice] under assumptions of radical underspecification. In fact, fricatives in Shona contrast on the basis of voicing, so [+voice] is expected to be underlyingly marked even under assumptions of contrastive underspecification. This harkens back to the discussion of whether [β] is phonologically a fricative or a sonorant. Of course, marking the redundant voicing value of a sonorant is unwarranted under assumptions of either radical or contrastive underspecification. If [β] is a sonorant phonologically, then there is no reason for it to bear a value for the feature [voice] at UR. This is another reason to assume that [β] is a fricative underlyingly.

Under the present proposal, the mutation [β] → [zv] proceeds as follows: the feature [+strident] links to a consonant that is specified [+voice] and characterized for a labial place of articulation. The result of this linkage is a voiced labiocoronal strident [zv].

14. -βaβa 'be bitter' → -βazva 'make someone/something bitter'



Stops That Do Not Become Affricates: [mb] → [nzv], [ng] → [nz]

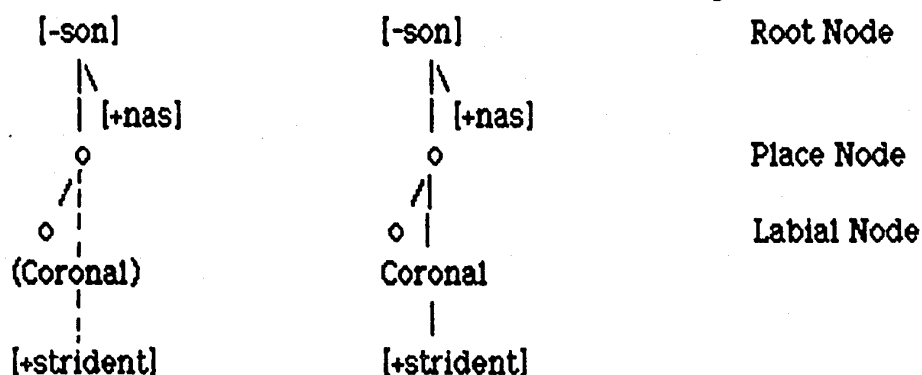
Not all stops become affricates. The examples show a prenasalized stop alternating, not with an affricate, but with a prenasalized fricative.

15. a. -βimba 'be proud' → -βinzva 'cause (someone) to be proud'
b. -tégá 'buy' → -ténzá 'cause (someone) to buy'

This kind of alternation is consistent with the view that prenasalized obstruents are distinguished on the basis of place of articulation, rather than on the basis of a value for the feature [continuant]. In other words, they are not stops phonologically. In this view, the gaps among the prenasalized consonants follow directly from their featural makeup, rather than being fortuitous.

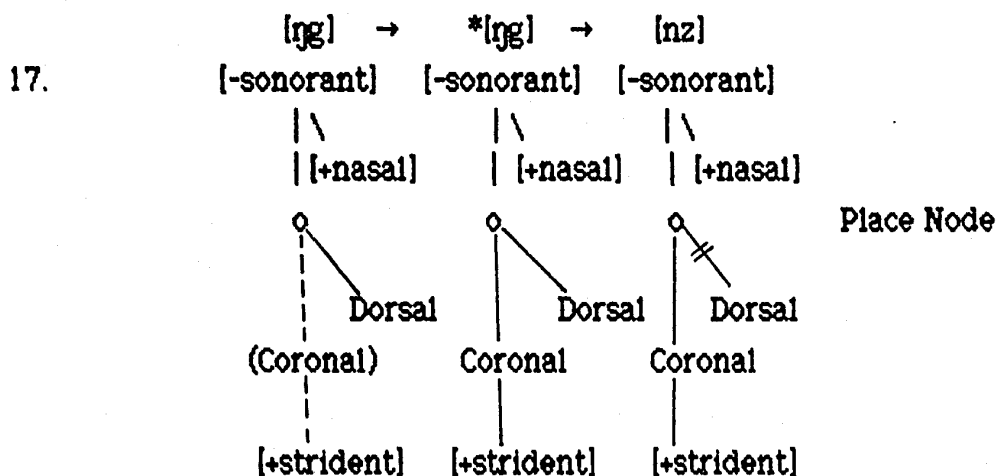
Now consider the derivation of the above example 15a. shown in 16.

16. -bimb- 'be proud' → -binzva 'make (someone) proud'



In this approach, the [mb] represents the features Labial [+nasal] [-sonorant], without indication of its realization as a stop, fricative, or affricate. The introduction of the feature [+strident] implies a coronal place of articulation. Thus, the resulting feature complex includes the following features; Labial, Coronal [+strident], [+nasal], [-sonorant]. In Shona this feature complex is manifested as the prenasalized labiodorsal fricative.

The mutation [ŋg] → [nz] illustrates the same lack of a continuant distinction between prenasalized stops, fricatives, and affricates. The velar prenasal is phonetically a stop; the coronal strident prenasal segment is realized as a fricative. However, the mutation of the velar prenasal also illustrates the Dorsal Delinking that we saw in the mutation [k] → [ts].



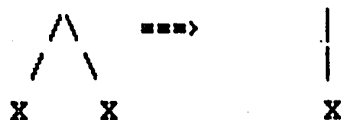
The same explanation is also applicable in the case of the velar prenasal. That is to say, if the output of causative mutation retained both a Coronal and Dorsal Node, it would not be clear if the configuration referred to the passive of a coronal strident or the causative of a velar. The two processes are thus disambiguated by Dorsal Delinking in causative mutation. If a verb final segment retains the Dorsal Node, then it is a passive.

4.1.4 Discussion

The preceding analysis is remarkably straightforward, for all the apparent complexity of Shona causative mutation. In all cases except those involving Dorsal Delinking, the featural inputs of causative formation are identical to the featural output. Let us briefly contrast this with an analysis based on the assumption of contour segment affricates and prenasalized stops. Such an analysis has been proposed by Myers (1990; 1991), so it will serve as the basis of comparison. To begin with, the representation of the affricates and prenasalized stops is unrelated to their distribution in the inventory. This is not an economy, since the other features required by the present analysis are required anyway under the dual continuant approach. A second complication of the dual continuant analysis is that because the affricate is conceived to bear both continuant specifications – in a particular order – the analysis is required to account for the source of both and to have a mechanism for combining them.

With respect to the former, Myers apparently relies on the notion of contrastive underspecification to account for the presence of both continuant values. However, in a few instances contrastive underspecification is abused. For example, Myers classes [β] as a sonorant. Yet, to achieve the correct results, [β] → [zv], it must be specified [+voice], despite the fact that there are no voiceless sonorants in Shona. Moreover, the features [sonorant] and [consonantal] are assumed to define the Root Node. There is no principled explanation as to how a sonorant becomes a non-sonorant.

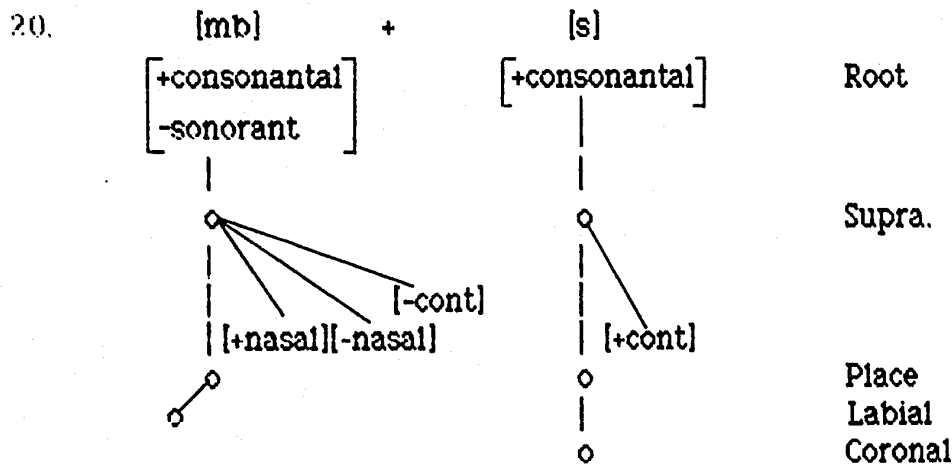
19. Twin Sisters Convention (Myers)



Where x is a Node or feature

Myers uses the convention to reduce two Supralaryngeal Nodes or two Place Nodes into a single Supralaryngeal or Place Node, though the two Nodes often dominate different features and are not, in fact, identical, particularly in the case of contour segments. Let me lay out the problem in more detail. Myers assumes the features [continuant] and [nasal] are dependent on a Supralaryngeal Node. If a derived affricate carries both values for the feature [continuant], there must be a source for each feature. The source of [-continuant] is presumed to be a stem final stop; the causative suffix -s is the hypothesized source of the [+continuant]. Yet, where different continuant values are present on each of the input segments, the Supralaryngeal Nodes can not, in fact, be claimed to be identical. On the other hand, without some external mechanism, like the Twin Sisters Convention, the contour segment affricate can not be derived.

Consider the complications this introduces to the mutation [mb] → [nzv]. Myers does not assume that the feature [+continuant] per se, from the causative morpheme, links to the stem consonant; rather, he assumes that the Supralaryngeal Node of -s links to the Supralaryngeal Node of the stem consonant, creating a structure with two Supralaryngeal Nodes and two Place Nodes, each with its attendant set of specifications. The representations shown here are consistent with those proposed by Myers.



First, there would be linking of the Supralaryngeal Node of [s] to the Root of [mb]. It is not clear what motivates linking; one obvious possibility is that linking is a means, other than epenthesis, of solving the illegal cluster problem. The substance above the Supralaryngeal Node of [s] would then be deleted by Stray Erasure. The Twin Sisters Convention would subsequently reduce the two Supralaryngeal Nodes and the two Place Nodes into single such nodes. If the function of the Twin Sisters Convention is to fuse two identical specifications, its application here looks very suspicious. The only thing similar about the Supralaryngeal Nodes of these two segments is the presence of the Nodes themselves. Certainly the featural content of each is different in every respect. Why they would merge under the auspices of the Twin Sisters Convention is unclear. However, merger must occur to derive a segment with two values for the feature [continuant] that are assumed to characterize an affricate. Actually, in this instance the feature [-continuant] subsequently deletes, ostensibly because of the absence of a prenasalized affricate with this particular place of articulation in the inventory.

In sum, an analysis relying on the notion that [ts] is a strident stop is not only possible, it is preferable to a dual continuant analysis. First, a strident stop analysis is far simpler and more coherent. It makes use of features that are already required in the dual continuant analysis. Also, it is not forced to rely on the suspicious application of mechanisms whose sole

purpose in the analysis is to derive the affricate representation that is assumed. Moreover, the present approach makes predictions about the distribution of obstruents in the Shona inventory. The representations proposed by Myers are completely unrelated to gaps in the inventory, though the fate of feature combinations created by causative formation is claimed to be determined by them.

4.2 Setswana Causatives

The idea that there is a single causative suffix can be profitably applied to the analysis of Setswana causatives. On the surface, Setswana, like Shona, has two means of forming the causative, either via suffixation or via consonant mutation. Suffixation and epenthesis are referred to only in passing throughout the course of the analysis; the focus is on mutations. Despite notable differences in their inventories, causative formation in Setswana is remarkably similar to causative formation in Shona; a variety of segments, including [p, t, r, x, n, l] undergo mutation. The output of mutation is, in most, but not all cases, a coronal affricate, [ts^(h)].

The primary source of phonetic information on Setswana is a comparative phonetic study of Setswana, Sesotho, and SaPedi by Tucker (1929). Another frequently cited source, and the one that provides the most comprehensive body of information about causative formation is Cole (1955). Where specific references are not provided, the information has been taken from these two sources. This is supplemented with personal observations (though not systematic linguistic fieldwork), made while living in Botswana from 1974 - 1979 and 1981 - 1982. Where other sources are relevant, where there are differences of opinion with regard to basic facts, or where particular pages are important, specific references are provided.

The following table provides representative data, as well as summarizing the consonants that undergo mutation and the mutations that each undergoes. The table shows stops unmarked for aspiration or glottalization undergoing mutation. This is to be understood as an indication

that these features are unaffected by the process; an ejective stop remains an ejective, an aspirated stop remains an aspirate.

2.1. Causative Mutations of Setswana

SOUND CHANGE	EXAMPLES
[l] → [ts]	-rola 'doff' → rotsa -lala 'lie' → latsa
[t] → [ts]	-eta 'go' → etsa
[p] → [č ^ω]	-t4hapa 'wash' → -t4hač ^ω a
[x] → [s]	-theoxa 'descend' → -theosa -čoxa 'get up' → -čosa
[φ] → [ts ^h]/[č ^{hω}]	-leoφa 'sin/err' → -leots ^h a/-leoč ^{hω} a
[n] → [ñ]/[nts]	-kopana 'join' → -kopaña -bona 'see' → -bontsa

The segments [p, t, d, l, φ, x, n] are inputs to causative mutation. The set [ts, tsh, č^ω, č^{hω}, s, ñ, nts] comprises the output. I argue that we should not be looking for a way to distinguish, phonologically, the set of consonants that undergoes mutation from the set that does not. I suggest that the phonological character of any consonant allows it to undergo causative mutation in Setswana, but that independent factors prevent it. For instance, no verbs ending in [b] undergo mutation, though verbs ending in voiceless bilabial stop [p] and voiced alveolar stop, [d]/[l] often do. Similarly, verbs ending in the velar stop [k] do not undergo consonant mutation in causative

formation in Setswana. These could be regarded simply as accidental gaps. I propose that such mutations would be indistinct from others. This will be pursued in the course of the analysis.

No particular phonological attributes are correlated with the ability to undergo consonant mutation. Nonetheless, as in Shona, some consonants are more likely to undergo mutation than others. For instance, the mutation [x] → [s] is highly productive in Setswana; however, there are a number of verbs ending in [x] that form the causative via suffixation, rather than via mutation (e.g. *tshexa* 'laugh' → *tshexisa* 'make (someone) laugh'). Therefore, the phonological identity of the final consonant must play some role in mutation, but it can not be the sole determinant of causative formation alternative.

Cole (1955) divides the mutation/suffixation causatives according to identity of the stem-final consonant and whether the verb is 'primitive' or 'derived'. However, in addition to there sometimes being confusion about what it means to be derived or primitive, neither primitive nor derived verbs consistently form the causative in one way. This is underscored by the fact that a number of verbs – whether they are claimed to be primitive or derived – form the causative either by suffixation or mutation and, unlike in Shona, the variants are usually identical in meaning (e.g. *bona* 'see' → [*bontsa*] ~ [*bonisa*] 'make (someone) see'). Cole indicates that *-isa* causatives are the more modern alternative, but I can find no confirmation of this. Contradicting the idea is that, in some cases, the *-isa* forms reported by Tucker are apparently supplanted by mutation forms reported by Cole thirty years later (e.g. *bonisa* 'make (someone) see' is considered 'old-fashioned' or indicative of another dialect). This discrepancy may be attributable to dialect differences or an insufficient time frame, but clearly there are a number of issues here that remain unresolved. The point is that there are more than phonological factors involved in the mutation/suffixation distinction. At this time, I can not account for why certain words ending in a particular consonant undergo mutation while others do not, or why certain words permit either alternative, while others do not.

2.2 The Setswana Consonant Inventory

	LABIAL	ALVEOLAR	ALVEOPAL.	DORSAL	LARYNGEAL
STOPS					
ejective	p'	t' ts' tɬ'	ɕ'	k'	*
aspirated	ph	th tsh tɬh	ɕh	kx/kʰ	*
voiced	b	d/l * *	(j)	*	*
FRICATIVES					
voiceless	ɸ	s	š	x	h
voiced	*	r	*	*	*
SONORANTS					
nasals	m	n	ɲ	ŋ	*
glides	w	*	j	*	*

The conflation of the stops and affricates is argued for in Chapter Two and it raises an interesting point that is presented here as an aside.

According to Maddieson (1984) a language usually has stops at more places of articulation than it has fricatives. Under the view that affricates belong to a different class of segments than stops, there are fricatives at more places of articulation than stops in the Setswana inventory, in contradiction to the general pattern. However, if affricates are stops, and sub-coronal features count as a distinct places of articulation, Setswana conforms better to the general pattern. This further supports the view that affricates are stops.

Setswana appears to have far fewer obstruents than Shona. For one thing, there seems to be a much smaller range of acceptable places of articulation than in Shona. There do not appear to be any complex segments, in the sense of segments requiring more than one articulator node (but see the discussion on labialized segments to follow). Unlike Shona, any segment of the above inventory could be adequately described by a single articulator.

This is illustrated in hierarchical representations contained in Appendix 6. Incidentally, the structures for particular segments relevant to the analysis of causatives are also presented in this discussion, subsequent to a general articulatory and phonological introduction to the more novel features of the Setswana inventory.

The inventory of consonants shown above does not provide any indication of labiocoronal segments, which suggests that the Labial and Coronal Nodes do not co-occur underlyingly. This bears on the question of whether output segments [čʷ, čʰʷ] represent underlying feature combinations or not. In turn, this reflects on the role and domain of Structure Preservation (Kiparsky, 1985; Archangeli & Pulleyblank, 1986, etc.) in causative mutations. Labialized consonants, including coronals, occur freely in Setswana. A chart of the labialized segments is provided below. Such segments are not usually considered part of the phoneme inventory of the language, but that may not be true. Including a segment in the underlying inventory is tantamount to claiming that its occurrence is unpredictable. Thus, to claim that a given segment is labialized underlyingly is to accept that its labialization is unpredictable from the environment. Consonants tend to be labialized before rounded back vowels in Setswana, so any consonants that are labialized only before round vowels are properly excluded from the underlying inventory. However, the labialized consonants shown on the chart below frequently occur before front vowels. Tucker implies that labialization is unpredictable when he notes that its explanation must lie in historical phonology (Tucker, 1929 p. 76). He also acknowledges that the presence of labialized consonants before front vowels raises an "interesting phonemic problem". The most likely reason that labialized segments have been excluded from the underlying inventory is that they are so often the product of passive formation, which involves either -iwa suffixation or mutation of the final consonant of the stem to a labialized segment. In short, labialized segments are very often derived. However, there are a number of minimal pairs distinguished on the basis of labialization, though the absence of reliable tone information leaves some

room for uncertainty. Those shown here are only a few of many that could be cited.

23. a. šahala 'become new' vs. š^ωahala 'become desolate'
 b. -rat^hla 'chop' vs. -rat^{hω}a 'be chopped'
 c. nta 'louse' vs. nt^ωa 'war, fight'
 d. -rala 'draw a straight line' vs. -r^ωala 'carry, bear'
 e. l^ωetse 'is sick' vs. letse 'has lain down'
 f. xol^ωala 'to be sick' vs. xolala 'to spend the night'

The following chart shows the consonants that may be labialized before non-rounded vowels in Setswana.

24. Labialized Consonants in Setswana.

	LABIAL	CORONAL		DORSAL
		ALVEOLAR	ALVEOPALATAL	
STOPS		t ^ω th ^ω d ^ω /l ^ω t ^ɬ ^ω t ^{ɬh} ^ω	č ^ω č ^h ^ω	k ^ω kx ^ω
FRICATIVES		r ^ω	š ^ω	x ^ω
NASALS		n ^ω	ɲ ^ω	ŋ ^ω

Conspicuously absent from the summary of sounds that may be labialized are labial consonants, for example *[p^ω], and alveolar stridents *[s^ω], *[ts^ω], and *[tsh]. This latter gap plays a significant role in causative mutations that will be discussed in the course of the analysis.

4.2.1 Description of Relevant and Less Familiar Sounds

An overview of the basic articulatory and distributional facts about the input and output segments is now provided as a preamble to their proposed hierarchical representation and the analysis of causative mutations. In Setswana there is a phonemic contrast between aspirated and ejective stops and affricates. This is undisputed. However, both Tucker (p. 51) and Cole (p. 19) note that, while an aspirated stop or affricate is always audibly aspirated, an ejective stop is often simply unaspirated. My own observation confirms that glottalization occurs in particularly careful speech, but not in casual connected discourse. Even in a list of minimal pairs being pronounced to highlight the distinction between aspirated and ejective consonants, the non-focus ejectives were usually pronounced as plain unaspirates. For example, in the pair /diphok o/ 'news' vs. /dip^ʔok^ʔo/ 'ghosts', [p] was ejective, but [k] was pronounced as a plain, unaspirated velar stop.

The output [nts] is not a prenasalized stop, but a sequence of a nasal and a homorganic affricate. There are two main reasons for considering [nts] a sequence, or cluster, rather than a prenasalized stop, as in Shona. First, a nasal can precede only a voiceless stop or affricate in Setswana, unlike in Shona, where the succeeding obstruent must be voiced. Second, a nasal preceding a stop is syllabic in Setswana. Thus, when a nasal precedes a stop or affricate, it occupies a separate syllable from the stop or affricate, which forms the onset of the following syllable. Each of these reasons is considered briefly, in turn.

A nasal preceding a stop, affricate, or nasal, is always homorganic to the succeeding consonant, suggesting that the nasal is placeless and that it shares the place specifications of the following segment. Unless the succeeding segment is a homorganic nasal, it is always voiceless. Tourville (1991) maintains that in true prenasalized segments the obstruent is voiced. Of course, that would be unexpected if the nasal and stop actually constitute a prenasalized segment that has a single laryngeal specification.

There are three main pieces of evidence to support the claim that a nasal preceding a stop or affricate in Setswana is syllabic. First, there is articulatory evidence. When a nasal precedes a stop or affricate, it is pronounced as a distinct syllable (Tucker, 1929; Cole, 1954). For instance, the word ntsi 'fly' is always pronounced [n. tsi]; mphaxo 'provisions' is realized as [m.pha.xo]. Further supporting the special, potentially syllabic, status of the nasal are the stress facts of the language. In Setswana, the only word final consonant that may occur is the nasal [ŋ]. Stress in Setswana falls predictably on the penultimate syllable except when the word ends in the velar nasal. If one assumes that stress is assigned to the penultimate mora of a word and that nasals are moraic, stress receives a unitary account. In a word of the shape VNCV**, such as xanne 'refuse', stress falls on the first nasal, as expected.

In contrast to Setswana, Shona nasals are not syllabic. Shona, like Setswana, prefers minimally bisyllabic words. However, unlike Setswana, when a monosyllabic word begins with a nasal in Shona, epenthesis occurs to create a bisyllabic word (e.g. na 'four' → Shona [ina] versus Setswana [ŋna]). On this topic, we should also note that in Shona there are motivations for considering nasal obstruent co-occurrences as prenasalized segments that are lacking in Setswana. For example, syllable structure in Shona is strictly CV; a consonant, including a nasal, is constrained to occur only in the onset of a conventional CV syllable. If nasals followed by obstruents are analyzed as clusters, rather than single segments, they violate the general CV pattern. In Setswana surface forms CVN are freely permitted; analyzing nasals and obstruents as prenasalized segments in that language does not obviate the need to recognize a broader range of syllable types than in Shona.

The final piece of evidence presented in support of the view that nasals are syllabic are tone facts. In addition to being pronounced syllabically, a nasal bears tone. Usually a word final nasal carries the tone of the preceding syllable, but in some declensions it carries a different tone. An example of this are the second declension locatives in which the word final nasal is low toned but in which the preceding vowel may carry a different

tone (e.g. *nōxèṅ* 'snake (locative)') (Tucker, 1929). A nasal preceding an obstruent carries a tone which may be different from the tone of the vowel that succeeds the obstruent (e.g. *ṅkú* 'sheep'). In sum, the evidence suggests that, contrary to the case in Shona, nasals precede obstruents; the two do not constitute a single segment, but a sequence. This fact is important, as we will see subsequently, because it provides further insight into the principles underlying causative formation.

Before leaving the topic of nasals, let us consider the sound [ɲ]. The main question here is whether this is best considered one sound, as the chosen symbol suggests, as a sequence [nj], or as a palatalized nasal [nʲ]. From an articulatory point of view, Tucker notes specifically that 'it is the result of a single articulation of the blade and front of the tongue against the hard palate, the tongue tip being depressed' (p. 33). Doke (1926) calls it pre-palatal, as does Cole. If the sound were, in fact, a nasal-glide sequence or a palatalized segment, it would be the only such sound in the language. No other Cj sequences occur in this dialect, nor are there any other Cj segments. These facts support the interpretation of this as a single segment, an alveopalatal nasal.

Both Tucker and Cole agree that it is not so common as the other nasals, but there is marked difference of opinion about its distribution that I have not sorted out. Tucker claims that [ɲ] is rare before [i] and [u]. Cole claims that it is rare before [e], [u], [o]. Another distributional point of debate into which I do have some insights is the occurrence of [ɲ] before homorganic affricates [č] and [j]. Tucker maintains that [ɲ] occurs only before vowels or [ɲ] (e.g. *ɲɲe* 'small'). Cole states that [ɲ] does occur before the alveopalatal affricate and he cites several examples, including *nche* 'ostrich' and *xonjalela* 'to sow for me'. The answer to this debate seems to lie in different levels of description. Certainly, the nasal before the alveopalatal is post-alveolar; it is not the alveolar nasal [n] that occurs before [t] and [ts]. However, we do not hear any glide-like component of a nasal before an alveopalatal affricate. For instance *ɲɲe* is pronounced [ɲ. ɲe], with both nasals sounding similar to the medial one in the English word *onion*. In

contrast, *nche* is not pronounced *[ŋ. ɕhe]. These facts, including the differences of opinion expressed by Tucker and Cole are consistent with the view that nasals are homorganic to a following stop or affricate, that [ŋ] is a distinct phoneme, and that it is prohibited before an alveopalatal, except as part of a geminate [ŋŋ] (Goldsmith, 1990).

The voiced segments [d, l] are members of the same phoneme. In Setswana [l] is articulated much 'like the average initial l in English words, not very clear, and decidedly not dark.' (Tucker, p. 48). It is further noted by Cole to be distinctly alveolar. The [d] sounds like the voiced alveolar plosive of English. The first point to note about the behaviour of [l] and [d] is that they are in complementary distribution in Setswana. The latter variant occurs before high vowels [i] and [u] while [l] occurs elsewhere. Thus we see the following *-isa* causative alternations:

25. a. *xobala* 'to read' → *xobadisa* 'to cause to read'
- b. *xolela* 'to weep' → *xoledisa* 'to cause to weep'
- c. *xolala* 'to lie' → *xoladisa* 'to cause to lie'

Verbal noun alternations further support the view that [l] and [d] are variants of the same phoneme.

26. a. *-kwala* 'write' → *-mokwadi* 'writer'
- b. *-bola* 'rot' → *sebođu* 'rotten thing'

The choice of variant depends on the height of the following vowel. There is undoubtedly ATR harmony in the language (LaCharité, 1989), but it has not yet been systematically and thoroughly studied. As in a number of other African languages, the high vowels are [+ATR] (Archangeli & Pulleyblank, forthcoming) and there is an ATR contrast among the mid vowels. Nonetheless, it seems clear that with respect to [d]/[l] alternations, height is the determining factor. The [d] does not occur before mid vowels [e] and [o], regardless of what their ATR value might be.

There is some disagreement over whether or not [l] is syllabic in Setswana. Tucker claims categorically that it is never syllabic in Setswana, though it is in both closely related languages SaPedi and Sesotho. Cole contends that [l] is frequently syllabic in the eastern dialects, but less commonly in the northern ones. The dialect under consideration is classified as one of the central dialects, so Cole's position on this point is consequently unclear. I have not heard a syllabic [l] around the Gaborone area, so I assume that it is not permitted. Syllabic [l] results from vowel elision; those few items which are reported to contain syllabic [l] in SaPedi and Sesotho are pronounced with the vowel in the dialect in question (e.g. SaPedi lla 'cry' ~ Setswana lela).

The [l] never alternates with [tʃ], the way that [ʃ] does in SaPedi and Sesotho. In fact, [tʃ] occurs in Setswana where SaPedi and Sesotho have [ʃ] (e.g. Sotho ʃaba 'stab' ~ Setswana tʃhaba). However, non-fricative [l] enjoys the same distribution, including complementary distribution with [d], in all three languages. These facts support Tucker's claim that [l] and [ʃ] are not to be considered voiced and voiceless lateral counterparts within or across the three languages.

When the morphology places a nasal before [l], the latter mutates to [t]. This alternation falls under the heading of Strengthening or Hardening, some aspects of which are discussed in Chapter Five. Of interest here is the fact that [l] behaves in a parallel fashion to [b] and identically to [d].

27. a. lo - di 'string' → din - ti 'strings'
- b. -l^wa 'fight' → -n - t^wa 'war'
- c. lo - bu 'earth' → dim - pu 'earths'

In alternations where consonant mutation occurs but where voicing is retained, such as in diminutive formation which is discussed at length in Chapter Five, the [l] and [d] retain their voicing:

28. a. k^hudu 'tortoise' → k^hu^j^wana 'small tortoise'

b. bot^hale 'wisdom' → bot^hajana 'small wisdom'

The conclusion is that Setswana [l] is not a sonorant but an obstruent, phonologically. The assumption made here is that it is a stop that is non-distinct from [d] at the level of underlying representation. The conclusion that [l] is a stop, as opposed to a fricative, is motivated partly by differences in the behaviour of [l] and [r], to which we now turn.

The Setswana [r] is a fully rolled alveolar, similar to that heard in Afrikaans (Tucker, p. 47; Cole, p. 27). As far as its behaviour is concerned, it is noted to optionally and occasionally reduce to a flap before the vowel [i]. It may also be syllabic, but only when it occurs before another [r] (e.g. rra 'Mr., sir'). This occurs in all dialects and indicates a fundamental difference between the phonological status of [r] and [l] in Setswana.

In some dialects, for example the T^hware and the T^haping, the rolled [r] may be replaced by [h]. Thus a word like dira 'work' is realized as [diha]. Interestingly, the same alternations occur with [ɸ], [s], and [x]. The implications of this are included in the discussion about the representation of fricatives later in this chapter and in Chapter Five. The point to note at this time is that [r] patterns with fricatives in this respect. The [r] also patterns with fricatives in Strengthening processes which convert voiced stops to voiceless ones and fricatives to voiceless stops. The difference between the hardening behaviour of fricatives and stops is that fricatives harden to aspirated stops, whereas stops do not:

29. a. lobaka 'time' → dipaka 'times'
- b. loleme 'tongue' → dite^me 'tongues'
- c. losika 'vein' → dits^hika 'veins'
- d. lo^ɸatsa 'chip' → dip^hatsa 'chips'
- e. lorole 'dust' → dithole 'dusts'

The articulatory and phonological evidence supports the view that, in Setswana, the [r] is a voiced coronal fricative, rather than a stop as it is in Shona, or a sonorant, as in English.

Finally, let us consider the articulation and general patterning of the fricatives, to which some reference has already been made. The aspiration of the voiceless fricatives at the phonetic level is well documented (Brown, 1892; Jones, 1916; Tucker, 1929; Cole, 1955). Cole describes [ɸ] as being 'rather lax, the lips being kept fairly wide apart. With many speakers it appears to have a double articulation, a combination of bilabial [ɸ] and glottal [h]' (p. 24). This pronunciation is often reflected in the orthography, where the sound may be indicated by the digraph fh. The fricative [s] is described by Tucker as a 'breathed alveolar sibilant (hissing) fricative' and [š] as a 'breathed alveolar semi-sibilant (hushing) fricative... very like what is heard in English *shut* with, however, no tendency, under normal circumstances, to round the lips.' (p. 38). The [x] is characterized as a 'breathed velar fricative' (p. 43). Some dialects of Setswana, such as Tshaping, systematically substitute [h] for [ɸ], so that words like lefifi 'darkness' are pronounced [lehihi]. In fact, it was noted previously that some dialects substitute [h] for other fricatives, including [r]. The processes of diminutive formation and Strengthening covered in Chapter Five show that fricatives in Setswana alternate with aspirated stops and affricates. This suggests that aspiration is not just a phonetic feature of fricatives, but a phonological one.

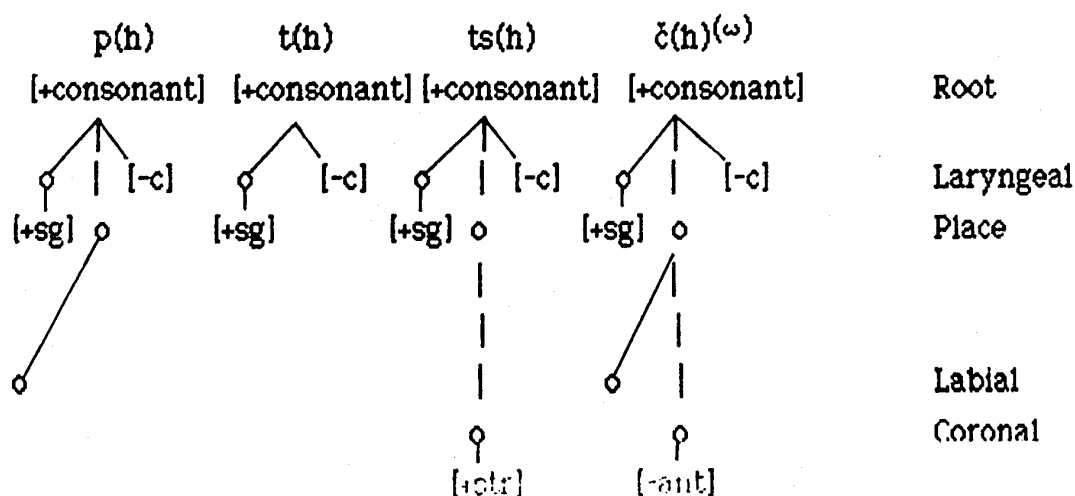
With respect to the distribution of coronal fricatives, the most salient aspect concerns alternations between [s] and [š]. The [š] occurs before all vowels, but [s] may not occur before back round vowels [o], [ɔ], or [u]. In fact, the same restriction is true for [ts] and [tsh]. SaPedi and Sesotho lack this restriction, and where they have [s] before a back round vowel, Setswana substitutes [š] (e.g. Sesotho soka 'stir' ~ Setswana šoka). Recall that the table of labialized segments in Setswana also shows that [s], like [ts] and [tsh], may not be labialized. The reader may well question this claim, given that the name of the language Setswana and the country Botswana contradict

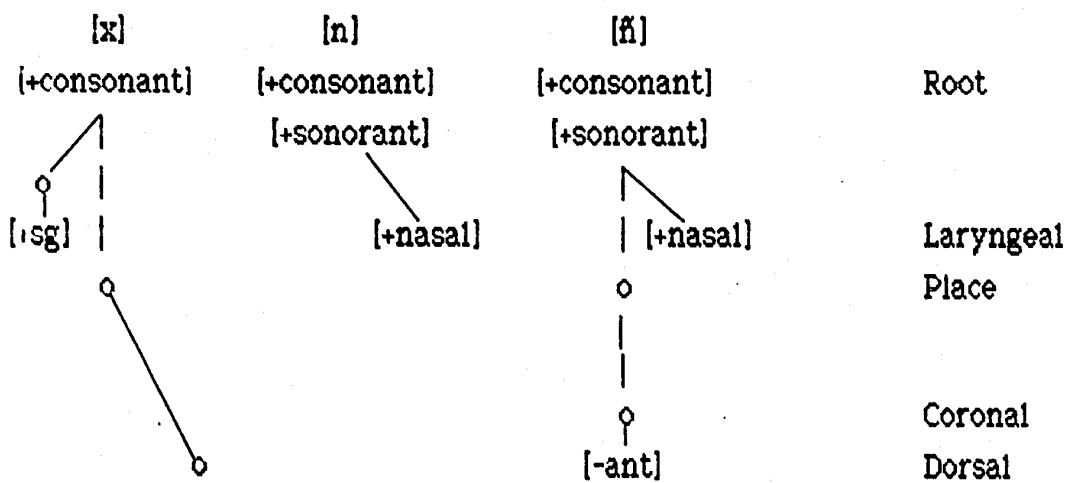
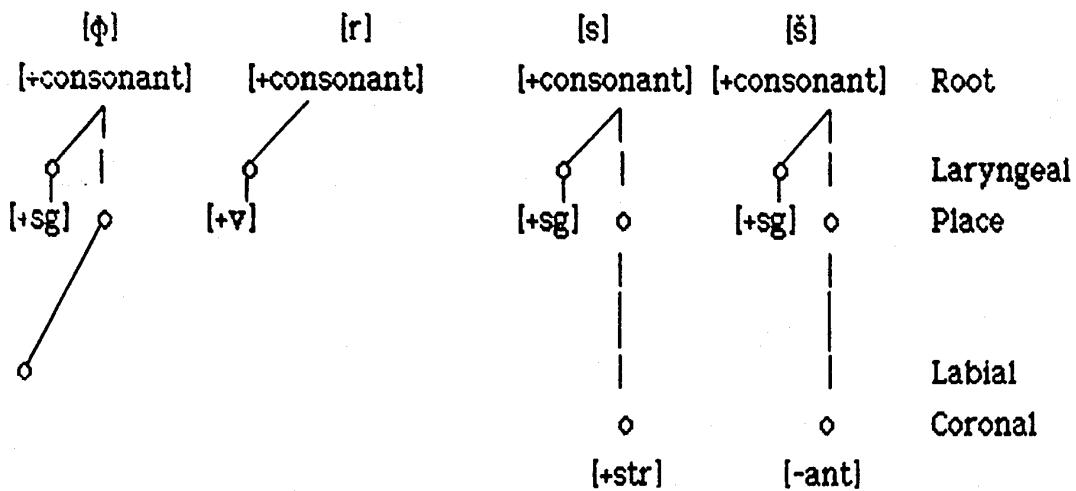
it. I have no explanation for these exceptions, though I will note, first, that they are indeed exceptions and, second, that prior to Independence thirty years ago, the names were pronounced with an alveopalatal, as reflected in the spellings chwana / chuana and Bechuanaland.

4.2.2 The Representation of Relevant Segments

The preceding discussion of basic articulatory and distributional facts has been provided to familiarize the reader with important basic facts about the relevant sounds and as a justification for the following proposed hierarchical representations. The parentheses around a feature, for example, aspiration on stops and affricates, and labialization on the alveopalatal, and features linked to the hierarchy with a finely dotted line indicate possible aspects of the representation. In this case, 'possible' means that if the segment is aspirated or labialized, the features linked by dotted lines are present. If the segment is not aspirated or labialized, the features linked by dotted lines are not present in the representation. This is done simply to save space.

30. The Representation of the Relevant Segments





4.2.3 The Analysis

At the heart of the proposed analysis of Setswana causative mutations is the claim of feature co-occurrence restrictions in the language. These are informally summarized, along with the changes that they precipitate, in the following table:

31. Co-occurrence Restrictions and Changes in Causatives

FEATURE CO-OCCURRENCE RESTRICTIONS	AFFECTED MUTATION	REPAIR/CHANGE
*[+voice] [+strident]	l → ts	[+voice] delinking
*[Labial] [+strident]	p → č ^ω	[+stri] delinking
		[+stri] delinking
		[-cont] insertion
		[-ant] insertion
		[Labial] delinking
*[Dorsal] [+strident]	x → s	[Dorsal] delinking
*[+nasal] [+strident]	n → fi	[+stri] delinking
		[-ant] insertion
*[-anterior] [+strident]	fi → nts	[+nasal] spread
		[-ant] delinking
		[-cont] insertion
	n → nts	[+nasal] spread
		[-cont] insertion

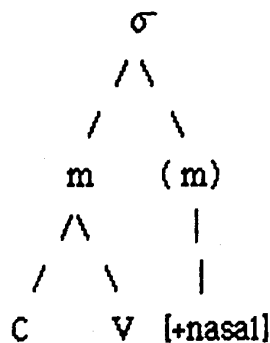
With the exception of the restriction *[-anterior] [+strident], these feature co-occurrence restrictions operate over the domain of the first mora of the syllable. Underlying this assumption is a synthesis of views by Goldsmith (1990) and a proposal by Hyman (1985). Taken from Goldsmith are principally the notions that

- the onset and first member of the nucleus count as a unit for a number of processes, including a domain for the distribution of features;
- the coda constitutes a separate domain for the distribution of features;

- a language typically sets restrictions on the features that occur in each domain;
- the coda permits the occurrence of features that form a subset (often a very restricted subset) of the features that may occur in the first domain.

However, the syllable structure proposed by Goldsmith does not adequately express the notion of a domain comprising the onset and the first member of the nucleus. For this, I turn to Hyman (1985). The syllable template that I propose for Setswana is modelled very closely on Hyman's proposal. The 'm' stands for mora. The second mora is enclosed in parentheses to indicate that it is an optional part of the syllable. It may only be filled by the feature [+nasal].¹²

32.



The preceding synthesis leads to the following generalization about the feature co-occurrence restrictions that play a prominent role in the analysis of Setswana causative mutation.

¹² I include both moraic structure and a skeleton, primarily for the convenience of being able to refer C's and V's. Most researchers working within a moraic framework argue that the CV tier or skeleton is not required (e.g. McCarthy & Prince, 1985; Bagamihl, 1989; Ito, 1989; Archangeli, 1990). I accept their arguments; however, it is much easier to refer to C's and V's than to the left or right branch of the first mora, for example.

33. The Feature Co-occurrence Constraint

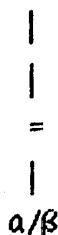
*X
|
a
β where a and β are two features
that may not be dominated by
the same X and where X may be a
single mora or segment.

In most cases, X is the first mora of the syllable, but in one case, *[-anterior] [+strident], X may refer to the C-slot (i.e. the lefthand root node dominated by the mora). The reason for raising this possibility is that we do not want to rule out sequences of strident consonants followed by front vowels, which are assumed to be Coronal [-anterior] (see Chapter Five for a discussion of vowel features). Perhaps a better solution would be to assume that front vowels are simply Coronal, without being specified for a coronal dependent. This is considered in the following chapter. For the sake of the current argument, let us assume that the feature co-occurrence restriction *[-anterior] [+strident] is referenced to the melody, rather than the prosodic tier.

The feature co-occurrence restrictions contribute to the definition of the underlying inventory (Archangeli & Pulleyblank, forthcoming) and they may constrain segment sequences. These feature co-occurrence restrictions trigger repairs when a violation occurs (Paradis, 1988a; 1988b). Two particular repair rules active in Setswana causative mutations are the following:

34. Repair Rules

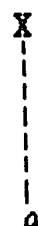
a. Delinking



where a and β are features in the following configuration:



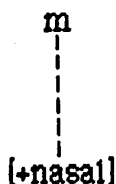
b. Insertion



where a is a feature that is compatible with others dominated by the same X and with other restrictions of the language.

The nasal mutations also motivate the need for a rule that links a free [+nasal] autosegment to the second mora of a syllable to the left of the trigger:

35. Nasal Linking



Nasal linking is part of a general strategy to preserve as much of the input as possible. It operates right-to-left, like many other processes in Setswana (e.g. a mid vowel is harmonized to a following high vowel in Setswana; stress is referenced to the right edge of the word). The linking must be non-iterative, because otherwise we would see effects further to the left in at

least some cases where a non-nasal feature tries to relink. For instance, a disengaged [strident] may not link to a preceding mora, but it could conceivably link to a mora on the left that dominated the features defining [t]. This never occurs. The general strategy is formalized as follows (there is a brief discussion of the formalization of repair rules to follow shortly):

36. Function: Insert
 Type: structure
 Direction: right-to-left
 Trigger: a free autosegment
 Target: a mora that does not dominate another feature
 inhospitable to the free autosegment
 (inhospitability being defined by the feature co-
 occurrence restrictions).
 Iterativity: non-iterative

This rule plays a less obvious role in causative mutation generally, due to the fact that the second mora of a syllable in Setswana may be filled only by the feature [+nasal]. The other consonant features that are delinked, for example, [Labial], [Dorsal], [-anterior], may not spread because they will not find an appropriate target. Features that can not be linked to higher order structure are phonetically unrealizable.

One point about the delinking rule (see a. above) that I wish to stress is that the choice of feature to be delinked is essentially arbitrary to the extent that either feature is a potential candidate for delinking. The choice of feature is, however, constrained by other factors in the grammar, such as the need to keep lexical entries and morphological processes distinct. Thus, the repair says, in essence, that one of the two features illicitly dominated by the same mora or Root Node must be delinked; however, the choice of which feature will remain and which will delink in a given instance is determined by independent factors.

As suggested by the formalization of nasal linking, I assume that

repair is parameterized as set out in Archangeli & Pulleyblank (1986, forthcoming).

37. Parameter Settings for Phonological Rules

- 1) function: insert or delete
- 2) type: content or structure (i.e feature(s) or path(s))
- 3) direction: left-to-right or right-to-left
- 4) iterativity: iterative or non-iterative

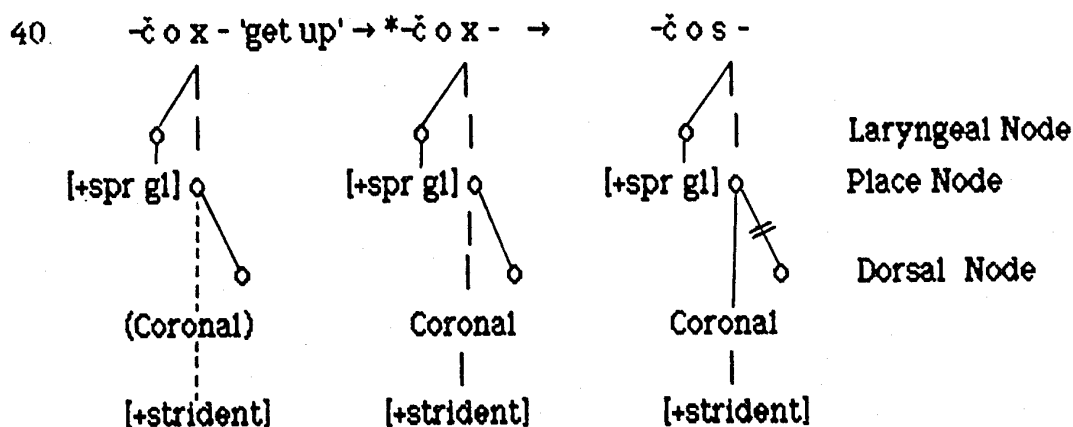
In addition, there are generally conditions on targets and triggers. The delinking repair (a.) introduced in 4.2.3 is a rule that deletes structure. The insertion repair (b.) is one that inserts content. It is, in fact, not always certain whether feature deletion or delinking is involved in the first repair rule. I have assumed feature delinking for the sake of consistency; the nasal mutations indicate delinking which, in the absence of evidence to the contrary, is therefore assumed of all the other deletion repairs involved in Setswana causative formation. That would be the default setting, in any case (Archangeli & Pulleyblank, forthcoming, p. 259). The nasal mutations also indicate that nasal linking operates from right-to-left, so the same is assumed for all others. This is the non-default setting. The fact that only a single target undergoes change indicates that the rules are non-iterative.

We are now ready to consider the mutations themselves. Because the mutations are more complex than in Shona, each is considered separately. The order of presentation is as follows:

- 38.
- a. [t] → [ts]
 - b. [x] → [s]
 - c. [l] → [ts]
 - d. [p] → [čʷ]
 - e. [ɸ] → [tsh] ~ [čhʷ]
 - f. [n] → [ɲ] ~ [nts]

[x] → [s]

In this particular mutation, the input and output of mutation are fricatives. This is one of the two most productive mutations of Setswana, just as [k] → [ts] is one of the most productive of Shona. This parallel is especially interesting, given that the absence of a velar affricate in Shona is cited by Myers (1990; 1991) as the reason that [k] mutates to [ts], rather than [kx]. The reader is reminded that Setswana, unlike Shona, has a velar affricate [kx] (see Table 33.). These two parallel mutations indicates that affrication, per se, is not the goal of causative formation. The parallel also shows that the Coronal place of articulation is crucially involved in causative formation and confirms the view that the causative morpheme is characterized by the feature [+strident], rather than [+continuant]. The crux of the problem is that, to get the right results, we must assume that the causative morpheme contributes a coronal place of articulation, but if the causative is defined as [+continuant] $\underline{s}$, there is no reason to expect it to have a Coronal Node at that level. If the causative lacks coronal place of articulation and if causative mutation proceeds as suggested by Myers (see Discussion that follows presentation of Shona causatives), then one expects no change in the Setswana causatives of verbs ending in [x]. The morpheme $\underline{s}$ should contribute its [+continuant] feature and the output should be a Dorsal continuant [x]. If $\underline{s}$ lacks a specified Coronal Node, there is no motivation for deleting the Dorsal Node and inserting a default Coronal Node. However, in Setswana [x] mutates to [s], indicating that the Dorsal place of articulation is somehow replaced by a coronal one. If the causative is properly characterized as [+strident], and if this feature depends on the Coronal Node, then the genesis of the resulting coronal place of articulation is explained. Under the present assumptions, the mutation [x] → [s] is depicted below:



The fact that the resulting segment is [s] shows that the Dorsal Node is lost. Consideration of the featural characterization of the segments given in Appendix 6 indicates that the source of the problem must be a co-occurrence restriction against the features *[+strident] [Dorsal]. This is expressed as

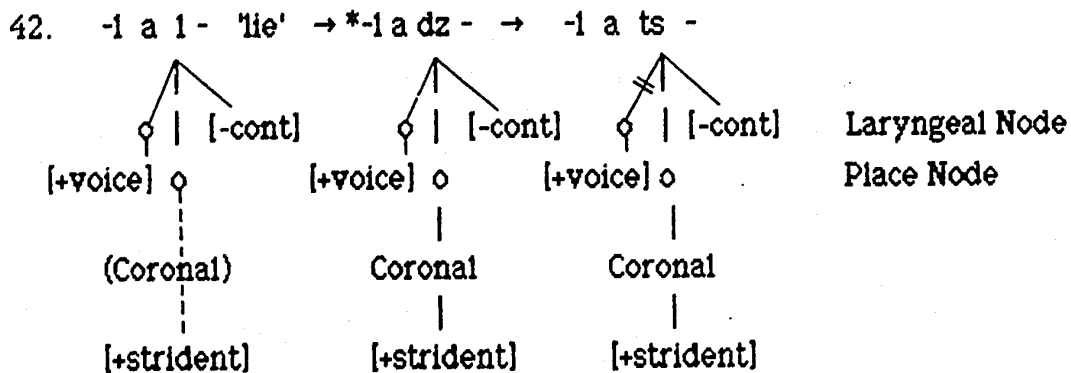


The restriction can not be against coronal-dorsals since front vowels are assumed to be characterized by a Coronal Node (see Appendix 6 and discussion in Chapter Five) and they are permitted to occur with velar consonants. Of course, an added benefit of the present assumption is that a restriction against the co-occurrence of the features *[+strident] [Dorsal] is consistent with a co-occurrence restriction against the features *[+strident] [Labial] that is seen in two other mutations, [p] → [čʷ] and [ɸ] → [tʃh] ~ [čhʷ]. The reader will also recall that a similar restriction is required to explain the distribution of affricates and fricatives, all of which are [+strident], in Modern Yucatec Maya. There the feature [+strident] does not link to a consonant that is either Labial or Velar. The fact that a similar restriction

holds in another unrelated language indicates that it is not just an ad hoc device invoked to explain this particular Setswana causative mutation.

[l] → [ts]

This is reminiscent of the Shona [r] → [dz] mutations in two respects: first, both [l] → [ts] and [r] → [dz] represent the most productive causative mutation of their respective languages. That is to say, in Shona a verb ending in [r] is most likely to undergo mutation, rather than suffixation; in Setswana a verb ending in [l] is most likely to do so. Second, [l] in Setswana behaves like a voiced stop, just as [r] does in Shona. The mutation of [l] proceeds as shown:



The feature co-occurrence constraint and the repair rule are depicted here, in isolation from the derivation shown above:

43. a. Feature Co-occurrence Restriction b. Repair Rule



The question that most obviously emerges is why the resulting sound is not [dz], that is why the feature [+voice] delinks. In his account of Shona causative mutations, Myers (1990; 1991) relies on the absence of a particular segment from the inventory. One could validly claim that the same holds true in Setswana; there is no voiced alveolar affricate [dz] in the inventory. Indeed, this is true for all dialects of Setswana. However, this misses a generalization. A segment of the inventory is really a particular combination of features and there are no combinations that involve both the feature [+voice] and [+strident]. Therefore, not only is there no voiced alveolar affricate, there is no voiced alveolar fricative [z]. A feature co-occurrence restriction *[+voice] [+strident] accounts for both gaps.

There is a possible objection to the view that [+voice] and [+strident] are prohibited from co-occurring. I have claimed via the proposed feature representations previously presented that the Setswana alveopalatal affricate is characterized as a [-anterior] stop, which is consistent with the claim that [+strident] and [+voice] do not co-occur phonologically. However, in the Introduction, I also stated that the alveopalatal affricate may be phonologically [+strident], at least in some languages. Perhaps this is the case in Setswana and the voiced alveopalatal affricate [j] is evidence of that fact and thus a contradiction of the present claim. There are different lines of rebuttal that might be presented. First, there is the argument that the voiced alveopalatal affricate is not even phonetically [+strident]. The voiced alveopalatal affricate of Setswana is noted to be softer than that of English (Sandilands, 1953). Tucker, a phonetician trained under Daniel Jones, details articulatory differences, stating that 'in SePedi and SeChuana, however, the tip of the tongue seems depressed, and the blade brought more into play' (p. 58). In other words, there is no cupping of the tongue, which I believe to be an articulatory correlate of the feature [strident]. Incidentally, Tucker does not consider [j] a distinctive sound of the language, in spite of its occurrence in some words of the language. This suggests another response that might be made to objections against the co-occurrence of [+voice] and [+strident] in Setswana.

This second possible line of rebuttal rests on the question of whether the voiced alveopalatal [j] is properly considered part of the synchronic underlying inventory of the language. Cole (1955) considers it to be, no doubt based on the existence of words such as [diʃo] 'food' in the language. However, there are remarkably few words containing [j], even according to Cole. One is a borrowed word, Lejuta 'Jew'. It should be noted, though, that in other borrowed words containing [j], the voiceless alveopalatal affricate is substituted. For example, porridge is borrowed into Setswana as [p^halet^he]. In fact, most of the native words containing [j] are all derived from one verb -ja 'eat'. These include moji 'one who eats', -jesa 'feed', -jela 'eat for', etc. Besides the -ja derivatives, there are very few words containing [j]. Interestingly, all these same words are represented orthographically with y, rather than by j by Brown (1892) and Wookey (1905). This implies that they noted the distinct difference between the voiced alveopalatal affricate of English and the softer sound of Setswana and that they did not relate that Setswana sound to the [j] of English so readily as to the palatal glide. Both Cole and Sandilands, who assume that [j] is part of the underlying inventory of Setswana, acknowledge that it is replaced by [ç] in the Eastern dialects. In sum, it is not unreasonable to conclude that [j] is not a segment of the underlying inventory. If this is true then [j] clearly can not serve as a counterexample to the claim of a co-occurrence restriction against the features *[+voice] [+strident]. However, even if there is a voiced alveopalatal, it does not seem either phonetically or phonologically accurate to characterize it as a voiced strident. I assume that there is an underlying segment, which I continue to transcribe with the symbol [j], that is designated as a voiced [-anterior] stop underlyingly and that resists becoming [+strident], even phonetically.

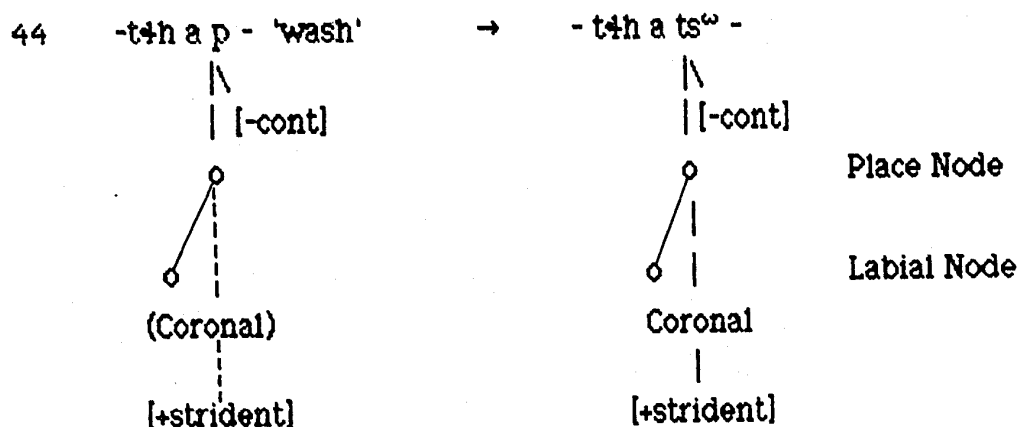
Prior to leaving the mutation [l] → [ts], let us consider another possibility that not just voiced stridents, but voiced fricatives generally are prohibited in Setswana. This presents alternatives, each of which is problematic, on other fronts. First, a restriction against voiced fricatives presupposes some characterization of the set of fricatives. Obviously, one

could not rely on the absence of a continuant feature to characterize the set of fricatives; for one thing, this would limit the feature [+voice] to occur only with consonants that are [-continuant]. This would have to be qualified in some way so that redundantly [+continuant] vowels and [-continuant] nasals could be voiced, but so that the redundantly [+continuant] fricatives remained voiceless. Alternatively, one could require that both values for the feature [continuant] be present at UR, so that the set of fricatives could be characterized by the presence of [+continuant] and the constraint could be stated as *[-voice] [+continuant]. Another alternative is to assume that [+continuant], rather than [-continuant], is the active continuant value. Either of these last two assumptions would complicate several analyses, including causative formation and Strengthening (cf. The D-effect, Chapter One).

Finally, it is suggested here that [r] is a fricative; more specifically, it is a voiced fricative. If this is indeed correct, as several processes of Setswana suggest, then the claim that there are no voiced fricatives at all in Setswana can not be valid. In short, the simplest assumption that we can make is that there is a feature co-occurrence restriction *[-voice] [+strident] in the language. This restriction accounts for the absence of certain underlying feature combinations (i.e. segments of the inventory), such as [dz], and it triggers the repair of violations created by word formation processes, in this case, causative formation. The repair rules will be stated explicitly once a more comprehensive picture of the constraints has been presented.

[p] → [čʷ]

The main challenge presented by this mutation is to explain why the resulting sound is [čʷ], rather than [tsʷ], as the proposed principles of causative formation would lead us to expect. According to what has been suggested, the mutation should proceed as indicated:



The feature [+strident], introduced by the causative, should dock onto the stem-final [p], characterized as Labial [-continuant]. The result should be a segment bearing Labial and Coronal Nodes and terminal features [-continuant] and [+strident]. These features can be reasonably assumed to characterize a labialized affricate [ts^ω]. This happens in some dialects of the language, and in the closely related language, Sesotho, but not in the dialect with which we are concerned.

The table of labialized segments presented earlier indicates that there is no [ts^ω] in the inventory of labialized segments. One might argue, as noted previously, that labialized segments occur underlyingly and that the failure of [p] to mutate to [ts^ω] is attributable to the lack of this segment in the underlying inventory. Again, this misses a generalization; there is no [s^ω] in the inventory either. A co-occurrence restriction *[+strident] [Labial] accounts for both gaps. Recall, too, that a co-occurrence restriction *[+strident] [Labial] is also crucial to a general account of the distribution of strident fricatives and affricates in Modern Yucatec Maya. The two feature co-occurrence restrictions *[+strident] [Dorsal] and *[+strident] [Labial] thus account for phenomena in another unrelated language, as well as providing a unitary account of two different inventory gaps within Setswana. In fact, as we shall see, the co-occurrence restriction *[+strident] [Labial] is also in evidence in the mutation alternations of [ϕ], so the restriction accounts not for one mutation, but two.

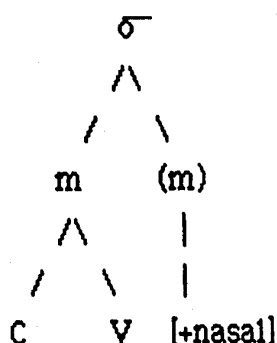
Moreover, a feature co-occurrence restriction $*[+strident][Labial]$ accounts for the fact that neither [s] nor [ts] may precede round vowels [o], [ɔ], or [u]. An appeal to the absence of a particular segment does not generalize in this way. However, the fact that the feature co-occurrence restriction governs sequences of segments, as well as the makeup of a single segment raises interesting questions about its proper formalization. How can we express this fact? Let us consider the fact that a round vowel may be **succeeded** by a strident consonant.

45. -leoφ- 'sin, err' → -leotsh-/-leočh^ω- 'cause to sin, err'

The co-occurrence restrictions are presumed to function as a constraint on features that co-occur on a single segment, as well as in one particular sequence, but not the other. What is the difference between the two orders? The answer is that in Setswana a round vowel succeeded by a strident is necessarily in a separate syllable than the strident, since the strident can only occupy the onset position of a syllable, never the coda. In Setswana, only a nasal may occupy the coda position. On the other hand, a vowel following a strident forms the nucleus of the same syllable of which the strident is the onset. This way of looking at the matter is loosely modelled on an approach by Goldsmith (1990). Briefly, he argues that the syllable is a primary licenser, which is endowed by the grammar with the capacity to license particular sets of features. He further notes that in language after language, the onset and the first element of the nucleus consistently behave as a unit. The syllable acts as the licenser for both, while the coda (if present) functions as a secondary licenser, which typically licenses only a subset of the features that may be licensed by the syllable node. As in the case of many languages (e.g. Selayarese), the coda in Setswana licenses only the feature [nasal]. As noted in the introduction to the analysis the internal syllable structure proposed by Goldsmith is ill-suited to the expression of a unit consisting of the onset and the first member of the nucleus. However, an appropriate internal organization has been proposed by Hyman (1985).

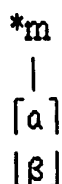
He suggests that the syllable node dominates weight units that will be called moras here, in keeping with current practice. The first mora of the syllable dominates the onset and the vowel. The second mora is optional, in this case, and licenses only the feature [+nasal].

46.



The feature co-occurrence restrictions of Setswana that have been introduced may thus be generalized in the following way (m represents the mora; α and β represent distinct features licenced by the same mora):

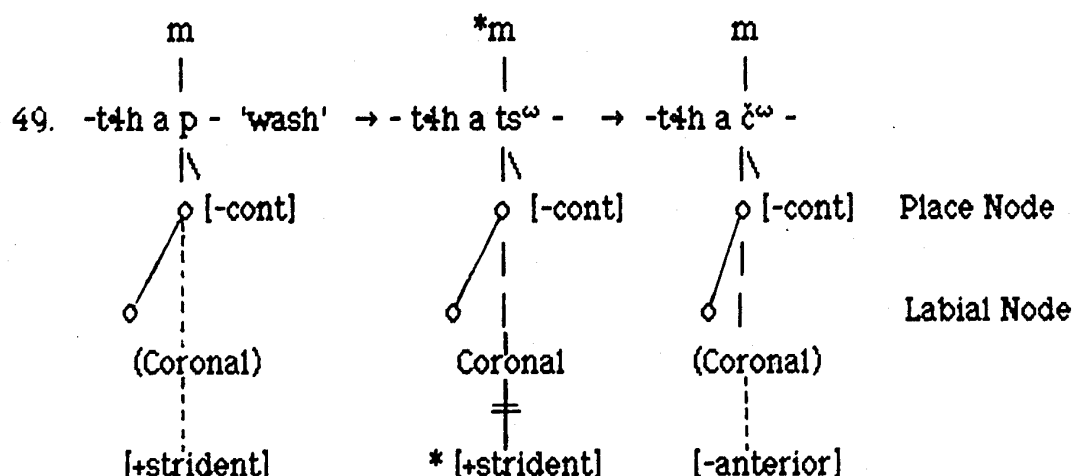
47.



This is to be interpreted as a feature co-occurrence restriction to the effect that two features α and β can not be licensed by the same mora. This explains why the sequence [+strident] [Labial] is ruled out, while the sequence [Labial] [+strident] is not. In the first case, both features are dominated by the same mora. This is also true if the features occur on a single hierarchy. In the second case, the features are dominated by different moras, by virtue of being in different syllables. We will see that defining the domain of the feature co-occurrence restrictions in this way has important ramifications for the mutations of nasals in causative formation.

Kiparsky, 1985).¹³

Notice that in the case of [-anterior] insertion, it is not an illicit feature co-occurrence that is repaired; rather a denuded Coronal Node is supplied with a dependent. Interestingly, it is not supplied with the default feature [+anterior], which would yield [t]. This is a consistent pattern in Setswana and it reinforces the notion that the mutations are structure preserving. An illicit feature is delinked and replaced, not by the opposite, default feature, but by another dependent which does not violate the feature co-occurrence restrictions. Bare Coronal Nodes do not occur underlyingly; they may therefore be disallowed on these grounds. The mutation [p] → [č^ω] proceeds as shown below:



A maximally simple and adequate account rests on the assumption of a co-occurrence restriction * [+strident] [Labial] that prevents these features

¹³ Kiparsky (1985) claims that lexical representations are governed by a system of conditions on what feature values may be underlyingly marked and that this system prohibits non-distinctive features from being marked at UR. If voiceless fricatives are indeed aspirated, this condition is too strong. The second part of Kiparsky's notion of Structure Preservation is more relevant to the present situation. It states that the marking conditions that hold at UR are applicable to derived representations, including the output of word-level rules. (p. 92). Since [+strident] and [-anterior] do not co-occur in the underlying representation, their co-occurrence is not tolerated on the output of causative formation.

from being linked to the same mora. When the causative word-formation process creates a violation of this restriction, it must be repaired. Repair consists of delinking one of the offending features, in this case [+strident]. Note that if [Labial] were delinked, the mutation of [p] would be indistinct from the mutation of [t]. This suggests that while deletion of either offending feature is a logical possibility, independent factors dictate that the only repair strategy available in the present instance is the delinking of [+strident].

[ɸ] → [tsh] ~ [čh^ω]

Another fairly productive mutation involves the transformation of [ɸ] to either [tsh] or [čh^ω]. According to Cole (1955), the first mutation is preferred, but some stems permit either alternative, in which case the variants are identical in meaning.

50. a. -leoɸ- 'sin, err' → -leotsh-/-leočh^ω- 'cause to sin, err'
 b. -neteɸ- 'be nice' → -natetsh-/-natečh^ω- 'cause to be nice'
 c. -tɬhaleɸ- 'become wise' → -tɬhaletsh-/-tɬhalečh^ω- 'cause to become wise'

Prior to demonstrating how the mutations proceed, it is necessary to address two questions. The first is why such alternations occur. What motivates the variation? The second question is why the output of fricative mutation is, in either case, an affricate, rather than a fricative, as the principles of causative formation, manifested in the mutation [x] → [s], lead us to expect. Let us take up each question, in turn.

The first question has already been addressed. The mutation [p] → [č^ω] and restrictions against sequences *so, *su lead to the conclusion that there is a feature co-occurrence restriction *[+strident] [Labial] in Setswana. The repairs that follow the creation of feature co-occurrence violations generally involve the delinking of one of the offending features. The

alternates of [ɸ] mutation are the result of repairing the feature co-occurrence violation in two logically possible ways. That is to say, if causative formation creates a feature co-occurrence *[+strident] [Labial], it can be corrected in two possible ways. Either [+strident] can be delinked, as is the case in [ɸ] → [tʰω] or Labial can be delinked, as in [ɸ] → [tsʰ].

51.

a.
|
=
|
[+strident]

b.
|
=
|
Labial

This alternation suggests that, all else being equal, either feature may be delinked to repair the illicit feature co-occurrence. It further suggests that the delinking rule can be characterized in the following way:

52. Rule of Repair of Illicit Feature Co-occurrences

|
=
|
α/β

This is to be interpreted as 'delink α or β', where α and β are two features that create a feature co-occurrence violation. That is to say, where α and β are two features related in the following way:

53.

*m
|
[
α
β
]

Now let us consider the second question raised by the mutation of [ɸ], why the resulting segments are affricates, rather than fricatives. I assume that this involves [-continuant] insertion. The most likely explanation for [-continuant] insertion in cases where [Labial] is retained is that it serves to distinguish the output of causative mutation from passive formation. In passive formation, a verb-final consonant is labialized. Verbs ending in [ɸ] involve mutation to [ʃ]; if causative mutation did not involve [-continuant] insertion, the outputs of causative formation and passivization would be identical. For example, *leɸa* 'pay' becomes *leʃwa* 'to be paid'. Why [-cont] is inserted when [Labial] is delinked is unclear. Cole claims that [čh^w] is the 'original' form, implying that [tsh] has been derived from [čh^w], but there seems to be no justification for this assumption. Tucker, who predates Cole by thirty years, provides data that suggests that the [tsh] forms predominated earlier, though alternative forms are indicated then, too. The net result is that there is a likely explanation for [-cont] insertion when [+strident] is delinked and [Labial] retained, but not when [Labial] is delinked and [+strident] remains. Perhaps simple analogy is the reason.

The insertion of [-continuant] parallels that of [-anterior] insertion and suggests the following general characterization:

54. Rule of Insertion

X
⋮
a

This should be interpreted as 'insert a', where a is a feature that is compatible with other features on the same path (cf. Archangeli & Pulleyblank, 1986, p. 58) and that respects other constraints of the language.

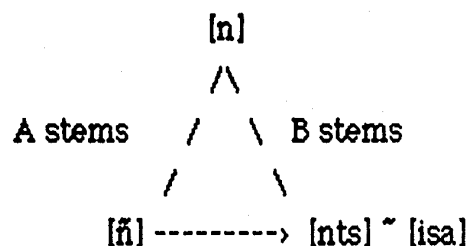
[n] → [ñ] ~ [nts]

In the mutation of [ɸ] a single word might form the causative in different ways. In contrast, different stems undergo mutation to [ñ] than undergo mutation to [nts]. Most of the stems that undergo mutation to [ñ] are those that have acquired their final nasal by becoming reciprocals (let us refer to these as A stems). In other words, the causative usually operates on a clearly derived verb.

55. a. -rat- 'love' → -ratana 'love each other' → -rataña 'cause to love each other'
 b. -leb- 'look at' → -lebana 'look at each other' → -lebaña 'cause to look at each other'

Another difference between the variants of [ɸ] mutation and the variants of [n] mutation is that the former are identical in meaning while the latter are semantically distinct. For example -kopaña is derived from -kopana 'meet each other' and it means 'join', whereas -kopantsa means 'cause to join'. It can not mean 'cause to meet each other'. These facts suggest that [n] may mutate directly to [nts] (if the verb stem is underived; let us call these B stems), or that [ñ] may mutate to [nts]. The [nts] causatives, but not [ñ] causatives, may alternatively form the causative via suffixation. This is represented in the following diagram:

56.



At the heart of all the mutations is a co-occurrence restriction on the features $*[+nasal] [+strident]$. Let us continue to assume that the restriction prevents the features $[+nasal] [+strident]$ from being linked to the same mora:

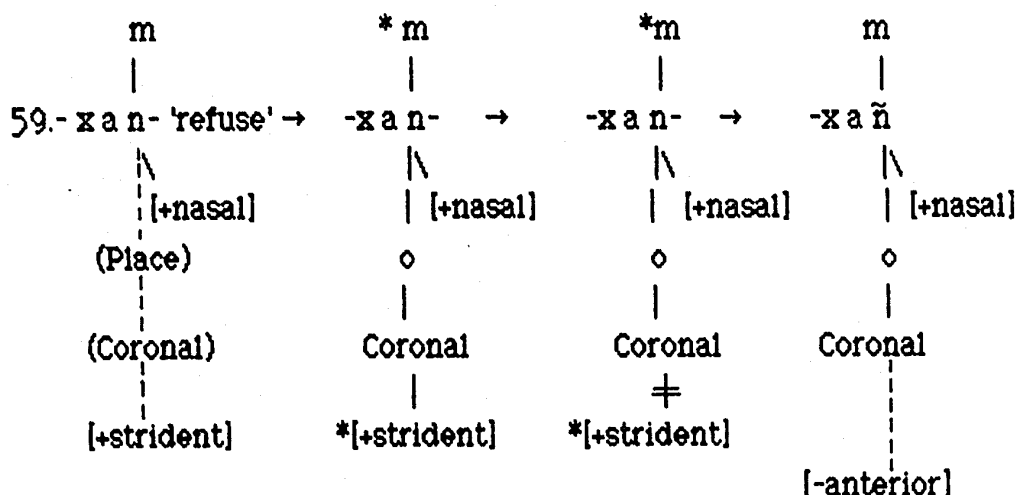


The co-occurrence restriction operates slightly differently in each of the three nasal mutations, $[n] \rightarrow [\tilde{n}]$, $[\tilde{n}] \rightarrow [nts]$, and $[n] \rightarrow [nts]$. Consider each of these mutations in turn.

First, let us look at $[n] \rightarrow [\tilde{n}]$ as exemplified by 55 a. and b., repeated here for convenience:

58. a. -rat- 'love' $\rightarrow$ -ratana 'love each other' $\rightarrow$ -rataña 'cause to love each other'
 b. -leb- 'look at' $\rightarrow$ -lebana 'look at each other' $\rightarrow$ -lebaña 'cause to look at each other'

The immediate concern is the fact that the feature $[strident]$ is not visible, despite the fact that these are causatives and that $[+strident]$ is claimed to be the causative morpheme. This is reminiscent of the mutations $[p] \rightarrow [\check{\omega}]$ and $[\phi] \rightarrow [\check{h}\omega]$. The feature co-occurrence restriction $*[+strident] [+nasal]$ results in the delinking of the feature $[+strident]$. The Coronal Node generated by strident linking remains, to be supplied with an appropriate coronal dependent, $[-anterior]$. This is shown by the following example.

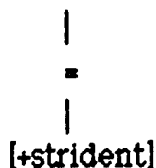


The previous discussion has suggested that repair consists of delinking one of the offending features and/or inserting another that is compatible with other features licenced by the same syllable node and with other constraints of the language. The evidence presented also indicates that independent factors, such as the need to maintain a distinction between two different word formation processes or lexical items, may constrain the choice of feature to be delinked. The delinking of $[+strident]$, rather than $[+nasal]$, supports this view. For example, if $[+nasal]$, instead of $[+strident]$ were deleted, the resulting form would be $-xasa$, but that is a different word, meaning 'scatter', in Setswana.

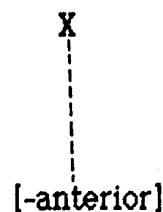
The particular rules active in this mutation are the following:

60.

a. Delinking

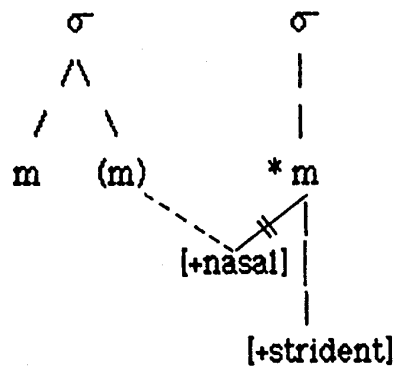


b. Insertion



As in the mutation $[\phi] \rightarrow [\check{\omega}h]$ and $[p] \rightarrow [\check{\omega}]$, the feature $[-anterior]$ is inserted following strident delinking. If default features were supplied, one

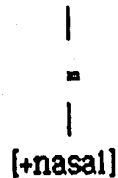
62.



The fact that nasal comes to occupy the second mora of the preceding syllable argues for feature delinking rather than deletion. The further assumption made here is that all the mutations that involve getting rid of a problematic feature behave in the same way, that is to say, they delete the path, rather than the feature itself. The fact that the nasal feature links leftward, rather than rightward, also suggests that the rule operates from right-to-left. Again, it is assumed that all the delinking rules of causative mutation are similar in this respect, though delinking, per se, does not manifest directionality in the obvious way that other rule types, such as spreading do. However, one difference between the *-isa* causatives and the mutation causatives may, in fact, be directionality. If the feature [+strident] does not link to the final consonant of the verb, then it occupies the onset of a syllable to the right of that consonant. In other words, the rule that forms *-isa* causatives may be set to operate left-to-right rather than right-to-left, as the nasal mutations indicate. The delinking rules are set to operate right-to-left, so the delinked feature has nowhere to go, since the available lefthand slots are, in all but the nasal cases, inhospitable to leftward linking.

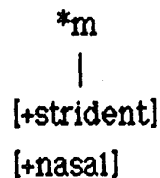
Now let us return to the topic of the particular nasal mutation [n] → [nts]. The following delinking rule is active in this mutation.

63.



where [+nasal] is a feature in the following configuration:

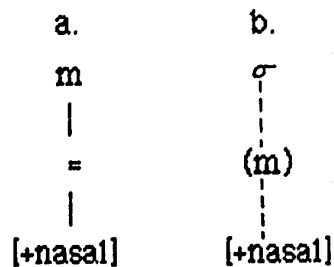
64.



The choice of which feature to delink is constrained by the need to maintain a distinction between reciprocal and non-reciprocal verbs. The reciprocals delink [+strident], leading to the mutation to [ñ]. The non-reciprocals must therefore delink [+nasal], if the distinction between the two types of verbs is not to be neutralized.

There must also be a linking rule, which spreads the delinked feature [+nasal] to the second mora of the preceding syllable.

65.

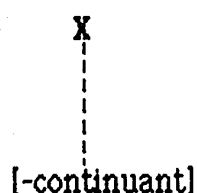


Of course, it is also possible that [+nasal] delinks from its original mora in the process of spreading. The coherence of the causative mutations in other respects, and the fact that nasal does not routinely spread leftward, that it spreads to the second mora of the preceding syllable only under very constrained circumstances, such as these, argues that spread is not what triggers the delinking. Rather, delinking facilitates spread, in this instance.

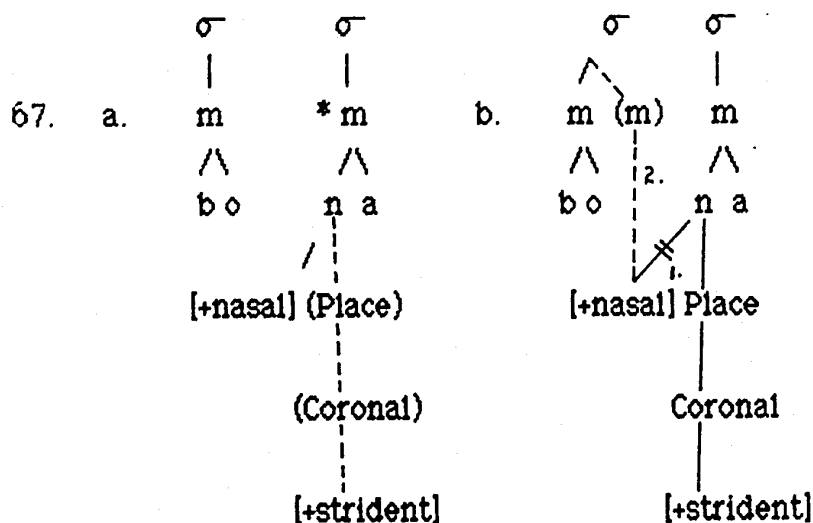
The position taken here is that this mutation involves the linking of the freed autosegment [+nasal] to the first available anchor to the left.

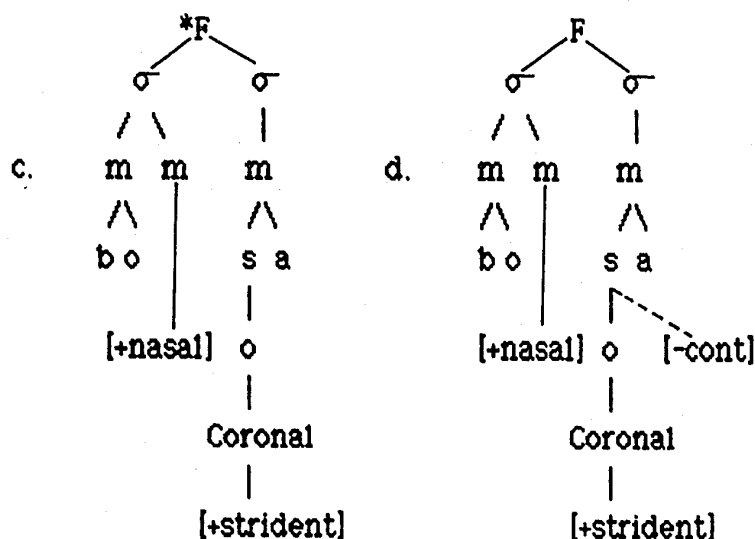
The fact that [+nasal] spreads to the second mora of the preceding syllable creates another problem. In Setswana, a nasal may only precede a stop or affricate. In other words, if [+nasal] precedes [+strident], the second segment must be a strident stop. Another rule involved in this mutation is [-continuant] insertion.

66.

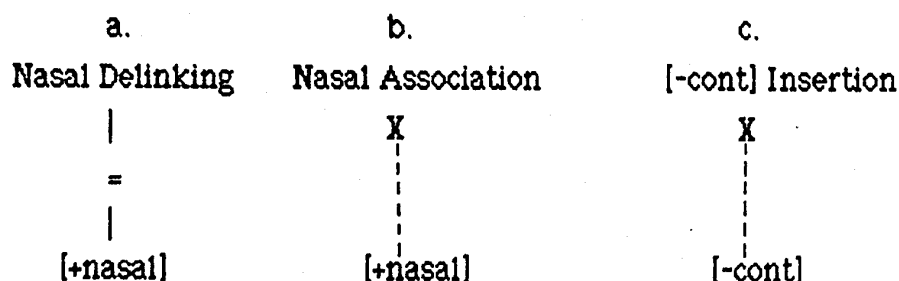


This is the only feature that sanctions the occurrence of [+strident] on a slot succeeding one that is specified [+nasal]. The derivation [n] → [nts] thus proceeds as follows:





68. The Rules of [n] → [nts] Mutation



A few lexicalized reciprocal causatives are permitted to undergo successive causative mutation. For example, kopafia 'join' becomes kopantsa 'cause to join'. The first question about this mutation concerns the obvious loss of [-anterior]. We must remember that the [ñ] is not only [+nasal], but [-anterior] as well. The short answer is that [-anterior] delinks and, because it can not be linked to higher-order structure, it is lost. Recall that the coda position can be filled only by the feature [+nasal]. Therefore, the feature [+nasal] from the segment [ñ] may associate to the second mora of the preceding syllable, but the feature [-anterior] may not. On the other hand, we have seen in previous mutations that the features [+strident] and [-anterior] do not co-occur. Recall that the presence of [-anterior] in mutations such as [ɸ] → [čʷh] was accounted for by positing strident

delinking. The behaviour of this nasal mutation supports the view that [+strident] and [-anterior] are considered incompatible in Setswana. They do not occur together in the underlying representation of segments, as we have seen. However, this feature co-occurrence restriction must govern the co-occurrence of features occurring on a single segment, rather than those that may be linked to a mora, as in the case of other feature co-occurrence restrictions. The evidence for this is that strident consonants freely precede front vowels, which are assumed to be [-anterior] (see Chapter Five). If the restriction operated over the domain of a mora, these sequences would be ruled out, as in the case of sequences such as *so, *so, and *su.

The choice of which feature to delink, [+strident] or [-anterior], is constrained by the need to distinguish single and double causatives. For example, if [+strident] delinked in the present case, there would be no distinction between 'join' (kopafā) and 'cause to join'. The delinking rule active in this mutation is the following:

69.

$$\begin{array}{c} | \\ = \\ | \\ [-\text{anterior}] \end{array}$$

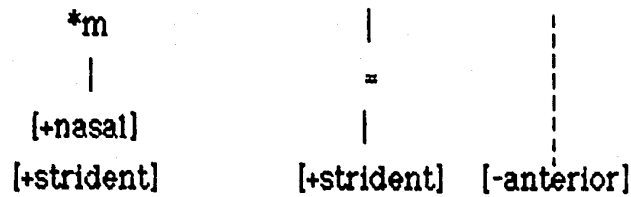
The rule of nasal spreading that we saw in the mutation [n] → [nts] is also active in this mutation, as is the rule of [-continuant] insertion. These rules do not need to be ordered, though there is no evidence to suggest that they are not. Once [+strident] has linked, there is a two-fold problem with the resulting feature combination; it combines the features [+nasal] [+strident] and the features [-anterior] and [+strident]. These illicit feature co-occurrences can not be simultaneously corrected by delinking [+strident] because to do so would obscure the distinction between the simple reciprocal causatives and the reciprocal causatives that undergo successive causative formation.

The repair rules involved in causative mutations are summarized in the following table.

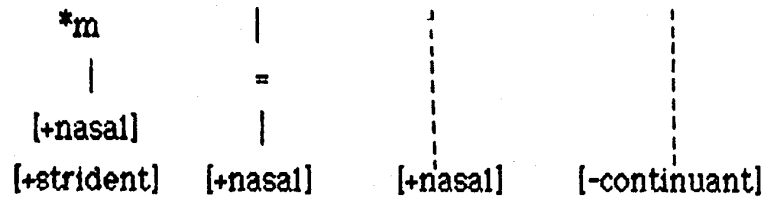
70. The Constraints and Repair Rules of Causatives

Mutation	Constraint	Repair Rule	
[x] → [s]:	*m Dorsal [+strident]	 = Dorsal	
[i] → [ts]:	*m [+voice] [+strident]	 = [+voice]	
[p] → [čʷ]	*m Labial [+strident]	 = [+str]	 = [-ant]
[ɸ] → [tsh] ~ [čʷh]	*m Labial [+strident]	 = [+strident]	 = Labial [-continant]

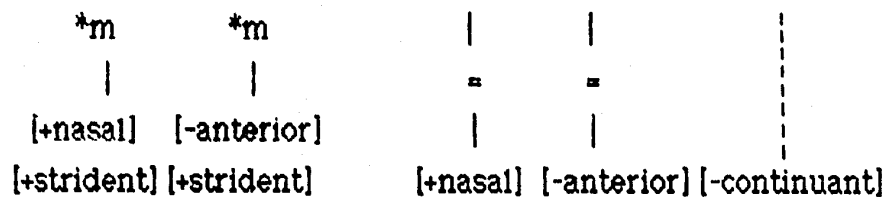
[n] → [ñ]



[n] → [nts]



[ñ] → [nts]



4.2.4 Conclusions

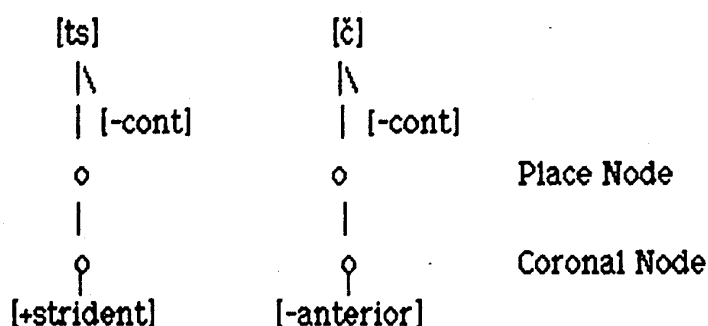
Despite the complexity of causative mutations in Setswana, they can be accounted for with a small common core of rules: the first is a rule that delinks one of two incompatible features. The second is an insertion rule. We have seen that the choice of which feature deletes is determined by factors external to the rule itself, such as the need to keep causatives and passives distinct. Feature insertion meets the following criteria:

- It is compatible with other features linked to segment X (i.e. it does not violate a feature co-occurrence restriction and it is structurally appropriate. For example, a denuded Coronal Node can not be supplied with a non-coronal dependent);

- It does not violate other restrictions of the language (e.g. the OCP, the need to keep lexical entries distinct, the need to maintain a distinction between different morphological processes, etc.);
- The resulting feature combination occurs in the underlying representation.

In one sense, the explication of the repair rules is peripheral to the present concern with the representation of the affricate. One common thread throughout the analysis of causative mutation is the assumption that the coronal affricates of Setswana are underlyingly represented as follows:

7.1. The Representation of [ts] and [č]



This, along with the assumptions that causative formation links [+strident] to the final consonant of the verb stem and that [+strident] is incompatible with certain features of those consonants, underlies this account of causative mutation in Setswana.

The feature co-occurrence restrictions are motivated, not solely by the causative mutations, but by independent facts of the language. For example, in addition to accounting for different causative mutations, the co-occurrence restriction against [+strident] and [Labial] is independently required to account for the fact that sequences of strident consonants followed by round

vowels are prohibited. It also explains why labialized stridents fail to occur elsewhere in the grammar. The same feature co-occurrence restrictions also account for inventory gaps. In sum, the feature co-occurrence restrictions account for a variety of phenomena in Setswana. Because of this they indicate a deeper level of explanation than an appeal to inventory gaps.

The same depth of explanation can not be achieved by assuming that affricates are defined by both values for the feature [continuant]. It is obviously false to claim that feature co-occurrence restrictions such as *[+continuant] [[Dorsal], *[+continuant] [Labial], or [+continuant] [-anterior] underlie the mutations. Segments such as [ɸ], [x], and [ʃ] contradict the idea. If feature co-occurrences are not at the root of causative mutation, then what is? Appealing to gaps in the inventory will not work on its own. For example, in the mutation of [ɸ] and [x], a causative defined as [+continuant] should effect no change because there is no reason for it to have a Coronal Node. The [+continuant] should apply without obvious effect to [x] and [ɸ]. Of course, this is not what occurs. The outputs are coronal; therefore, the causative must be characterized as Coronal, without apparent reason. The appeal to inventory gaps is not an economy in any respect. For instance, in the case of [ɸ], the insertion of [-continuant] must be independently accounted for since the segment [ʃ^ω] does occur in the underlying inventory. The net result is that appealing to inventory gaps forces another set of assumptions (such as Contrastive Underspecification), but it does not offer any advantages in terms of simplicity. However, it is considerably more limited in its explanatory power. For instance, one may attribute the emergence of [t͡ʃ^ω] to the absence of *[ts^ω] in the underlying inventory, but that fails to capture the more general fact that *[s^ω] is also absent and that sequences of stridents followed by round vowels are prohibited. An analysis based on the assumption of co-occurrence restrictions, all of which involve the feature [+strident], is far more explanatory. This analysis also shows that combining the features [+strident] and [-continuant] results in the creation of a coronal affricate [ts].

Chapter Five

The Derivation of Affricates in Other Morphological Processes of Setswana

Chapter Four provides an in-depth look at causative formation, a process in Setswana that derives affricates. In fact, there are other morphological processes of the language that create affricates. These processes include diminutivization, passivization, and Strengthening, which are particularly interesting for the points of contrast they provide to causative formation. Such points of contrast yield further insights into the structure of segments in the language and the conditions under which affricates may be created. In so doing, these processes further justify the representation of affricates argued for in this thesis, notably the view that affricates are stops underlyingly and that they are not characterized by both values for the feature continuant. To save repetition and interruption, the most frequently cited references are normally omitted. These are, first, Cole (1955) and, to a lesser extent, Tucker (1929). The data have been supplemented by personal observation. Specific references are provided only when differences of opinion, other sources, or particular page numbers are relevant.

5.1 Diminutive Formation

The diminutive in Setswana is formed by suffixing -ana (or, less often and for reasons that remain unexplored, -ane) to the noun stem, as shown in 1.

1.
 - a. noxa 'snake' + -ana → noxana 'small snake'
 - b. p^heta 'bead' + -ana → p^hetana 'small bead'
 - c. k^xosi 'chief' + -ana → k^xosana 'petty chief'
 - d. mot^se 'village' + -ana → mot^sana 'small village'

Unlike these forms, other cases of diminutive formation involve several stem changes that are apparently so complex that they have often been considered suppletive (Herbert, 1977). As 1. shows, there has been deletion

of a vowel, but further examples indicate that diminutive formation may also trigger mutation of the final consonant of the noun stem.

2. a.
 - i. leoto 'foot' + -ana → leot^{wa}ana 'small foot'
 - ii. nčuču 'penis' + -ana → nčuč^{wa}ana 'small penis (curse)'
 - iii. pet⁴o 'adze' + -ana → pet⁴l^{wa}ana 'small adze'
 - iv. seolo 'ant-heap' + -ana → seol^{wa}ana 'small ant-heap'
 - v. mokoro 'canoe' + -ana → mokor^{wa}ana 'small canoe'
 - vi. loušo 'spoon/ladle' + -ana → louš^{wa}ana 'small spoon/ladle'
- b.
 - i. t⁴hapi 'fish' + -ana → t⁴hač^{wa}ana 'small fish'
 - ii. ts^hepe 'springbok' + -ana → ts^hech^{wa}ana 'small springbok'
 - iii. kxolobe 'pig' + -ana → kxoloj^{wa}ana 'small pig'
 - iv. mora^ɸe 'nation, tribe' + -ana → morač^{wa}hana 'small nation'
 - v. lexo^ɸi 'palm (of the hand)' + -ana → lexoš^{wa}ana 'small palm'
 - vi. lorole 'dust' + -ana → lora^ɸjana 'a bit of dust'
 - vii. podi 'goat' + -ana → potshane/poč^hane 'small goat'
 - viii. p^hoti 'duiker' + -ana → p^hotsana 'a small duiker'
 - ix. lobati 'board' + -ana → lobatsana/lobačana 'small board'
 - x. lemote 'mud wall' + -ana → lemočana 'small mud wall'
 - xi. set⁴are 'tree' + -ana → set⁴ats^hana 'small tree, shrub'
 - xii. namane 'calf' + -ana → nama^ɸiane 'small calf'

The following facts emerge from the data:

- Labialization of the final stem consonant occurs when the final stem vowel is [u], [o], [ɔ].
- Labialization of the final stem consonant also occurs if that consonant is [p], [b], [ɸ]. Such labialization is always accompanied by consonant mutation that is referred to in the literature as palatalization.

- Consonants [p, b, ϕ , d, l, t, r, n] ¹⁴ mutate in diminutive formation.
 - a. [p, b, ϕ] become labialized alveopalatal affricates;
 - b. [t] becomes either an alveolar or alveopalatal affricate;
 - c. [d/l, r] become voiced alveopalatal affricates or voiceless aspirated alveolar affricates;
 - d. [n] becomes an alveopalatal nasal.
- Stem final consonants [s, ts, č] do not mutate. ¹⁵
- Stem final front vowels [i], [e], [ɛ] trigger mutation.

The data do not indicate whether velar consonants followed by front vowels undergo mutation. The absence of data is undoubtedly due primarily to distribution facts. Velar consonants [x], [k^h], [kx] do not occur before front vowels. The ejective velar [kʰ] occurs before front vowels, (though no relevant native diminutives could be found in the available sources). In other circumstances when the velar stop precedes a front vowel, it is reported to be realized as palatal stop [c]. Cole (1955) further notes that this alternates dialectally with [č].

3. /kʰikʰa/ 'mortar' → [cika]/[čika]

¹⁴ [d] and [l] are generally assumed to be allophonic variants. [d] occurs only before high vowels [i] and [u]; [l] occurs before non-high vowels [e] [o], [a]. This is discussed in 4.2.1.

¹⁵ Recall that words containing the voiced alveopalatal affricate are relatively few and no nouns containing a voiced alveopalatal affricate followed by a front vowel could be found. I therefore attribute the absence of the voiced alveopalatal affricate from this set to that gap. Should such a noun be found, it is predicted that it will be immune to mutation.

I therefore assume that velar consonants do not undergo consonant mutation in diminutive formation by virtue of the fact that they do not occur in the relevant environment. There is not assumed to be anything in their structure that, a priori, rules out the possibility of mutation.

4. Consonant mutations of diminutive formation

- | | | |
|----|---|---|
| a. | <p>t → t^ω</p> <p>d/l → d^ω/l^ω</p> <p>r → r^ω</p> <p>tʃ → tʃ^ω</p> <p>č → č^ω</p> <p>š → š^ω</p> <p>k → k^ω</p> <p>kx → kx^ω</p> | <p>[Labial] is added to the feature specifications of the stem final consonant when the consonant is followed by [u], [o], [ɔ].</p> |
| b. | <p>p → č^ω</p> <p>b → j^ω</p> <p>φ → š^ω</p> | <p>Coronal [-anterior] is added to the feature specifications of the stem final consonant when the consonant is followed by [i], [e], [ɛ].</p> |
| c. | <p>t → ts/č</p> | <p>Coronal [+strident] or [-anterior] is added to the feature specifications of stem-final [t] when it is followed by [i], [e], [ɛ].</p> |
| d. | <p>d/l → tsh/j</p> <p>r</p> | <p>Coronal [+strident] or [-anterior] is added to the feature specifications of the stem final consonant when the consonant is followed by [i], [e], [ɛ].</p> |

- e. n →ñ Coronal [-anterior] is added to the feature specifications of the stem final [n] when it is followed by [i], [e], [ɛ].

One of the same feature co-occurrence restrictions evident in causative formation is prominent also in diminutive formation. Voiced consonants [r], [d/l] mutate either to voiceless (aspirated) alveolar affricates or voiced alveopalatal affricates, echoing the feature co-occurrence restriction *[+voice] [+strident]. Other feature co-occurrence restrictions, such as *[+nasal] [+strident] and *[Labial] [+strident] exert their influence in a slightly more subtle fashion, but they too are evident in diminutive mutations.

The restriction that is at the heart of diminutive formation is a restriction against the creation of onsetless syllables. CV syllables are strongly preferred in Setswana (as in all languages). Non-CV syllable types (syllabic nasals and syllables consisting of a single vowel) figure in only about 10% of the vocabulary. About 90% of the Setswana vocabulary consists solely of CV syllables.¹⁶ Therefore, while it may be true that there is some variety of permissible syllable structures, one must bear in mind that all non-CV syllables make up a small percentage of the vocabulary. The constraint is formalized by Ito (1986) as Avoid $\sigma[V]$. It is a constraint on the output of derivations.

This constraint is violated in the process of forming diminutives.

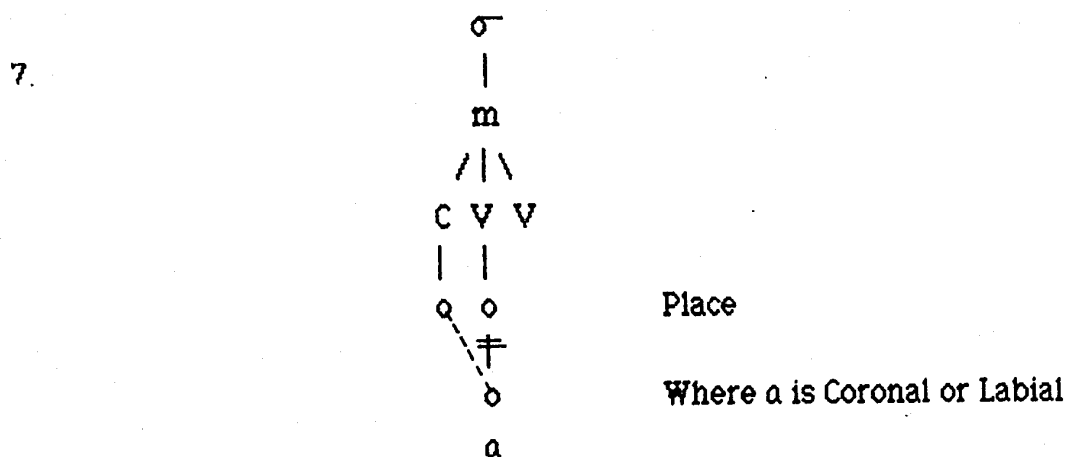
5. σ σ^* σ σ
 ^ ^ | ^
 p o d i a n a

¹⁶ This estimate is admittedly rough, being largely based on a word count over about 20 randomly selected pages of Brown's dictionary. Doug Pulleyblank has noted that choice of pages could really affect the outcome if, for example, only consonant-initial word pages were sampled. This was not the case. However, only about one tenth of the dictionary (30 out of 300 pages) contain vowel-initial words, so it is unlikely that the present estimate would be seriously undermined by a truly scrupulous sampling.

One means of resolving the violation is to link the onsetless vowel to the preceding syllable, or more correctly, to the mora of the preceding syllable.



However, the first mora of the syllable is maximally binary in Setswana, so the resulting structure can not be allowed to persist. One means of repairing the problem is to merge the stem final front vowel with the preceding consonant. There are different possibilities for merger that are consistent with the available facts. I assume that merger involves place assimilation since the results are constrained principally by the place feature combinations that occur underlyingly.



The fact that place assimilation sometimes results in the creation of an illicit segment type does not block its occurrence. This is in accord with the theory of constraint violations and repair strategies proposed by Paradis (1988) and Paradis & Prunet (1988). The requirements of the syllable take precedence over the requirements of the segment and the requirements of the syllable, in being met, may create segment structure violations.

In the repair of segment structure violations, the same rules are evident in diminutive formation as in causative formation:

8. a. Insert

b. Delete

X
|
a

X
|
+
|
a

Where a is one of two incompatible features – as defined by the feature co-occurrence restrictions of the language.

The fact that [+strident] links to a voiced consonant indicates that a feature co-occurrence restriction does not always block the insertion of a feature. However, in most cases the feature inserted meets the criteria set out in Chapter Four. It respects the feature co-occurrence restrictions and abides by the feature combinations that occur at UR.

5.1.1 The Vowels of Setswana

Considerably more work needs to be done to establish the vowel phonemes of Setswana and their precise phonetic realizations under various conditions before a definitive proposal for their representations may be advanced. The most promising and recent analysis thus far is that put forward by Khabanyane (1991) for southern Sotho, of which Setswana is one dialect. The vowel phonemes are listed here: [i, e, ɛ, a, ɔ, ɔ̃, o, u]. The less familiar symbols [ɛ̃] and [ɔ̃] represent sounds that are distinguished from [ɛ] and [ɔ] respectively, by the feature Khabanyane calls [Expanded (pharynx)]. I assume this is covered by the more familiar feature [+ATR] (cf. Meechan,

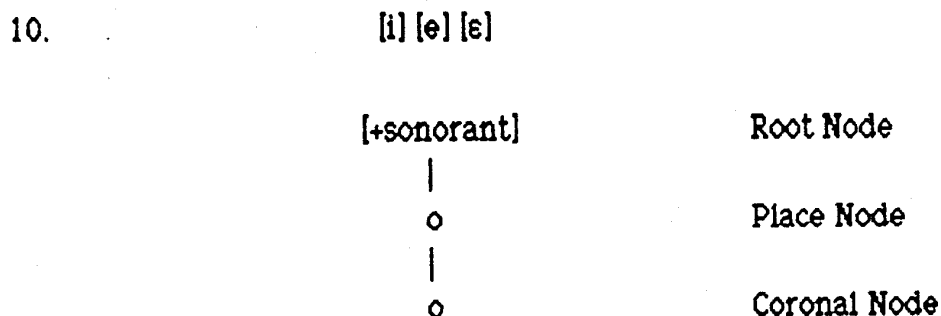
1992; Archangeli & Pulleyblank, forthcoming). This is confirmed by the fact that [ɛ] and [ɔ] become [ɛ̥] and [ɔ̥] under the influence of a succeeding [i] and [u] that are generally assumed to be [+ATR].

9. a. lema 'cultivate' ~ molemi 'cultivator'
- b. leɸa 'pay' ~ leɸuwe 'has been paid'
- c. bola 'rot' ~ sebɔdu 'rotten thing'
- d. sɛba 'gossip' ~ mosɛbi 'one who gossips'
- e. betɬa 'sharpen' ~ betɬuwe 'has been sharpened'

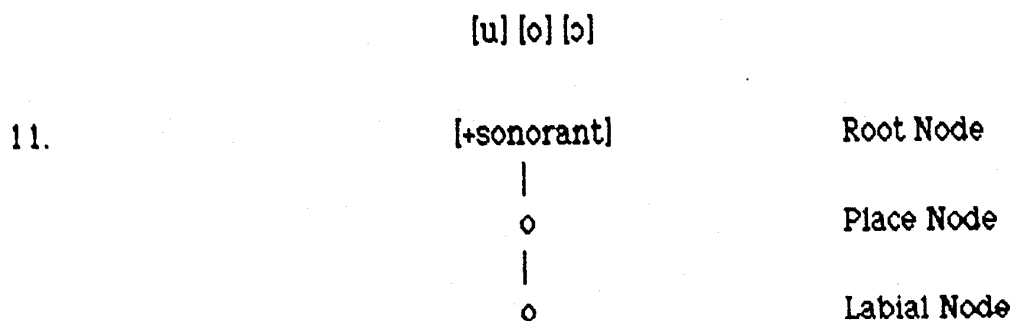
Unfortunately, the distinction between the mid vowels is not often represented orthographically, due partly to the fact that the orthographic conventions predate much systematic linguistic investigation and partly to confusion over terminology. For instance, Cole represents 'more open' mid vowels as ɛ̥ and o̥ and 'close' – which I assume to mean [+ATR] – mid vowels as e and o. There is no distinction between [e] and [ɛ], or else it is subsumed under the open/close distinction. Tucker represents the 'open' vowels with the symbols ɛ̥ and o̥ and the 'normal' mid vowels as e and o. Brown (1875), whose orthography remains influential today (the edition of his dictionary referenced in this thesis was reprinted in 1982), ignored the close/open distinction altogether and the [ɛ] is represented as ɛ̥. In modern text the symbol 'e' is used for all these sounds. Because of the confusion and because it is irrelevant to diminutive formation, the [ATR] and height distinctions are often ignored in the transcriptions provided here.

Vowels [i], [e], and [ɛ], represent at least two different heights and ATR values, trigger consonant mutation in diminutive formation. I therefore conclude that frontness, the attribute that is common to all three of the triggering vowels, is the relevant factor in diminutive formation. Front vowels are assumed to be Coronal (following Keating, 1988; E. Pulleyblank, 1989a; Lahiri & Evers, 1991; Hume, 1992). The process of diminutive formation further supports the view of Hume (1992) that, although front vowels are Coronal [-anterior], the [-anterior] is redundant for vowels. This

means that the front vowels, unlike the coronal consonants, are represented with a bare Coronal Node underlyingly.

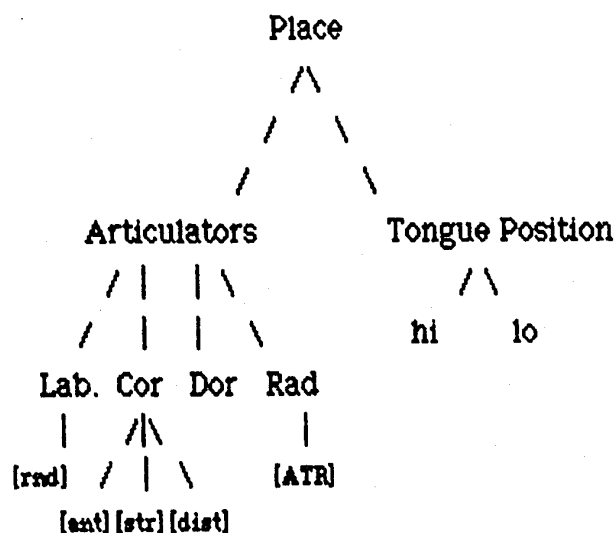


I extrapolate from Hume in assuming that round vowels, which are also relevant to the analysis of diminutives and to passive formation, are characterized with a Labial Node that is redundantly [+round]. As in the case of front vowels, only the primary articulator node is relevant to the discussion; height and ATR distinctions among the labial vowels are not. Vowels [u], [o], [ɔ] all trigger labialization. They are represented as follows:



I leave for future study the important question of how to represent the distinctions within these two sets of vowels. I currently envisage representations along the lines suggested by Lahiri and Evers (1991) who argue for a distinction between the Articulator and Tongue Position Nodes. The former dominate the articulators, the latter the tongue height features.

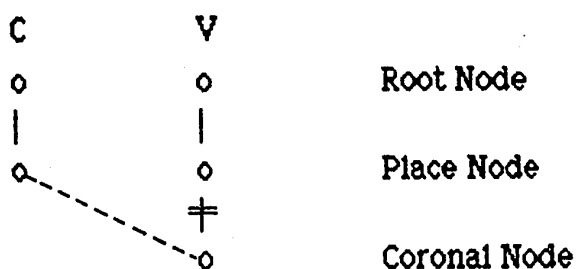
12.



5.1.2 The Analysis of Setswana Diminutives

The proposed approach permits us to account for diminutives that exhibit labialization of the final stem consonant, and those that exhibit palatalization, in a unitary way. In the present analysis, both palatalization and labialization involve the linking of the vowel's Place Node to the Place Node of the final stem consonant. Since palatalization is the focus of the discussion, linking of stem final front (i.e. Coronal) vowels to their preceding stem consonants is illustrated:

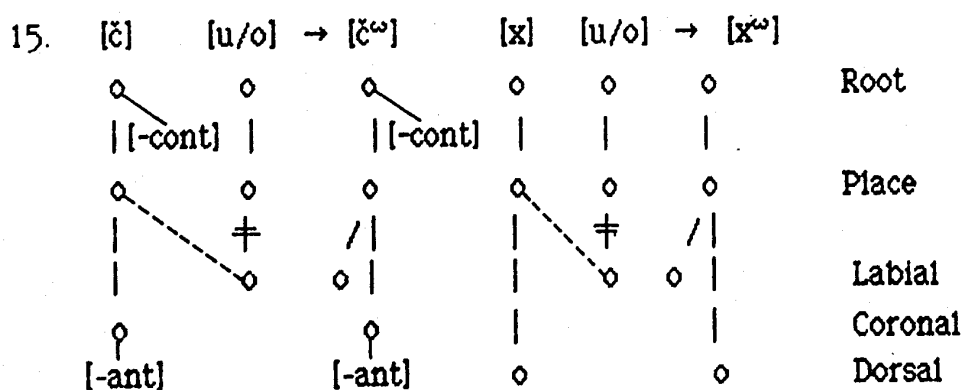
13.



This linking constitutes the point of departure for the mutations of diminutive formation. It is a view of diminutive formation that allows us to account for apparent diversity of diminutive mutations in a coherent way. Consider, first, mutations of the form C V [Labial] → C^ω and C [Labial] V [Coronal] → C [Labiocoronal]. In the diminutives that simply labialize the final stem consonant, the final round vowel of the stem is considered to be the source of the labial node that is manifest in labialized consonants:

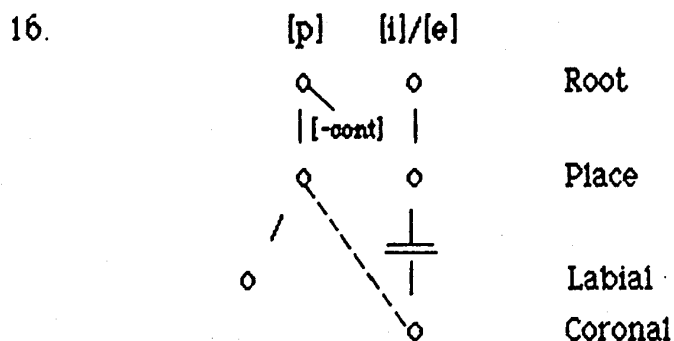
14. a. ntɬo 'house' → ntɬ^ωana
 b. nɛuɕu 'penis' → nɛuɕ^ωana
 c. pholo 'ox' → phol^ωana

This is most simply accounted for as the coalescence of the vowel and the consonant or the combination of their specifications (aspiration of fricatives is omitted, to save space):



The data also show that labialization occurs when the stem-final vowel is [i] or [e], provided that the preceding consonant is Labial. When this occurs there is affrication as well, but let us for the moment ignore that aspect of the mutation. Tucker concludes that labialization of the resulting segment

must have derived in a transparent manner from segments that have since disappeared. Stahlke (1976) argues that the process is productive and that labialization must come from the labial consonant. However, the proposal is not formalized. The present characterization of segments and labialization formalizes the process and in so doing provides an insightful way to unite two apparently diverse sources for labialization. In this view, labialization does not derive from the vowel directly, but from the articulation specifications ([Labial]) provided by the vowel. Therefore, it follows that the introduction of that same specification by another type of segment provides the ingredients for labialization. In this case, the Labial Node is provided by the consonant.

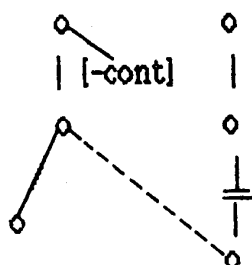


In short, the assumption that diminutive formation involves the linking of the specifications of the final vowel of the stem to those of the preceding consonant allows us to account for apparently different sources of labialization. It does not rely on the notions of suppletion, or unexplained deletion of triggering vowels.

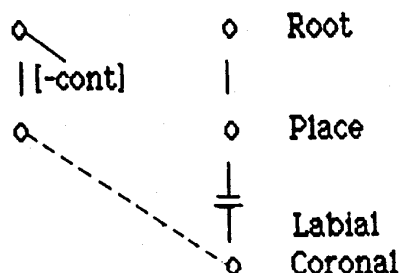
Now let us consider how this view of diminutive formation accounts for other types of mutation, including the process of affricate formation, that is referred to in the literature as palatalization. The particular consonant mutations begin as indicated in the following diagrams (which ignore laryngeal distinctions).

17. Some Consonant Mutations

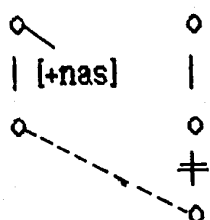
a. [p]/[ph]/[b] [i]/[e]



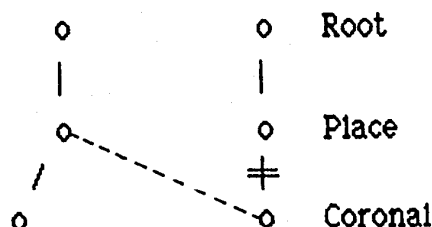
b. [t]/[d]/[l] [i]/[e]



c. [n] [i]/[e]

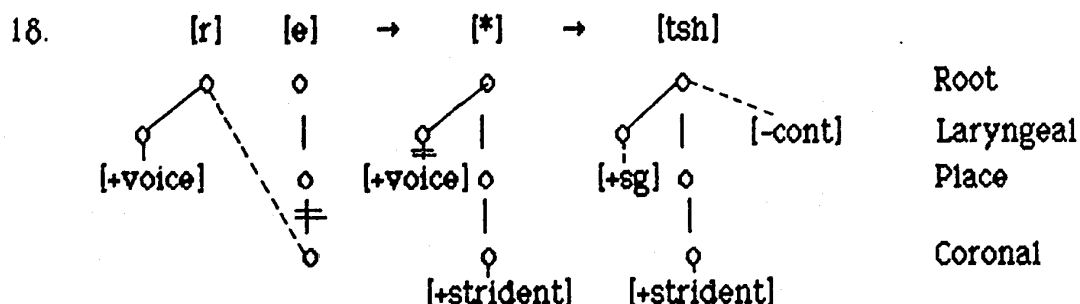


d. [ɸ] [i]/[e]

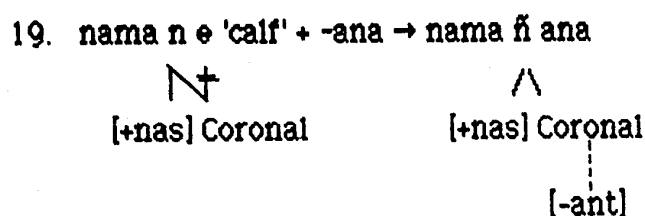


The labial consonants end up with a labial and a coronal node. As discussed in the previous chapter, alveolar affricates can not be labialized, so the labialized coronal stop is [-anterior], that is [č^w]. The normally placeless consonants [n, t, d, l] acquire a Coronal Node in merger. They are apparently further required to have coronal dependents. We have seen in the previous chapter that coronal dependents [strident] and [anterior] are active elsewhere in the language. This suggests alternatives. If coronal dependent [strident] is selected, then [ts] should result; if [-anterior] is selected, then [č] should result. Surface variation in diminutive forms support this view of alternatives. However, we have also seen that certain co-occurrence restrictions apply. For instance, it was argued that features [+voice] and [+strident] may not co-occur in Setswana. This means that a voiced affricate may only be alveopalatal. An alveolar strident must be voiceless. The surface variants support each of these points.

Surface variation can not be accounted for entirely by the phonology. Some items are consistently pronounced with an alveolar affricate; others with an alveopalatal. Sometimes the stem consonant of a single word may mutate to either the alveopalatal or the alveolar affricate (e.g. lobati 'board' → lobatsana/lobačana). This is, to some extent, dialect specific and independent of the phonology. In some cases, either the alveolar or alveopalatal affricate is acceptable within a dialect. Again, such latitude is apparently not attributable to the phonology (cf. the variant English pronunciations of either). No particular consonant from the set [t, d, l, r] consistently becomes [ts], while another consistently becomes [č]. If the consonant is voiced, it may retain its voicing, in which case the mutated consonant is necessarily alveopalatal (e.g. lorole 'dust' → lorojana). If a voiced consonant becomes an alveolar affricate, voicing is necessarily lost (e.g. setlare 'tree' → setlatshana), but the resulting consonant is aspirated. An incompatible laryngeal specification is replaced with one that may co-occur with [+strident]. This is reminiscent of the retention of the Coronal Node following [strident] delinking in causative formation. In this case, too, the feature is deleted, but not the Node that dominates it. It remains to be specified with another dependent that occurs underlyingly. If it were supplied with the default feature, we would expect the result to be glottalized (see Chapter Four for a discussion of the fact that glottalization is unmarked underlyingly in Setswana). [-cont.] insertion is discussed shortly.



Now let us consider the remaining cases of diminutive mutation. The nasal behaves in diminutive formation exactly as we have been led to expect by causative formation and other diminutive mutations. It acquires a Coronal Node from the final front vowel of the stem. A consonant Coronal Node is required to have a dependent. The features [nasal] and [strident] may not co-occur, so the simplest change involves the assignment of [-anterior]. This derives the alveopalatal nasal [ɲ].



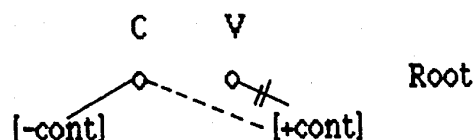
Mutations involving fricative [ɸ] again provide alternatives, but they differ somewhat from the alternatives of causative formation in which [ɸ] → [ts^h] or [tʃ^h]. In diminutive formation, some words with final stem consonant [ɸ] undergo mutation to [ʃ^ω]. This is shown in the example given at the outset of the chapter. However, in other words it becomes [tʃ^hω] (e.g. moraɸe 'nation' → morač^hωana but lexoɸi 'palm' → lexoš^ωana). As in the case of other labial consonants, the choice of coronal dependent is limited to [-anterior], by virtue of the fact that alveolar affricates and fricatives may not be labialized. Variation revolves around the insertion of [-continuant]. The input consonant is a fricative, unmarked for [continuant], as is the triggering vowel. This accounts for the derivation of the alveopalatal fricative. The number of items in which the final consonant [ɸ] remains a fricative is relatively small and it seems to be getting smaller. There is an indication that affricate formation is on the increase; items that are recorded by Tucker as undergoing mutation to [ʃ^ω] are more recently recorded as undergoing mutation to [tʃ^hω]. According to Cole, whose research postdates that of Tucker by thirty years, [ɸ] **always** becomes [tʃ^hω] in diminutive formation. The insertion of [-continuant] has no clear motivation (in contrast

to [-continuant] insertion in $\phi \rightarrow [\text{ch}^\omega]$ of causative formation, where it is plausibly done to keep causatives and passives distinct). It is true that consonants are optimally [-continuant] in the language and so-called hardening or strengthening is a widespread process in Setswana. At the present this is the closest I have been able to come to explaining [-continuant] insertion.

In the final analysis, the process of diminutive formation is of interest for the following reasons: like causative formation, diminutivization often creates affricates. Causative formation favours the creation of alveolar affricates, a fact that is accounted for by assuming that the causative morpheme consists of the feature [+strident]. In contrast, the process of diminutive formation derives either alveolar or alveopalatal affricates. This is explained as involving the merger of a front vowel, specified with a Coronal Node, and a consonant. However, a consonant may not be specified for a Coronal Node unless it bears a coronal dependent. In Setswana the choice of coronal dependents are the features [-strident] or [-anterior]. If [+strident] is selected, an alveolar affricate results; if [-anterior] is selected, then an alveopalatal affricate results. Other aspects of diminutive mutations, such a devoicing versus the retention of voicing, are consequences of the same co-occurrence restrictions evident in causative formation.

A dual continuant affricate is not amenable to similar treatment. The central problem is that deriving an affricate involves bringing together both values for the feature [continuant]. In several cases (e.g. stems with final stop consonants) the source of [-continuant] seems obvious, but the source of [+continuant] is not. Under any view of underspecification, there is no reason for vowels to be specified [+continuant]. Even if there were some motivation for the [+continuant] specification of vowels, it is unclear how the mutations might proceed. The fact that [continuant] is a root dependent suggests that merger must first involve the linking of both Root Nodes to a single consonant slot.

20.



The result would be an affricate representation of the type proposed by Clements & Keyser (1983). This leaves the problem of accounting for the apparent merger of the consonant and vowel place specifications. Moreover, this approach does not obviate any of the assumptions regarding the loss of [voice] or other features, for example in the mutation [r] → [tsh]. It is also unclear why in cases where the velar stop merges with the front vowel an alveopalatal rather than a velar affricate is created. If affrication involves bringing together two continuant values and the output is referenced to the underlying inventory, a velar affricate is expected. In sum, the assumption of a dual continuant affricate, in addition to failing to account for the distribution of affricates in inventories, leads to a more complex and problematic analysis of Setswana diminutives.

5.2 Passive Formation

There is some debate over the precise identity of the passive suffix in Setswana. Cole considers it to be [wa]. Most Batswana consider the passive suffix to be -[wa]. However, according to Tucker (1929) and Myers (1990) the passive is [w]. How are these diverse views reconciled? To begin with, there is no doubt that the surface passive suffix is often [iwa].

21. a. disa 'herd, look after' → disiwa 'be herded, looked after'
- b. ntsha 'remove' → ntshiwa 'to be removed'

The final [a] is more reasonably considered an indicative mood indicator that is independent of passive formation and, therefore, not a part of the passive

suffix. Another final vowel, [e], occurs in the subjunctive, whether the verb is active or passive. In parallel with the assumption that the causative suffix is actually a floating feature [+strident], rather than a segment, let us assume that the passive consists of the floating feature [+round]. The epenthesis of [i] in the passives of Shona is justified by Myers, along with causative epenthesis. The essential point of the justification is that clusters of the form Cw are not permitted in Setswana, just as in Shona. Therefore, when [+round] occupies the X-slot adjacent to a consonant, an illicit cluster is created and epenthesis is triggered. Epenthesis is further supported by the fact that epenthetic [i], as opposed to underlying [i], does not trigger [ATR] harmony.

22. a. rekiwa 'bought' *rɛkiwa

b. rekisiwa 'has been made to buy' *rɛkisiwa.

One might reasonably ask why the feature is not simply realized as a round vowel, rather than a glide [w]. Thus, a form such as -ratoa, rather than -ratiwa, would result. There is evidence that this occurred at an earlier stage in the language, though Tucker notes that such forms were already rare and considered archaic at the beginning of this century. Their disappearance is most likely attributable to the preference for CV syllables.

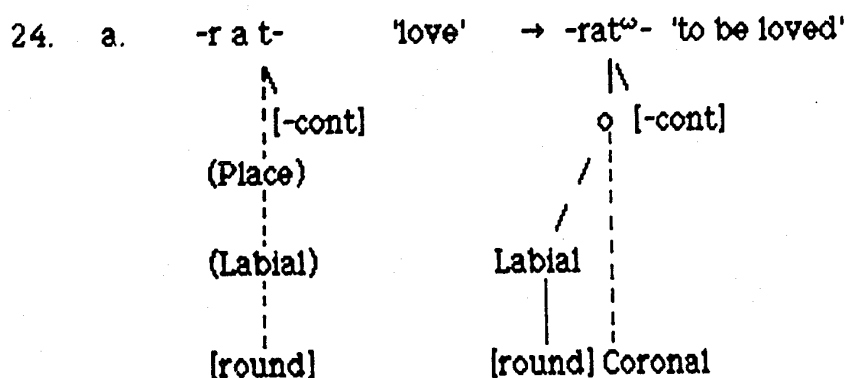
Passivization creates affricates [čʷ] and [čʷh], but unlike causative and diminutive formation, such mutations are not widespread throughout the process. Some relevant data are provided here:

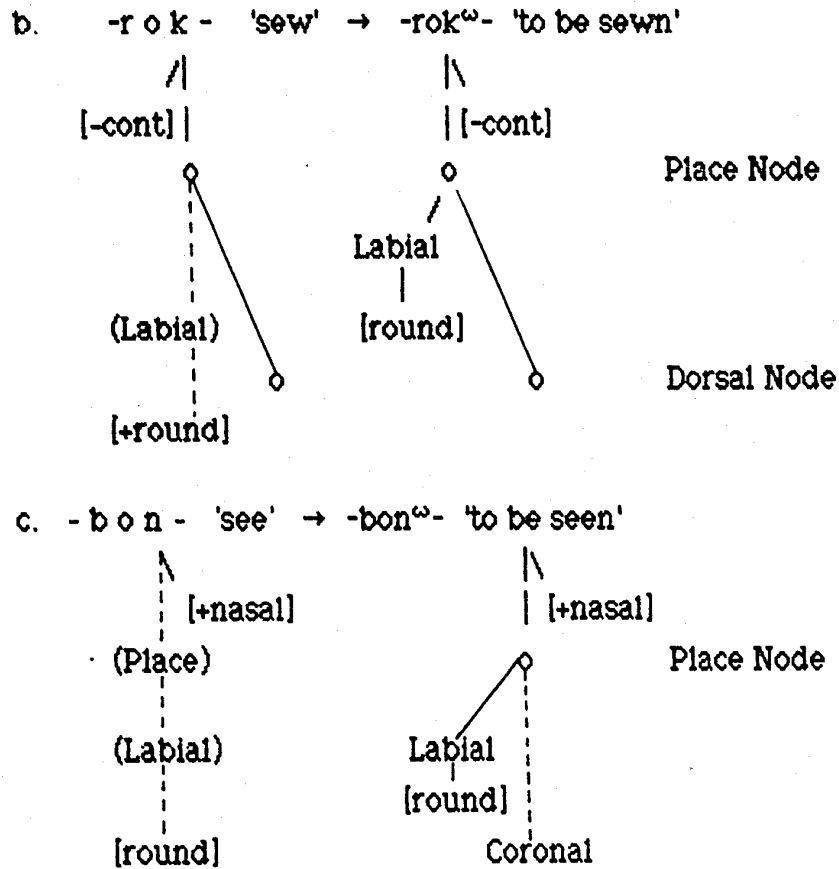
23. a. i. -bop- 'create' → -bočʷa/-bopiwa
 ii. -leb- 'look at' → -lejʷa/-lebiwa
 iii. -tɬhoph- 'select' → -tɬhočʰʷa/-tɬhophiwa
 iv. -leɸ- 'pay' → -lešʷa/-leɸiwa
- b. i. -dis- 'herd' → -disiwa
 ii. -ntsh- 'take out' → -ntshiwa

- c.
- | | | | |
|------|-------|---------|-------------------------------|
| i. | -bon- | 'see' | → -bon ^{wa} /-boniwa |
| ii. | -rat- | 'love' | → -rat ^{wa} /-ratiwa |
| iii. | -rok- | 'sew' | → -rok ^{wa} /-rokiwa |
| iv. | -ax- | 'build' | → -ax ^{wa} /-axiwa |

The data show that only the non-nasal labial stop consonants undergo mutation to affricates. Those verbs ending in labial consonants optionally undergo passive formation via -iwa suffixation. That is to say, the feature [+round] links either to the final stem consonant, causing consonant mutation to an alveopalatal affricate, or [+round] occupies an adjacent slot, creating an illicit Cw cluster that is repaired by epenthesis. Stems ending in [ɸ] may undergo mutation to [ʃ^w] or they may suffix with -iwa. Those verb stems ending in [s], [ts], or [tsh] form the passive only with -iwa. If the final stem consonant is an alveolar or velar stop, or a velar fricative, the passive is formed by labializing the final consonant or, less preferably, via -iwa suffixation.

In the most straightforward cases, such as in 23c., the passive derivation operates as follows:



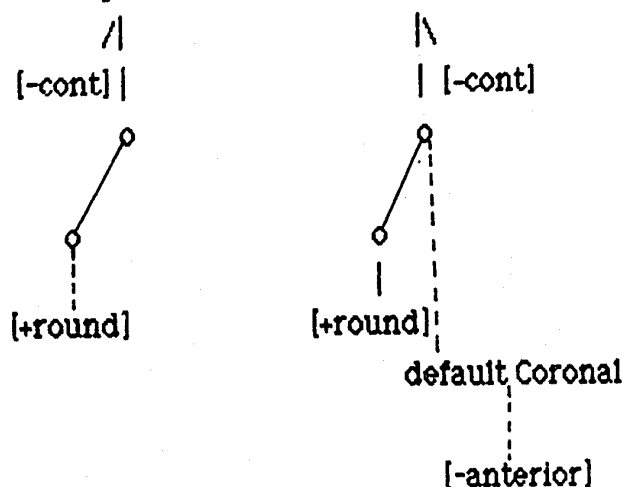


If the final segment is (unmarked) Coronal or if it is Dorsal, the feature **[+round]** docks, creating a labialized consonant. The Coronal Node is supplied by default, either before **[+round]** docks or after. If the Coronal Node is generated before passive formation applies, and if a consonant bearing a Coronal Node is required to bear a dependent, then why do dependents **[-anterior]** or **[+strident]** not make their presence felt? If **[-anterior]** were assigned, then **[t]** should undergo mutation to **[č^ω]**. The same is true if **[+strident]** were assigned, given the restriction against labializing stridents that has been observed in both causative and diminutive formation. If the Coronal Node is generated after **[+round]** docks and generates a Labial Node, then the question of why a Coronal Node is additionally supplied must be asked. Why is the resulting segment not simply a labial, so that **[t] → [p]** and **[n] → [m]**? The labial node carrying a **[+round]** dependent may only be interpreted as a secondary articulation in Setswana. Recall from the chart of

labialized segments presented in Chapter Four that labial consonants are never labialized. Only (some) coronals and velars may be labialized. This constraint holds at the level of UR and throughout the derivation. Therefore, a segment bearing a Labial [+round] specification must bear either a Coronal or Dorsal Node as well. In the absence of another such specification, the default Coronal is supplied. Thus, the passives do not argue for the prior assignment of default features, an assumption that would be inconsistent with the rest of the passive analysis and with the rationale for mutations that has adequately accounted for causative and diminutive variation.

The reasons for surface variation in the passive are the same as those proposed to account for variation among causatives. The restriction against labialized labials has just been reintroduced. Consider how this restriction influences the passivization of verbs ending in labial consonants [p], [ph], [b], [ɸ]. The feature [+round] need not generate a Labial Node, since these segments are already so specified. If the feature [+round] links, it can only be interpreted as a secondary articulation. Another place of articulation is therefore required. A default Coronal Node is supplied as well as its dependent feature [-anterior], in obedience to the co-occurrence restriction *Labial [+strident], presented in Chapter Four.

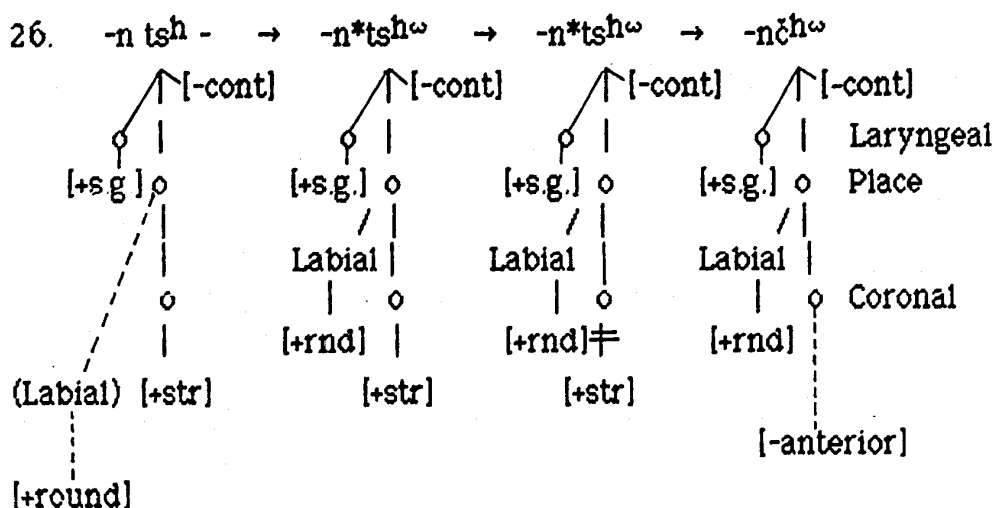
25. - b o p 'create' → -bočʷ- 'to be created'



Place Node

Labial

The failure of roots ending in [s], [ts], and [tsh] to labialize is also attributable to the co-occurrence restriction *Labial [+strident]. If [+round] were to dock onto those consonants, they would obligatorily become [-anterior]. In the case of the affricates, at least, it would not then be clear whether the resulting form was passive 'be taken out' or causative 'cause to take out'.



The fact that causative formation of verbs ending in [ɸ] triggers [-continuant] insertion, whereas in the passive [ɸ] mutates to [š^ω] may also be linked to the need to keep the causative and passive forms distinct. The mutation of [ɸ] is optimally accounted for in the same way as the mutation of other labial consonants. However, the fact that [ɸ] does not bear the feature [-continuant] means that the resulting segment is a fricative [š^ω], rather than an affricate [č^ω]. Recall that [-continuant] insertion in the case of the causative raised a question of its motivation. The present analysis of the causatives and passives of Setswana reveals how the mutations could conceivably neutralize the distinction between the two morphological processes.

The arguments against a dual continuant affricate representation are essentially the same for the passive as for the diminutive. To recap, there is no obvious source for the [+continuant] feature, upon which the derivation of

a dual continuant affricate relies. Moreover, the formation of passives suggests that the default values have not been supplied at this point, (if they ever are). Otherwise, the mutations of passivization are unexplained. For example, in the passivization of a labial consonant, the default Coronal should be specified [+anterior], if we are dealing simply with routine assignment of default features. Thus [p] should mutate to [tʷ], not [tʰ]. The resulting mutations are apparently still referenced to the permissible feature combinations of underlying representations. Also, as in the case of diminutive formation the failure of [k] to become affricate [kx] is unexplained under a dual continuant approach. If the passive supplies the feature [+continuant], (and note that we must further assume that the passive is a segment, not a floating feature), to a velar stop, then the result should be a labialized velar affricate, not a labialized velar stop. In sum, the dual continuant approach provides a less adequate account of Setswana passives.

5.3 Strengthening

Another process of Setswana that derives affricates is Strengthening or Hardening. This process is of particular interest because, in addition to alveolar and alveopalatal affricates, a velar affricate may be derived. Affricates [ts], [tʃ], and [kx] are produced from fricatives [s], [ʃ], and [x], respectively. Different morphological operations have this effect. One is plural formation (with prefix di- or din-) of a certain class of nouns.¹⁷ Hardening always occurs in the stem-initial position.

27. a. lo - ʔatsa 'chip' → di - p^hatsa 'chips'
 b. lo - sika 'vein' → di - ts^hika 'veins'
 c. lo - xopo 'rib' → di - kxopo 'ribs'

17. The number given to this class varies, according to how the classes are numbered. Some researchers number singular and plural classes separately; others assign the same number to the singular and plural. Therefore, I do not worry about the particular number designation of the noun class concerned.

which turns into the velar affricate [kx]. In the discussion of inventories and overlap between stops and affricates in the velar region (Chapter Two) it was argued that [kx] and [kh] are non-distinct in Setswana. This conclusion was based primarily on two kinds of evidence, the fact that they are in complementary distribution, and the lack of minimal pairs distinguished on this basis. Strengthening of the velar fricative to [kx], when other fricatives become aspirated stops, supports this conclusion.

A brief digression is in order at this point. The specification of the feature [+spread glottis] poses a problem for both Radical Underspecification and Contrastive Underspecification. The problem for both views is that it is not required to distinguish the fricatives; the fact that all voiceless fricatives are aspirated suggests that the feature should be redundant and therefore unspecified at the level of Underlying Representation. In contradiction to what is claimed by Radical Underspecification, more than the minimal amount of featural information necessary to distinguish segments is specified. The specification of [+spread glottis] is no less problematic for Contrastive Underspecification. Fricatives do not contrast on the basis of aspiration, so there is no reason, according to the tenets of Contrastive Underspecification, for fricatives to be specified [+spread glottis]. Moreover, there is no evidence that both values of features that clearly do contrast are specified. For example, it was shown in Chapter Four that aspiration is marked on stops and affricates but that the contrasting feature [+constricted glottis], was unmarked at UR.

The most appealing solution to this dilemma appears to lie in the newly proposed theory of Combinatorial Underspecification (Archangeli & Pulleyblank, forthcoming). There it is shown that a language activates certain feature values and that these combine to create the segment inventory of the language. Some combinations are ruled out by phonetically grounded feature co-occurrence restrictions. Often this still leaves various possibilities for defining a given segment, only some of which contain a minimal amount of information necessary to distinguish the segment from others in the inventory. A language may go with one of the more-than-

minimally specified combinations. In addition to being very new, the theory has thus far focussed on the vowel features and the specification of vowel inventories. It has not yet been applied to consonants and consonant inventories. To attempt to do so for Setswana would be a major undertaking. Therefore no more can be done here than to point out the inadequacies of Radical Underspecification and suggest a tack that future investigation might profitably take.

Let us return now to the topic at hand. Strengthening also occurs when nouns are formed from verbs. Cole (1955) attributes hardening to the juxtaposition of a nasal consonant, the hallmark of noun formation for these verbs, and another consonant. He notes that in Setswana the nasal usually falls away, but that the consonant mutations always show up. In fact, those mutations affect only voiced consonants or fricatives. Voiceless stops and affricates do not undergo any change, presumably because they are already [-continuant] and voiceless:

29. a. - ϕ a 'give' → mp^ho 'gift'
- b. -l^wa 'fight' → nt^wa 'war'
- c. -xa 'draw water' → ŋkxo 'water pot'
- d. -šot^ha 'deride' → č^hot^ho 'derision'
- e. -xana 'refuse' → kxano 'refusal'

C. Rice (1989) assumes that the nasal is the source of the [-continuant] feature in all cases of hardening. However, in the previous chapter we established that nasals occur only before stops, affricates, or other nasals (creating a geminate nasal) in Setswana. It was assumed that co-occurrence restrictions of the language triggered the insertion of [-continuant], not that [-continuant] was provided by the nasal. One problem with assuming that the nasal is the source of [-continuant] is that it is unclear why nasals would be specified for [-continuant], under any view of underspecification. Myers (1990) argues that prefixes are added in the lexicon, but a strong argument can be made that the causative (as well as the passive and applicative) are

added post-lexically.¹⁹ Noun formation precedes causative and passive formation. Yet evidence from those processes suggests that when causatives and passives are formed, the segments are still underspecified. This precludes the assumption that the nasal has acquired a [-continuant] feature by default, by the time nominalization occurs. Of course, one might assume that if [+spread glottis] can be specified for voiceless fricatives, then it is not unreasonable to suggest that [-continuant] is specified for nasals. The problem is that although Strengthening is a notable feature of Setswana and accompanies a variety of morphological processes, there is no evidence outside of Strengthening that nasals might be specified [-continuant].

More compelling evidence that [-continuant] does not originate directly from the nasal emerges from the fact that the nasal seldom actually occurs on the surface when consonants are hardened. The plural formation examples above show only one case in which the nasal is present before the hardened consonant (lo-šo → di^hŋo). Similarly, the nasal does not occur on the surface in two of the nominalization examples, 29d. and e. The above examples show that the nasal occurs only in the case of monosyllabic stems. Tsonepe (1987) shows that many words beginning with nasals involve historically monosyllabic stems, providing independent evidence that the syllabic nasal is inserted to avoid a non-preferred monosyllabic word. Recall the example -na 'four' which becomes nna in Setswana, but ina in Shona. Of course one might turn this argument around by suggesting that the nasal is permitted to delete in the case of polysyllabic words, and prevented from deleting if deletion leaves a monosyllabic item. This possibility is belied by the number of bisyllabic and polysyllabic words that supposedly resist the process of nasal deletion and keep the nasal (e.g. mmoni 'seer'; nnete 'truth'; xo-njalela 'to sow for me', etc.). In short, there is a coherent account for the

¹⁹ In LaCharité (1989), I looked at Swahili affixation in the light of Baker's (1989) Incorporation Theory. Words with several affixes, including the causative, applicative, and passive, provide persuasive evidence that such affixation obeys syntactic principles, notably the Head Movement Constraint and the Empty Category Principle. The Setswana words behave in an identical fashion, in this respect. If the causative and passive suffixes adjoin in conformity with syntactic principles, they are necessarily post-lexical.

occasional presence of the nasal in these processes, but there is not for widespread nasal deletion. This points to the conclusion that the prefixing of the nasal is not really the central aspect of nominalization or plural formation. There is more evidence that the processes of nominalization and plural formation involve [-continuant] insertion than there is that they involve nasal insertion followed by nasal deletion. Of course, the point of current interest is that [-continuant], whatever its source or motivation, creates stops and affricates from fricatives. This is entirely consistent with the theory of affricates that is proposed in this thesis.

Interestingly, the affricate [tʃ] is not created from [l], as might be expected. Stems with [l] have that sound mutated to [t]. This further supports the view that in Setswana [l] is already specified [-continuant]. If it were specified [+lateral], it is reasonably expected to mutate to [tʃ], under the assumption that lateral affricates are [-continuant] [+lateral]. This raises questions about the appropriate representation of this affricate, which is not derived by any process and which does not undergo mutation in any process, though lateral fricative [ʃ] tends to harden to [tʃ] in SaPedi and SeSotho (cf. Tucker, Cole). However, in SaPedi and SeSotho, ordinary liquid [l] is less restricted in its occurrence than in Setswana and it may be syllabic. Nonetheless, [l] hardens to [t] in those languages as well. If we are to maintain the position that [tʃ] is a lateral stop, then we must assume that [l] is specified [-continuant] and [+voice] underlyingly. This would normally be the specification of [d], which is simply a predictable variant of [l] in Setswana. The laterality of [l] would then be a phonetic, rather than a phonological feature of the segment in Setswana. There is thus no way that [tʃ] could be derived from [l] in Setswana.

The dual continuant account is also inadequate as an account of Strengthening because of what it must presuppose about the availability of both values for the feature [continuant]. Of course, given that stops and fricatives are primarily involved, one might assume contrastive underspecification to account for the presence of both feature values. However, contrastive specification is not independently required and it does

not help in explaining other morphological operations, such as diminutive and passive formation.

5.4 Summary

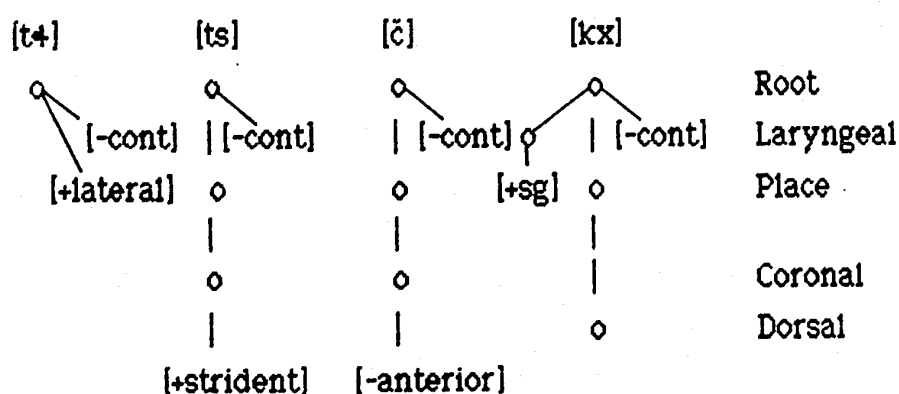
The following processes create affricates in Setswana:

1. Causative formation: The affricate most usually created is the alveolar affricate [ts]. This is analyzed as involving the linking of a floating feature [+strident] that links to the final stem consonant. Where this creates a violation of feature co-occurrence restrictions, features are delinked and/or inserted to repair the violation. This approach provides a coherent account of causative variation. It also explains the limited range of affricates created, unlike the dual-continuant approach, which erroneously predicts that affricate [kx] should be derived from a velar stop.
2. Diminutive formation: Coalescence of a stop consonant and a front (i.e. Coronal) vowel creates alveolar and alveopalatal affricates. Variation is accounted for by the choice of coronal dependents available ([+strident] or [-anterior] and the same restrictions (such as *[+nasal] [+strident]) required to account for variation in causative mutations.
3. Passive formation: The feature [+round] labializes final stem consonants. If those consonants are stops, they remain stops; if they are fricatives, they remain fricatives. However, an independently attested prohibition against the labialization of labial consonants forces labial stops to become alveopalatal affricates. This is in keeping with the facts that Coronal is the default place of articulation; that Coronal consonants are required to bear a coronal dependent; that the choice of coronal dependents is limited to [+strident] and [-anterior] in Setswana; that Labial and [+strident] may not co-occur; and, finally, that [-anterior] stops are realized as affricates.

4 **Strengthening**: The insertion of [-continuant] creates a variety of affricates, including [tsh] from [s], [čh] from [š], and [kx] from [x]. This is predictable under the view that affricates are stops. This process also provides evidence that fricatives are specified [+spread glottis] and that [l] is [-continuant] in Setswana.

The processes that create affricates support the view that affricates are stops. There is no distinct affricate class, therefore, there is no general affricate representation. Setswana causative, diminutive, passive formation and Strengthening provide extensive independent evidence for the affricate representations put forward by Shaw (1989;1991). The alveolar affricate [ts] is most plausibly characterized as a strident stop. The alveopalatal affricate is a [-anterior] stop. The lateral affricate is tentatively assumed to be a lateral stop, though the absence of processes affecting or deriving this sound implies that this conclusion requires further study. At the level of underlying representation, the palatal and velar affricates are non-distinct from palatal and velar stops, respectively.

3.0 The Representation of Setswana Affricates



5.5 General Conclusions and Suggestions for Further Study

5.5.1 The representation of Affricates

The most general conclusion of this research is that affricates are stops. This assumption provides the means for superior analyses of processes and co-occurrence restrictions involving affricates than does the assumption that affricates are characterized by both values for the feature [continuant]. Moreover, the assumption that affricates are stops explains why their distribution in segment inventories is dependent on the distribution of stops. The inventory evidence strongly suggests that this is not accidental and that it holds of all languages that have both stops and affricates. However, dependency in their distribution is unexpected behaviour for a segment that is supposedly designated part of a distinct class, as the dual continuant account necessarily implies. The assumption that affricates are stops also explains the absence of rules that affect a range of affricates or derive a range of affricates. The additional features required to account for overlap between alveolar/dental affricates and stops (i.e. the feature [strident]) also provides the tools for the analysis of processes that target certain affricates and fricatives. Meanwhile, the inherent limits on this feature also explain the absence of rules that target a range of affricates and fricatives, to the exclusion of stops.

5.5.2 Inventories as Evidence

Because a study of inventories reveals a property of affricates that can not be ignored, it confirms that segment inventories are a useful source of evidence about the internal structure of segments. Though the distribution of segments in inventories does not replace or supercede evidence from phonological processes, it can profitably be used to supplement it. We have seen that the process of rationalizing diverse sources of information leads to greater insights and firmer conclusions than can be reached through the

study of a single type of evidence.

5.5.3 The Marked Continuant Value

While the evidence firmly supports the conclusion that affricates are stops, it does not indicate that [-continuant] is always marked at the level of underlying representation. The Shona and Setswana data are most straightforwardly accounted for under the assumption that [-continuant] is the underlying value and that [+continuant] is unmarked underlyingly (and in the case of Setswana and Shona even postlexically). However, evidence from Telugu and Yucatec suggests that somewhat simpler analyses are achieved under the assumption that [+continuant] is underlyingly marked. The evidence from these languages still supports the view that affricates are stops, but it further suggests that stops are unmarked for the feature [continuant] underlyingly.

5.5.4 The Segment as a Derived Notion

The Setswana and Shona evidence underscores the normally assumed, but often forgotten, notion that segments are a derivative notion. A segment is a particular co-occurrence of features. Phonological processes do not 'convert' one segment to another. However, the perception of a particular segment is crucially dependent on the features in the immediate environment. The system seeks to resolve the features available at a given point into familiar patterns of co-occurrence. Thus, adding or subtracting features from a feature constellation may lead to changes that seem, on the surface, inexplicable. For instance, it is not immediately obvious how [p] [i] relate to [čʷ]. Stahlke remarks that the palatalization rule "is about as unnatural a rule as can be imagined," (1976, p. 47). One must look into the featural representation of these segments to understand how sequence [p] [i] might be reinterpreted as [čʷ].

5.5.5 Underspecification

A model of Radical Underspecification has been assumed to the greatest extent possible throughout this research, and it has proved to be a very successful assumption in most cases. Though a representation is always far from fully specified at UR, there are indications that the representation of a segment does not always contain only the barest minimum of featural information. For instance, the Setswana fricatives are specified [+spread glottis], though fricatives do not contrast on the basis of aspiration and the feature is logically redundant. Assuming a model of Contrastive Underspecification does not solve the puzzle, given that aspiration is not contrastive among fricatives, and given the fact that Contrastive Underspecification is not required in any of the other circumstances that have been investigated as part of this thesis. In line with claims of Radical Underspecification, only a single value for any feature, contrastive or not, is required at UR. In the final analysis, it seems we must allow a language to specify more than the logical minimum of information, without requiring it to specify both values for any feature within a particular class of segments. I suggest that revisions to underspecification along the lines proposed by Archangeli and D. Pulleyblank (1992) might provide a useful model. However, that model, termed Combinatorial Underspecification, has been proposed for vowels and works with a comparatively small feature inventory. Its application to consonant systems will require considerably more study. Nonetheless, a useful start has been made by demonstrating the recurring potency of certain consonant features, including [-anterior] and [+strident]. Also, the analyses of various processes of Shona and Setswana demonstrate the role of co-occurrence restrictions, most of which have some clear phonetic motivation, in ruling out various logically possible feature combinations. If we are to take seriously the view that segments are not basic entities, that they are feature bundles, then we must stop appealing to the absence of a segment in the inventory as the reason certain processes do not occur. We must look beyond the explanation that a certain segment is not

in the sound inventory and consider why it is not, or can not, be in the inventory. Combinatorial Underspecification holds out some promise in this regard.

As far as the choice of feature values available to a language is concerned, there are still a number of outstanding questions. These are summed up in the question of the extent to which languages are free to activate the unmarked value for a particular feature. For instance, it seems we must allow languages to activate either [+continuant] or [-continuant] underlyingly. However, on the basis of the foregoing research one might reasonably hypothesize that only [+strident], [-anterior], [+nasal] are available. The opposite values, [-strident], [+anterior], and [-nasal] seem not to be required. This, in turn, raises the question of whether such features might not as well be considered privative, if languages may not use the opposite values. Also, the Setswana cases indicate that redundant values are missing even post-lexically. There is no phonological reason to assume that they are ever filled in. Of course, a good deal more research is required on these issues.

5.5.6 Prenasalized Stops

Finally, the present conclusion that affricates are not characterized by both continuant values raises the question of whether prenasalized stops should be characterized as contour segments. Their distribution in the Shona inventory suggests that they are not, but a good many more inventories and phonological processes involving prenasalized stops need to be studied before a firmer conclusion can be reached. If prenasalized stops are not contour segments, then the possibility of bearing both values of the same feature can be ruled out in principle.

Appendix 1. Inventories Containing Affricates in Complementary Distribution with Stops with Respect to Place of Articulation

Achumawi (j)	Gã (čh, j, čʷ, jʷ)	Masai (č)
Akan (cc, j̄, ccʷ, j̄ʷ)	Goldi (č, j)	Mixtec (č)
Amharic (č, čʰ, j)	Guajiro (č, hč)	Neo-aramaic (č, j)
Apinaye (č)	Hausa (č, j)	Nera (j)
Arabic (j)	Hindi-Urdu (č, čh, j, j)	Nubian (tθ, dθ, č, j)
Asmat (č)	Iai (č, j)	Ojibwa (č, hč)
Bambara (č, j)	Irish (č, j)	Osmanli (č, j)
Basque (ts, ts, č) ²⁰	Japanese (č, j)	Po-Ai (č, čh)
Beja (j)	Kanuri (č, j)	Quechua (č, čh, čʰ)
Bengali (č, čh, j, j)	Karok (č)	Sedang (č, j)
Berta (j)	Kefa (č, čʰ, j)	Siriono (č, nj)
Burmese (č, čh, j)	Khalaj (č)	Somali (č)
Cheremis (č)	Khasi (j)	Swahili (č, j)
Chuvash (č)	Kunama (č, j)	Tacana (č, tʃ)
Cofan (č, čh, j)	Kurdish (č, j)	Taishan (č, čh)
Dakota (č, čh, čʰ)	Lahu (č, čh, j)	Tarok (č, j)
Delaware (č, č)	Lulseño (č)	Telugu (č, j)
Diegueño (č)	Lungchow (č, čh)	Tunica (čh)
English (č, j)	Luo (č, j)	Wapishana (č)
Farsi (č, j)	Luvale (č, nj)	Washkuk (č, nj)
Fur (j)	Manchu (č, j)	Wolof (qX)

²⁰ As with several other inventories, there is some question as to where Basque belongs. According to Maddieson, it would be considered a BII inventory. Discussion in Chapter Three suggests that the stops and affricates are in complementary distribution

Appendix 2: Inventories Containing Affricates in Complementary Distribution with Stops and Fricatives with respect to Place of Articulation

Abipon (č)	Itonama (č, čʔ)	Punjabi (č, č:, čh, čh:, j, j:)
Ainu (č)	Kharia (č, čh, j, j̃)	Saʼban (č, j)
Alabama (č)	Khmer (č, čh)	Saek (cç)
Amahuaca (č)	Korean (č, čh, č̥)	Sara (j)
Andamese (č, j)	Kota (č, j)	Shasta (č, čʔ)
Ao (cç)	Kurukh (č, j)	Sinhalese (cç, j)
Araucanian (č, t̪)	Logbara (č, j)	Siona (č)
Bandjalang (j)	Malayalam (č, j)	Spanish (č)
Batak (j)	Maranungku (č)	Sudanese (č, j)
Brahui (č, j)	Moro (č, j)	Ticuna (č, j)
Dagbani (č, j)	Mundani (č, čh, j, j̃)	Tiwa (č)
Evenki (č, j)	Nez Perce (qʰ)	Yakut (č, č:, j, j:)
Igbo (č, j, j̃)	Ostyak (tʃ)	Yana (čʔ, čh, j)
Island Carib (j)	Papago (č, j)	Yaqui (č)
		Yukaghia (č, j)

Appendix 3: Inventories Containing Affricates that Overlap with Stops in the Dental/Alveolar Region

Abkhazian (tsʰ tsh dz čʰ čh j čʰ čʰh j čʰʷ jʷ)	Ik (ts tsʰ dz tʰ č j)	Russian (ts č)
Adzera (tsh dz)	Iraqw (tsʰ tʰʰ)	Seneca (dz)
Albanian (ts dz č j cç j)	Javanese (ts tʃh)	Southeast Pomo (ts tsʰ)
Aleut (ts)	Jingpho (ts dz č čh j)	Squamish (ts tsʰ tʰ tʰ č čʰ)
Amo (ts č j)	Jivaro (ts č)	Standard Thai (ts tʃh)

Amoy (ts tsh dz j)	Kan (ts tsh cç cçh)	Suena (dz)
Amuesha (tsh čh čh tsh)	Kashmiri (ts tsh dz čh čh j)	Sui (ts tsh č, čh)
Armenian (ts tsh ts' č čh č')	K'ekchi (ts ts' č č')	Tagalog (ts)
Ashuslay (ts ts č č)	Kirghiz (ts, č)	Tahltan (ts ts' dz t4 t4' d4 č č' j)
Atayal (ts)	Kullo (ts, ts', č, j)	Tamang (ts tsh t4 d4)
Awiya (ts č j)	Kwakw'ala (ts tsh dz t4 t4h d1)	Tarascan (ts tsh č čh)
Eribri (ts č)	Lak (tsh ts: ts' tsh ^ω ts ^ω : ts ^ω č čh č' č ^ω č ^ω)	Tiddin Chim (ts)
Bulgarian (ts ts' č j)	Lakkia (ts tsh)	Tigre (ts' č č' j)
Campa (ts č)	Lappish (ts č)	Tlingit (ts ts' dz t4 t4' t4h d4 č č' čh)
Cashinahua (ts č)	Lelemi (ts dz)	Tolowa (ts' č čh č' ts')
Chacobo (ts č)	Lithunanian (ts ts' dz č j)	Tonkawa (ts)
Chamorro (ts dz)	Malagasy (ts dz t4 d4)	Totonac (ts č)
Changchow (ts tsh tsh)	Mandarin (ts tsh ts ts cc cch)	Tsou (ts)
Chontal (ts ts' č č')	Mazahua (ts tsh ts' č čh č')	Tuva (ts, č)
Chumash (ts tsh ts' č čh č')	Mazatec (ts ndz č nj ts ndz)	Tzeltal (ts ts ts' ts')
Dizi (ts' č č' j)	Mixe (ts)	Wappo (ts ts' č č')
Ewe (ts dz)	Mongolian (ts dz č j)	Wichita (ts ts: tsh ts')
Fuchow (ts tsh)	Moxo (ts č)	Wintu (t4 t4' č č' j)
Garó (ts dz)	Navaho (ts tsh ts' t4 t4h t4' d4 č čh č')	Wiyot (ts tsh č čh)
Georgian (ts tsh ts' č čh č')	Nootka (ts ts' t4 t4' č č')	Yao (ts tsh dz)

Greek (ts dz)	Ocaina (ts dz č)	Yareba (dz)
Greenlandic (ts)	Otomi (ts')	Yucatec Maya (ts ts' č č')
Guahibo (ts)	Paez (ts č)	Yuchi (ts tsh ts' dz č č' j)
Gununa-Kena (ts ts' č č')	Pashto (ts dz č j)	Yulu (dz)
Hakka (ts tsh)	Puget Sound	Yurak (ts)
Hamer (ts)	Quileute (ts ts' tɬ tɬ' č č')	Zoque (ts)
Hebrew (ts)	Romanian (ts, č, j)	Zuni (ts' tsh č' čh)
Hungarian (ts dz č j cɟ Jj)	Rukai (ts)	

Appendix 4: Inventories Containing Affricates that Overlap with Stops at Non-dental/ Alveolar Places of Articulation

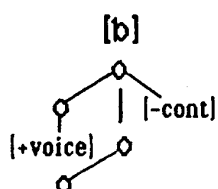
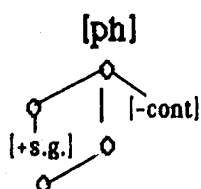
Acoma (tsh ts' dz čh č' j tʃh tʃ' ɟʒ)
 Angas (č j)
 Azerbaijani (č j)
 Chipewyan (tθ tθh tθ' ts tsh ts' tɬ tɬh tɬ' č čh č' kxh kxh^ω)
 Beembe (pf pfh ts tsh)
 Burushaski (ts tsh č čh j tʃ tʃh tʃ')
 Cayapa (ts č)
 German (pf ts)
 Gilyak (čh)
 Haida (tɬ tɬ' dʒ č čh č')
 Hupa (ts tsh ts' tɬ' č č' č^ω)
 Jaqaru (ts tsh ts' č čh č' tʃ tʃh ɟʒ)
 Kabardian (ts ts' dz qχ qχ^ω)
 Komi (č j cɟ Jj)
 Margi (ts dz č j)
 Muinane (č j)
 Setswana (tsh ts' tɬh tɬ' čh č' j kx)
 Tavgy (kx)
 Teke (pf bv č j)

Appendix 5: Inventories Without Affricates

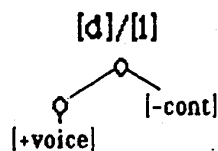
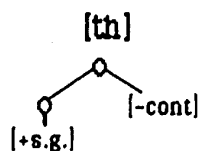
Alawa	Hawaiian	Pawaian
Arabana-Wangamura	Hop	Roro
Arabela	Iwam	Rotokas
Aranda	Kadugli	Sebei
Auca	Kaliai	Selepet
Barasano	Kanakuru	Senadi
Bardi	Karen	Sentani
Bariba	Kariera-Ngarluma	Shilha
Bashkir	Katcha	Socotri
Birom	Ket	Songhai
Bisa	Kewa	Tabi
Boro	Klamath	Tama
Breton	Kolari	Tamein
Busera	Komi	Tampulma
Carib	Kpelle	Taoripi
Cham	Kunipaipa	Telefol
Chatino	Kunjen	Temne
Chuave	Maba	Tiwi
Chukchi	Mabuiag	Tuareg
Dafia	Maidu	Tucana
Dan	Malakmalak	Vietnamese
Dani	Malay	Wantoot
Daribi	Maori	Western Desert
Dera	Maung	Wik-Munkan
Diola	Mura	Yagaria
Diyari	Mursi	Yay
Doayo	Nambakaengo	Zande
Elfik	Nambiquara	
Fasu	Nasiol	
Finnish	Ngizim	
French	Nimboran	
Gadsup	Norwegian	
Gbeya	Nunggubuyu	
Guarani	Nyangi	
Gugi-Yalanji	Nyangumato	

Stops:

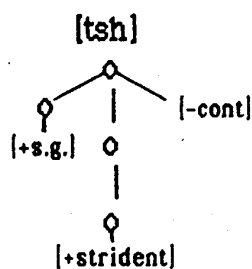
[p]
|
|-cont]



[t]
○ — [-cont]



[ts]
|
|-cont|
|
|
|
[+strident]

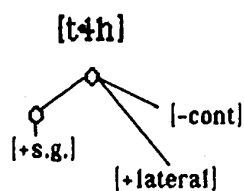


[t₄]

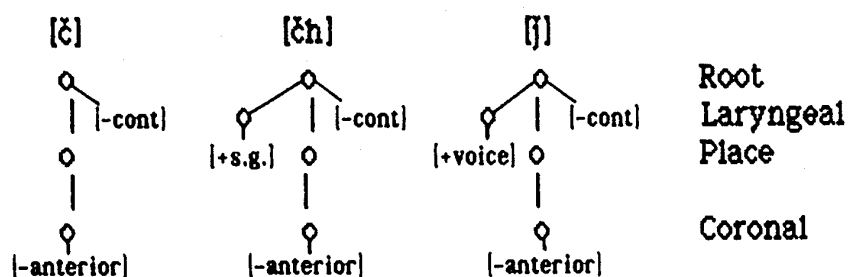
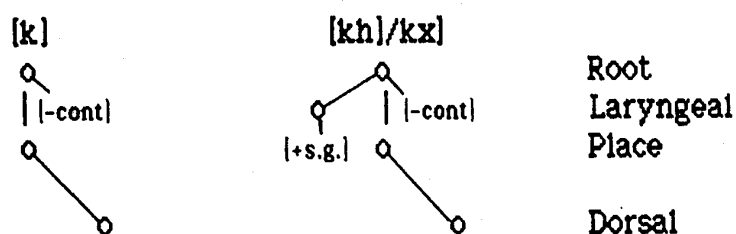
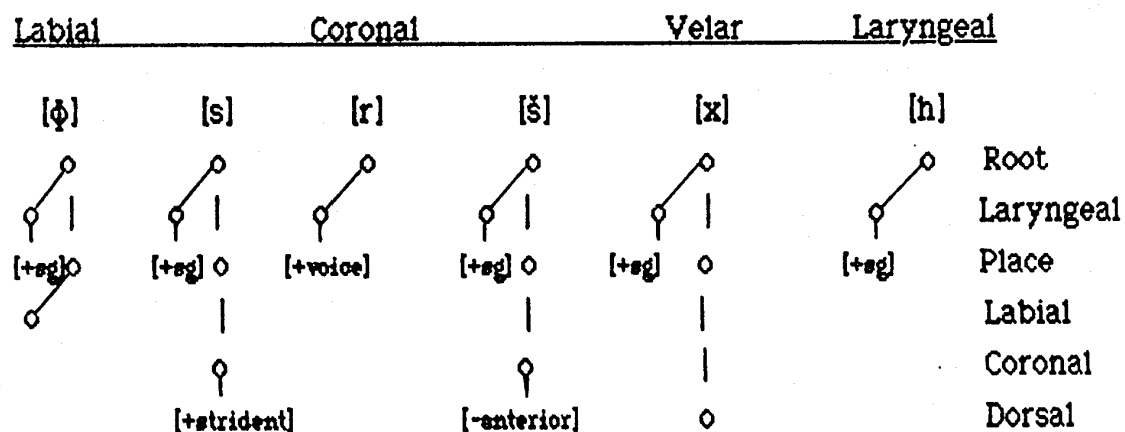
○

[-cont]

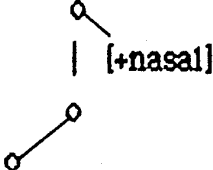
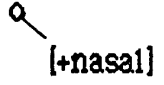
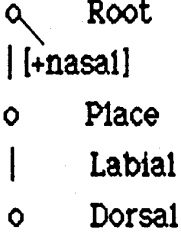
[+lateral]



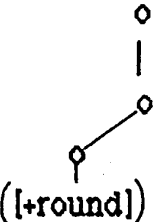
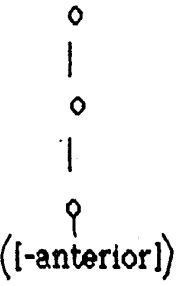
Root
Laryngeal

Coronal**Velar****Fricatives:**

Nasals:

Labial	Coronal	Velar
[m]	[n]	[ŋ]
		

Glides:

Labial	Coronal
[w]	[j]
	

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